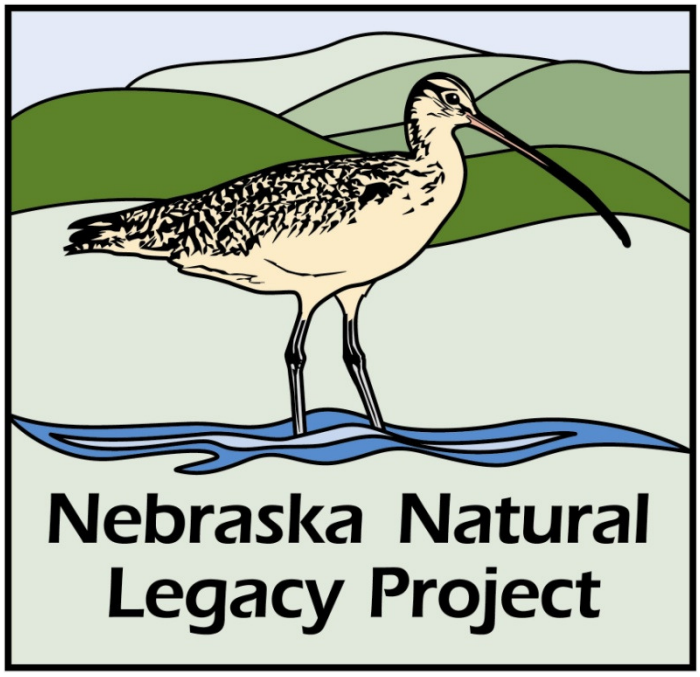
The Nebraska Natural Legacy Project



State Wildlife Action Plan

2nd edition

2011

The Nebraska Natural Legacy Project

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Numerous individuals contributed to the success of this endeavor.
Appendix 1 lists the members of the various teams that worked on the Nebraska Natural Legacy Project.

Acknowledgments

Natural Legacy Partnership Team

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A special thank you is due to Dr. Mark Pinkerton and Bill Grewcock for serving as the Nebraska Natural Legacy Project development committee co-chairs.

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Foreword

As Nebraskans, we value wildlife for many different reasons. Whether you are a hunter who is fervent about stalking a mule deer, an angler who lives for the thrill of catching a trophy, a birdwatcher who rises before the sun to see an elusive warbler, or simply a grandparent who looks forward to sharing a passion for butterflies with a child—wildlife is interwoven in the fabric of our culture. The animals and plants that make up Nebraska's natural legacy offer all of us a vital connection to our past, a resource to be enjoyed in the present, and a responsibility to conserve for future generations. The Nebraska Natural Legacy Project lays out a vision for conserving our state's rarest species while at the same time perpetuating the continued existence of more common species.

When the Nebraska Game and Parks Commission first began work on a state wildlife action plan (Nebraska Natural Legacy Project), we had to decide on an approach that would ensure we developed the best plan possible. The agency could have drawn only from the expertise of professional biologists, or alternatively sought input from a wide diversity of stakeholders. We decided to utilize both and what resulted was one of the largest collaborative efforts ever undertaken on behalf of wildlife in the state's history. Public input meetings, conservation practitioner workshops, and dozens of meetings with the state's biological experts and conservation and agricultural leaders has culminated in a proactive conservation plan that is based on the best available science and has a high probability for successful implementation.

This plan uses a comprehensive dataset to identify priorities for the conservation of the state's rarest species and natural habitats. It also provides a roadmap to guide conservation work in those landscapes that offer our greatest hope for conserving the full array of biological diversity. Through this process, we have significantly increased our understanding of species and habitats, identified critical threats to animals and plants, developed actions that will lead to conservation of Nebraska's biological diversity, and established a solid partnership approach.

A twenty-five member Partnership Team that represents the interests of Nebraska's conservation, agricultural, and Native American communities guides this planning process. The efforts of these individuals help ensure that this plan is supported by and useful to the majority of the state's citizens. The Partnership Team also provides a forum for the exchange of ideas and collaborative decision-making and raises the level of trust and respect amongst its participants. Many individuals have contributed to the development and implementation of Natural Legacy, as well as its revision.

In today's ever changing society, it's more important than ever that we have a plan for the future. Although we are headed towards uncharted waters, we now have a compass and a roadmap that better prepares us for the challenges ahead. The future for Nebraska's natural legacy looks bright.

Dr. Mark Pinkerton

Nebraska Game and Parks Commissioner

Chapter 1

Introduction and Purpose

Mission Statement

The mission of the Nebraska Natural Legacy Project is to implement a blueprint for conserving Nebraska's flora, fauna and natural habitats through the proactive, voluntary conservation actions of partners, communities and individuals.

To facilitate the development and implementation of a state wildlife action plan for Nebraska, the following guiding principles were developed by the Partnership Team.

Guiding Principles

Through the process of development, the Nebraska Natural Legacy Project shall…

- … be open, transparent and inclusive.
- … be built on a foundation of sound economic and scientific principles.
- … keep the public informed and involved.

The blueprint produced by the Nebraska Natural Legacy Project shall…

- …recognize private landowner participation is critical to the project's success.
- …recognize and respect property rights and address property issues.
- …have opportunities for conservation actions and partnerships across the state.
- …ensure all participating are respected and treated fairly.
- …encourage involvement through consistent and thorough information exchange.
- …provide opportunities for developing conservation partnerships regardless of ownership.

Conservation actions as a result of the Nebraska Natural Legacy Project shall…

- … be voluntary and incentive based.
- … minimize the use of land acquisition as the primary tool for habitat conservation and instead principally use actions directed toward conservation on private lands.

Purpose and Need

Nebraska's rich biological diversity is composed of thousands of plant and animal species interacting with each other and the environment. The flora and fauna of the state, along with the natural habitats they occupy, form Nebraska's natural heritage – a legacy that should be treasured just as much as our cultural heritage. Unfortunately, populations of many once common species have declined because of a variety of stresses, including habitat loss, habitat degradation, diseases, and competition and predation from invasive species. While conservation actions in the past have had notable successes, they have not been sufficient to stem the overall tide of species decline. There is a need for a comprehensive, systematic and proactive approach to conserving the full array of Nebraska's biological diversity.

The goals of the Nebraska Natural Legacy Project are to:

1. Reverse the decline of at-risk species (and avoid the need for state or federal listing as threatened or endangered)
2. Recover currently listed species and allow for their de-listing
3. Keep common species common
4. Conserve natural communities

Almost all existing natural habitat in Nebraska, and the biological diversity it supports, resides on lands under private ownership. All Nebraskans can benefit from the strong conservation tradition and sound stewardship of private landowners. The Nebraska Natural Legacy Project seeks to continue this tradition, while at the same time creating new opportunities for collaboration between farmers, ranchers, communities, private and governmental organizations and others for conserving Nebraska's biological diversity, our natural heritage. The Nebraska Natural Legacy Project is non-regulatory, voluntary, incentive-based conservation. As stewards for the next generation, it is everyone's responsibility to ensure the treasures that were handed to us by nature and our predecessors are still here for future generations of Nebraskans to enjoy.

Conservation Funding

For more than fifty years, state fish and wildlife agencies have benefited from funds provided by the Federal Aid in Wildlife Restoration Act (Pittman-Robertson) and the Federal Aid in Sport Fisheries Restoration Act (Dingell-Johnson, Wallop-Breaux). These monies are collected through a federal excise tax on hunting and fishing equipment. In conjunction with revenues collected through the sale of hunting and fishing licenses and habitat stamps, these funds have provided consistent support for the conservation and management of game fish and wildlife species. These monies have been critical to the establishment of the Game and Parks Commission's long-term conservation planning and have led to significant results in Nebraska. Species such as white-tailed deer, pronghorn antelope, bighorn sheep, elk, Canada geese, turkey and walleye, which were in low numbers or extirpated from the state in the early 1900s, have shown dramatic rebounds.

In Nebraska, game species make up about 1% of the estimated 30,000 species in the state. While many of the state's nongame species have received substantial benefits from habitat conservation and restoration directed at game species, their needs have not been fully met. Conservation efforts for these species have in large part been opportunistic and crisis-driven, limited by a lack of funding and by a lack of strategic approaches to species and habitat conservation. Today, with more than 1,300 species in the U.S. listed on the Federal Endangered and Threatened species list, and many more species in decline, the need has never been greater for a complimentary source of funding to support the conservation, protection, and restoration of the full array of species, especially those not covered under traditional funding strategies. The Nebraska Natural Legacy Project takes measures that aid in the recovery of declining species and ensure that common native species remain common.

A coalition including more than 6,000 organizations representing wildlife enthusiasts such as birdwatchers, hunters, anglers, and others was organized in the mid 1990's and is one of the largest grassroots coalitions of its kind in the nation's history. This coalition, known as Teaming with Wildlife, was created in part to demonstrate support for federal wildlife conservation funding that can be used to address the needs of declining fish and wildlife. In response to the Teaming with Wildlife Coalition, Congress established the Wildlife Conservation and Restoration program and the State Wildlife Grants Programs in 2001.

As a requirement for receiving funding through these two new programs, Congress required each state to develop a State Wildlife Action Plan (SWAP). Nebraska's plan is called the Nebraska Natural Legacy Project. The SWAP developed in Nebraska and in every other state provide an essential foundation for the future of wildlife conservation and a stimulus to engage the states, federal agencies, and other conservation partners to strategically think about their individual and coordinated roles in prioritizing and delivering conservation work. The Natural Legacy Project is designed as a blueprint for conservation that all organizations can use in Nebraska, not simply a plan for the Nebraska Game and Parks Commission.

Eight Required Elements of the State Wildlife Action Plan

Congress identified eight required elements to be addressed in each state's wildlife action plan. Congress also directed that the strategies must identify and be focused on the "species of greatest conservation need," yet address the "full array of wildlife" and wildlife-related issues. The U.S. Fish and Wildlife Service and the Association of Fish and Wildlife Agencies have developed additional guidance on information needed to meet the eight elements (see Appendix 2). The strategies must provide and make use of these eight elements:

(1) Information on the distribution and abundance of species of wildlife, including low and declining populations, as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and,

(2) Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and,

(3) Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and,

(4) Descriptions of conservation actions proposed to conserve the identified species and habitats and priorities for implementing such actions; and,

(5) Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and,

(6) Descriptions of procedures to review the strategy at intervals not to exceed 10 years; and,

(7) Plans for coordinating the development, implementation, review, and revision of the plan with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or administer programs that significantly affect the conservation of identified species and habitats.

(8) Congress also affirmed through this legislation that broad public participation is an essential element of developing and implementing these plans.

To address both "species of greatest conservation need," and the "full array of wildlife," the Natural Legacy Project used a two-pronged approach – focusing on habitats and selected individual species. The Project has identified as a priority the conservation of multiple examples of each of the natural communities (habitat types) in the state. This approach conserves the vast majority of species – keeping common species common. For those species missed by this approach, typically the rare and imperiled species, attention was focused on individual at-risk species. To identify locations of key habitats, information on known locations of natural communities and at-risk species was used to identify a series of Biologically Unique Landscapes (BULs). These landscapes offer some of the best opportunities to conserve the full array of biological diversity (see Chapter 3 for explanation of methods used), though conservation in the state is not be limited solely to these landscapes. In addition to identifying problems or stresses affecting species and their habitats, we also identified a number of barriers that are impeding effective conservation. We have identified a set of overarching conservation strategies and actions to address the stresses and barriers that can be applied anywhere in the state (Chapter 4), as well as site-specific actions for each of the Biologically Unique Landscapes (Chapters 5-8).

Value of a State Wildlife Action Plan to Nebraska

The nationwide completion of State Wildlife Action Plans was viewed as a watershed event in the history of conservation in the United States. Conservation has traditionally taken a species-by-species approach and focused on a limited number of species. Previous conservation efforts aimed at non-game species have often focused on those species that were on the brink of extinction; however, these "emergency room" efforts at recovery are expensive and not always successful. A new proactive approach was needed that addressed the full array of wildlife - keeping common species common, while also preventing our at-risk species from declining to the point of threatened or endangered status.

State Wildlife Grant (SWG) funding has been instrumental in helping the state undertake this comprehensive planning process, the Nebraska Natural Legacy Project and implementing the plan. The development process itself has engaged new partners, strengthened existing partnerships, and significantly raised awareness about the state's biological diversity. The resulting blueprint is designed to provide guidance and strategic focus to agencies, organizations, communities and individuals interested in implementing conservation.

The Wildlife Conservation and Restoration Program and State Wildlife Grants Programs have provided new funding opportunities for conservation organizations in Nebraska. The Nebraska Game and Parks Commission has made a large share of these funds available to dozens of conservation organizations and universities through a competitive grants program (see Appendix 3). Projects currently underway and already completed have increased our knowledge about the species and habitats found in Nebraska and contributed towards their conservation. Continuation of a competitive grants program will be beneficial to implementation of the Natural Legacy Project.

State Wildlife Grant funding is a turning point in wildlife conservation funding, but it cannot possibly meet all the needs of Nebraska's wildlife species. The actions outlined in this document suggest ways to use existing monetary resources efficiently, but new funding sources and new partnerships must also be explored. The responsibility for implementation of this plan rests with *all* Nebraskans.

One of the greatest strengths of the Nebraska Natural Legacy Project has been the diverse collaboration that has resulted from this planning process. Representatives from a variety of stakeholders assist with development of operational plans that are critical to implementation of the Nebraska Natural Legacy Project.

Chapter 2

Plan Development Process

Organizational Structure

The Nebraska Natural Legacy Project is designed to be a blueprint for biological diversity conservation in Nebraska. To be comprehensive, its development required the input of a wide variety of agencies, organizations and individuals. Implementing a blueprint of this magnitude cannot be accomplished by one agency – it must be a collaborative effort of many entities and individuals. For its implementation to be successful there must be broad participation in developing the blueprint. To facilitate this collaboration and accomplish the many tasks required to develop the plan, eight teams were established. Six of the eight teams included members from outside of the Game and Parks Commission. See Appendix 1 for a list of the members of each team.

Partnership Team

Audubon Nebraska
Ducks Unlimited, Inc.
Farmers Union
Nebraska Alliance for Conservation and Environment Education
Nebraska Association of Resources Districts
Nebraska Bird Partnership
Nebraska Cattlemen
Nebraska Corn Board
Nebraska Corn Growers Association
Nebraska Department of Agriculture
Nebraska Farm Bureau
Nebraska Forest Service
Nebraska Game and Parks Commission
Nebraska Land Trust
Nebraska Soybean Association
Nebraska Wildlife Federation
Nebraska Wildlife Society
Pheasants Forever, Inc.
Ponca Tribe of Nebraska
Rainwater Basin Joint Venture of Nebraska
Sandhills Task Force
The Nature Conservancy
U.S.D.A. Natural Resources Conservation Service
U.S. Fish and Wildlife Service
U.S. Forest Service

Partnership Team
The partnership team is composed of twenty-five representatives from federal and state agencies, non-governmental organizations, and the Ponca Tribe of Nebraska (see box). Its roles included developing guiding principles for plan development, ensuring the plan was effective and useful to a variety of entities, developing and participating in a public participation process, reviewing initial drafts of the plan, and providing guidance during plan implementation. The partnership team represents many of the entities and individuals that have been involved in implementing this blueprint.

Science Team
This team was composed of science staff from the NGPC Wildlife and Fisheries Divisions, faculty from the University of Nebraska-Lincoln School of Natural Resources, and representatives from non-governmental organizations in the state. The team was charged with developing the scientific approach of the plan (see Chapter 3), identifying at-risk species and biologically unique landscapes, identifying future research needs, and conducting species expert workshops to gather information on at-risk species.

Wildlife Education Team
This team was composed of naturalists, formal educators, Project WILD, Project WET and Learning Tree Coordinators and administration staff from the Nebraska Department of Education. The role of this team was to identify the needs for both formal and non-formal conservation and environmental education and develop statewide strategies to address these needs.

Core Team
This team was composed of Commission staff including the two co-chairs of this planning effort, a planning assistant/biologist, a GIS specialist, and support staff. The primary role of this team was to coordinate and support the efforts of the other teams, oversee public and professional input, and oversee development of the final document.

Public Involvement

The Partnership Team assumed an active role and ownership in the public input process. The Partnership Team met in advance of the Natural Legacy public meetings for planning purposes. At this meeting, participants were asked to determine how best to reach out to the public and gather input on the stresses affecting species and habitats and the conservation actions needed to address those stresses. This group developed a process that included public input meetings in each of the four ecoregions (Tallgrass Prairie, Mixedgrass Prairie, Shortgrass Prairie and Sandhills). Partnership Team members volunteered to co-sponsor and co-facilitate public input meetings. To ensure good attendance at the meetings, Partnership Team members utilized their organizations' outreach capabilities to encourage their members to attend.

The series of public input meetings were held across Nebraska to address concerns, include ideas from communities, and promote Natural Legacy. Public input meetings were held during the spring and summer of 2010. These meetings occurred in 10 cities (Beatrice – April 28, Lincoln – May 17, Kearney – May 20, Omaha – May 26, North

Platte – May 27, Norfolk – June 2, Scottsbluff – June 15, Chadron – June 16, Valentine – June 22, and Thedford – July 8). Facilitation techniques were customized to individual group size. The method proved to be highly successful in gathering relevant public input. To be used, comments and suggestions had to adhere to guiding principles developed by the Partnership Team. Input was categorized and similar comments were grouped into summary statements that were then incorporated into the revised draft plan that was made available online for public commentary. In each of the public input meetings, participants were asked to answer the following questions:

Questions asked at Public Input Meetings in 2010

1) What additional stresses to wildlife in your area need to be addressed?
2) What additional actions within biologically unique landscapes (BULs) can lead to improvements for wildlife and habitat?
3) What is needed to increase collaboration between private landowners, agencies, and organizations interested in wildlife conservation?
4) What are the impediments to active conservation in these BULs?
5) What local environmental education and outreach needs exist in your community?
6) What would encourage people to get involved locally to implement Natural Legacy's objectives?

Conservation Practitioner Involvement

The purpose of the conservation practitioner workshops was to gather input on stresses, conservation actions, barriers to conservation, and research and inventory needs. Eight conservation practitioner workshops were held in the spring and summer of 2010 in Lincoln – May 17, Kearney – May 20, North Platte – May 27, Norfolk – June 2, Scottsbluff – June 15, and Chadron – June 16, Valentine – June 22, and Thedford – July 9. Natural resource and agricultural professionals discussed concerns and strategies regarding the state wildlife action plan. Participants included individuals from local, state and federal natural resource agencies, private conservation organizations, and universities. This input was categorized and used to identify stresses to species and habitats, develop conservation actions (in conjunction with the aforementioned public input), and identify research and inventory needs. The stresses and conservation actions listed in the statewide chapter, in the ecoergion chapters and each Biologically Unique Landscape description represent the compilation of input from all the mentioned sources. They were filtered by the guiding principles developed by the Natural Legacy Partnership Team, but every effort was made to represent the information gathered. They represent the best available information at this time, and do not necessarily apply to each parcel of land. A small group facilitator and recorder gathered input to update the Natural Legacy Projects based on the following questions:

Questions asked at Conservation Practitioner Workshops in 2010

1) What additional threats to wildlife habitat in your area need to be addressed? What additional conservation actions should be considered?
2) What information gaps exist and what are the research questions to explore?
3) What is needed to advance conservation efforts in the biologically unique landscapes?
4) Are there "information products" we should be developing to enhance conservation effectiveness and landscape/BUL planning (i.e., what tools do you need to be more effective)? What opportunities exist for sharing this information?
5) Assuming a 5-10° increase in temperature in the next 50 years and changes in precipitation, how can we assist wildlife populations as they try to adapt to altered conditions?
6) For those BULs that adjoin the NE border, what approaches would be helpful in extending conservation efforts beyond state boundaries?
7) What biodiversity "hotspots" in these BULs provide wildlife viewing/educational opportunities?

Additional Input

A series of one-day workshops were conducted with experts on birds, fishes, mammals, insects, mollusks, reptiles/amphibians, and plants in Nebraska. The goals of the workshops were to review and revise the Natural Legacy Project list of at-risk species, assess the vulnerability of Tier I species to climate change, and gather information on at-risk species including habitat requirements, stresses, research and inventory needs, and locations of populations that are not already in the Natural Heritage database. A wealth of information was gathered, much of which is included in Appendix 8. Information on locations of at-risk species was used to help select the biologically unique landscapes (see Chapter 3). The meeting groups also discussed new, species-specific threats, research and inventory needs, and conservation actions.

Involving Partners in Plan Implementation

The task of conserving Nebraska's biological diversity is far larger than one organization can accomplish on its own. For this reason, the Nebraska Natural Legacy Project was designed from the beginning to be a statewide blueprint for many to use. We involved a wide variety of agencies, organizations and individuals in developing the Natural Legacy plan. Throughout this document, we stress the importance of involving these partners in its implementation. In the ecoregion chapters we identify some existing conservation partnerships and in Chapter 4 list specific conservation actions to encourage the development of new and support existing partnerships that can facilitate the conservation of biological diversity.

The Natural Legacy Partnership Team will remain engaged in involving partners in implementation across the state. The Natural Legacy Partnership Team's previous tasks included approving which Biologically Unique Landscapes would be the "flagships" to begin implementation. After Flagship Biologically Unique Landscapes were established, the team's role has expanded to fund allocation through a granting process for innovative projects. This has been successful in securing new partners and beginning work in new areas of the state. This team's involvement will continue to evolve as implementation continues to evolve.

At the project level, local conservation practitioners have established a collaborative precedent; projects are typically accomplished using a variety of partners. Private landowners are a fundamental partner, but projects typically include other state and federal partners. This has allowed local practitioners to efficiently accomplish habitat improvement by engaging partners with mutual interest in projects. This locally driven approach will continue.

Natural Legacy partners are also involved in state wildlife action plan implementation through their participation in an external competitive grants program. Since the inception of federal wildlife diversity funding in 2001, a significant portion of Nebraska's Wildlife Conservation and Restoration Program and State Wildlife Grants funding has been made available to partners through a competitive grants program. These grants have resulted in on-the-ground conservation projects/initiatives, added to our knowledge of the state's biological diversity, and built capacity to improve delivery of conservation. Criteria used to evaluate these grants correspond directly to actions identified in the Nebraska Natural Legacy Project.

Plan to Review and Revise

A living and working document requires periodic review and revision. Within every 10 years, an extensive formal revision of the plan will be conducted. The Partnership Team will be asked to help evaluate accomplishments and assess if goals, actions and strategies need to be adjusted. The formal revision is similar to the initial process in that a team of partner agencies and organizations guides the process and seeks significant participation from conservation practitioners and the public. During that process, we gather information regarding success of implementation of conservation actions, outreach and education efforts, and accomplishment of priority goals. An adaptive management approach is used to adjust strategies and actions based on lessons learned. Natural Legacy Project revision is an open process; during each iteration, invitations will be extended to additional stakeholders to increase involvement.

In order to help evaluate progress, a database has been developed to track plan implementation. Information tracked includes conservation goals, types of conservation actions implemented, agencies, organizations or individuals involved in the implementation, species and habitats affected, number of acres or miles of stream affected, location, project cost, and funding sources.

Information on at-risk species, habitats, and biologically unique landscapes is maintained in the Commission's Natural Heritage database. This is updated as new information becomes available through inventory and research projects. The biologically unique landscapes database is linked to the species and habitat database and will automatically be updated with new information, which will facilitate revisions to the landscape boundaries and evaluation of goals.

The Tier I and Tier II at-risk species lists will be periodically reviewed and revised by taxon experts. This revision will occur on an ongoing basis as new information on abundance, distribution, and population trends becomes available, with an overall review every five to ten years. The most recent reviews occurred autumn 2010.

We identified Biologically Unique Landscapes (BULs - see Chapter 3) as areas of the state with the greatest potential for at-risk species and natural community conservation. Additional planning at BUL or regional scales will identify priorities and goals for these geographic areas. This process will involve others who are responsible for conservation work within the BUL or who may be affected by the planning outcome. This process would ensure that implementation of conservation actions in each Biologically Unique Landscape focuses on what is additive to the network of conservation lands and necessary for at-risk species sustainability.

Original State Wildlife Action Plan Development (2004-05):

The original Nebraska Natural Legacy Project Partnership Team is listed in Appendix 1. In addition to the Partnership, Science, Wildlife Education/Recreation, and Core teams, the following teams contributed to the first edition of the state wildlife action plan:

Internal Support Team
This team was composed of the Game and Parks Commission's (NGPC) upper level administrative staff and two commissioners from the agency's Board of Commissioners. This team's responsibility was to provide policy oversight, ensure that the blueprint met the required elements, and provide guidance for the Commission's conservation efforts.

Outreach Team
This team included staff from the USDA Natural Resources Conservation Service, Audubon Nebraska, Nebraska Environmental Trust, The University of Nebraska-Lincoln and four Divisions within the Game and Parks Commission. The team assisted with planning for public input meetings and provided guidance regarding multiple methods of reaching the public.

Conservation Actions "Team"
This "team" included over 400 individuals who provided input at public input meetings, a conservation practitioner workshop, expert meetings and other forums to identify stresses affecting species and habitats and conservation actions to address those stresses. Input provided by team members was used to draft the statewide and ecoregional chapters.

Ecoregional Writing Teams
These four teams were composed of members from each of the four respective ecoregions. Team members consisted of a private landowner, Partnership Team member, public lands manager, private lands biologist, and a member of private conservation organization. Their role was to help draft the chapters on each ecoregion.

Public Involvement
Sixteen public input meetings were held during the fall of 2004. Over 350 citizens participated in the meetings and averages of over 100 comments were recorded at each meeting. Participants were asked to answer the following questions:

Questions asked at Public Input Meetings in 2004

1. What stresses are changing wildlife habitat in your area?
2. What conservation actions could positively impact Nebraska's species and their habitats?
3. What is needed to increase collaboration between private landowners, agencies and organizations interested in wildlife conservation?
4. What could be included in a blueprint that would call Nebraskans to action?
5. What should be measured as an indicator to determine if Nebraska's conservation plan is working?

Conservation Practitioner Involvement
Nearly 100 conservation practitioners attended a 2-day professionally facilitated workshop in Kearney, NE on October, 2004 to discuss issues pertinent to the state's biological diversity. A small group facilitator and recorder gathered input based on the following questions.

Questions asked at Conservation Practitioner Workshops in 2004

1. What are the stresses to aquatic species and habitats in your ecoregion?
2. What are the stresses to terrestrial species and habitats in your ecoregion?
3. What should be measured as an indicator to determine if conservation actions are successful?
4. What are the barriers to conservation in your ecoregion?
5. What private land incentives are needed to conserve the state's biological diversity?
6. What land management activities are needed to conserve the state's biological diversity?
7. What land protection options are needed to conserve the state's biological diversity?
8. What research and inventory is needed to conserve the state's biological diversity?
9. What educational strategies are needed to conserve the state's biological diversity?
10. What policy/legislation is needed to conserve the state's biological diversity?
11. What capacity issues are barriers to implementation of conservation actions?

In 2004, a series of one-day workshops was conducted with Commission field staff in each of the Commission's Districts. The primary goal of the workshops was to identify and gather information on sites in each District that contain terrestrial and aquatic habitats in good condition. Additional information collected included habitat types and relative condition of habitat, current land use, and stresses that could change habitats in the area. This information was used to help select biologically unique landscapes and identify stresses in those landscapes. To gain additional knowledge about the distribution and abundance of at-risk species and ecological communities, field inventory work was conducted during the 2003 and 2004 field seasons. The Science Team prioritized survey work by selecting for inventory those species and communities that were most at-risk and for which we had the least amount of data. Inventories were conducted for selected small mammals, birds, reptiles, insects, fishes, and ecological communities. Inventory work was conducted by qualified biologists, under contract to the Commission. All inventory data were entered into the Natural Heritage database and used in the analyses. Taxonomic experts contributed additional information that was beneficial in developing the State Wildlife Action Plan.

Chapter 3

Methodology: Identifying Natural Communities, At-risk Species and Biologically Unique Landscapes

A Systematic Approach to Biological Diversity Conservation

The task of conserving the biological diversity of Nebraska is daunting. Loss of habitat continues to occur and the list of species that are declining and becoming at-risk is growing, while human and financial resources for conducting conservation remain limited. Because of competing societal demands and limited funds, it is not feasible to conserve every tract of undeveloped land and certainly in a given year, only a small fraction of the land may be conserved. While opportunistic or ad hoc approaches to conservation in the past have done good work, they do not appear to have stemmed the tide of species decline. Therefore, we need to improve the efficiency and effectiveness of conservation action by taking a more systematic approach to identifying and prioritizing what components of biological diversity we are trying to conserve and where in the state we should focus conservation efforts. (See Margules and Pressey 2000, Groves 2003 for excellent overviews of systematic approaches to conservation planning)

A Systematic Approach to Conservation

Identify which components of biological diversity to focus conservation actions on (e.g. species, natural communities)

Identify where to focus conservation actions

- Select sites based on known occurrences of target species and natural communities
- Select sites where there is a high probability that the target species and communities will persist over the long term
- Select sites from across the range of distribution of the species or community to capture important variation

Set quantitative conservation goals so that multiple populations of each target species and occurrences of each natural community are conserved

There are estimated to be more than 30,000 species in the state, the majority of which are insects. There is simply not enough time, personnel, knowledge, or money to work on all these species individually. Fortunately, these species do not occur randomly but co-occur in assemblages (natural communities or habitats) that are repeated across the landscape. The challenge is to focus on a subset of species and communities that will have a high likelihood of conserving the full array of biological diversity. One approach that has been used is known as the coarse filter/fine filter approach (Noss 1987, Hunter 1991).

The coarse filter focuses at the scale of natural communities (habitats), both aquatic and terrestrial. Conserving and managing multiple, high quality examples of each of the various community types in the state (e.g., different types of prairies, wetlands, forests, etc.) should conserve viable populations of most species. For those species that fall through the pores in the coarse filter (primarily rare, imperiled, or wide-ranging species), a species by species (fine filter) approach is needed. For this planning process, we identified a set of natural communities to use as the coarse filter and a set of at-risk species to use as the fine filter.

Example of the Coarse Filter/ Fine Filter Approach

Conserving multiple examples of headwater streams should conserve most, but not all, of the species that occur in that habitat. The blacknose shiner is a rare, state-listed fish species that occurs in headwater streams in the northern portions of the Sandhills, Shortgrass Prairie and Mixedgrass Prairie ecoregions in Nebraska. If one were to conserve 20 randomly selected, high quality examples of headwater streams across this range, there is a high probability that none of them would contain blacknose shiner. Thus, to conserve this species we must focus on this species individually and conserve headwater streams that contain blacknose shiner populations.

While we want to increase conservation throughout the state, there is a need to focus scarce resources on those areas that offer the best opportunities to conserve the full array of biological diversity and the best chances for success. To utilize the coarse filter/fine filter approach, we have selected as priorities those sites that have known occurrences of natural communities and populations of at-risk species. For many species that have low mobility or high site fidelity, it is important to conserve sites with known populations rather than sites with potential habitat for the species.

In order to be most effective at conserving biological diversity, we need to focus on those sites where there is the highest likelihood that the populations and communities will persist over the long term. For individual species, this would include sites with a large population size, good age class structure and evidence of successful reproduction. For natural communities, this would include sites with a good representation of expected native species, few invasive exotics, and relatively intact ecological processes that maintain these communities (e.g., fire, grazing, flooding). Unfortunately, for some community types such as saline or playa wetlands, there are few high quality examples remaining and for other types such as tall-grass prairie, there are no examples left that are of a size similar to what historically would have been found here. In these cases, habitat restoration will play an important role in conservation.

Another factor that affects viability is the landscape context within which the population or community exists. Species and communities do not occur in isolation but are part of a landscape mosaic. A number of species, particularly birds and mammals, utilize more than one habitat type during their life cycle and these habitats need to co-occur in close enough proximity to be useful. Species and communities are inextricably linked to the

landscapes in which they occur and thus may not persist over the long term without adequate conservation of the larger system. Functional landscapes can be defined as those in which the mosaic of native community types is relatively intact and the ecological processes that sustain the species and communities are still functioning or can be simulated through management (Poiani et al. 2000). We need to identify not only high quality examples of at-risk species populations and natural communities but also those that are nested together and exist within functional landscapes. Seeking landscapes with clusters of at-risk species and high quality communities also increases the efficiency of our conservation efforts.

A strategic approach to conservation also needs to take into account the distribution of species and communities when selecting sites. Species vary genetically across their range of distribution. This variation may be important to the long-term survival of the species in the face of environmental change. In a similar fashion, the species composition of individual community types can vary across the range of the type. For example, tall-grass prairie in the southeast portion of Nebraska can have a somewhat different mix of plants and animals than tall-grass prairie in the northeast part of the state. In order for the coarse filter to be effective, this variation needs to be captured in the planning process. While it is not practical to conduct detailed genetic analyses of all at-risk species or inventory all community types, a prudent alternative is to try and conserve examples of populations and communities from across their range.

One of the most difficult questions facing conservation planners is: How much is enough? How many populations of a species or examples of a community do we need to conserve in order to ensure long-term survival? We know that conserving just one example is likely inadequate and that we need to conserve multiple, high quality examples of each species and community type to provide redundancy and ensure persistence in the face of environmental and human-induced change. In addition to identifying "how much," conservation goals should have a geographic component so that examples are selected from across the range of the species or communities. This will help capture the variation and ensure that "not all your eggs are in one basket."

Although principles from genetics, conservation biology and ecology can offer guidance in setting quantitative conservation goals, our knowledge of the life history requirements of species and how ecosystems function is too incomplete to provide definitive answers. Groves (2003) suggests four reasons it is important to set quantitative conservation goals, even with the uncertainties involved:

1. Goals allow an evaluation of how effective a proposed system of conservation areas will be in representing the conservation targets.
2. Setting goals allows planners and managers to better understand and account for the trade-offs that often must be made in trying to sustain human communities and natural communities.
3. Goals will have a strong influence in determining the number of conservation areas that are needed.
4. Goals provide a vision for conservation success.

For the Nebraska Natural Legacy Project, we have set quantitative conservation goals using the best guidance currently available with the realization that these goals are an approximation and will no doubt change as new knowledge becomes available. Our conservation goals were set for the number of populations of a given species to be conserved rather than an overall population size and for the number of occurrences of a given natural community type rather than an overall number of acres of that type. These goals facilitate a conservation strategy that focuses on sites with known occurrences of species populations and high quality examples of natural communities.

One of the goals of the Nebraska Natural Legacy Project is to identify a set of priority landscapes that, if properly managed, would conserve the majority of Nebraska's biological diversity. These landscapes, which we are calling Biologically Unique Landscapes (BULs), were selected based on known occurrences of at-risk species and natural communities. In addition to at-risk species, these landscapes support a broad array of common species. The following sections describe the approach we used to identify the at-risk species, natural communities, and BULs.

Natural Communities: A Coarse Filter

A variety of entities have been used as a coarse filter in conservation planning, including natural communities (Anderson et al. 1999), ecological systems (Comer et al. 2003), physical features and landscapes. We have chosen to use natural communities as described in Natural Communities of Nebraska (Rolfsmeier and Steinauer 2010). Since the development of the initial Natural Legacy Project in 2005, the Natural Community classification has been revised. Appendix 7 includes the communities from the revised classification. The 84 terrestrial community types described here cover wetland and upland types (any habitat with rooted vegetation) and are part of the National Vegetation Classification system (Grossman et al. 1998), which is the standard classification used by federal agencies. Unfortunately, there currently is no statewide classification system for open water habitats (lakes, rivers, streams) and there is an urgent need for the development of such a system.

We have chosen to use natural communities because of the fine scale of resolution of this system, which is effective at "capturing" the full array of species and ecological processes. For example, the upland hardwood forests along the Missouri River bluffs harbor an almost completely different suite of plants and animals than the short-grass prairies in the panhandle, and both of these species assemblages would be distinct from the saline marshes in Lancaster County. In order to conserve the full array of species, we need to conserve examples of each of the community types.

For natural communities to be an effective coarse filter in capturing biological diversity, we need to select examples of communities that contain, as much as possible, the full complement of species one would expect in that type. For example, a never-plowed prairie that is used as pasture and has been treated with a broadleaf herbicide will harbor far fewer species than a similar prairie that has not been so treated. Broadleaf species (forbs) typically make up 80-90% of the plant species diversity in a prairie and there are

numerous insects that utilize those forbs. So the conservation of the pasture would be less effective at capturing biological diversity than conservation of the untreated prairie.

Examples of communities selected for conservation should also be part of an intact landscape and have more ecological processes intact or able to be simulated with management (e.g., fire, grazing). These examples have higher ecological integrity and are more likely to persist over the long term.

The Nebraska Natural Heritage Program has been collecting and maintaining information on natural communities since 1987. Field surveys record not only the location of occurrences and species present, but also rate the overall condition of the habitat. The Element Occurrence Ranking (EORanking) uses a four level scale (A-D) to rank the habitat based on its size, condition and landscape context. For example, an "A" quality occurrence of a prairie would be of relatively large size, containing most of the native species one would expect in that prairie type and few invasive exotic species, and be surrounded by relatively intact landscape. Data from the Heritage database on the location and condition of natural communities were used in selecting the Biologically Unique Landscapes (see below).

Setting Conservation Goals

Conservation goals for natural communities were set following the guidance in Anderson et al. (1999). Under these guidelines, the distribution of the community type in Nebraska, relative to the rest of its range, is a factor in setting goals. For example, a community type that occurs only in Nebraska (e.g., Sandhills fen, paper birch springbranch canyon forest) would have the highest quantitative goal since its conservation is entirely dependent on actions taken in Nebraska. Those community types whose distribution is mostly outside of Nebraska (peripheral) would have the lowest goals since they will be conserved primarily by actions that occur outside of the state.

In addition to the distribution of the community, the patch type of the community was used in setting goals. Communities can be classified into 3 main types: matrix, large patch, and small patch. A few community types are dominant (matrix-forming) and historically covered thousands to millions of acres. In Nebraska, these would include the main prairie types (e.g., tall-grass, mixed-grass, sandsage). The majority of community types are patch types and nest within the matrix types, covering only a small portion of the landscape. Large patch communities may form extensive cover over some areas but usually their boundaries are correlated with a dominant local process such as hydrology, landform, soil-type or fire pattern. These large patch types typically occur in patches of less than 1,000 acres. Examples in Nebraska include many of the forest and woodland communities. Small patch communities are even smaller and more restricted, requiring specific natural conditions. They typically occur in patches of 100 acres or less. Examples in Nebraska include many of the wetland and shrubland types.

Anderson et al. (1999) noted that as a general rule, conservation planners need to include more examples of patch communities to buffer against the higher probability of attrition over time because of environmental change. Patch communities are smaller in extent and

multiple examples may be needed to add up to substantial area and viable populations for specialist component species. In addition, individual examples may be less likely to contain the full complement of component species than a large example of a matrix community and thus more examples are needed to capture the full complement of species.

We developed the following criteria for setting goals for the number of occurrences of natural communities to conserve. Goals for each of the community types (e.g., tall-grass prairie) can be found in Appendix 7.

Goals for Natural Communities: Number of Occurrences to be Conserved

Distribution	Matrix	Large Patch	Small Patch
Endemic/Restricted	8	14	20
Limited	3	5	10
Widespread	1	2	5
Peripheral	1	2	5

Endemic/Restricted: communities that only occur within NE or generally have more than 90% of their range within the state.

Limited: communities that occur primarily within one region (e.g., Great Plains).

Widespread: communities that are common in a number of regions and widespread in NE.

Peripheral: communities that are found mainly in other regions, generally less than 10% of the range is within NE.

At-risk Species: The Fine Filter

In order to prioritize which species to focus scarce resources on, the Nebraska Natural Legacy Project Science Team developed a two-tiered approach to identifying those species that may be at-risk of extinction or extirpation from the state. The Tier I species are those that are globally or nationally at-risk. The Tier II list contains those species that are at-risk within Nebraska while apparently doing well in other parts of their range. The rationale for the two-tiered list was to focus attention and resources first on those species that may be headed for global extinction (and federal listing as Threatened or Endangered) and secondarily focus on those species that may be facing extirpation from Nebraska but appear to be stable globally. The Tier I list includes species that are currently state or federally listed as well as those that may be headed for listing. One goal of the Nebraska Natural Legacy Project is to prevent imperilment of species and the need for listing and another goal is recover currently listed species to allow for their de-listing. Additionally, there is a goal to keep common species common and the coarse filter (described in the previous section) should ensure this goal is met.

Species were chosen from a variety of taxa including mammals, birds, reptiles, amphibians, fishes, mollusks, insects, and plants. We did not have adequate information to evaluate certain taxa (e.g., fungi, bryophytes) and only certain types of invertebrates (e.g., mollusks, some groups of insects) had adequate information to allow evaluation of their imperilment status.

For the initial development of the Nebraska Natural Legacy Project, the Science Team developed criteria for selecting the Tier I and II species (see box) and selected an initial set of species that fit the Tier I criteria. This list was sent to experts on the various taxa for review. These reviews were used to revise the list. Toward the end of the process to develop the Natural Legacy Project, we conducted a series of expert workshops (mammals, birds, reptiles, fish, insects) and the list was reviewed again and revised. For the 2011 revision, the Science Team reviewed and revised the selection criteria and the taxa experts reviewed and revised the Tier I and Tier II lists in a series of workshops covering mammals, birds, reptiles, fish, insects, mollusks, and plants.

Criteria for Selecting Tier I At-risk Species

Species were included in the Tier I list that met one or more of the following criteria:

State and Federally Listed Species: Species listed as Threatened or Endangered under the federal Endangered Species Act or the Nebraska Non-game and Endangered Species Conservation Act. Recovery and de-listing of these species is a goal of the plan.

Heritage Ranked Species: Species ranked by NatureServe and the Natural Heritage Network as globally critically imperiled (G1), imperiled (G2) or vulnerable (G3). Or species ranked as either state critically imperiled (S1), imperiled (S2) or vulnerable (S3) in all or nearly all states in their range.

Declining species: Species whose abundance and/or distribution has been declining across much of their entire range. For land birds, the Partners in Flight national watch list was used as a guide.

Endemic Species (or nearly so): Species whose entire range of distribution occurs within or primarily within Nebraska. Conservation actions in Nebraska would be critical to the conservation of the species.

Disjunct Species: Species whose populations in Nebraska are widely disjunct (200+ miles) from the species' main range of distribution. Such populations may contain genetic variations that could be important to the long-term survival of the species. Species must be ranked as critically imperiled (S1) or imperiled (S2) within Nebraska.

Criteria for Selecting Tier II At-risk Species

Tier II species were those that did not meet the Tier I criteria but were ranked by the Nebraska Natural Heritage Program as either State Critically Imperiled (S1), State Imperiled (S2) or State Vulnerable (S3) (see Appendix 4 for explanation of ranks). For plant species, only species ranked S1 or S2 were selected.

Eighty-nine species were identified as meeting the Tier I criteria. The list of Tier I species is found in Appendix 8 along with information about their conservation status, range in Nebraska, stresses, inventory and research needs and a list of the Biologically Unique Landscapes where they are known to occur. We identified 679 species as meeting the Tier II criteria and the list is found in Appendix 9. During the development of the Nebraska Natural Legacy Project, the Heritage state ranks were reviewed and revised for amphibians, reptiles, mammals, fish, birds and a limited number of insects.

We have identified 768 species in Nebraska as at-risk (i.e., met Tier I or Tier II criteria). This is far too many to deal with in a detailed manner in conservation planning. We will focus most of our effort on the Tier I species. These are the species for which we are setting quantitative goals and identifying sites important to the conservation of the species. Tier II species were also used in identifying biologically unique landscapes but did not have specific goals set for them.

The Tier I and Tier II at-risk species lists will be periodically reviewed and updated by taxon experts. As new information on abundance, distribution, and population trends becomes available, species will be added to or removed from the lists. These lists were developed to help prioritize conservation planning/action and do not have legal or regulatory ramifications.

Setting Conservation Goals

Population viability analyses (PVAs) have been used for setting conservation goals for a limited number of species. These analyses are a quantitative method used to predict the future status of a population or collection of populations. During conservation planning in Florida (Cox et al 1994, Kautz and Cox 2001), population viability analyses were conducted on 11 focal species (birds, reptiles, mammals). Their results suggested that an appropriate goal for all the target species was to conserve a minimum of 10 populations. While detailed PVAs have been conducted for only a small number of species, the thought processes behind PVAs can be used in setting goals for other species. Using a simple equation (Morris et al. 1999), one can calculate the probability that all populations of a species will go extinct over a period of time given the probability of extinction of any given population. This model assumes that the fates of the individual populations are not correlated and that there is little movement among the populations.

We set an initial goal of 10 populations as a minimum for conserving a species. Using the equation from Morris et al. (1999) and assuming moderate viability of each population (40% chance of survival over a 100 year period), conservation of 10 populations gave a greater than 99% probability of at least one population surviving over that time period. This goal was then modified based on the proportion of the species' total distribution that was contained within Nebraska. For species that were endemic to Nebraska (or found also within a limited range outside the state), the goal was set at 10. These are species whose long-term protection will depend primarily on conservation actions taken in Nebraska. The goals were then reduced as the proportion of the species range outside of the state increased (see box below for goals). These species will be conserved by actions in a number of states, not just action in Nebraska. Regardless of distribution patterns, we set a minimum goal of 10 populations for state listed threatened and endangered species. This was to ensure the long-term survival of the species within Nebraska and enable de-listing.

Goals were also occasionally modified on a case by case basis. For example the Ute ladies'-tresses orchid (state and federally listed), after extensive surveys, has only two known populations in Nebraska. Populations of this species are sparsely distributed across its entire range and it is likely the current distribution in the state represents its pre-Euro-american settlement distribution. The goal for this species was set at two. Goals for all Tier I species are listed in Appendix 8.

Goals for Tier I Species: Number of Populations to be Conserved

Endemic/Restricted/State Listed	10
Limited	7
Widespread	4
Peripheral	1
Disjunct	1

Endemic/Restricted/State Listed: species that only occur within NE or generally have more than 90% of their range within the state.

Limited: species that occur primarily within one region (e.g., Great Plains).

Widespread: species that are common in a number of regions and widespread in NE.

Peripheral: species that are found mainly in other regions, generally less than 10% of the range is within NE.

Disjunct: Species whose populations in Nebraska are widely disjunct (200+ miles) from the species' main range of distribution.

Selecting Biologically Unique Landscapes

The goal of this process was to identify a set of landscapes that offer some of the best opportunities for conserving the full array of biological diversity in Nebraska. Landscapes were selected based on known occurrences of natural communities and at-risk species and were selected to meet the goals we had set for each community type and Tier I species.

We conducted two different analyses (SPOT and Heritage Hotspots) of data in the Natural Heritage database. Results of these analyses were used in conjunction with other spatial data layers to help delineate the boundaries of the landscapes.

SPOT (Spatial Portfolio Optimization Tool, see Appendix 5) is a computer algorithm that selects areas based on the goals, set by the user, for the number of occurrences of communities and species that are to be conserved. The program identifies a set of areas that meet identified goals in the least amount of total area with the least amount of fragmentation (most clustering of species and communities). In this analysis, we used data in the Heritage database for all terrestrial communities and the Tier I at-risk species. To help ensure that the best examples were selected, we used only those occurrences with an EORank of A or B, (for those occurrences that were ranked). The areas identified by this process can be viewed as the minimum area needed to meet the goals. The results can be displayed as a GIS layer or map.

The Heritage Hotspots layer was developed using the Section (square mile) grid of Nebraska (see Appendix 6). Each Section was given a score based on the number and conservation ranks of species and communities found within them. Sections were classified by score range (1-5, 6-10, etc) and the classes were portrayed in different colors to allow us to visually identify hotpots of natural community and at-risk species diversity. Data from all Heritage tracked species (Tier I and II) were used as well as the community data.

While the Heritage Database represents the most comprehensive, statewide data on at-risk species and natural communities in the state, inventory work is far from complete in Nebraska. Supplemental expert information was used to help delineate the landscapes. In addition to the above spatial data, we developed a GIS layer in which the Commission's District field staff had delineated areas that contain relatively intact and high quality habitat. We also conducted a series of workshops with species experts (fish, birds, mammals, insects, reptiles and amphibians). Participants in these workshops delineated areas in the state with high concentrations of at-risk species. In the case of the fish expert workshop, they also identified areas with high quality streams with a good overall diversity of species. And finally, we utilized the National Land Cover Data (1993) to help identify relatively intact landscapes.

The results from the SPOT analysis were used to identify the nuclei of the landscapes. The additional layers were used to expand the boundaries of the landscapes so that they were clusters of community and at-risk species occurrences within a relatively intact

landscape. There was no prioritization among landscapes, each contains a somewhat different assemblage of communities and species and therefore, each is needed to complete the conservation of Nebraska's biological diversity.

BUL Boundary Changes (2010)

Since 2005, local biologists have focused their work in Biologically Unique Landscapes, and have collected more information about species and natural communities. They requested a process to modify the boundaries. Due to the tight timeframe of our 2010 revision process, we did not re-run the GIS analyses that were used in delineating the initial set of BULs. Instead, the Nebraska Natural Legacy Science Team developed a set of criteria for evaluating proposed changes to the BUL system (see Appendix 11). A request for boundary change proposals was sent out to conservation practitioners who have been working in the BULs. The Science Team reviewed the initial proposals, made suggestions for changes to the proposals, reviewed the final proposals, and then made recommendations for each proposal to the Natural Legacy Partnership Team for final approval.

Five minor BUL boundary adjustments were approved; Southeast Prairies, Saline Wetlands, Verdigris-Bazile, Middle Niobrara, and Central Loess Hills. A major boundary adjustment was approved for the Rainwater Basin. This area was delineated using different criteria than the other BULs. The Rainwater Basin boundary was delineated using physical features (soils, topography), rather than biological features used for other BULs (occurrences of at-risk species and natural communities), and was designed to encompass all the wetlands in the landscape. The large size of the landscape is important. Annual spatial variation in precipitation means that wetlands in some parts of the landscape may be dry in a given year while others may have water. Thus, wetlands need to be conserved over a large geographic area to insure that some are suitable as migratory stopover sites in a given year. Another difference is that other BULs were delineated to include relatively intact landscapes while the RWB is primarily an agricultural landscape with imbedded wetlands. When the focus of conservation is migratory stopover sites, it may be less important that the landscape is intact than when trying to conserve resident species.

Analysis of BUL System

An analysis was conducted to see how well the set of 40 Biologically Unique Landscapes offered opportunities to meet the quantitative conservation goals set for communities and Tier I species. Documented occurrences and expert knowledge of locations of species and communities were assessed to determine if there was ample opportunity in the existing system of BULs to meet the conservation goals specified in the Nebraska Natural Legacy Project. Ample opportunity was identified when there were numerous occurrences (many more than the goal) of the given species or community within multiple BULs, or when the entire, or nearly entire, range of the species or community in the state occurs within BULs. The existing system of BULs provided ample opportunity to meet the conservation goals for 66 (74%) of the Tier I species. For all but one of the remaining Tier I species, their goals could be partially met within the existing system.

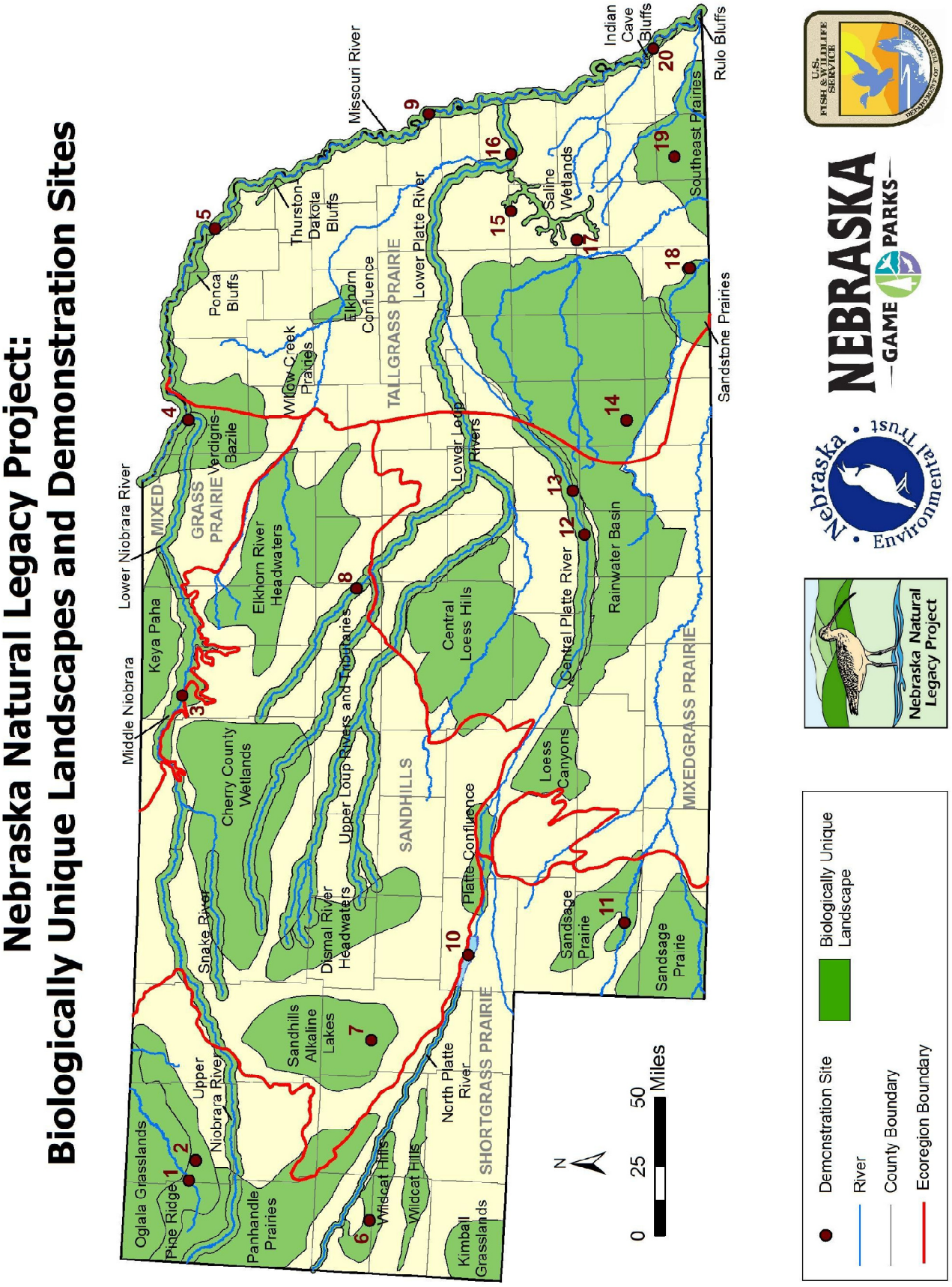
Many of these species whose goals weren't met, have few documented occurrences and their distributions are poorly known, so it is unclear how well the system may meet their needs. For natural communities, the system provided ample opportunity to meet the goals for 75 (90%) of the community types. The goals for the remaining community types can be partially met in the current system. The high percentage of community goals met by the current BULs indicates that the system is suitable for conserving the vast majority of common species.

The current set of BULs may not be adequate to address the needs of wide-ranging species. We did not attempt to identify corridors or connections between landscapes that would allow for the movement of these species. The lack of corridor identification may also mean that the current BUL system may not provide for species that need to shift their distribution range in response to climate change. In addition, migratory bird species that do not have high fidelity to nesting sites (e.g., many grassland nesting birds) may not be captured well by this approach. While nesting record data were used to identify landscapes, there is no guarantee that the birds will return to those sites in subsequent years. However, given our limited knowledge of the habitat requirements of most species, it may be safest to target action at those sites where they are known to nest rather than potential habitat. Similarly, those species that only occur in Nebraska during their migration and do not have high fidelity to particular stopover sites (e.g., whooping crane) may not be well served. While a number of selected landscapes have documented occurrences of whooping crane roost sites, we do not have data indicating which of those may be used more often than others.

While the set of landscapes described here does not meet the needs of all species in Nebraska, it appears to offer ample opportunity to meet the needs of the vast majority. Many of the BULs are quite large and no doubt further inventory work will identify additional occurrences of at-risk species and natural communities. Further inventory is also needed to be able to identify additional landscapes to round out the system.

Natural Legacy Demonstration Sites

A set of demonstration sites was selected to represent examples of habitat conservation opportunities in the state of Nebraska. A multi-organizational team of conservation practitioners chose sites that currently demonstrate or have great potential to demonstrate the mission of the Nebraska Natural Legacy Project. For more information on Natural Legacy Demonstration Sites, see Chapter 4.


Nebraska Natural Legacy Project:
Biologically Unique Landscapes and Demonstration Sites
Oglala Grasslands
Pine Ridge
Panhandle Prairies
Upper Niobrara River
Lower Niobrara River
Middle Niobrara
Keya Paha
Cherry County Wetlands
Snake River
Sandhills Alkaline Lakes
Wildcat Hills
Wildcat Hills
Kimball Grasslands
North Platte River
Dismal River Headwaters
Upper Loup Rivers and Tributaries
SANDHILLS
SHORTGRASS PRAIRIE
Platte Confluence
Central Loess Hills
Elkhorn River Headwaters
MIXED GRASS PRAIRIE
Verdigris-Bazile
Ponca Bluffs
Willow Creek Prairies
Elkhorn Confluence
Thurston Dakota Bluffs
Missouri River
TALLGRASS PRAIRIE
Lower Loup Rivers
Lower Platte River
Saline Wetlands
Central Platte River
Rainwater Basin
Loess Canyons
Sandsage Prairie
Sandsage Prairie
MIXEDGRASS PRAIRIE
Indian Cave Bluffs
Rulo Bluffs
Southeast Prairies
Sandstone Prairies
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
N
0
25
50
Miles
Demonstration Site
River
County Boundary
Ecoregion Boundary
Biologically Unique Landscape
Nebraska Natural Legacy Project
Nebraska Environmental Trust
NEBRASKA GAME PARKS
U.S. FISH & WILDLIFE SERVICE

Nebraska Natural Legacy Project Demonstration Sites

1 Fort Robinson State Park
2 Ponderosa Pine Wildlife Management Area
3 Niobrara Valley Preserve
4 Niobrara River State Park
5 Ponca State Park
6 Wildcat Hills
7 Crescent Lake National Wildlife Refuge
8 Calamus Wildlife Management Area and State Recreation Area
9 Boyer Chute National Wildlife Refuge
10 Lake McConaughy
11 Enders Reservoir
12 Lillian Annette Rowe Bird Sanctuary
13 Platte River Prairies
14 Kissinger Basin Wildlife Management Area
15 Saline Wetland Complex
16 Schramm Park State Recreation Area
17 Spring Creek Prairie
18 Rock Glen WMA and Rock Creek Station State Historical Park
19 Burchard Lake Wildlife Management Area
20 Indian Cave State Park

Chapter 4

Conservation Actions to Address Barriers to Conservation and Stresses Affecting Species and Habitats

During the planning phase of the Nebraska Natural Legacy Project, conservation practitioners and the public were asked to help identify the barriers that limit or preclude conservation, key stresses to species and habitats, and actions needed to overcome barriers and stresses to species and habitats. Barriers, stresses and actions were identified by (1) the public at input meetings and through the Nebraska Annual Social Indicators Survey (NASIS), (2) conservation practitioners who participated in workshops and regional meetings, (3) species experts who attended a series of workshops, and (4) members of the public and conservation practitioners who provided comments during the review of the plan. Existing conservation plans were also reviewed and appropriate stresses, barriers and actions were incorporated into this plan.

Proposed conservation actions were run through a filter of guiding principles developed by the Natural Legacy Partnership Team to ensure they were biologically sound, economically feasible and sensitive to private landowner needs. Although most input was gathered on an ecoregional basis and specific barriers, stresses and conservation actions have differing levels of importance in each of Nebraska's four ecoregions, most have statewide relevance. Therefore, issues were incorporated into a single chapter to reduce redundancy. Key barriers, stresses and actions in each ecoregion and Biologically Unique Landscape are identified in ecoregion chapters.

The Natural Legacy Project uses voluntary, incentive based approaches to conservation. It does not evaluate existing state or federal regulatory programs that affect biological diversity (e.g., water or air quality regulatory programs, at-risk species protection laws). This strategy therefore does not provide recommendations for changes to regulatory programs that have been initiated already nor the need for additional such programs.

Because 97% of the state is in private ownership (principally farms and ranches), conservation of the state's flora and fauna is largely dependent upon support and participation by private landowners. Extensive public input helped ensure that proposed conservation actions were reasonable and practical. Economic feasibility should take into account the cost of conservation actions and direct impacts on local economies. Conservation actions should be evaluated considering costs and benefits for meeting conservation goals. With full implementation, the partnership and perspective of landowners is invaluable. Input from private landowners is sought continually throughout implementation.

The stresses and actions identified in the following section, along with the at-risk species, communities, and priority landscapes identified in Chapters 5-8, comprise the nucleus of the conservation blueprint. Implementation of the conservation actions on a statewide level will help ensure that a significant number of opportunities for conservation of biological diversity in Nebraska are acted upon.

Actions Needed to Overcome Barriers and Threats

- Increase collaboration and communication
- Increase environmental education
- Improve conservation programs and incentives
- Facilitate species and ecosystem adaptation to climate change
- Promote management that is more compatible with conserving biological diversity
- Focus conservation on the best opportunities
- Maintain and expand the network of public and private conservation lands
- Demonstrate success
- Increase participation in nature-based recreation

Advance Collaboration and Communication

No single government agency or private organization has the authority, financial resources, or staff to assume the entire responsibility for conserving Nebraska's biological diversity. Implementation of a state wildlife action plan requires the cooperative efforts of a wide range of governmental entities, private organizations and citizens. Partnerships and cooperative arrangements can be used to promote collaboration and communication. This approach should help reduce duplication, increase information sharing, establish trust, and promote more efficient allocation of resources to conservation priorities.

In the past, a lack of communication and collaboration between resource professionals and agricultural producers has created tension and conflict regarding fish and wildlife conservation. Many of these conflicts have arisen from issues related to endangered species, water management, and a perceived lack of respect for private property rights. As a result, trust has eroded and collaboration on a broader range of conservation issues has been impeded. Information about conservation opportunities to landowners is often insufficient or unclear. Many individuals who are interested in conservation programs may not be aware of conservation opportunities or know whom to contact.

82% of Nebraskan's feel that "at-risk" species would be conserved most effectively by a partnership of governmental and private organizations.

Source 2004 NASIS Survey

Communication amongst conservation practitioners is often inadequate. Without a consistent exchange of information and opportunities to collaborate, conservation practitioners run the risk of being uninformed about programs and species needs. Improved communication and collaboration between agencies and conservation practitioners can lead to greater efficiency and result in new and innovative solutions to conservation problems.

Actions Needed to Advance Collaboration and Communication:

Support existing locally-based conservation partnerships in each of Nebraska's ecoregions that include a diversity of stakeholders (e.g., farmers, ranchers, community leaders, public and private conservation organizations). When possible, any new partnerships should be modeled after existing successful partnerships (e.g., Sandhills Taskforce, Rainwater Basin Joint Venture).

1. Support existing and develop new regional forums that include diverse representation from landowners, agencies, private organizations and others that facilitate the exchange of ideas, promote networking, and engage in problem-solving to address issues related to endangered species management, public lands ownership and management, landowner confidentiality, private property rights, etc. Present Natural Legacy information at various forum meetings. Distribute local contact information and address concerns by conducting seminars, workshops, and social functions that promote communication, cooperation and the exchange of ideas.

2. Develop and widely distribute clear and concise publications about conservation programs, stresses to biological diversity, and actions needed to conserve biological diversity. Make it widely available in printed and electronic formats.

3. Regularly inform the public of proposed initiatives, management actions, policy changes, and conservation successes and failures through public meetings, workshops, field trips, one-on-one meetings, seminars, presentations at stakeholder meetings, media, and other effective venues.

4. Develop and implement recognition and appreciation programs to acknowledge the efforts of farmers, ranchers, acreage owners, organizations, community leaders, and others who demonstrate meritorious achievement in the conservation of biological diversity.

5. Design and conduct training programs that instruct conservation practitioners and others in effective public participation techniques.

6. Strive for shared responsibility between landowners, agencies, organizations, and communities when implementing the Nebraska Natural Legacy Project.

7. Institute a citizen-science and education initiative that draws on volunteers of all ages to assist with monitoring, research, stewardship, and education of natural habitats and wildlife. Opportunities are available with existing programs (e.g., Master Naturalist, Adopt-A-Stream, Project FeederWatch) and should be supported.

8. Improve existing and establish new communication channels among conservation practitioners and their agencies/organizations to improve coordination, reduce conflicting and confusing messages conveyed to the public, and to develop a shared vision for the conservation of biological diversity.

9. Facilitate conservation projects by communicating information about possible funding sources, trained contractors, and resources such as native seed suppliers. Encourage involvement in conservation programs, particularly featuring acres where producers are experiencing a decreased profit margin. In many cases, producers may realize no net loss from their participation in conservation programs.

10. Seek opportunities to facilitate understanding and collaboration between the rural and urban publics.

11. Establish networks between public land managers and neighboring private landowners to improve communication, increase respect, and build trust.

12. Look for opportunities to collaborate with bordering states to develop and implement conservation strategies for Biologically Unique Landscapes that truncate Nebraska state lines.

Increase Environmental Education

Education is an essential part of conservation. For the Nebraska Natural Legacy Project to succeed, Nebraskans need to be knowledgeable about the state's rich biological diversity and the stresses that threaten its existence. An environmentally literate citizenry is critically important to sustaining natural environments and making ecologically responsible choices regarding built or otherwise altered locations. When presented in an unbiased and scientifically accurate manner, environmental education (EE) is an essential tool that empowers learners of all ages to rise to the challenge of making sound decisions. People who become engaged in the natural world are more likely to appreciate the conservation of biological diversity and ecological integrity.

Topics relating to Nebraska's natural environment provide numerous opportunities for student learning. Most children have an innate interest in the natural world, yet time constraints, transportation issues, inadequate teacher training, lack of materials, curriculum requirements, and other factors are barriers to teachers wishing to deliver environmental education. The interdisciplinary nature of environmental education makes it appropriate for many subject areas, yet EE is mainly used in science disciplines. Although the 2003 Nebraska Conservation and Environment Literacy Survey indicated that 98% of Nebraskans support the teaching of environmental education in classrooms, most school districts provide only token support. Effective programs should show how such education can benefit students in core disciplinary areas and how it can help educators reach key standards.

The motto "Nebraska - The Good Life" underscores the importance of a healthy and sustainable environment to the well-being of the state's residents. The increasing urbanization of Nebraska, reliance on technology, and competing interests for unscheduled time is changing people's level of attachment and perceived reliance on the environment. It's critically important that both urban and rural Nebraskans maintain or establish a sense of place whereby they value, understand, interact with, and appreciate the local environment in which they live. Achieving a sense of place is contingent upon Nebraskans of all ages

having easy access to materials, trained educators, and opportunities to be immersed in the natural environment.

An environmentally literate citizenry has extensive social, ecological, and economic implications. The important role of education in furthering biological diversity conservation is becoming better understood and more widely accepted. According to the 2004 NASIS survey, 94% of Nebraskans feel that increasing education programs is very or moderately important to reverse the decline of "at-risk" species. Putting more resources into education can produce long-term societal benefits and help ensure continued and expanded support for the actions necessary to conserve biological diversity.

Actions Needed to Increase Environmental Education:

1. Work with universities and colleges across the state to ensure pre-service teachers are prepared with adequate science, ecological, and nature education knowledge before graduating. This could be accomplished by adding environmental education-specific courses or encouraging mentorships with current classroom educators already incorporating environmental education into their curriculum.

2. Provide quality training and support to formal and non-formal educators to increase capacity for environmental education. Examples of training opportunities include advanced ecoregion or ecosystem-specific workshops dealing with local flora and fauna and creation of workshops and resources specific to the Nebraska Natural Legacy Project (e.g., at-risk species information).

3. Support existing and develop new programs/partnerships/materials to improve learning opportunities to all age and ability levels (early childhood, school-aged students, adults) that will increase awareness, knowledge, appreciation, and shared responsibility of Nebraska's biological diversity. Examples include but are not limited to Nebraska-specific curricula, activity guides, workshops/programs, educational trunks, portable classroom/laboratory, field trips, distance learning opportunities, websites, videos, posters, etc.

4. In collaboration with the state Department of Education, seek to address important issues related to biological diversity in state education content standards; specifically, but not limited to, state science standards. Additionally, work with the Nebraska Department of Education to adopt and incorporate the Nebraska Environmental Literacy Plan. This plan seeks to develop environmentally literate students and ensure that all students, by the time they graduate high school, are knowledgeable about Nebraska's natural resources and environmental issues and willing to act on this knowledge to help conserve our natural legacy and solve our environmental problems.

5. Increase opportunities for students and adults to experience and learn about Nebraska's natural communities by improving access to and organizing events such as tours, volunteer workdays, environmental festivals, field trips, etc. oriented around these natural communities. Promote the stewardship and widespread participation in

outdoor activities, leading our citizenry to find and appreciate new values for the natural world.

6. Support individuals and groups that can address obstacles related to increasing Nebraskans' awareness, knowledge, and commitment to conserve biological diversity. Examples of individuals or groups include leaders from private and public conservation groups, educational institutions, formal and non-formal educators, community leaders, private landowners and others.

7. Support existing programs that promote the development of natural communities (e.g., prairies, wetlands, native woodlands) at schools, parks, government offices, housing developments, businesses, etc. that can be used by the public to learn about biological diversity.

8. Raise awareness about the role of farming, ranching and urban/suburban backyards in biological diversity conservation. Develop mentoring programs for landowners regarding ecologically-sound farming and ranching practices. Create neighbor networks where landowners can share information and help each other with projects.

9. Work with partners, such as Cooperative Extension, to develop and conduct workshops for landowners, producers, community leaders, conservation practitioners, educators and others on topics such as prairie conservation, at-risk species management, invasive control, forest management, aquatic resources, available cost-share programs for projects, etc. Workshops should be offered at diverse times and seasons to accommodate various schedules including evening, weekends, and workdays.

10. Use multiple media outlets (e.g., television/radio, print advertisements, internet, billboards, public displays) to increase awareness and support for Nebraska's biological diversity and inform the public of progress made to conserve species and habitats.

11. Host workshops for non-formal environmental educators to help them understand the state education standards and how their programs can connect to these standards.

12. Work with school administrators to see environmental education as critical to the development of well-rounded, knowledgeable students and citizens. Involve school administrators on nature or environmentally-related field trips.

13. Provide an incentive-based program to encourage teachers to incorporate EE into their curriculums. Incentives could include: giveaways, free passes, travel scholarships (for educators to attend workshops/conferences or for classrooms to attend a field trip), or grants to help incorporate new EE resources.

14. Further train and develop a volunteer network of educators to facilitate enhanced quality programming in our state parks, nature centers, and through our diverse partner organizations, utilizing programs such as Nebraska Master Naturalist, Hunter Education, Boater Education, Aquatic Education, Project WILD, and Flying WILD.

15. Have high school and/or college students with an environmental-conservation background (e.g., a student conservation association) teach Natural Legacy classes/programs for experience and/or a stipend.

16. Organize or support scholarship programs for students who demonstrate a commitment to environmental conservation and pursue conservation-related trainings and degrees.

17. Initiate education efforts relating to reduction of global climate change and its potential effects on Nebraska's environment and wildlife.

Improve Conservation Programs and Incentives

Most conservation practitioners and many private landowners can attest to the large number and complexity of conservation programs. Landowners with an interest in conservation often have to wade through a sea of paperwork and long lists of options in order to enroll in programs or initiatives. It's often difficult for conservation practitioners to keep abreast of the many program offerings and it can be overwhelming for landowners who are interested in conservation but also want to make the best business decision. Although varying organizational missions and policies will likely always necessitate that there be multiple programs, better collaboration on the part of agencies implementing existing or developing new programs is needed to make conservation more "landowner-friendly."

The demand for technical and financial incentives by landowners to do conservation work is growing and is outpacing our ability to meet demand. Current resources need to be increased or made more efficient to meet the growing demand for landowner assistance. Some landowners simply need technical guidance provided from a best management practice guide and others need direct assistance through one-on-one consultation by a wildlife biologist. Many landowners also need financial incentives such as cost-share for doing habitat improvements, infrastructure to change management, or direct payments to set aside habitat or to enroll in conservation easements. Delivery of technical and financial assistance can include local (e.g., Natural Resource Districts), state (e.g., Nebraska Game and Parks Commission, Nebraska Forest Service), federal (e.g., Natural Resources Conservation Service, US Fish and Wildlife Service) agencies or private organizations (e.g., Pheasants Forever, The Nature Conservancy, National Wild Turkey Federation, Ducks Unlimited).

To be effective, biologists providing technical assistance must have a familiarity and understanding of conservation programs and knowledge of habitat requirements of species. Although no two conservation practitioners are likely to give identical advice to a landowner, it's important that management recommendations be based on the best available science. Landowners often become frustrated and lose confidence in organizations and agencies when resource professionals fail to communicate and give conflicting or contrasting advice. In

many cases, inconsistencies between related conservation programs result from a lack of communication within the conservation community. In other cases, agency missions differ and program rules reflect those differences. Policy differences (e.g., where to site tree plantings) between agencies can lead to confusion by the public and conflict between resource professionals. When possible, conservation agencies and organizations should strive for consistent policies to maximize biological diversity conservation throughout the state.

Conservation programs and financial incentives need to be voluntary, uncomplicated, flexible, and make economic sense in order for them to meet the test as "landowner-friendly." Private landowners may feel that too much of their decision-making authority or income potential is surrendered in order to participate in conservation programs. In addition, some programs are overly rigid and don't allow for changing conditions or the use of adaptive management practices. Although limited funding will often not allow conservation program payments to meet or surpass the income potential of intensive land uses such as cropping, it can provide an economic cushion when transitioning to management systems that may be more economically sustainable (e.g., changing from season-long to rotational grazing). Many landowners are willing to incur some loss in income if necessary to improve overall landscape condition, increase wildlife populations, and develop recreational opportunities.

Local economics play a significant role in conservation program participation. This includes property taxes which are a significant barrier to conservation program participation. One issue is that changes in land use or policies that result in lower property taxes are often not desirable because the revenues available for schools and roads are reduced. Another issue is that many landowners, including recreational landowners, typically need their property to generate at least sufficient income to pay property taxes. This leads many landowners to seek management alternatives that provide fewer benefits for "at-risk" species. Additionally, in recent years, the value of high quality wildlife recreation lands has risen at a higher rate than other lands, causing property values and associated property taxes to increase on working lands.

Actions Needed to Improve Conservation Programs and Incentives:

1. Seek private landowner and multi-organizational input when developing conservation incentive programs to 1) help ensure they are landowner-friendly (voluntary, incentive-based, adaptable, economically feasible, confidential, etc.), 2) support the missions of a broad array of conservation organizations, and 3) effectively conserve biological diversity. When possible, model new programs after successful programs used elsewhere and keep overall process relatively simplified.

2. Assess the barriers (e.g., permit processes) to landowner participation in conservation programs and use that information to improve existing programs and in developing new programs.

3. Explore opportunities to provide private landowners with incentives/income for assisting with restoration projects (e.g., native seed harvest), engaging in activities that support biological diversity (e.g., providing nature-based recreation opportunities, marketing of biological diversity-sustainable products), or being willing to tolerate wildlife-associated economic losses.

4. Seek opportunities to increase the focus of existing conservation programs (e.g., Wild Nebraska, EQIP) and funding sources to better conserve biological diversity and natural communities.

5. Develop a best management practice handbook to assist private and public landowners and land managers in the best methods to restore and manage natural communities.

6. Explore new funding sources that provide sustainable and equitable compensation for landowners who participate in programs that conserve biological diversity. Regularly adjust incentive rates to reflect changing economic conditions.

7. Seek to increase the capacity of agencies and organizations to provide efficient and high quality technical assistance to private landowners who are interested in conserving biological diversity.

8. When possible, seek to safeguard the local tax base by providing equitable compensation (e.g., payment in lieu of taxes) when conservation projects result in a significant reduction in property taxes.

9. Consider local economic impacts of conservation projects. Consider costs and benefits of actions to meet conservation goals, including needs for further conservation actions when goals have been met.

10. Seek out and promote innovative solutions to economic constraints on landowners interested in conserving biological diversity. These could include but are not limited to tax deferments, capital gains tax relief, and conservation buyer programs.

11. Develop and promote voluntary projects/programs aimed at conserving threatened and endangered species on private land and provide assurances to participating landowners that no additional future regulatory restrictions will be imposed (e.g., Safe Harbor Agreements).

12. Develop partnerships with community planning leaders, business leaders, and private organizations to develop best management practices (e.g., cluster housing) that can help ensure residential and commercial developments minimize the impacts to natural communities and biological diversity.

13. Collaborate with the Department of Natural Resources and Natural Resource Districts to discuss the impacts of watershed planning decisions made under LB 962 on fish, wildlife, and related resources in those watersheds. Undertake a watershed-by-watershed assessment of the impacts of changing streamflow conditions on biological diversity, starting with the watersheds under the most threat from increased water use.

Facilitate Species and Ecosystem Adaptation to Climate Change

Climate is one of the primary factors influencing species distribution and abundance. Thus, climate change is likely influencing species and ecosystems by altering fundamental interactions with other species and the physical environment, which could lead to a cascade of impacts throughout ecosystems. Many in the conservation community believe that climate change will be the greatest challenge to conserving biological diversity in the coming decades.

Climate change is already having a significant impact on species and documented effects include: shifts in species distributions, changes in phenology of species, and de-coupling of co-evolved interactions. In addition, climate change is expected to alter ecological processes such as fire pattern and hydrology and exacerbate a number of non-climate stressors such as habitat loss and fragmentation, pollution, and the spread of invasive species, pests, and pathogens.

One way that species have responded to climate change since the last ice age has been to shift their distribution to higher elevations or latitudes. Similar range shifts have already been documented and are expected to continue and increase in the future. However, two aspects of the current climate change may make this response problematic. There is currently significant habitat fragmentation and barriers to long distance movement and the rate of climate change is expected to be greater than in the past. In addition, during past climate change, species-level shifts in range and abundance were species-specific, with species migrating at different rates on different routes, and not as intact natural communities. Thus, we are likely to see natural communities disaggregating, depending on intrinsic response rates, and reconfiguring in potentially novel combinations, upslope or further north.

Phenology refers to the timing of annual life-cycle events such as the seasonal timing of flowering or migration. Many species operate on seasonal cues that are directly related to climate, so changes in climate may lead to changes in phenology of some species. The onset of spring, as measured by a variety of natural phenomena, has been occurring earlier since 1900, which in turn has led to shifts in the phenology of breeding, hibernation, migration, pollination, and productivity of some species. Studies have documented changes in timing of flowering, migration, insect emergence, and peak biomass. Climate change will influence both plant and animal phenology, potentially disrupting crucial interactions that influenced species persistence as well as how ecosystems function and what services they provide.

Species are not expected to respond uniformly to climate change but will respond individually with changes in distribution and/or phenology. Thus, there is likely to be a de-coupling of ecological relationships among species as they respond to climate change in different ways at different rates. For example, the timing of emergence of an insect

pollinator may shift and become out of synch with the flowering time of its host plant. This de-coupling may lead to local extirpations and have significant impacts on ecosystem structure and function. This may be one of the greatest impacts facing many wildlife species, which, given their mobility, are otherwise able to adapt to climate change by shifting their ranges.

Potential climate change effects on fire, hydrology, habitat fragmentation, pollution, and invasive species are discussed in subsequent sections of this chapter. Tier I at-risk species have been evaluated for their vulnerability to climate change and that information is found in Appendix 8. For additional information on potential impacts of climate change on species and ecosystems, and possible conservation strategies, see the further reading section at the end of the references.

Given the uncertainty in the magnitude, rate, and nature of future climate change, uncertainties about how climate change will interact with other species/ecosystem stressors and the limited understanding of how species and ecosystems will respond to the changes, the initial focus of the Natural Legacy Project will be on "no regrets" adaptation strategies. These are strategies that will provide net conservation benefits regardless of climate change. In addition, since it is difficult to make detailed recommendations given the above uncertainties, the initial adaptation strategies listed here are fairly broad. As climate predictions become more refined and knowledge of biotic responses to climate change increase, more specific strategies can be developed.

Climate Change Adaptation Strategies:

1. **Reduce the impacts of non-climate stressors**
   Because of the interconnectedness of climate and natural systems, climate change is expected to affect other system stressors such as invasive species, pests, pathogens, pollution, and habitat loss, degradation, and fragmentation. These stressors may be exacerbated by climate change and/or the stressors may limit the ability of the species or ecosystem to cope with climate change. Addressing existing stressors is one of the most valuable and least risky strategies, in part because of the large existing body of knowledge about their impacts and solutions.

2. **Restore and maintain ecological processes and ecosystem function**
   Natural systems are dependent on a variety of ecological processes including disturbance and hydrologic regimes (e.g., fire, flooding, etc), energy and nutrient flows, and species dispersal. Past human alteration of these ecological processes has been a stressor on natural systems. Restoration and maintenance of these processes can increase the resilience of systems to climate change. Restoring and maintaining biological diversity can also increase the ecological resilience of ecosystems, and thus increase their adaptive capacity in the face of climate change.

3. **Protect and maintain a network of conservation areas**
   This strategy would increase the extent of terrestrial and aquatic habitats that are protected from non-climate threats. The strategy could also be used to protect movement corridors or stepping stones to allow for species dispersal in response to climate change.

4. **Restore and maintain habitat and landscape connectivity**
   Managing species and their habitats in the context of climate change will require an increased emphasis on connectivity to enable species to move into locations with appropriate climatic conditions. Maintaining habitat connectivity at the scale needed for climate change adaptation will require strategic planning and investment and meaningful collaboration among public and private parties.

5. **Increase knowledge about climate change impacts and species and ecosystem responses**
   There is a great deal of uncertainty regarding future climate change and the impacts to and responses of species and ecosystems. We need to increase our understanding of these impacts and responses in order to develop and implement more effective conservation strategies. Means of filling these knowledge gaps include vulnerability assessments, monitoring, experiments, and modeling.

6. **Utilize an adaptive management approach in implementing adaptation strategies**
   Any strategy for managing the effects of climate change on species and ecosystems should be deployed within an adaptive management framework to enable managers to learn from previous management activities and to respond quickly and creatively to the challenges posed by climate change.

Promote Management that is more Compatible with Conserving Biological Diversity

Nebraska's 48,000 farms and ranches cover nearly 46 million acres (93% of the total land area), making landowners the primary stewards of Nebraska's biological diversity. Activities on these lands directly impact individual species, natural communities, and larger ecosystem processes (e.g., hydrology, stream quality, nutrient cycling). According to the 2004 NASIS survey, over 90% of Nebraskans felt that farmers and ranchers should have a major or moderate role in conserving "at-risk" species in the state. In order to meet this public expectation, the state's farmers, ranchers, and conservation organizations will need to collaborate and share responsibility for the conservation of biological diversity.

Nebraska has nearly 1,600 square miles of public conservation lands. These existing protected areas (e.g., national wildlife refuges, national forests, national monuments, state parks, wildlife management areas) are critical to the conservation of biological diversity. However, past management approaches have not always taken into consideration the needs of the greatest array of species. For example, more public lands could be enhanced for wildlife, using prescribed burns and grazing appropriate to local plant communities. Public perception reflects these sentiments. According to the 2004 NASIS survey, 90% of Nebraskans feel that improving management on existing public lands is very or moderately

important to reversing the decline of at-risk species. In order to more fully conserve biological diversity on public lands, increased resources, training, support, and encouragement will be needed.

Maintenance of biological diversity will require that conservation efforts be directed at a broad range of land use issues and management practices on both private and public lands. In the past, management actions on public and private lands have been directed disproportionably at a relatively small subset of species (e.g., game species, threatened and endangered species) and inadequately at conserving intact natural communities. There is a need to broaden the focus of management and seek to implement strategies that benefit a broader array of Nebraska's biological diversity.

Nebraska's urban and rural citizens need to share responsibility for our culture's impacts on biological diversity and play a role in future conservation efforts. Biological diversity cannot be conserved solely on public lands or solely on private lands. Instead, conservation efforts will need to combine improved management on existing public lands, by protecting some additional lands through acquisition and conservation easements, and by implementing voluntary and incentive-based conservation actions on private lands.

In the last two centuries, land use and land management practices have significantly altered Nebraska's biological landscape and the ecological processes that sustain the flora and fauna of the state. Historically, the primary forces that shaped the pattern of plants and animals on our landscape have been climate (e.g., droughts, floods), fire, and grazing. Today, additional factors such as artificial changes to hydrology, competition and predation from invasive species, habitat fragmentation, pollution, and climate change directly impact species and alter ecological processes, leading to degradation of habitat. Conservation practitioners identified six key stresses that are impacting biological diversity in Nebraska: 1) altered fire frequency, 2) altered grazing strategies, 3) altered hydrology, 4) introduction of invasive species and pathogens, 5) habitat fragmentation, and 6) pollution. The stressors will interact with climate change and may be exacerbated by it and/or the stressors may limit the ability of species or ecosystems to cope with climate change. Climate change and its potential effects on biodiversity should also be considered as management plans are developed.

Fire Management Systems

Historically, fire was a natural disturbance to Nebraska's ecosystems, serving as an important influence on biological diversity. Prior to European settlement, fires likely occurred on a 1-5 year interval in eastern Nebraska and a 10-20 year interval in western Nebraska. Suppression of fire is one of the primary factors that alter Nebraska's natural communities. Today, less than one percent of the state's grasslands and woodlands are likely burned in any given year. The Loess Hills region of the mixed-grass prairie of Nebraska is a prime example of the problems associated with fire suppression. The rapid expansion of eastern red-cedar trees across this region has degraded and fragmented natural communities and is leading to declines in native species and reduced livestock forage. Fire serves an important role in prairie maintenance by promoting nutrient cycling, creating microhabitats, and increasing plant vigor and native plant diversity. Fire leads to similar benefits in woodland communities. Though some areas with dense tree cover may require mechanical thinning prior to burning in order to reduce fuel loads and prevent stand-replacement fires. There is

also an important but poorly understood interaction between fire and grazing. In the past, burned areas often received intense grazing from bison or other herbivores following fire. This combination is rarely applied in today's landscape.

Models project that climate change will result in an increase in fire frequency, particularly in the western U.S. The length of the fire season has increased over the past three decades and the amount of area burned in the west has increased six-fold in the last twenty years. In Nebraska, an increase in fire frequency would likely have the largest impact in the Pine Ridge and Wildcat Hills, where decades of fire suppression have resulted in heavy fuel loads. Historically, wildfires in those areas were low intensity, ground fires burning through open pine woodlands. With current conditions, wildfires would likely be high-intensity crown fires which may have a more negative impact on the habitat. For the grassland habitats in the state, fire suppression efforts have kept fire frequency at levels far below what was experienced historically, and an increase in fire frequency would likely be beneficial to those systems.

A growing number of individuals are becoming interested in using fire to control woody plant invasion or revitalize grasslands. Many landowners don't have the capacity (e.g., equipment, burn crews) or expertise to use fire safely. Conservation practitioners often lack the resources to carry out the desired level of burning on private or public lands, and few private contractors are willing to burn because of liability concerns. Several cooperative efforts are underway to increase interest in prescribed fire. The Prescribed Burn Task Force and Great Plains Fire Learning Network hold workshops and demonstration burns for private landowners in order to promote prescription burning.

Actions Related to Fire:

1. Promote the safe use of prescribed fire as a tool for grassland/wetland/forest restoration and management through public outreach and internal communication among conservation organizations and agencies. Conduct demonstration burns as a means to facilitate understanding and acceptance of burning.

2. Increase the capacity of private landowners to burn by providing technical and financial assistance, equipment, fire-training workshops, how-to guides and other assistance.

3. Identify and seek to overcome barriers that limit the ability of managers and private individuals to conduct prescribed burning on private and public lands.

4. Develop and distribute a "best management practices guide" on prescribed burning that can be used to improve management of grasslands, woodlands, and riparian areas for biological diversity. Include information on sources of technical information, funding programs, equipment needed, etc.

5. For select grasslands, evaluate the use of patch-burn grazing and other grazing systems that combine the interaction of fire and grazing to mimic pre-settlement disturbances. Timing, intensity, and duration of any fire-grazing system need to be carefully planned and implemented. Biologists and ranchers should carefully coordinate management strategies.

6. Consult with species experts and perform pre-burn evaluations to minimize impacts to species that may lack the ability to re-colonize a site following burning.

7. Assist prescription burning efforts through education, training, and participation to promote and support the establishment of burn cooperatives made up of local landowners, agencies and partners.

8. Provide training and support to landowners and others to conduct rapid pre/post burn monitoring and assessment.

9. For woodland and forest systems, particularly in western Nebraska, use mechanical tree-thinning and prescribed fire to increase the resiliency of the system to wildfires.

Grazing Management Systems

Nebraska contains approximately 22 million acres of rangeland and pastureland. Most grassland-associated plant species have evolved with and are maintained by grazing, so ensuring that the existing 22 million acres are sustained for cattle grazing is important for biodiversity. Grazing is a conservation tool that can promote structural heterogeneity, native plant diversity, and can help control invasive species, depending on application. Managing both the timing and intensity of grazing is important to achieving plant health and diversity and maximizing benefits to the widest variety of species. Grazing can be applied in a manner that is mutually beneficial to the goals of biodiversity conservation and cattle production.

Historically, grazing patterns were likely driven by fire frequency and weather. Today, most grazing takes place in the absence of fire and with relatively little variation in timing and intensity. As a result, large areas of prairie have shifted from diverse mixes of native grasses and forbs to grasslands dominated by a relatively small number of grasses (often non-native species such as Kentucky bluegrass and smooth brome) and less palatable early successional forbs such as western ragweed, snow-on-the-mountain, soapweed and musk thistle. This conversion has taken place after years of season-long grazing and has been intensified by broadcast applications of herbicide and inter-seeding of non-native grasses. Restoration of these sites is often very difficult even if a more diversity-friendly grazing system is introduced.

Both overgrazing and a lack of grazing can be detrimental to biological diversity. Overgrazing can severely impact the composition of grasslands, favoring species rarely grazed by cattle and adapted to consistent grazing pressure. Overgrazing near streams and wetlands can increase the amount of sediment and other pollutants entering water bodies. Conversely in the absence of fire, the lack of grazing can lead to a loss in plant diversity because of thatch accumulation, competition by non-native species, and loss of microhabitats

necessary for propagation of some species. A lack of grazing on wetlands can favor the establishment of monotypic stands of robust emergent plants.

Haying and mowing can serve as alternatives to grazing and provide benefits to species and habitats. Haying and mowing can be particularly effective at controlling woody encroachment and removing thatch but lack some benefits of grazing such as selective herbivory, soil disturbance from hoof action, and nutrient cycling through animal waste. Under homogenous haying or mowing practices, plant composition and habitat structure often decline and natural re-seeding can be inhibited.

Actions Related to Grazing/Haying:

1. Promote and support the use of diverse grazing/haying systems on private and public lands that enhance biological diversity and sustain natural communities. Initiate research that evaluates the effectiveness and profitability of biological diversity-friendly grazing/haying systems (e.g., reduced stocking rates, rotational systems).

2. Develop and distribute a "best management practices" guide on grazing that can be used to improve management of grasslands and riparian areas for biological diversity. Include information on sources of technical information, funding programs, wildlife-friendly fencing specifications, etc.

3. Promote and support the development of locally-based grazing cooperatives and incentive programs that can be used to facilitate grazing of playa wetlands, small disjunct prairie sites, woodlands and other sites with low grazing income potential.

4. Support diverse haying strategies (e.g., on wet meadows) that stagger timing and height of cutting, promote increased plant and animal diversity, and avoid peak nesting periods for grassland birds.

5. Promote the use and availability of locally adapted native seed sources for pasture and rangeland seedings.

6. Promote livestock grazing/haying systems that have built-in drought management contingencies (e.g., grass banking).

7. Seek and promote economic alternatives that help reduce further conversion of important rangelands and pastures to cropland.

Altered Hydrology

Historically, Nebraska had approximately 3 million acres of wetlands and nearly 24,000 miles of rivers and streams. Today, approximately 35% of the state's wetlands have been lost including nearly 90% of some playas, saline wetlands, and wet meadows. Although most of the state's rivers and streams have been significantly modified from reductions in flows and through channelization, the Sandhills ecoregion stands out as containing some of the most unaltered rivers and streams remaining in the Great Plains. Continued conservation of the state's wetlands, rivers, and streams are critically important to sustaining biological

diversity. Nearly half of Nebraska's Tier I at-risk species are dependent upon wetland or riverine habitats.

Approximately one million acres of wetlands have been lost in Nebraska, principally through drainage for agricultural development. The loss and alteration of wetlands has reduced habitat for many resident and migratory species and has resulted in severe overcrowding for spring migrating waterbirds. The lack of management or disturbance of existing wetlands has led to the spread of invasive species and the usurping of wetlands by a few dominant plants, resulting in a decline in natural biological diversity. Although past governmental programs facilitated wetland drainage, a shift in public attitudes in the 1970's and 1980's has resulted in increased interest by agencies, communities and private landowners to understand and conserve wetlands.

There have been substantial changes to Nebraska's rivers during the last two centuries. Nebraska's largest rivers historically experienced large fluctuations in flows, particularly in the spring when snow melt and spring rains scoured sandbars and moved sediment, creating treeless expanses favored by migratory birds and other species. Direct diversion of surface flows and pumping from alluvial wells for irrigation and municipal water supplies has substantially reduced stream flows in many rivers, caused others to dry up completely, and impacted native aquatic and terrestrial communities.

Although, droughts are a natural phenomenon in the Great Plains, conflicts over water use are intensified during extended dry periods. Healthy wildlife and plant communities are well adapted to withstanding long periods of drought, but biological diversity is threatened as rivers and streams reach or exceed full appropriations. Diversion of water from streams and rivers during drought can greatly reduce the amount of deep-water refugia available to fish and raises water temperatures that can result in fish and invertebrate mortality. Pumping of groundwater for irrigation, municipal and other uses lowers water table levels that would otherwise sustain grassland plants through hot and dry periods. Dams and other barriers on rivers and streams restrict fish and wildlife movements, leaving large expanses of potential habitat uninhabited and/or suppressing gene flow among populations.

Climate change may significantly alter the hydrology of wetlands, rivers, and stream in the state. Projections are for increases in the intensity of periodic droughts, increases in evapo-transpiration loss from rising temperatures, and increases in the frequency of heavy precipitation events, leading to more frequent and intense flooding. Predictions for the Rocky Mountains are for an increased proportion of winter precipitation to come as rain, thus reducing the overall snowpack. In addition, the earlier onset of spring will result in earlier melting of snowpack. Both of these trends have been observed in recent decades. These changes will impact the timing and amount of Platte River flows, and the species and habitats that depend on them, particularly in late summer.

As public awareness of the value of wetlands and natural flowing rivers has changed, efforts to restore these important habitats on both private and public lands have increased. Across the state, hundreds of wetlands have been voluntarily restored and countless other restoration projects are planned in the future. The ability of landowners to use wetlands for grazing and

hay production after restoration helps meet landowner needs for income and maintains some level of disturbance that promotes wetland health.

The conservation of Nebraska's streams, rivers, and their associated aquatic habitats will require hard work, compromise, and a shared vision for conserving Nebraska's biological diversity and sustaining an agricultural economy. Much is to be gained by conserving both, but change will be necessary. It is recognized that in some instances in the state, irrigation may augment habitat. Pools of water are generated in areas that would otherwise be dry. These water sources can be useful to wildlife. Innovative solutions are required to ensure there is enough water to meet the needs of people and wildlife and that effective measures are taken to maintain water quality.

Actions Related to Hydrology:

1. Seek to maintain or restore the natural hydrology of rivers, streams, and wetlands to sustain biological diversity and ecosystem function. Accomplish this through the use of voluntary incentives, sound bio-engineering solutions, and through collaborative decision-making.

2. Establish an interdisciplinary working group that can develop a shared vision for the judicious use of limited water resources by developing drought mitigation strategies, alternative cropping/irrigation methods, etc. that conserve and enhance biological diversity and lead to increased economic sustainability.

3. Assess where current stream flows are inadequate and flow appropriations would most effectively contribute to the maintenance of biological diversity in Nebraska.

4. Promote the development of an integrated water management plan for all water uses throughout the state.

5. Promote and provide incentives for the use of wildlife-friendly conservation buffers, grassed waterways, sediment traps etc. on lands adjacent to wetlands, rivers, streams, reservoirs, and lakes to prevent siltation and protect water quality.

6. Strengthen existing or establish new statewide partnerships responsible for promoting wetland, river, and stream conservation.

7. Promote the value of naturally meandering rivers and streams, role of floodplains as habitat, and the need to maintain or closely simulate the natural hydrograph of rivers and streams to benefit biological diversity.

8. Evaluate the impacts of new dams, additional groundwater and surface water withdrawals, channelization, and levy/dike construction on biological diversity.

9. Promote the development and use of water conservation measures such as more water-efficient irrigation systems, xeriscape landscaping, water-conserving appliances, etc.

Introduction of Invasive Species and Pathogens

Most natural communities in Nebraska have been impacted by invasive species, in most cases by plants that were deliberately or accidentally introduced by people. Many naturalized species such as common dandelion and ring-necked pheasant appear to have little impact; whereas, others significantly affect biological diversity. Aggressive exotic species negatively impact native species through competition, direct predation, disruption of food chains, or by altering habitat or ecological processes. Nationally, invasive species are considered the second leading threat to biological diversity, second only to direct habitat loss. According to the 2004 NASIS survey, 58% of Nebraskans feel that non-native species are very or moderately likely to threaten at-risk species in the state and another 21% didn't know if exotics had a significant impact.

Most of Nebraska's native grasslands include a mix of native and non-native species. Exotic grasses such as smooth brome, Kentucky bluegrass, and cheatgrass are aggressive and often increase under season-long grazing or when there is soil disturbance. Invasive forbs such as musk thistle, leafy spurge, and sericea lespedeza impact both natural communities and grazing lands, resulting in impacts to biological diversity and the grazing industry. The control of noxious weeks often results in unintentional impacts to native plants.

Invasive plants such as reed canary grass, common reed, and purple loosestrife are threatening many of Nebraska's wetlands. Other species such as Canada thistle and Russian/Autumn olive, and Eurasian water-milfoil, have impacted many of the state's wetlands. Introduced species significantly reduce plant diversity and animal use of wetlands. Some species such as saltcedar may impact the hydrology of wetlands and rivers by increasing water consumption. Nebraska's forests are threatened by garlic mustard and other plants that competitively exclude native species.

Many introduced animal species directly threaten biological diversity. The western mosquitofish competes with and often excludes the native plains topminnow. Common carp can alter bottom substrates and impact water quality and silver carp can disrupt food chains. House sparrows and European starlings compete with native cavity nesting birds for nest sites. The zebra mussel may threaten the state's native mollusks. And at several locations in the state, feral hogs have become established. The impacts of introduced species that are important for recreation such as Rainbow trout, bullfrogs, and red fox are not well known but need to be assessed.

Less is known about the impact of pathogens on wildlife in Nebraska. Diseases such as avian cholera have resulted in large die-offs of waterfowl during spring migration. West Nile virus has been documented to cause mortality in more than 150 species, including humans, but its impact on overall biological diversity is unknown. Blue tongue can result in severe mortality and chronic wasting disease could potentially have a devastating effect on native ungulates. More resources need to be dedicated to understanding the impacts of diseases and other pathogens on biological diversity, and proactive solutions need to be identified and implemented.

Climate change is expected to interact with other environmental variables to affect the abundance, distribution, spread, and impact of invasive species, pests, and pathogens. Along with native species shifting their ranges, invasive species and pathogens are expected to expand their ranges into newly suitable environments. Invasive species often have good dispersal abilities and will be able to take advantage of newly suitable habitats. These invasive species, pests, and pathogens will cause stresses on native species that are struggling to cope with a changing climate.

Actions Needed to Reduce the Impacts of Invasive Species and Pathogens:

1. Support existing cooperatives, such as the Nebraska Invasive Species Project, with the intent to organize a diverse network of agencies and organizations to gather and share information about invasive species, new control measures, control efforts that are underway, distribution of invasive species, and funding issues. Collaboratively develop and widely distribute a list of all known invasive species that threaten the state's biological diversity and develop best management practices that can be used to control or reduce the spread of those species.

2. Develop and implement early detection and rapid response programs for invasive species, pests, and pathogens.

3. Use and promote restoration and management techniques that utilize native, locally-adapted species whenever possible. Discourage the use of non-native species in restoration/management projects.

4. Encourage private seed companies to provide local-ecotype seed and harvesting and planting services.

5. Renovate aquatic habitats by removing introduced rough fish to improve water quality, enhance aquatic vegetation and increase biological diversity.

6. Seek measures that prevent the introduction, breeding, and use of potentially invasive non-native species by nurseries, hatcheries, universities, etc.

7. Develop and distribute best management practices and educational materials to reduce the inadvertent transport of invasive species, pests, and pathogens.

8. Collaborate with natural resource organizations and others to develop a list of preferred plant materials (e.g., trees, shrubs, grasses, forbs) that can be used in urban and rural settings with little threat to biological diversity. Develop guidelines that will help ensure potentially invasive species do not spread to natural communities.

9. Develop guidelines for the application of herbicides and use of biocontrols targeted at invasive species so that impacts to biological diversity are minimized.

10. Initiate a public outreach campaign on the impacts of invasive species on biological diversity.

11. Investigate the factors leading to the spread of invasive species, diseases, and other pathogens and their impacts on biological diversity. Track the spread of invasives and transmission of pathogens to better develop and implement proactive conservation actions.

12. Develop and implement protocols to better monitor, assess impacts, respond to, and manage disease stresses in Nebraska.

13. Develop proactive management actions to impending disease stresses (e.g., chronic wasting disease, West Nile virus) to help limit future impacts to biological diversity.

14. Assess possible risks of invasive species spread from commercialized wildlife operations and work with facility managers to take appropriate preventative measures.

Habitat Fragmentation

Any type of habitat can become fragmented when it is altered in a way that reduces its amount and quality for wildlife populations. Large-scale habitat fragmentation has occurred over most of the state with the exception of the Sandhills. Conversion of native habitats to crop fields, housing developments, and roads are the principal sources of fragmentation. Acreage development, particularly on native prairie sites, is resulting in accelerated loss and fragmentation of remaining grasslands. Infrastructure such as roads, dams, cell phone towers, wind energy turbines, and fences can impact species directly by altering movement or increasing mortality. Other forms of fragmentation can lead to the introduction or spread of invasive species or alteration of ecological processes such as predator-prey relationships. Habitat fragmentation has particular consequences for species that are relatively immobile, or area-sensitive species that require large intact landscapes.

Nebraska, the Arbor Day state, has a long and proud history of tree planting. Tens of millions of trees have been planted to provide shelter to livestock, as windbreaks for homes, for aesthetics and as wildlife habitat. However, the planting of trees in native grasslands can negatively impact grassland-dependent species and some invasive trees like eastern red-cedar can rapidly spread into adjacent habitats, fragmenting prairie landscapes.

Nebraska is ranked among the top ten states in the nation for wind energy potential. Wind energy is seen as a “green” energy source because during the operation of a wind energy facility, there are no emissions of greenhouse gases or other pollutants. In general, the conservation community supports the development of wind energy as it has the opportunity to provide a renewable form of energy that can enhance economic well-being for Nebraskans, and is a means of reducing climate change, which will have significant impacts on wildlife. However, no energy source has yet been found to be without some degree of environmental costs and wind energy is no exception. Proper placement of wind turbines and their associated power lines is essential to prevent further fragmentation of the landscape. For example, one should avoid siting turbines near wetlands, rivers, and/or riparian corridors as these are excellent habitats for many native species. For more detailed

siting recommendations, refer to the Wind Guidelines developed by the Nebraska Game and Parks Commission and its partners.

A prevalent response of species to climate change has been to shift their distribution ranges to find suitable conditions. Migration of species ranges is only feasible if suitable habitat is both available and accessible. However, for many species, habitat fragmentation has reduced their ability to shift their ranges. Managing species and their habitats in the context of climate change will require an increased emphasis on connectivity. Maintaining habitat connectivity at the scale needed for climate change adaptation will require strategic planning and investment and meaningful collaboration among public and private parties.

One approach to offset the impacts of habitat fragmentation and climate change to wildlife is to identify, restore, and conserve corridors for species movement. However, identifying corridors can be challenging. Studies of past species range shifts show that species do not move in a straight line and current modeling capability is not able to predict where suitable conditions for a particular species may be in the future. In addition, restoring and conserving a large scale corridor in a highly fragmented area like the tall-grass prairie ecoregion would be expensive and politically difficult. A more fruitful approach may be to research and implement strategies to make the working landscape matrix more permeable to species dispersal.

Actions Needed to Reduce Habitat Fragmentation:

1. Provide incentives to private landowners to maintain natural habitats and to cooperatively manage large blocks of habitat as complexes that conserve biological diversity.

2. Collaborate with planning commissions, county commissions, and building associations to site new housing units in a manner that reduces fragmentation of existing natural communities.

3. Seek to enlarge habitat complexes by restoring converted or degraded sites within larger landscapes of habitat. Create habitat corridors to connect disjunct tracts of habitat.

4. Discourage the placement of woody plantings and food plots within natural grassland communities, especially when it will result in increased fragmentation.

5. When possible, take into consideration potential impacts to biological diversity when selecting sites for cell phone towers, wind turbines, dams, fences and other semi-permanent structures. It is preferable to site facilities on previously altered landscapes, such as areas of extensive cultivation, near towns, or urban and industrial areas, while making the greatest possible use of existing access roads and utility corridors. See Nebraska Game and Parks Commission guidelines for wind energy development.

6. Collaborate with transportation planners (e.g., NE Dept. of Roads, Federal Highway Administration) to minimize impacts to at-risk species and their habitats.

7. Seek to remove or create bypass structures around dams and other impediments that restrict the natural movement of aquatic species.

Pollution

Water pollution is a principal stress to aquatic species and overall biological diversity. Water pollution includes both point and non-point sources and can include toxic chemicals, sediment, nutrients, minerals such as road salt, pesticides, and animal or human waste. Climate change projections are for an increase in the frequency of short duration/high intensity precipitation events, which will result in increased surface run-off and transport of pollutants to water bodies. Pollutants can result in direct mortality to species (e.g., fish kills from toxic chemicals) or can alter natural communities and ecosystem function (e.g., eutrophication resulting from phosphorus run-off). Bioaccumulation of toxic substances can impact entire food chains and reduce the recreational value of aquatic resources. Nebraska has 1558 stream segments flowing over 16,000 miles and 528 lakes and reservoirs that cover more than 148,000 acres. For the 2010 Nebraska Water Monitoring Programs Integrated Report, the Nebraska Department of Environmental Quality conducted assessments on 413 stream segments and 225 lakes equating to more than 9,000 miles of streams and 138,000 lake acres being assessed. Of the 413 stream segments assessed, 221 were supporting their assigned uses, while 192 were impaired. Of the stream segments considered impaired, 63% were due to the presence of E. coli, 16% due to impaired biology, 10% due to fish consumption advisories, and 11% due to atrazine. Lake assessments found 123 lakes impaired and 102 supporting their assigned uses. Of the lakes considered impaired, 39% were due to nutrients, 28% due to fish consumption advisories, 19% due to pH, and 14% due to low dissolved oxygen.

Most Nebraskans recognize water pollution as an important threat to biological diversity. According to the 2004 NASIS survey, 92% of Nebraskans stated that water pollution is very likely or moderately likely to threaten at-risk species. In Nebraska, local Natural Resources Districts, the Nebraska Department of Environmental Quality, and the federal Environmental Protection Agency regulate water quality. These agencies and others help implement a number of voluntary best management practices to help prevent or mitigate sources of water pollution.

Actions Needed to Reduce the Impacts of Pollution:

1. Promote the practice of integrated pest management (e.g., non-chemical controls such as bio-control and tillage, spot spraying) through outreach and incentives to minimize impacts to biological diversity.

2. Facilitate information exchange between conservation practitioners, landowners, and the public regarding the sources and impacts of pollution on wildlife. Provide regulatory agencies (like NDEQ) with information on the impacts of pollution on biological diversity to help make better decisions.

3. Implement and seek funding for conservation practices such as filter strips, grassed waterways, sediment control basins, and grassed buffers to minimize the effects of fertilizers and pesticides on wetlands, streams, rivers and reservoirs.

4. Work with agricultural and conservation partners to prioritize installation of conservation buffers, conservation tillage practices, etc. within watersheds where benefits to biological diversity would be highest.

5. Promote management practices that limit the impacts of nutrients, sedimentation, bacteria and pesticides to help protect water quality. Examples include nutrient application on cropland, sediment control on construction sites, incentives for organic farming and low-chemical farming, etc.

6. Share information with agencies and stakeholders about the importance of biological diversity and the benefits of locating power plants, factories, animal feeding operations, homes and other potential sources of pollution in places that will have minimal impact on river, stream, and wetland water quality. When optimal siting is not feasible, state-of-the art waste containment facilities should be constructed.

Focus Conservation on the Best Opportunities

Conservation of Nebraska's biological diversity is an enormous undertaking and the human and financial resources needed to address this task remain limited, even with new federal funding. Conservation efforts in the past have been largely opportunistic and while important work has been done, it was not always the most efficient and effective use of limited resources. For example, using scarce funds to protect a lower quality tall-grass prairie with less biological diversity may preclude the protection of a higher quality prairie with more biological diversity. Given that habitat loss will continue, those higher quality prairies may be lost before an "opportunistic" approach would conserve them.

We need to improve the efficiency and effectiveness of conservation by taking a more systematic approach to identifying and prioritizing the components of biological diversity we wish to conserve and where in the state we should focus conservation efforts. Being more efficient and effective means implementing conservation actions that provide the best opportunities to maximize conservation of biological diversity, minimize resource conflicts, and avoid future stresses.

Whenever possible, agencies and organizations should pursue strategic rather than opportunistic approaches to biological diversity conservation. Multiple objectives can often be met by taking a habitat-based approach that benefits multiple species and habitats. Conservation efforts should be focused, when possible, on areas with multiple habitat types and opportunities to benefit at-risk species. They should also focus on those sites that offer the best opportunity for long-term success in sustaining species and ecological communities. For target species, these include sites at which the species' populations have a high estimated viability (large population size, appropriate age class, successful reproduction, and few threats). For ecological communities, these would include sites with a high percentage of expected native species, few invasive exotic species, and where ecological processes

essential to maintaining the community (e.g., fire, grazing, flooding) persist or can be simulated through management. Sites that have structural and functional complexity, high habitat quality, and close to their full complement of species are also likely to be more resistant and resilient to climate change.

In developing the Nebraska Natural Legacy Project, we utilized a systematic approach to identifying at-risk species, ecological communities, and biologically unique landscapes in the state (see chapter 3). This effort was based on the best available data and represents a first attempt to take a statewide, systematic and strategic approach to the conservation of biological diversity. Using an adaptive management strategy, we continue to adjust our wildlife conservation priorities and actions. We hope these efforts will prove useful in identifying conservation targets and focal areas in the state, making the best use of our limited resources.

Actions Needed to Focus Conservation on the Best Opportunities:

1. Conduct inventories to identify additional Biologically Unique Landscapes that contain high-quality examples of ecological communities and populations of at-risk species.

2. Continue inventory of the currently described Biologically Unique Landscapes to better identify areas within them where multiple conservation objectives can be met.

3. Provide information to conservation planners and practitioners to help focus conservation actions. Decision-support tools (e.g., GIS data, models) may be used to evaluate options.

4. Implement actions at those sites that offer the best opportunity for success in the long-term conservation of species and ecological communities.

5. Work to ensure that high-quality occurrences of all terrestrial and aquatic community types in Nebraska are under long-term protection and management.

6. Work to ensure that occurrences of viable populations of at-risk species are under long-term protection and management.

7. Monitor changing conditions and population fluctuations to better adapt management efforts as needed.

Maintain and Expand the Network of Public and Private Conservation Lands

The continued loss and degradation of natural habitats undermine efforts to conserve biological diversity in the state. Nebraska's ranches, farms and private and public conservation lands provide the foundation for a support system for the state's flora and fauna. Almost all existing habitat in Nebraska is under the stewardship of private landowners, and this will continue. Maintaining and improving existing habitat on working farms and ranches

is key to conserving biological diversity and offers the greatest hope for success. There is also a need for some lands to be put under long-term protection and managed specifically for biological diversity. A network of conservation lands is needed that includes a combination of protected working private lands and public and private conservation areas managed for the purpose of perpetuating biological diversity.

Habitat loss is the primary cause of species decline. Most of the state's natural communities, with the exception of those found in the Sandhills and a few other areas, have undergone extensive losses. Some, like the tall-grass prairie have been reduced to less than 2% of their original extent. While it is possible to restore cropland and other altered lands, reestablishing the full complement of biological diversity is often impractical and prohibitively expensive. To be able to conserve the full array of biological diversity, we need to conserve existing natural habitats that are still in relatively good condition. John Weaver the acclaimed prairie ecologist noted:

> "Prairie is much more than land covered with grass. It is slowly evolved, highly complex, and centuries old. Once destroyed, it can never be replaced by man."

An important way to ensure that species, habitats, and ecosystem processes are maintained over time is to devote some portion of the landscape to those specific purposes. This can be done by expanding the network of lands that have long-term protection from conversion/ degradation and to manage these lands principally for biological diversity. This network of conservation lands does not have to be limited to those owned by government agencies or conservation organizations. Private lands with conservation easements, long term leases or management agreements could also be included. Length of conservation easements and long-term management should be carefully considered. Collaboration with private landowners adjacent to lands under long-term protection can enlarge or buffer these lands resulting in larger blocks of habitat. These lands do not need to be managed to the exclusion of human uses. The key lies in the emphasis on biological diversity values, not as a collateral or subsidiary benefit, but as a primary goal for managing the land.

Consideration of climate change can inform decisions when selecting sites for protection. Sites with greater habitat and topographic diversity will allow species to move locally to find suitable conditions as the climate changes. In addition, the more heterogeneous and complex a site, the more microhabitats are likely present that can meet requirements for a wide range of species. Selecting sites within intact landscapes will also facilitate species movement. A network of conservation areas should include representation of all habitat and community types as well as ample replication.

New approaches to land conservation that take into account the dynamic nature of climate change effects on species and ecosystems will likely be needed. One approach that is being discussed is to protect a network of conservation "stages," nature reserves that capture the geophysical diversity (topography, soils, geology) of a region. Conserving a full spectrum of different geophysical settings, stratified across elevation zones and latitudes, may offer an approach to conservation that protects diversity under both current and future climates. Instead of aiming to maintain a particular species composition, the conservation of ecosystems defined by geophysical settings puts more emphasis on accommodating dynamic

processes, maintaining ecological function and building adaptive capacity. These new approaches allow for species distributions to shift, and for novel communities to form, while still conserving the maximum biodiversity. This approach would conserve the ecological "stage" rather than the temporary "actors." This approach would need to be a combined strategy to insure that the actors are able to move between stages.

In some cases, voluntary acquisition of land by public agencies or private conservation organizations is an appropriate conservation alternative. With less than 3% of the state in public conservation lands, Nebraska has one of the lowest percentages of public land in the country. A large proportion of the state's public land is in the Sandhills and the northwestern corner of the state, leaving many natural communities under-represented or not included at all as public trust lands. Acquisition of under-represented natural communities from willing sellers by private or public conservation groups would help ensure the long-term conservation of biological diversity. In addition, 25% of the Tier I at-risk species have no documented occurrences on public lands and therefore are not ensured long-term habitat protection. A number of these species may have habitat management requirements that are not conducive to achieving an economic return. Thus, public or private conservation ownership may be the most practical way to maintain some species. To be acceptable to the public, these acquisitions should ensure that payments are made in lieu of property taxes to maintain the local tax base. Public lands have the additional benefits of meeting recreational, educational, research and other societal needs.

There is also a need to improve management on existing public and private conservation lands so that the needs of a greater array of species can be met. Public land managers and private conservation groups often lack the financial and human resources to adequately manage their lands for biological diversity. Demands on managers' time to control invasive species and administer public use often leave little additional time to restore or manage natural communities. Insufficient capacity to monitor and evaluate management activities and a lack of information about species habitat requirements and management alternatives serve as barriers to improved conservation land management. These issues need to be addressed so that public and private conservation organization lands can more fully contribute to the conservation of our natural heritage.

Actions Needed to Improve the Network of Public and Private Conservation Lands:

1. Identify and secure long-term protection for unique or high quality natural communities through actions such as conservation easements, land exchanges, voluntary acquisition, or conservation buyer programs.

2. Identify and conserve corridors or "stepping stones" to allow for species movements in response to climate change.

3. Promote land acquisition policies that are founded on willing-seller/willing buyer principles, maintain the local tax base, and provide equitable compensation to landowners.

4. Start a natural areas program (modeled after successful programs in other states) that identifies and protects biologically unique sites that are managed to perpetuate Nebraska's biological diversity.

5. Encourage and support the formation of new or expansion of existing land trusts to acquire and manage conservation easements that conserve biological diversity in Nebraska.

6. Improve or change management on public lands to better protect, enhance, and sustain biological diversity and natural communities.

7. Establish voluntary cooperative agreements with private landowners adjacent or near existing public or private conservation lands to facilitate large-block management for conservation and recreation. Provide financial incentives, technical expertise, and recognition to landowners willing to enter into management agreements.

8. Create a forum whereby landowners, community leaders, and conservation practitioners can discuss land management issues and observe management practices in use on public lands. Use the forum to engage in collaborative problem-solving.

9. Facilitate the long-term protection of biologically important lands enrolled in short-term conservation programs (e.g., Conservation Reserve Program, private lands programs) through conservation easements.

10. Seek opportunities to improve management on publicly-owned lands that are not part of the conservation network (e.g., Bureau of Education Land Fund holdings) to increase benefits to biological diversity.

11. Support efforts to provide voluntary public access to private conservation lands that are managed for biological diversity.

Demonstrate Success

Components of at-risk species conservation include demonstrating successful habitat management and sharing this story with the public. Engaging local communities is a necessary component of establishing the Nebraska Natural Legacy Project statewide as a guide for conservation. When local communities are engaged in local conservation initiatives, there is greater understanding of at-risk species conservation, willingness to participate in conservation actions, and greater collaboration among landowners and conservation practitioners. This sets the stage for collaborative habitat improvement projects that cross ownership boundaries.

One way to demonstrate success and engage local individuals is through demonstration sites. There are many conservation projects and lands across Nebraska that offer improved wildlife habitat. Natural Legacy Demonstration Sites should capture Nebraska's representative habitat types and management that is currently fostering the mission of the state wildlife action plan. Demonstration sites need to provide habitat for at-risk species and the support

necessary for sustainable management. Demonstration sites should be open for the public to view conservation projects and results and learn more about a site's unique qualities, importance to at-risk species, and management practices that sustain biological diversity.

Actions Needed to Demonstrate Success:

1. Establish Natural Legacy Demonstration Sites across Nebraska.

2. Advertise Natural Legacy Demonstration Sites and hold regular meetings to discuss management and at-risk species conservation.

3. Support conservation management actions at these locations.

4. Develop informational materials branded with the Nebraska Natural Legacy Project suitable for each location.

The following sites have been selected as Nebraska Natural Legacy Demonstration Sites based on their locations across the state and potential for public demonstrations.

Natural Legacy Demonstration Sites:

1. Fort Robinson State Park
2. Ponderosa Pine Wildlife Management Area
3. Niobrara Valley Preserve
4. Niobrara River State Park
5. Ponca State Park
6. Wildcat Hills
7. Crescent Lake National Wildlife Refuge
8. Calamus Wildlife Management Area and State Recreation Area
9. Boyer Chute National Wildlife Refuge
10. Lake McConaughy
11. Enders Reservoir
12. Lillian Annette Rowe Bird Sanctuary
13. Platte River Prairies
14. Kissinger Basin Wildlife Management Area
15. Saline Wetland Complex
16. Schramm Park State Recreation Area
17. Spring Creek Prairie
18. Rock Glen Wildlife Management Area and Rock Creek Station State Historical Park
19. Burchard Lake Wildlife Management Area
20. Indian Cave State Park

Increase Participation in Nature-based Recreation

Broad participation in nature-based recreation (e.g., wildlife and wildflower viewing, hunting, fishing, canoeing) has social, ecological, and economic benefits. According to the 2004 NASIS survey, 77% of Nebraskans felt it was very important that people have an opportunity to view wildlife and 66% felt it was very important that people have the opportunity to hunt and fish. Increasing opportunities for high quality, nature-based recreation will help establish or maintain personal connections to biological diversity, motivate individuals to support conservation efforts, and meet an obligation to provide recreation to the state's citizens.

Without sustainable populations of wildlife and intact natural communities, opportunities for nature-based recreation are severely diminished. Nature-based recreation can serve as a strong incentive for conserving biological diversity. However, without adequate controls, recreation and conservation can be in conflict. Nature-based recreation must be appropriately managed and at times controlled to limit impacts to species and habitats and to maintain quality recreational experiences.
The economic diversification that can result from nature-based recreation or natural amenities can help provide a much-needed boost to rural communities. Many Nebraska communities are facing long-term declines that are leading to economic stagnation. Community leaders are seeking new and innovative ways to reverse this decline. The high level of interest in the Nebraska Birding Trails initiative is one example of how nature-based tourism is seen as a partial solution to economic troubles. For biological diversity conservation to succeed, it will be necessary for conservation decision-makers, community leaders, and businesses to collaboratively develop a long-term sustainable economic vision that includes conservation of the state's natural assets.

Actions Needed to Increase Participation in Nature-based Recreation:

1. Collaborate with agencies, private organizations, and communities to develop new and enhance existing wildlife-viewing infrastructure (e.g., roadside pull-offs, interpretive signage, viewing platforms). Promote the use of wildlife viewing sites through the media and established networks of nature enthusiasts.

2. Develop resources and a support system to assist communities with sponsorship of wildlife-related events (e.g., eagle viewing days, crane celebrations, hunter breakfasts, fishing tournaments) that have recreational, educational, and entertainment value and provide community economic benefits.

3. Identify sites conducive to greenway development and provide resources and support to help communities engage in collaborative planning to develop long-term strategies that meet conservation, economic, and recreational goals.

4. Develop and support programs that increase the number of individuals who are knowledgeable about and committed to promoting nature-based recreational opportunities. Support the establishment of naturalist programs in state parks and other recreational areas.

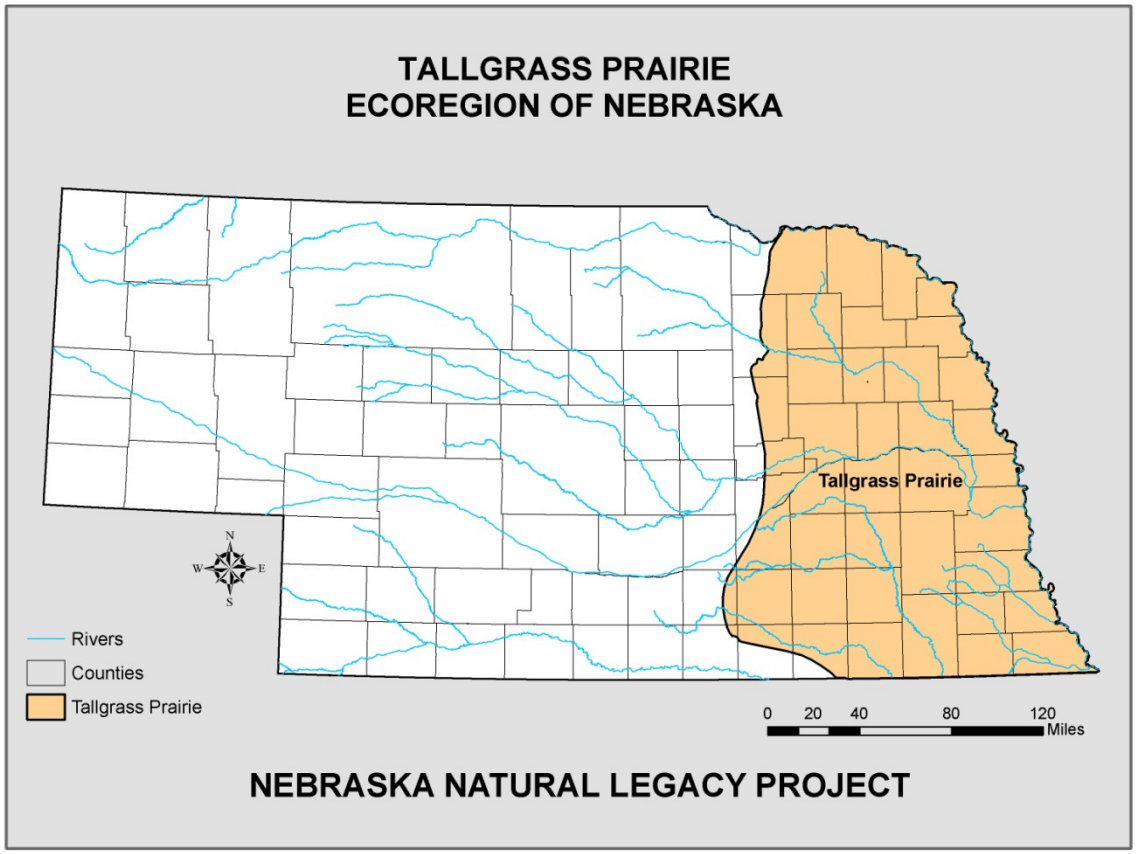
5. Develop partnerships with landowners to provide wildlife viewing (e.g., birding trails), hunting, and fishing opportunities on private lands and seek to provide fair compensation for providing these services. Develop collaborative eco-tourism marketing plans for different regions of the state that can be used to expand nature-based tourism and increase economic sustainability.

6. Develop and populate a database of private and public nature-based recreation sites. Make the information available to the public in a user-friendly manner through social media, websites, current popular technology and/or a printed publication.

7. Distribute educational materials for nature-based users that identify potential problems associated with recreation use (e.g., ATV's, impacts of boaters, wildlife viewing disrupting wildlife.)

Chapter 5

Tallgrass Prairie Ecoregion



Introduction

Early explorers described the tall-grass region as a sea of grass with open horizons and abundant wildflowers rooted in rich soils. The tall-grass prairie once extended from eastern Nebraska to Indiana and from Texas to southern Canada. In Nebraska, the Tallgrass Prairie Ecoregion covers the eastern fourth of the state, but this prairie type also extends further westward into the Mixedgrass and Sandhills Ecoregions along stream valleys of the Republican, Platte, Loup, and Niobrara rivers. Today less than one percent of tall-grass prairie remains in the continental United States. Approximately two percent of Nebraska's tall-grass prairie remains mostly as remnants less than eighty acres in size.

Glaciers, wind and water have shaped the topography of the tallgrass region over the last several million years. Today, the land surface is mainly rolling hills intersected by stream valleys. The elevation changes from 850 feet above sea level in the far southeastern corner of Nebraska to approximately 1,700 feet at the western edge of the Tallgrass Prairie Ecoregion. Receding glaciers left evidence of their passing through till deposits and hilly

moraines. After the glaciers receded, windblown loess was deposited over the till. These materials, with organic matter provided by thousands of years of prairie vegetation, form the basis for the deep, fertile soils that typify eastern Nebraska.

The Tallgrass Prairie Ecoregion receives 25 to 36 inches of annual precipitation, more than other ecoregions in the state. Roughly three-fourths of the rainfall is during the growing season, between April and September with May and June being the wettest months. Temperatures average highs of 90 degrees Fahrenheit in mid-summer and lows of 10 degrees Fahrenheit in mid-winter.

The ecoregion contains stretches of two of Nebraska's major rivers. The Missouri River is the state's largest river and forms the northern and eastern boundaries of the Tallgrass Prairie Ecoregion flowing approximately 350 miles in Nebraska. Along the river, the terrain includes bluffs and river terraces and floodplains.

The Platte River is a classic example of a prairie river. Historically, the river was shallow with a braided channel measuring three miles at its widest with a multitude of sandbars. The floodplain was 15 miles wide and was typically covered with lush wet meadows and freshwater marshes. Spring floods limited tree growth and created wide sandbars barren of vegetation. The ecoregion has many smaller streams including Papio Creek, Turkey Creek, and Bazile Creek.

This ecoregion includes several types of wetlands including the saline wetlands and Todd Valley wetlands. Eastern saline wetlands occur in swales and depressions within the floodplains of Salt Creek and its tributaries in Lancaster and southern Saunders counties. The salinity originates from salt-rich groundwater inflow. The salts are derived from underground rock formations deposited by an ancient sea that once covered Nebraska. These wetlands have saline soils and salt-tolerant vegetation. The Todd Valley wetlands are small, clay-lined, closed depressions located in loess soils. They are seasonally-flooded and are found in an ancient valley of the Platte known as the Todd Valley.

Vegetation

Though historically upland tall-grass prairie was the dominant plant community of the region, eastern Nebraska has a diversity of other community types ranging from deciduous woodlands to saline wetlands. Upland tall-grass prairie is dominated by big bluestem, Indian grass, switchgrass and Canada wild-rye. These grass species can reach six feet or taller, especially when rooted in rich, moist stream valleys. Tall-grass prairies also include hundreds of species of wildflowers and other forbs. Examples of these include showy goldenrod, prairie blazing-star, skyblue aster and purple coneflower.

Native woodlands are found mainly in the more mesic and fire-protected stream valleys and bluffs. They are most extensive in the Missouri River valley and its lower tributaries. Cottonwoods, willows, boxelders, and American elm dominate wetter floodplain woodlands in the tallgrass region. The drier river bluffs support oaks, hickories, basswood, black walnut and other deciduous trees. These woodland habitats, particularly oak and hickory bluff woodlands provide essential habitat for migrating birds.

Wet meadows are found in stream valleys where the water table remains near the soil surface throughout the year. The loamy to sandy soils support lush vegetation dominated by sedges, spikerushes, prairie cordgrass and switchgrass. Marshes were common in river floodplains prior to settlement. Common marsh plants included broad-leaf cattail, bulrushes, bur-reed, smartweeds, and arrowheads.

Animals

More than 300 species of resident and migratory birds have been documented in the Tallgrass Prairie Ecoregion. Nesting waterbirds include wood duck, green heron, northern pintail, blue-winged teal and mallard. The region supports populations of greater prairie-chicken and a full complement of grassland birds including Henslow's sparrow, dickcissel, grasshopper sparrow, bobolink, vesper sparrow and Swainson's hawk. Although woodlands are mostly confined to stream corridors, woodland species such as Bell's vireo, black-and-white warbler, rose-breasted grosbeak, and orchard oriole are common breeding species.

The Tallgrass Prairie Ecoregion is home to more than 55 mammal species; most have a widespread distribution and can also be found in central and western Nebraska. The small mammal fauna of the region includes plains pocket gopher, prairie vole, plains pocket mouse, thirteen-lined ground squirrel, and Franklin's ground squirrel. Species such as the masked shrew and jumping mouse can be found associated with wet meadows and other wetlands. Prior to European settlement, the tallgrass prairie region was home to large mammals such as bison, elk, and mule deer. Free-roaming bison no longer occur in the region; however, white-tailed deer are common big game animals and mule deer are infrequently found in upland grasslands. The most abundant large predator of the region is the coyote, but other predators such as the red fox and American badger can be found here as well. The bobcat, least weasel, long-tailed weasel and American mink can be found in wooded areas, wetlands and along river valleys. The native large predators that were present prior to European settlement such as the mountain lion, black bear, grizzly bear, and gray wolf are extremely rare or extirpated from the region.

Streams, rivers and lakes in the Tallgrass Prairie Ecoregion are home to over 75 species of fish. Many common species are big river generalists that can withstand wide variation of environmental extremes. Among these are the channel catfish, flathead chub and river carpsucker. Game fish, primarily northern pike, largemouth bass, walleye, and bluegill, have been introduced into many lakes and ponds. Exotic species such as grass, common, silver and bighead carp have found their way into most of the major rivers and lakes in the region.

Fifty-three species of amphibians and reptiles are found in the Tallgrass Prairie Ecoregion, including two salamanders, five toads, six frogs, eight turtles, up to eight lizard species and twenty-four snakes. All of the amphibians use wetlands for breeding; however, the Great Plains toad, plains spadefoot and Woodhouse's toad spend most of their adult life in the uplands. Aquatic turtles such as the northern painted turtle, false map turtle and common snapping turtle are common in wetlands, lakes and ponds. The six-lined racerunner and northern prairie skink inhabit dense grasslands and are relatively common but seldom seen. The five-lined skink inhabits the Tallgrass Prairie Ecoregion but is rare. The bull snake, western fox snake, yellow-bellied racer and plains garter snake are the most common snakes.

The venomous timber rattlesnake, massasagua and copperhead have highly limited distributions.

Insects are the most diverse and least studied animal group in the Tallgrass Prairie Ecoregion. They may also be the most important group ecologically and economically. They play vital roles as herbivores, predators, pollinators, decomposers, soil aerators, and as food for other wildlife.

History and Dominant Land Use

Archeological evidence suggests that Native Americans hunted big game in Nebraska around 12,000 years ago. Their cultures slowly evolved over the millinea. They entered and abandoned the central Plains as the climate fluctuated between periods of drought and times of plentiful moisture. During the late 18th century, prior to Euro-american settlement, the tribes inhabiting eastern Nebraska were Otoe, Omaha, Ponca, and Pawnee. They lived in earth-lodge villages and cultivated crops, and engaged in bison hunting.

In 1804, the Lewis and Clark expedition mapped what was to become the eastern boundary of Nebraska. In 1812, the St. Louis Missouri Fur Company built a post in present-day Washington County, one of the first Euro-american establishments in Nebraska. Bellevue, founded in 1823, was Nebraska's first permanent settlement. Tens of thousands of people traveled through the area on the Oregon/California Trail during the 1840s and 1850s.

In the early 19th century, the Great Plains was generally perceived as an area unfit for agriculture and settlement. The settlement in the tall-grass region began in earnest as a result of the passing of the Homestead Act in 1862. This enabled farmers to settle on 160 acres of free land. By 1900, most prime farmland in eastern Nebraska was settled by inhabitants of European descent. The Native American tribes had been relocated or decimated by disease, and the bison herds were exterminated. Reservations in eastern Nebraska include the Santee Sioux, Omaha, Winnebago and portions of Sac and Fox and Iowa reservations.

The land use changes in Nebraska because of the Homestead Act led to the development of an agriculture-based economy. Major crops grown in the tall-grass region include corn, soybeans, wheat, oats and alfalfa. Nebraska's dairy, pork and poultry industries are located primarily in the eastern portion of the state. Beef cattle production also occurs in the region. The livestock and poultry industries found here are great consumers of the corn, soybeans and other crops, helping to add value to these raw commodities. More recently, a significant proportion of the corn harvest has been used in ethanol production.

In recent decades, Nebraska farms have trended towards becoming fewer in number and larger in size. Since the 1950's, machinery and modern farming methods have made agriculture more efficient, thereby decreasing the number of people employed directly by agriculture. This trend caused rural residents to move to larger communities in search of jobs.

The state's largest urban centers, Lincoln and Omaha are located in the Tallgrass Prairie Ecoregion. Omaha was originally laid out in 1854 by a ferry company and quickly grew into a thriving commercial and cultural center. The eastern terminus of the first trans-continental railroad stimulated its growth. Agriculture also played a role in Omaha's development. Stockyards spurred growth in South Omaha, and by 1893 Omaha housed the nation's third largest stockyards. From these roots, Omaha has steadily grown and is now the 40th largest city and the 59th largest metro area in the nation.

Lincoln is the second largest city in Nebraska. Settlers were attracted to the Lincoln area by the potential industry of salt mining. For a time this was a thriving industry. In sunny weather a crust of salt would form on the ground that could be harvested. The salt mining industry was never fully developed and came to a halt when salt mines were developed in Kansas. When Lincoln was named as the state capitol, the city thrived and it continues to expand today.

Nature-based Recreation

Several of the state's top tourist attractions are outdoors in nature and provide conservation, education and recreation opportunities. The Henry Doorly Zoo sits on 110 acres and offers day camps, Scout programs, and family-friendly activities with a conservation message. The Bill and Berniece Grewcock Center for Conservation and Research provides state of the art medical and research capabilities in animal care and management, reproductive physiology, nutrition, genetics and genome resource banking. The Ak-Sar-Ben Aquarium Outdoor Education Center provides an opportunity to see fish and other wildlife native to Nebraska.

Several state parks and recreation areas offer a plethora of recreation activities that are easily accessible. For example, E.T. Mahoney State Park offers a water playground, hiking, camping and many other activities. Ponca State Park offers activities year round with the Missouri National River Resource and Education Center. At Platte River State Park, you can rent a tepee, go horseback riding and challenge yourself with some of the best mountain biking in eastern Nebraska. Two Rivers State Recreation Area and Branched Oak Recreation Area offer fishing, boating, swimming and hunting.

The tall-grass prairie offers a diversity of hunting opportunities. Quail hunters find greater success south of the Platte River in Johnson and Pawnee counties. Turkeys are abundant along the Missouri River, Platte River, Big Nemaha and Little Blue Rivers. Waterfowl hunting along the Missouri River and its marshy backwaters is some of the best Nebraska has to offer. White-tailed deer can be found throughout the region. The Missouri Bluffs also support an excellent squirrel population.

Wildlife viewing and birding enthusiasts find ample opportunities in this region with the diversity of habitats. This region's prairie-chicken population has been rising steadily in recent years, allowing for a limited hunting season and ample spring viewing opportunities. Fontenelle Forest, Indian Cave State Parks and Schramm State Park have wooded bluffs along the Missouri River that provide habitat for many migrating birds. Some warblers, thrushes, tanagers and other birds are seen almost exclusively in these areas during

migration. Tall-grass prairie remnants, like Nine-Mile Prairie and Spring Creek Prairie, provide opportunities to see grassland nesting birds.

There are opportunities also for canoeing, hiking and biking in this region. The Elkhorn River meanders through hilly areas with steep slopes, woodlands and dense forested areas interspersed with farmland. The Platte River is braided but usually has one deeper, darker channel suitable for canoeing. Sandbars in the river are used by waterfowl and shorebirds. The cowboy trail, Steamboat Trace Trail, MoPac East Trail and Oak Creek Trail all offer hiking and biking opportunities.

The Missouri River has perhaps the greatest untapped potential as a nature-based tourism destination. The ecoregion includes a 59-mile stretch of the un-channelized Missouri River that has been designated as a National Recreation River. The stretch from Gavin's Point Dam to Ponca State Park is used by canoeists but requires caution for navigating. Observers may also appreciate the unique geology of orange and white chalk and gray shale that is often exposed where the river has carved away at the bluffs.

Anglers can enjoy a diversity of fishing opportunities from large rivers to small farm ponds. Missouri River anglers can take advantage of smallmouth bass, walleye, sauger and catfish, which are plentiful in the river. Paddlefish archery in the Missouri River offers a different fishing experience. Trout are found at Grove Lake, Crystal Cove Lake, David City Park Ponds and several other lakes and ponds. Numerous impoundments and prairie streams offer warm-water angling opportunities throughout this region.

Nebraska Scenic Byway encourages travelers to enjoy the journey. The Lewis and Clark Scenic Byway re-traces the path of Lewis and Clark from Omaha to South Sioux City on U.S. Highway 75 where you can see wooded bluffs, open bottomlands, cropland and historic waterways. The Heritage Highway stretches from the Missouri River to south central Nebraska along U.S. Highway 136 and cuts across the land memorialized by Willa Cather. Travelers can enjoy Homestead National Monument of America, where they can visit the second oldest restored prairie. The Outlaw Trail Scenic Byway along Highway 12 begins at South Sioux City and ends in Valentine. Along this route you can observe the transition from forested bluffs to the Sandhills.

Over half of Nebraskans live in the Lincoln and Omaha metropolitan areas. The continuing urbanization of Nebraska has significantly increased demands for both traditional and modern outdoor recreational opportunities in eastern Nebraska. With this in mind, modern amenities and facilities can make nature recreation available to a larger population.

Education

Environmental education is a tool for sharing philosophies and techniques for improving the environment. Landowners, conservation organizations, school boards, students and teachers are just some of the groups with opportunities for sharing information. There are many existing partners engaged in agriculture education including the Cooperative Extension, which reaches out to agricultural producers and post-secondary education administration to provide curriculum for new professionals on disturbance techniques compatible with agricultural operations. There are many groups working on invasive species, with potential for collaboration including the Nebraska Invasive Species Project, housed at the University of Nebraska at Lincoln, Cooperative Extension, Weed Science Team at the University of Nebraska, Crop Watch publications, Crop Protection Clinics and Pesticide Applicator programs. Landowners are increasingly seeking alternative avenues to support their operations including eco-tourism, hunting, and fishing. There is additional potential to collaborate with partners such as the Nebraska Department of Economic Development to develop education programs.

There are currently at least three private organizations in the Tallgrass Prairie Ecoregion whose principal purpose is environmental education. These include Fontenelle Nature Association in Bellevue, Pioneer Park Nature Center in Lincoln, and Audubon Nebraska's Spring Creek Prairie Education Center near Denton. The region's Natural Resource Districts and state parks, especially Ponca, Mahoney, and Indian Cave are increasingly delivering nature-based education programming.

Education centers at Ponca State Park and the Lewis and Clark Interpretive Center in Nebraska City were constructed to help interpret and celebrate the 200th anniversary of the Lewis and Clark expedition. These facilities also help to increase awareness of and appreciation for the Missouri River. The ecoregion also includes two zoos, which provide many learning opportunities. The Folsom's Children's Zoo in Lincoln has an innovative high school that allows students to attend classes at the zoo. The Henry Doorly Zoo in Omaha and the Wildlife Safari near Gretna provide nature-based educational opportunities.

Because Nebraska's two largest school districts exist within the Tallgrass Prairie Ecoregion, there is a critical need for ample environmental education trainings and workshops for educators. There is already some interest in these ecoregion-specific trainings, but more needs to be done to show to both classroom educators and school administrators the need for quality environmental education. Additionally, because numerous colleges and universities are located within this ecoregion, there are great opportunities to train pre-service educators about Nebraska's natural resources, environmental education, and how to incorporate environmental education into their curricula.

Organizations and Partnerships

The Tallgrass Prairie Ecoregion has partnerships, coalitions and nature centers formed to conserve the region's biodiversity values. Groups include, but are not limited to, the following:

The Saline Wetlands Conservation Partnership is focused on a small geographic area, but has significant impact for species conservation. This partnership was formed to address the long-term needs of the saline wetlands, an area of approximately 100 square miles forming a wetland complex in Lancaster and Saunders counties. This partnership consists of nearly 20 partners with 5 full-share partners. The challenge for this partnership was to design conservation objectives that met the needs of the wetland complex and the community. An implementation plan for the conservation of Nebraska's Saline Wetlands was first completed in 2003. The plan goal is "No net loss of saline wetlands and their associated functions with a long-term gain in sustaining wetland functions through the restoration of hydrology, prescribed wetland management and watershed protection.
lincoln.ne.gov/city/parks/parksfacilities/wetlands/wetlandspartnership.htm

Missouri River Futures is a collaborative effort primarily between federal and state agencies to 1) improve communications and coordination among the Missouri River National Recreation River (MRNRR) stakeholders, thereby leading to more effective resource conservation through increased understanding of issues and concerns that affect conservation efforts and 2) identify and package an array of land protection and conservation programs that exist among agencies and non-government organizations, and where important, to develop new programs to meet the needs of landowners and others interested in the river's future. The initiation of this group in 2004 was needed since, in the past, organizations and agencies would typically work on similar Missouri River issues individually. Over 40 entities including state and federal agencies, community and local groups have given support to this effort. This group strives to improve effective management of the MRNNR by providing adequate education of the public, local landowners, and other stakeholders in order to facilitate their cooperation and participation in government efforts. Central to this education is making available information on the various programs offered by state and federal agencies.
missouririverfutures.com/index.html

Back to the River began with a planning alliance in 1995 for the Missouri River corridor. The focus area was Omaha and surrounding locations, including parts of Washington, Douglas, and Sarpy counties. The partnership includes local city representatives, city commissioners, NRD managers, educators, Nebraska Game and Parks staff, nature centers, Omaha Parks and Recreation staff, tourism representatives and Iowa Department of Natural Resources. Back to the River envisions a riverfront that is attractive to wildlife and to commerce. The goals of this group are to promote recreation and river access, encourage compatible economic development, emphasize historic and cultural resources, improve wildlife habitat, educate, maintain water quality, and endorse responsible floodplain management.
www.backtotheriver.org

The Upper Mississippi River and Great Lakes Region Joint Venture involves ten states and was established in 1993 in response to the needs of breeding and migrating waterfowl in the northern part of the Mississippi Flyway. The goal of the Joint Venture is to increase populations of waterfowl and other wetland wildlife by protecting, restoring and enhancing wetland and associated habitat. In 2003, a resolution was passed to provide all bird conservation consistent with the North American Bird Conservation Initiative. uppermissgreatlakesjv.org

Ecoregion-specific Stresses

Key Stresses

In addition to the stresses and conservation actions identified in this chapter for the Tallgrass Prairie Ecoregion, statewide concerns are identified also in chapter four. Conservation practitioners identified the following stresses as the top threats in the ecoregion.

Alteration of the frequency and intensity of natural disturbances: Tallgrass prairie, wetland, and forest habitats in the ecoregion were maintained historically by periodic fires and grazing. Today, the loss of fire has resulted in the degradation of thousands of acres of prairie by invasive species including eastern red-cedar. Grazing systems on prairie remnants, involving a higher concentration of grazers on fewer acres, often result in a loss of biodiversity and ecological function because practices do not mirror historical grazing patterns.

Spread of invasive species: Invasive species are severely threatening the ecoregion's biological diversity. Smooth brome, Kentucky bluegrass, reed canary grass, purple loosestrife, Eurasian phragmites, sericea lespedeza, garlic mustard, eastern red-cedar, and other species have competitively excluded native plants and degraded habitat for fish and wildlife. The introduction of carp, zebra mussels, emerald ash borer, feral hogs, and other species have altered habitats and increased competition for native species.

Loss of pollinators: Pollinators are essential to a well-functioning ecosystem. Pollinator habitat restorations can maintain or increase numbers of native pollinators (e.g., bees, moths, butterflies).

Excess deer browsing: Over-browsing by deer can degrade native woodlands and impact agricultural production in areas. Sarcoptic mange has affected many coyotes that would normally prey on deer. A stable predator population and harvest programs (e.g., antlerless deer harvest) can help maintain deer populations at a healthier level.

Altered hydrology and channel degradation of rivers and streams: Historically, the ecoregion's large rivers experienced spikes in flows during the spring and early summer. These spikes enabled sediment to be transported and deposited and for channels to meander and migrate, creating habitats important to many species. Reductions in natural flows have reduced habitat available to fish and other species. Channelization has caused streams to become incised, lowering water tables of adjacent wetlands and affecting plant composition.

Lack of awareness and knowledge about the region's biological diversity and ecological processes: Although the region's remaining native grasslands, woodlands, and wetlands are unique and of high value, most of the ecoregion's residents lack an awareness of the importance of these habitats to biological diversity. For example, individuals may perceive that numerous eastern red-cedars on the landscape are beneficial to all wildlife; when in fact, this particular land cover decreases overall habitat quality. Citizens have limited information and opportunity to learn about the ecoregion's natural communities and fish and wildlife. Private landowners may have a limited understanding of the complex ecological processes that are necessary to maintain biological diversity in the tall-grass region.

Sedimentation of rivers, streams, and wetlands: The close proximity of agricultural fields to rivers, streams, and wetlands has resulted in large volumes of sediment entering the ecoregion's water bodies. Sedimentation increases stream turbidity and changes bottom substrates, degrading habitat for fish and other aquatic species. Sedimentation of wetlands alters storage capacity and changes plant composition, reducing habitat available to waterfowl and other species.

Pollution by pesticides and urban and industrial runoff: The introduction of pesticides, storm sewer runoff, and industrial pollutants into rivers and streams is impacting water quality and exposes fish and other species to harmful agents. The indiscriminate use of herbicides on native habitats reduces plant diversity and overall biological diversity.

Conversion and fragmentation of natural habitats: Although the majority of the ecoregion's natural habitats have already been converted to agriculture, many remaining natural communities are threatened by continued development. Landowners have increasingly diverse goals for natural areas/communities, some of which are not compatible with biodiversity conservation. The expansion of urban areas into surrounding rural communities is accelerating the conversion of prairies, bluff woodlands, and wetlands.

Loss of natural areas because of local economics: Economic hardships are changing ownership patterns that could affect management decisions and ultimate stewardship of the land's natural resources. For example, recreational landowners may plant eastern red-cedar or build structures.

Loss of lands enrolled in conservation programs: Lands enrolled in programs such as the Conservation Reserve Program provide significant benefits to some species of wildlife. Changing economic conditions and reduced support may result in large tracts of conservation lands being converted to agricultural cropland. The loss of even a modest percentage of these lands will result in impacts to terrestrial and aquatic species.

Poorly-sited utility-scale wind turbines: Wind energy development is a growing industry in the Great Plains. There are many benefits to cleaner and renewable energy sources; nevertheless, in order to conserve biodiversity in the ecoregion, it is important to carefully consider the placement of wind turbines and their associated transmission lines in order to minimize wildlife habitat fragmentation. In particular, avoid placing turbines in native grasslands and woodlands or in primary migration corridors for waterfowl, raptors, the federally endangered whooping crane, and other bird species.

Biologically Unique Landscapes of the Tallgrass Prairie Ecoregion

A goal of the Nebraska Natural Legacy Project is to identify priority landscapes that, if properly managed, will conserve the majority of the state's biological diversity. These landscapes, referred to as Biologically Unique Landscapes (BULs), were selected based on the occurrences of at-risk species and natural communities. See Chapter 3 for a description of the methods used to select the landscapes.

The map on the following page shows the BULs for the Tallgrass Prairie Ecoregion. Following the map are brief descriptions of each BUL, including stresses affecting species and habitats, proposed conservation actions, and lists of the Tier I at-risk species and natural communities found in the landscape. In order to help prioritize conservation in each BUL, we denoted species that occur in only one or a few BULs with superscripts.

In the Tallgrass Prairie Ecoregion, some BULs are truncated by the Nebraska state boundary. We suggest opportunities for wildlife conservation in these areas based on review of corresponding adjacent state wildlife action plans.

Tallgrass Biologically Unique Landscapes

Elkhorn Confluence
Indian Cave Bluffs
Lower Platte River
Missouri River
Ponca Bluffs
Rainwater Basin (see Mixedgrass Prairie Ecoregion for description)
Rulo Bluffs
Saline Wetlands
Sandstone Prairies
Southeast Prairies
Thurston-Dakota Bluffs
Verdigris-Bazile (see Mixedgrass Prairie Ecoregion for description)
Willow Creek Prairies

Demonstration Sites of the Tallgrass Prairie Ecoregion

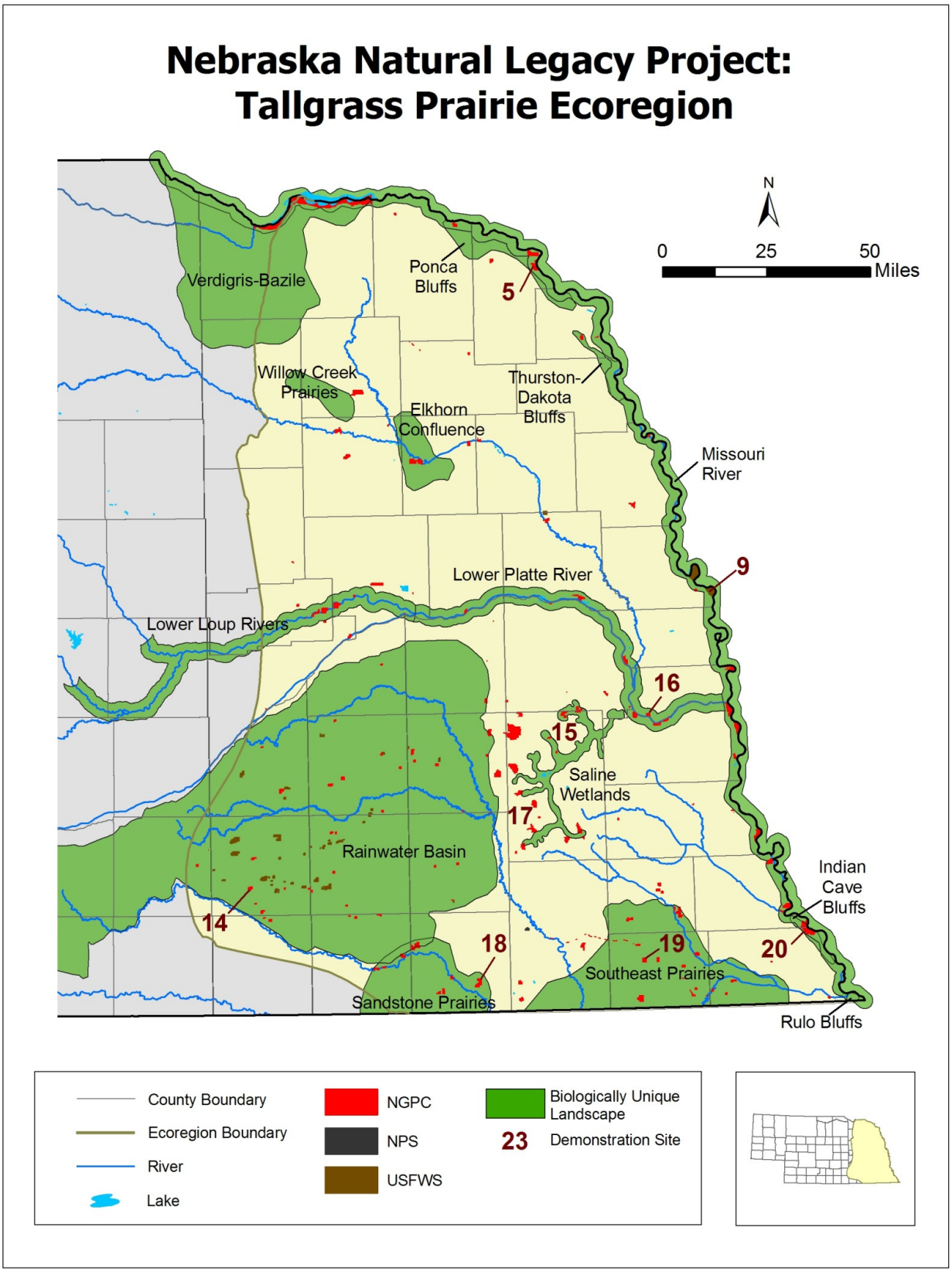
Demonstration sites are locations across the state with potential for showcasing conservation projects and the results of sustainable management to the public. They provide opportunities for learning about the site's unique qualities and importance to at-risk species. See Chapter 4 for information on selecting demonstration sites. The Tallgrass Prairie Ecoregion map shows the location of demonstration sites in the area.

Site name	# on map	BUL
Boyer Chute NWR	9	Missouri River
Burchard Lake WMA	19	Southeast Prairies
Indian Cave SP	20	Indian Cave Bluffs
Kissinger Basin WMA	14	Rainwater Basin
Ponca SP	5	Ponca Bluffs
Rock Glen WMA/Rock Creek SHP	18	Sandstone Prairies
Saline Wetlands Complex	15	Saline Wetlands
Schramm Park SRA	16	Lower Platte River
Spring Creek Prairie	17	N/A

Descriptions of each site are found in the write-up for the BUL in which the site is found, except for the Kissinger Basin WMA description which can be found in the Rainwater Basin BUL write-up in Chapter 6 – Mixedgrass Prairie Ecoregion. The Spring Creek Prairie site is not within a BUL and the description is included here.

17. Spring Creek Prairie - National Audubon Society

Spring Creek Prairie is one of the few large tracts of tall-grass prairie within easy driving distance from Lincoln. This 800-acre tall-grass prairie nature preserve has walking trails through tall-grass prairie. This prairie is managed using grazing and prescribed burning. A recently completed education center provides opportunities to the public.


Nebraska Natural Legacy Project:
Tallgrass Prairie Ecoregion
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Miles
Verdigris-Bazile
Ponca Bluffs
5
Willow Creek Prairies
Thurston-Dakota Bluffs
Elkhorn Confluence
Missouri River
Lower Platte River
9
Lower Loup Rivers
16
15
Saline Wetlands
17
Rainwater Basin
Indian Cave Bluffs
14
18
19
20
Southeast Prairies
Sandstone Prairies
Rulo Bluffs
County Boundary
Ecoregion Boundary
River
Lake
NGPC
NPS
USFWS
Biologically Unique Landscape
23
Demonstration Site

Elkhorn Confluence

Biologically Unique Landscape Description
This landscape includes the land around the confluence of the North Fork and South Fork of the Elkhorn River in Stanton County. The Elkhorn River floodplain is primarily cropland, but also contains cottonwood-dominated woodlands, wet meadows and freshwater marshes. The uplands on the south side of the river are composed of sand dunes originating from river alluvium. Dry-mesic sand prairie, mostly grazed, and bur oak woodlands occupy the dunes. Most of the sandy soils south of the river have been converted to cropland. The uplands north of the rivers contain more loam and are mostly in cropland though some degraded tall-grass prairies remain. Wood Duck Wildlife Management Area is the only protected area in the landscape.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure. Heavy grazing has promoted exotic invasion in many grasslands.
- Conversion of native prairies to cropland
- Invasive plant species in prairies and woodland, including Siberian elm, eastern red-cedar, smooth brome and garlic mustard
- Housing development
- Wetland drainage
- Increased nutrients in the stream
- Deer over-browsing

Conservation Strategies

- Implement planned grazing strategies on private and public lands to reduce exotic cool-season grasses and improve native plant diversity and vigor. Spring burning and spring grazing, sometimes used in combination, should be implemented as initial management practices to reduce exotic grass dominance. When exotics are under control, other grazing systems can be implemented.
- Implement tree-clearing programs on private and public lands; these can be done in combination with the prescribed fire and planned grazing
- Coordinate with landowners interested in using conservation easements to protect high-quality prairies
- Restore wetland hydrology at important sites
- Stream-quality monitoring
- Improved harvest of deer

Tier I At-risk Species

Plants:
None

Animals:
Bell's Vireo
Greater Prairie-Chicken
Henslow's Sparrow
Interior Least Tern
Blanding's Turtle
Bucholz Black Dash[2]
Married Underwing
Whitney Underwing
Regal Fritillary
Plains Harvest Mouse
Plains Pocket Mouse[4]
Plain Pocketbook[3]

Aquatic Communities:
Mid-order, Warm Water River

Terrestrial Communities:
Eastern Riparian Forest
Cottonwood-Peachleaf Willow Riparian Woodland
Cottonwood-Diamond Willow Woodland
Sandbar Willow Shrubland
Riparian Dogwood-False Indigobush Shrubland
Dry-mesic Bur Oak Forest and Woodland*
Freshwater Seep
Eastern Bulrush Deep Marsh
Cattail Shallow Marsh
Reed Marsh
Eastern Pondweed Aquatic Wetland
Upland Tall-grass Prairie*
Lowland Tall-grass Prairie*
Sandhills Dune Prairie
Perennial Sandbar
Sandbar/Mudflat

* Priority for conservation in this BUL
[1] This is the only BUL where the species is known to occur
[2] Known to occur in only one other BUL
[3] Known to occur in only two other BULs
[4] Known to occur in only three other BULs

Indian Cave Bluffs

Biologically Unique Landscape Description
This landscape includes the steep bluffs of the Missouri River in Nemaha and Richardson counties. The majority of the bluffs support an eastern deciduous forest of oaks, hickories and basswood. Because of its location in southeastern Nebraska, these woodlands support a high diversity of eastern deciduous forest plant and animal species. Tall-grass prairie remnants still occur on some bluff tops and south- and west-facing slopes. These have been greatly reduced in size and degraded over the years by shrub and tree encroachment resulting from lack of wildfires. Indian Cave State Park is the only protected area in the landscape.

Natural Legacy Demonstration Site

20. Indian Cave State Park - Nebraska Game and Parks Commission
This Park is approximately 3300 acres in size. The park is mostly wooded bluffs but is bordered by the Missouri River and includes a recently restored backwater. Natural communities at this park include oak hickory ironwood forest and red oak-basswood-ironwood forest. Park managers are currently working with neighboring landowners to eradicate garlic mustard. The managers improve wildlife habitat through a variety of techniques including prescribed woodland burns.

Stresses Affecting Species and Habitats
- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Invasive plant species, including garlic mustard, common buckthorn and other exotic plants.
- Tree and shrub encroachment of prairie remnants
- Lack of fire in native woodlands leading to increased tree and shrub densities
- Housing development and other forms of fragmentation
- High-grade logging
- Deer over-browsing in native forests and woodlands
- Invasive insects, especially the emerald ash borer
- Poorly-sited utility-scale wind turbines

Conservation Strategies
- Conduct annual surveys and implement control programs for garlic mustard, exotic buckthorns and honeysuckles and other invasive woodland plants on conservation lands and adjacent private lands
- Continued implementation of the Indian Cave State Park management plan including tree and shrub thinning and prescribed fire in park woodlands and invasive species control.
- Implement prescribed burns in native woodlands to enhance woodland structure, floral composition and oak regeneration on conservation lands and adjacent private lands.

- Coordinate with landowners interested in conservation easements or voluntary fee title acquisition to protect important habitats from development and commercial logging of mature forests
- Improved harvest of deer
- If emerald ash borer occur, remove infected trees and restrict the importation of firewood
- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to native species. See Nebraska Game and Parks Commission guidelines for wind energy development.

Tier I At-risk Species

Plants:
American Ginseng[4]

Animals:
Southern Flying Squirrel[3]
Cerulean Warbler[4]
Timber Rattlesnake
Wood Thrush
Regal Fritillary
Ghost Tiger Beetle

Aquatic Communities:
None

Terrestrial Communities:
Red Oak-Basswood-Ironwood Forest*
Oak-Hickory-Ironwood Forest*
Mesic Bur Oak Forest and Woodland*
Dry-Mesic Bur Oak Forest and Woodland*
Dry Upland Bur Oak Woodland*
Freshwater Seep
Upland Tall-grass Prairie
Eastern Sandstone Bluff and Cliff

* Priority for conservation in this BUL
[1] This is the only BUL where the species is known to occur
[2] Known to occur in only one other BUL
[3] Known to occur in only two other BULs
[4] Known to occur in only three other BULs

Lower Platte River

Biologically Unique Landscape Description

This landscape includes the Platte River channel and its floodplain from the river's confluence with the Loup River in Platte County eastward to its mouth in Sarpy County. The lower Platte River is a large, shallow, braided river. Sandbars and wooded islands are common within the channel. Much of the stream-bank is wooded, with the dominant species being cottonwood and eastern red-cedar. Sand-pits are common along the river, and in many areas the riverbank is lined with cabins. Most of the river floodplain is now cropland, though there are scattered wet meadows and marshes.

The lower Platte River receives water from the Loup and Elkhorn rivers and has a more stable flow than the central Platte River. The lower Platte River is unique in that its sandbars support numerous colonies of the federally and state listed piping plover and interior least terns. The construction of dikes and levees has constricted the natural channel and eliminated or isolated most of the floodplain sloughs, backwaters and wetlands. The narrowing of the channel has resulted in higher flow stages after heavy rain events that wash away tern and plover nests. The lower Platte also supports many rare large river fish including the lake sturgeon, blue sucker, sturgeon chub, and pallid sturgeon. Protected areas along this reach of the Platte River include Two Rivers SRA, Louisville SRA, Platte River State Park, and Mahoney State Park.

Natural Legacy Demonstration Site

16. Schramm Park State Recreation Area - Nebraska Game and Parks Commission

Schramm Park State Recreational Area is a relatively small but surprisingly biologically-rich area on the lower Platte River. Uplands are covered with oak forest with small patches of prairie. The floodplain has a large area of mature riparian forest. Natural communities at the area include dry-mesic bur oak forest and woodland and upland tall-grass prairie. One of the main needs at this park is cedar tree removal and invasive species management. Limited resources have restricted habitat management.

Stresses Affecting Species and Habitats

- Eurasian phragmites and other exotic plant invasion of stream-banks, sandbars, meadows, marshes and woodlands
- Invasive tree encroachment of woodlands and meadows (e.g., eastern red-cedar)
- Alteration of natural flows that otherwise would maintain sandbars and fish habitat
- Dike and levee construction
- Armoring of stream-banks
- Water withdrawal
- Continued cabin and house development adjacent to the river
- Excessive recreational use of the river (e.g., air boats, 4-wheelers), which disturbs tern and plover nesting

- Sandpit development, which eliminates native meadows, woodlands, and river channel.
- Conversion of wet meadows to cropland, including wetland drainage and dewatering resulting from lower groundwater levels
- Nutrient loading from septic tanks

Conservation Strategies

- Seek to maintain natural hydrology necessary to sustain ecosystem function and biodiversity
- Coordinate with landowners interested in placing conservation easements on undeveloped reaches of the river, wet meadows, and woodlands to protect them from development
- Undertake invasive tree clearing programs, focused on eastern red-cedar, Russian-olive, exotic buckthorns and honeysuckles, on selected stretches of the river to protect woodlands.
- Work with sand and gravel companies to site gravel pits away from ecologically-sensitive areas of the floodplain and to restore pits to wetland habitat after sand and gravel extraction has been completed
- Work to restore and maintain natural wetland hydrology
- Maintain and widen river corridor
- Install waste management facilities that reduce the number of individual septic tanks

Tier I At-risk Species

Plants:
Western Prairie Fringed Orchid

Animals:
Northern River Otter
Bell's Vireo
Interior Least Tern
Piping Plover
Wood Thrush
Blandings Turtle
Massasauga[3]
Blue Sucker[2]
Lake Sturgeon[3]
Pallid Sturgeon[3]
Plains Topminnow
Sturgeon Chub[2]
Pimpleback
Regal Fritillary
Married Underwing
Whitney Underwing

Aquatic Communities:
Mid-order, Warm Water River

Terrestrial Communities:
Eastern Riparian Forest*
Cottonwood-Peachleaf Willow Riparian Woodland*
Red Oak-Basswood-Ironwood Forest
Oak-Hickory-Ironwood Forest
Mesic Bur Oak Forest and Woodland*
Dry-Mesic Bur Oak Forest and Woodland*
Dry Upland Bur Oak Woodland*
Sandbar Willow Shrubland
Riparian Dogwood-False Indigobush Shrubland
Freshwater Seep
Eastern Cordgrass Wet Prairie*
Eastern Sedge Wet Meadow*
Eastern Bulrush Deep Marsh
Reed Marsh
Eastern Pondweed Aquatic Wetland
Upland Tall-grass Prairie
Lowland Tall-grass Prairie*
Perennial Sandbar*
Sandbar/Mudflat
Eastern Sandstone Bluff and Cliff

* Priority for conservation in this BUL
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[4] Known to occur in only three other BULs

Missouri River

Biologically Unique Landscape Description
This landscape includes the Missouri River channel, floodplain, and bluffs from the Nebraska/Kansas border to the Nebraska/South Dakota border. The Missouri River drains approximately 529,350 square miles of land, including the entire state of Nebraska. Historically, the Missouri was one of the most dynamic large rivers in North America. Natural runoff events (floods) in March - June were instrumental in creating the river's constantly meandering course. The River was more than a mile wide and 20 feet deep in places, and its channel laced with sandbars and forested islands. The river's floodplain was a mosaic of oxbow lakes, backwater marshes, wet prairies and floodplain forests.

Alteration of the Missouri River began in 1829 when the removal of tree snags was initiated to improve steamboat navigation. Between the 1930's and 1960's, a bank stabilization

project armored the banks and created a navigational channel between St. Louis, Missouri and Sioux City, Iowa. Between 1940 and 1964, six mainstream dams were constructed, which resulted in managed flows.

From an ecological perspective, these attempts to "tame the river" have had many negative consequences for riverine flora and fauna. Sediment transport has been interrupted, resulting in increased sedimentation above Gavins Point Dam and degradation of the streambed and draining of floodplain wetlands below the dam. Channelization has resulted in the elimination of sloughs, backwaters and oxbows. Many riverine species depend upon spring flood pulses as spawning cues and upon the availability of floodplain habitat for many of their life requisites. Alteration of natural flows and elimination of lateral riverine movement has resulted in declining populations of many big river species. There are nine state-listed species and five federally-listed species that occur within the Nebraska portion of the Missouri River corridor. The lack of properly-timed flows has also impacted the hydrology of the floodplain wetlands. The majority of the floodplain is now in cropland.

The stretches of the Missouri River from Sioux City to Gavins Point Dam and from the upper end of Lewis and Clark Lake to the South Dakota border have remained un-channelized and are designated as a National Recreational River. Although these reaches remain un-channelized, regulated flows have altered many natural riverine processes (e.g., sediment transport, annual flooding).

Federal mitigation dollars have helped fund several chute and channel restoration projects on the Missouri River in recent years, such as the Hamburg Bend, Kansas Bend, Langdon Bend, Decatur Bend and Tobacco Bend projects. In addition, Wetland Reserve Program dollars have become available for the restoration of Missouri River floodplain wetlands and associated habitats. The U.S. Army Corps of Engineers has worked to create new sand islands for least tern and piping plover nesting. A backwater area called Mulberry Bend was enhanced by removal of sediment for island creation. South Dakota Game, Fish and Parks (SDGFP) recently completed an evaluation of impacts to native fishes in this aquatic habitat. Protected areas in the BUL include Niobrara, Ponca, and Indian Cave State Parks, Boyer Chute National Wildlife Refuge, and a number of wildlife management areas.

Natural Legacy Demonstration Site

9. Boyer Chute National Wildlife Refuge - U.S. Fish and Wildlife Service
This Refuge was established to recover fish and wildlife habitat in the Missouri River and its floodplain. Refuge floodplains have been restored to near pre-channelization condition without affecting navigation on the main stem of the Missouri River. Boyer Chute is once again an ecologically-functioning part of the river. Close to 3,350 acres of floodplain woodland, tall-grass prairie, and wetland habitats now benefit Missouri River fishes, migratory birds, endangered species, and resident wildlife.

Stresses Affecting Species and Habitats

- Invasive plants and animals, including phragmites, reed canary grass, purple loosestrife, zebra mussels and exotic fish
- Altered natural flows will continue to threaten at-risk aquatic species, as well as some terrestrial species whose life-histories are closely linked to the availability of riverine habitat
- Channel down-cutting from lack of sediment, restricted channel, and constructed jetties.
- Wetland drainage and conversion
- Development pressure in riparian zones
- Deer over-browsing in riparian woodlands
- Chemicals in the water that work as endocrine disrupters in fish species

Conservation Strategies

- Seek to alter river flow management to conform to more natural flows
- Encourage levee setbacks and a functional connected floodplain according to the Galloway Plan (IFMRC 1994) and the National Research Council Report (2002)
- Restore river meandering where possible, restore meandering in off-channel chutes especially, reduce navigation channel where possible
- Restore sediment availability for river reaches downstream of Fort Randall Dam. Develop an erodible corridor for sediment input.
- Restore coarse particulate organic matter and large woody debris in the river
- Increase top width of the channelized reach in order to establish shallow water habitat diversity for fish and wildlife purposes
- Uphold wetland conservation provisions (e.g., Swampbuster) and studies that evaluate the abilities of aquatic wildlife to pass through dams
- Restore natural plant communities (e.g., wetlands, prairies, and woodlands) on the river floodplain and terraces
- Conduct education programs on invasive aquatic species identification, prevention, and inadvertent transfer.
- Establish zoning setbacks and possible land purchases to reduce fragmentation of riparian habitat
- Improved harvest of deer
- Use integrated pest management and nutrient management to reduce pollution run-off into tributaries

Collaborative Conservation Opportunities across State Borders

Coordinate with South Dakota, Iowa, and Missouri conservation agencies and tribes, particularly efforts to benefit riverine species of the Missouri River in greatest conservation need (identified in multiple state wildlife action plans). Nebraska at-risk species identified also in the South Dakota wildlife action plan include river otter, bald eagle, interior least tern, piping plover, pallid sturgeon, sicklefin chub, sturgeon chub, Higgins eye, and scaleshell. Nebraska at-risk species identified also in the Iowa wildlife action plan include river otter, southern flying squirrel, bald eagle, Bell's vireo, cerulean warbler, interior least tern, king rail, piping plover, timber rattlesnake, blue sucker, lake sturgeon, pallid sturgeon, and sicklefin chub. And, species identified also in the Missouri strategy include Bell's vireo,

cerulean warbler, king rail, timber rattlesnake, blue sucker, pallid sturgeon, and sturgeon chub. Species lists may be modified as new information becomes available. Innovative methods for sufficient information exchange could aid the collaborative process.

Coordinated habitat management actions (e.g., strategic grazing) should mirror medium to high priority conservation goals as identified in the South Dakota Comprehensive Wildlife Conservation Plan, priorities for conservation actions in the Iowa Wildlife Action Plan, and/or actions in the Missouri Comprehensive Wildlife Strategy. Collaborative conservation efforts across state borders should include researchers, federal and non-profit environmental program coordinators, and landowners, particularly those with properties extending over state lines. For example, conservation efforts coordinated by Missouri River Futures involve multi-state partners to address current issues regarding the Missouri River. South Dakota Game, Fish and Parks, Nebraska Game and Parks Commission, Iowa Department of Natural Resources, and the South Dakota, Iowa, and Nebraska Divisions of the Izaak Walton League of America (IWLA) formed the Tri-state IWLA Missouri River Initiative to work towards stated goals. Additionally, USDA prorams may have goals in common with Natural Legacy. NRCS Conservation Innovation Grants are already contributing to multi-state conservation efforts regarding various issues.

Tier I At-risk Species

Plants:
American Ginseng[4]
Nodding-pogonia[2]

Animals:
Northern River Otter
Southern Flying Squirrel[3]
Bell's Vireo
Cerulean Warbler[4]
Interior Least Tern
Piping Plover
Timber Rattlesnake
Blue Sucker[2]
Lake Sturgeon[3]
Pallid Sturgeon[3]
Sicklefin Chub[1]
Sturgeon Chub[2]
Flat Floater[1]
Higgins Eye[1]
Pistolgrip[2]
Scaleshell[1]
Regal Fritillary
Mottled Duskywing[4]
Married Underwing
Whitney Underwing

Aquatic Communities:
Large, Warm Water River*

Terrestrial Communities:
Eastern Riparian Forest
Cottonwood-Peachleaf Willow Riparian Woodland*
Eastern Cottonwood-Dogwood Riparian Woodland*
Cottonwood-Diamond Willow Woodland
Red Oak-Basswood-Ironwood Forest
Oak-Hickory-Ironwood Forest
Bur Oak-Basswood-Ironwood Forest
Mesic Bur Oak Forest and Woodland
Dry-Mesic Bur Oak Forest and Woodland
Dry Upland Bur Oak Woodland
Sandbar Willow Shrubland*
Riparian Dogwood-False Indigobush Shrubland*
Buffaloberry Shrubland
Freshwater Seep
Eastern Cordgrass Wet Prairie*
Eastern Sedge Wet Meadow*
Eastern Bulrush Deep Marsh*
Cattail Shallow Marsh*
Reed Marsh*
Eastern Pondweed Aquatic Wetland*
American Lotus Aquatic Wetland*
Upland Tall-grass Prairie
Lowland Tall-grass Prairie
Missouri River Valley Dune Grassland*
Missouri River Floodplain Terrace Grassland*
Northern Loess/Shale Bluff Prairie*
Perennial Sandbar
Sandbar/Mudflat*
Eastern Sandstone Bluff and Cliff
Northern Chalk Bluff and Cliff

* Priority for conservation in this BUL
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Ponca Bluffs

Biologically Unique Landscape Description
This landscape includes the steep bluffs of the Missouri along the un-channelized Missouri River in Dakota, Dixon, and Cedar counties. This reach of the Missouri River has been designated as a National Recreational River. The majority of the bluffs support eastern deciduous forest dominated by bur oak, basswood and ironwood. Remnants of tall-grass prairie and northern loess shale bluff occur on the bluffs. Cropland is scattered on rolling hills throughout the landscape. Ponca State Park is the largest protected area in the landscape.

Natural Legacy Demonstration Site

5. Ponca State Park - Nebraska Game and Parks Commission
Ponca State Park contains 1900 acres and includes the steep bluffs covered in hardwood forest and floodplains of the un-channelized Missouri River. Ponca State Park is located in the portion of the Missouri River designated as a National Recreational River. Restored sandbars in the Missouri River and backwater provide habitat for several listed species, while allowing the channel to meander restores the dynamic floodplain. This park has bur oak basswood-ironwood forest, dry-mesic bur oak forest and woodland, and upland tall-grass prairie.

Stresses Affecting Species and Habitats
- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Invasive plant species in native woodlands by eastern red-cedar, garlic mustard, common buckthorn, leafy spurge and exotic plants
- Tree and shrub encroachment of prairie remnants
- Housing development and other forms of fragmentation
- High-grade logging of woodlands
- Excess deer browsing
- Poorly-sited utility-scale wind turbines

Conservation Strategies
- Implement ecologically-sensitive planned grazing and prescribed fire strategies in native grasslands on private lands
- Conduct annual surveys and implement control programs on conservation lands and nearby private lands for garlic mustard, common buckthorn and other invasive woodland plants.
- Coordinate with landowners interested in using conservation easements and voluntary fee title acquisition to protect important habitats from development and commercial logging of mature forests
- Continue implementation of the Ponca State Park management plan including tree and shrub thinning in park woodlands, implementation of prescribed fire, and restoration of native grasslands and wetlands within the floodplain
- Improved harvest of deer

- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to native species. Avoid placing wind turbines and transmission lines in native plant communities and on bluff tops where they contribute to higher bird and bat mortality. Wind farms should not be located within the recommended radius of prairie grouse leks and nesting grounds. Turbines can be halted temporarily during peak migration periods for bats and birds. Pre- and post-construction monitoring should be implemented. See Nebraska Game and Parks Commission guidelines for wind energy development.

Collaborative Conservation Opportunities across State Borders
Coordinate with South Dakota organizations, particularly efforts to benefit shared species of greatest conservation need on the NE Ponca Bluffs/SD Missouri River Ecoregion border (i.e., Union, Clay, and Yankton Counties in SD). Identified species include bald eagle, interior least tern, piping plover, and regal fritillary. Species lists may be modified as new information becomes available. For example, South Dakota Game, Fish and Parks completed an osprey reintroduction project along the lower Missouri River in Clay and Yankton counties in 2010. Several nesting platforms were placed in the reintroduction area below Gavins Point Dam to encourage new nesting pairs. It is likely that new nesting pairs may breed in Nebraska or South Dakota.

Coordinated habitat management actions (e.g., strategic grazing) should mirror medium to high priority conservation goals as identified in the South Dakota Comprehensive Wildlife Conservation Plan. Collaborative conservation across state borders should include researchers, federal and non-profit environmental program coordinators, and landowners, particularly those with properties extending over state lines. It will be necessary to identify and develop staffing and funding sources for implementation of conservation actions beyond state boundaries.

Tier I At-risk Species

Plants:
American Ginseng[4]

Animals:
Bell's Vireo
Greater Prairie-Chicken
Wood Thrush
Regal Fritillary

Aquatic Communities:
None

Terrestrial Communities:
Bur Oak-Basswood-Ironwood Forest*
Dry-Mesic Bur Oak Forest and Woodland*
Dry Upland Bur Oak Woodland*

Freshwater Seep
Upland Tall-grass Prairie*
Northern Loess/Shale Bluff Prairie*
Eastern Sandstone Bluff and Cliff*

* Priority for conservation in this BUL
[1] This is the only BUL where the species is known to occur
[2] Known to occur in only one other BUL
[3] Known to occur in only two other BULs
[4] Known to occur in only three other BULs

Rulo Bluffs

Biologically Unique Landscape Description
This landscape includes the steep bluffs of the Missouri River in the far southeast corner of the state. The majority of the bluffs support eastern deciduous forest of oaks, hickories and basswood. Because of its location in extreme southeastern Nebraska, this landscape has a high diversity of eastern deciduous forest plant and animal species. Tallgrass prairie remnants occur on some bluff tops and south- and west-facing slopes. These have been reduced in size and degraded over the years by shrub and tree encroachment resulting from lack of wildfires. Scattered cropland and pastureland occur in the landscape. Some areas of woodland have been farmed or logged in the past. The Nature Conservancy's Rulo Bluffs Preserve is a high-quality protected area in the landscape.

Stresses Affecting Species and Habitats
- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Invasive woodland plant species, including garlic mustard, common buckthorn and other exotic plants, as well as increased density of shrubs in the forest understory
- Tree and shrub encroachment of prairie remnants.
- Invasive insects, especially the emerald ash borer is a potential threat
- Housing development and other forms of fragmentation
- High-grade logging
- Excess deer browsing
- Utility-scale wind energy developments

Conservation Strategies
- Promote ecologically-sensitive grazing strategies.
- Conduct annual surveys for garlic mustard and other invasive woodland plants and implement control strategies, especially on conservations lands and adjacent private lands
- If emerald ash borer infestations occur, remove infected trees and restrict the importation of firewood

- Coordinate with landowners interested in using conservation easements or voluntary fee title acquisition to protect important habitats from development and commercial logging of mature forests
- Offer voluntary financial incentives to private landowners to implement tree and shrub thinning and prescribed burning within high-quality native woodlands
- Improved harvest of deer
- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to native species. See Nebraska Game and Parks Commission guidelines for wind energy development.
- Provide education about woodland/forest ecology

Collaborative Conservation Opportunities across State Borders
Coordinate with Kansas and Missouri organizations, particularly efforts to benefit shared species of greatest conservation need on NE Rulo Bluffs/KS Eastern Tallgrass Prairie Conservation Region/MO Central Dissected Till Plains borders, especially forest and woodland (i.e., Brown County in KS and Holt County in MO). Nebraska Tier I at-risk species identified also in the Kansas wildlife action plan include southern flying squirrel, cerulean warbler, and timber rattlesnake. And, Tier I Nebraska species identified also in the Missouri strategy include cerulean warbler and timber rattlesnake. Species lists may be modified as new information becomes available. Innovative methods for sufficient information exchange could aid the collaborative process.

Coordinated wildlife management actions (e.g., invasive species management, wildlife corridor development) should mirror strategies identified in Kansas' Comprehensive Wildlife Conservation Plan and/or actions in the Missouri Comprehensive Wildlife Strategy. Collaborative conservation efforts across state borders should include researchers, federal and non-profit environmental program coordinators, and landowners, particularly those with properties extending over state lines. It will be necessary to identify and develop staffing and funding sources for implementation of conservation actions beyond state boundaries.

Tier I At-risk Species

Plants:
American Ginseng[4]
Nodding Pogonia[2]

Animals:
Southern Flying Squirrel[3]
Cerulean Warbler[4]
Wood Thrush
Regal Fritillary
Timber Rattlesnake

Aquatic Communities:
None

Terrestrial Communities:
Red Oak-Basswood-Ironwood Forest*
Oak-Hickory-Ironwood Forest*
Mesic Bur Oak Forest and Woodland*
Dry-Mesic Bur Oak Forest and Woodland*
Dry Upland Bur Oak Woodland
Freshwater Seep
Upland Tall-grass Prairie*
Eastern Sandstone Bluff and Cliff*

* Priority for conservation in this BUL
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[2] Known to occur in only one other BUL
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Saline Wetlands

Biologically Unique Landscape Description
This landscape includes the saline wetlands that occur in the floodplains of Salt Creek, Little Salt Creek and Rock Creek and surrounding uplands. The wetlands' salinity is derived from deeply buried salts brought to the soil surface through artesian groundwater flow. The marshes' vegetation is dominated by salt-tolerant species such as saltgrass, sea-blite, and saltwort. The majority of the uplands surrounding the marshes are in cropland, though there are a few tall-grass prairie remnants. Commercial and residential development is common in the landscape.

This landscape is significant in that it includes Nebraska's only saline wetland complex. Over 90 percent of the original saline wetlands within this landscape have been lost or highly degraded. The most viable remaining marshes occur in the two core areas in the upper reaches of the Little Salt Creek valley near Raymond and the Rock Creek valley near Ceresco. The Little Salt Creek wetlands contain the world's only known populations of the Salt Creek tiger beetle. This species is listed as state and federally endangered. The saline wetlands also contain the state's only known populations of the state-listed saltwort. Several protected areas occur within this landscape including Arbor Lake, Little Salt Creek, and Jack Sinn Wildlife Management Areas, the City of Lincoln's Shoemaker Marsh, Anderson Tract, and King Tract, the Lower Platte South NRD's Lincoln Saline Wetland Nature Center and Warner Wetland, and The Nature Conservancy's Little Salt Fork Marsh.

The Saline Wetlands Conservation Partnership has developed the *Implementation Plan for the Conservation of Nebraska's Eastern Wetlands*. The plan's goal is "no net loss of saline wetlands and their associated functions with a long-term gain in sustaining wetland functions through the restoration of hydrology, prescribed wetland management, and watershed protection." The plan has identified three categories of saline wetlands with Category 1 wetlands being of the highest quality.

Natural Legacy Demonstration Site

15. Saline Wetland Complex

The Saline Wetland Complex includes Jack Sinn WMA (NGPC), Arbor Lake (City of Lincoln), Whitehead Saline Wetlands (Lower Platte South NRD) and Frank Shoemaker Marsh (City of Lincoln). Eastern saline wetlands are considered critically imperiled. These locations have restored wetlands and habitat for listed species. Natural communities at this location include Eastern saline meadow and Eastern saline marsh. The Saline Wetland Conservation Partnership has been fundamental in facilitating collaboration between local entities to restore the few remaining saline wetlands.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Invasive plant species, including reed canary grass and narrow-leaf cattail, with some Eurasian phragmites and saltcedar
- Urban and residential development
- Light pollution which may adversely impact Salt Creek tiger beetles
- Down-cutting of streams leading to decline in groundwater levels, loss of salts from the wetlands, and general alteration of wetland hydrology
- Wetland drainage and sedimentation
- Conversion of saline wetlands to freshwater wetlands
- Poorly-sited utility-scale wind turbines

Conservation Strategies

- Protect high-quality wetlands through use of conservation easements or voluntary fee title acquisition. The wetlands in need of protection have been prioritized by the Saline Wetland Conservation Partnership, along with identifying strategies for their protection. Priority should be given to the saline wetland complexes in the upper reaches of Little Salt Creek near TNC's Little Salt Fork Marsh and those on Rock Creek near Jack Sinn WMA where stream down-cutting is still manageable.
- Protect uplands in the watersheds surrounding these wetlands from development through use of conservation easements or other protection measures
- Use in-channel structures and restore natural meanders, where feasible, to stop stream down-cutting and subsequent head-cutting into wetlands
- Channel storm-water away from saline wetlands in urban areas.
- Reduce and prevent the number of wells that lower hydrologic pressure or interrupt the hydrologic system needed for saline ecology
- Continue stream and wetland water-quality monitoring programs
- Develop and implement plans to control reed canary grass and narrow-leaf cattail in saline wetlands, especially on conservation lands
- Intensify management (e.g., prescribed fire and planned grazing) on conservation lands and private lands to improve the quality of saline wetlands
- Remap saline plant communities within the BUL and conduct studies to investigate saline soil properties

- Work with developers to increase use of cluster development in areas surrounding saline wetlands, protecting even very small saline habitats
- Develop and implement methods to restore the hydrology of saline wetlands
- Evaluate and possibly implement stream-bank pull-backs to improve Salt Creek tiger beetle habitat
- Work with the City of Lincoln and developers to reduce light pollution near saline wetlands (monitor and review city lighting ordinance)
- This landscape should be restricted from wind turbine development as it has been recognized as critical habitat to the federally endangered Salt Creek tiger beetle. The effects of development and run-off from site construction could be a threat to the beetle.

Tier I At-risk Species

Plants:
Saltwort[1]

Animals:
Bell's Vireo
Regal Fritillary
Salt Creek Tiger Beetle[1]
Plains Harvest Mouse
Pimpleback

Aquatic Communities:
Headwater, Warm Water Stream

Terrestrial Communities
Sandbar Willow Shrubland
Freshwater Seep
Eastern Saline Meadow*
Cattail Shallow Marsh
Eastern Saline Marsh*
Saline/Alkaline Aquatic Wetland*
Upland Tall-grass Prairie

* Priority for conservation in this BUL
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Sandstone Prairies

Biologically Unique Landscape Description
This landscape includes the bluffs and breaks along the Little Blue River and Rose Creek in Jefferson and Thayer counties. The soils in some parts of the area are shallow and derived from sandstone, with limited agricultural development in many areas. Large blocks of native tall-grass prairie still remain. These prairies are often interspersed with cropland. Many of the prairies have been disturbed from past grazing practices and invasive cool-season grasses. Eastern red-cedar and invasive deciduous trees are problematic in many areas. Bur oak woodlands occur in many of the drainage bottoms. Prairie fens occur occasionally in canyon bottoms and on side slopes.

The landscape contains some of the last remaining populations of the massasauga and timber rattlesnakes in the state. Even though many of the prairies are degraded, the large size of prairie remnants makes this area unique and provides an opportunity for landscape-scale tall-grass prairie conservation. The largest protected areas in the landscape include Rock Glen WMA, Rose Creek WMA, and Rock Creek Station State Historical Park.

Natural Legacy Demonstration Site

18. Rock Glen Wildlife Management Area and Rock Creek Station State Historical Park - Nebraska Game and Parks Commission
Rock Creek Station State Historical Park includes 350 acres with a high proportion of native vegetation. Uplands are covered with both oak woodland and tall-grass prairie. Riparian forest occurs along Rock Creek. The nearby Rock Glenn WMA includes 706 acres of rolling native upland and tree-lined drainages. Eastern red-cedar is a primary threat, so thinning in conjunction with burning and grazing are the primary conservation actions.

Stresses Affecting Species and Habitats
- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Conversion of native prairies to cropland and other uses
- Lack of fire has led to invasive tree encroachment in prairies and woodlands (e.g., honey locust, eastern red-cedar, osage orange)
- Exotic herbaceous plant invasion. In prairies, heavy grazing and annual mid-summer haying promotes exotic invasion.
- Housing development and fragmentation of habitat
- Agricultural run-off into streams
- Streambed degradation
- Clay mining for bricks in restricted areas.
- Poorly-sited utility-scale wind turbines

Conservation Strategies
- Implement invasive tree clearing programs on grasslands on conservation and private lands in conjunction with prescribed fire and planned grazing

- Conduct annual surveys for invasive plants in woodlands and prairies, especially on public lands
- Develop and implement control programs for garlic mustard, sericea lespedeza, and other invasive exotic species
- Protect priority streams from siltation and contaminants using methods such as stream buffers and grass waterways. Address water quality problems with watershed planning.
- Coordinate with landowners interested in using conservation easements or voluntary fee title acquisition to protect high-quality prairies
- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to native species. Wind farms should not be located within the recommended radius of prairie grouse leks and nesting grounds. Turbines can be halted temporarily during peak migration periods for bats and birds. Pre- and post-construction monitoring should be implemented. See Nebraska Game and Parks Commission guidelines for wind energy development.

Collaborative Conservation Opportunities across State Borders
Coordinate with Kansas organizations, particularly efforts to benefit like species of greatest conservation need on NE Sandstone Prairie/KS Eastern Tallgrass Prairie Conservation Region border (i.e., Republic and Washigton Counties in KS). Nebraska Tier I at-risk species identified also in the Kansas wildlife action plan include greater prairie-chicken, Henslow's sparrow, massasauga, timber rattlesnake, Arogos skipper, and Ottoe skipper. Species lists may be modified as new information becomes available. Innovative methods for sufficient information exchange could aid the collaborative process.

Coordinated wildlife management actions (e.g., invasive species management, wildlife surveys) should mirror strategies identified in Kansas' Comprehensive Wildlife Conservation Plan. Collaborative conservation efforts across state borders should include researchers, federal and non-profit environmental program coordinators, and landowners, particularly those with properties extending over state lines. It will be necessary to identify and develop staffing and funding sources for implementation of conservation actions beyond state boundaries.

Tier I At-risk Species

Plants:
None

Animals:
Greater Prairie-Chicken
Henslow's Sparrow
Loggerhead Shrike
Massasauga[3]
Timber Rattlesnake
Iowa Skipper
Ottoe Skipper

Regal Fritillary
Married Underwing
Whitney Underwing
Pimpleback
Plains Harvest Mouse

Aquatic Communities:
Headwater, Warm Water Stream
Mid-order, Warm Water River

Terrestrial Communities:
Cottonwood-Peachleaf Willow Riparian Woodland
Sandstone Upland Bur Oak Woodland*
Sandbar Willow Shrubland
Riparian Dogwood-False Indigobush Shrubland
Freshwater Seep*
Prairie Fen*
Eastern Cordgrass Wet Prairie
Eastern Sedge Wet Meadow
Eastern Bulrush Deep Marsh
Cattail Shallow Marsh
Upland Tall-grass Prairie*
Dakota Sandstone Tall-grass Prairie*
Lowland Tall-grass Prairie
Southern Sand/Gravel Prairie*
Perennial Sandbar
Sandbar/Mudflat
Eastern Sandstone Bluff and Cliff*

* Priority for conservation in this BUL
[1] This is the only BUL where the species is known to occur
[2] Known to occur in only one other BUL
[3] Known to occur in only two other BULs
[4] Known to occur in only three other BULs

Southeast Prairies

Biologically Unique Landscape Description
This landscape includes the rolling hills of western Richardson, Pawnee, southern Johnson, and southern Gage counties. The landcover is primarily cropland, but there are also many tall-grass prairie remnants dominated by big bluestem and Indian grass and reseeded native and exotic grasses. The native prairies are of two types: hay meadows and grazed pastures. The hay meadows are generally in better ecological condition. The Big Nemaha River drains the eastern portion of the region while the Big Blue River drains the western portion of the region. Eastern deciduous woodlands are found along the bluffs and floodplains of these

streams and their tributaries. The larger streams in the area have highly incised stream channels, though several smaller higher quality streams, including Wildcat, Turkey, Rock, and Yankee creeks, still remain.

The abundance of native and restored grasslands in the regions supports a stable population of greater prairie-chickens and other grassland birds. Burchard Lake WMA and Pawnee Prairie WMA areas are the largest protected areas in the landscape. These areas are strongholds for the largest remaining massasauga populations in Nebraska. The Barneston Bluff area in Gage County on the Big Blue River contains rocky woodlands, which support populations of timber rattlesnakes and copperheads.

Natural Legacy Demonstration Site

19. Burchard Lake Wildlife Management Area - Nebraska Game and Parks Commission

Burchard Lake WMA contains 560 acres, with a 150-acre reservoir, surrounded by native grasslands and hardwoods. The upland tall-grass prairie here is managed for a variety of species through prescribed fire and patch-burn grazing. There are greater prairie-chickens and two permanent blinds that are used to view the lek. Henslow's sparrows and massasauga benefit from land management practices.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Lack of fire has led to invasive tree encroachment, primarily Osage orange, honey locust, and eastern red-cedar in prairies and woodlands and exotic herbaceous plant invasion, primarily sericea lespedeza, crown vetch, old world bluestem, and smooth brome in prairies and garlic mustard in woodlands
- Invasion of Eurasian phragmites in riverine environments
- Conversion of native prairies to cropland
- Agricultural chemical and sediment run-off into streams
- Streambed degradation
- Mining of rare metals could become a threat in the near future
- Poorly-sited utility-scale wind turbines

Conservation Strategies

- Implement invasive tree clearing programs on conservation lands and private lands in conjunction with prescribed fire and planned grazing
- Conduct annual surveys and implement control programs for garlic mustard, sericea lespedeza and old world bluestem with a concerted effort on conservation lands
- Identify and protect priority streams from siltation and contaminants
- Coordinate with landowners interested in using conservation easements and voluntary fee title acquisition to protect high-quality prairies and establish riparian buffer strips
- Implement integrated public and private lands management. For example, work with private landowners with properties bordering WMAs to manage larger habitat blocks

- Work with mining and energy companies to choose development sites that avoid native plant communities and avoid impacts to important native wildlife habitat

Collaborative Conservation Opportunities across State Borders
Coordinate with Kansas organizations, particularly efforts to benefit like species of greatest conservation need on NE Southeast Prairie/KS Eastern Tallgrass Prairie Conservation Region border (i.e., Marshall, Nemaha, and Brown Counties in KS). Nebraska Tier I at-risk species identified also in the Kansas wildlife action plan include greater prairie-chicken, Henslow's sparrow, massasauga, timber rattlesnake, regal fritillary, pistolgrip, plain pocketbook, pondmussel, and threeridge. Species lists may be modified as new information becomes available. Methods for sufficient information exchange could aid the collaborative process.

Coordinated wildlife management actions (e.g., prairie restoration and rehabilitation) should mirror strategies identified in Kansas' Comprehensive Wildlife Conservation Plan. Collaborative conservation efforts across state borders should include researchers, federal and non-profit environmental program coordinators, and landowners, particularly those with properties extending over state lines. It will be necessary to identify and develop funding sources for implementation of conservation actions beyond state boundaries.

Tier I At-risk Species

Plants:
Missouri Sedge[1]

Animals:
Greater Prairie-Chicken
Henslow's Sparrow
Loggerhead Shrike
Wood Thrush
Massasauga[3]
Timber Rattlesnake
Iowa Skipper
Regal Fritillary
Married Underwing
Whitney Underwing
Pimpleback
Pistolgrip[2]
Plain Pocketbook[3]
Plains Harvest Mouse

Aquatic Communities:
Headwater, Warm Water Stream*
Mid-order, Warm Water Stream

Terrestrial Communities:
Eastern Riparian Forest
Cottonwood-Peachleaf Willow Riparian Woodland
Mesic Bur Oak Forest and Woodland*
Dry-Mesic Bur Oak Forest and Woodland*
Dry Upland Bur Oak Woodland*
Sandbar Willow Shrubland
Riparian Dogwood-False Indigobush Shrubland
Freshwater Seep
Eastern Cordgrass Wet Prairie*
Eastern Sedge Wet Meadow
Eastern Bulrush Deep Marsh
Cattail Shallow Marsh
Upland Tall-grass Prairie*
Lowland Tall-grass Prairie*
Perennial Sandbar
Sandbar/Mudflat

* Priority for conservation in this BUL
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[2] Known to occur in only one other BUL
[3] Known to occur in only two other BULs
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Thurston-Dakota Bluffs

Biologically Unique Landscape Description
This landscape includes the steep bluffs and floodplain of the Missouri River in Thurston and Burt counties in north-central Nebraska. The majority of the bluffs support eastern deciduous forest of bur oak, basswood and ironwood. The Missouri River floodplain contains some of the last remnants of cottonwood-dominated floodplain forest and wet meadows, though the meadows are somewhat degraded. The majority of the landscape lies within the Omaha and Winnebago Indian reservations. It is the largest intact deciduous forest in the state. There are primitive roads through the forest on the reservations and many scattered houses. Much of the forest on the reservations is divided into small ownership tracts with multiple owners making conservation delivery difficult.

Stresses Affecting Species and Habitats
- Invasion of garlic mustard, common buckthorn and other exotic plants in woodlands
- Woody encroachment in ridge prairies
- High-grade logging on private and reservation lands
- Housing development
- Excess deer browsing
- Poorly-sited utility-scale wind turbines

Conservation Strategies

- Conduct annual surveys for garlic mustard and other invasive plants in woodlands
- Develop and implement control programs for garlic mustard and other exotic woodland plants on conservation lands and reservations
- Coordinate with landowners interested in using conservation easements or voluntary fee title acquisition to protect important habitats from development and commercial logging of mature forests
- Develop and implement conservation planning in conjunction with tribes for reservation lands
- Offer financial incentives to private landowners to implement prescribed fire in the forests to control unwanted tree species and to promote native plants
- Offer educational programs to landowners and loggers about methods that improve habitat and allow for some tree removal
- Improved harvest of deer
- Communicate with energy companies and developers in an effort to minimize fragmentation and impacts to native wildlife

Tier I At-risk Species

Plants:
None

Animals:
Cerulean Warbler[4]
Wood Thrush
Regal Fritillary

Aquatic Communities:
Headwater, Warm Water Stream
Large, Warm Water River

Terrestrial Communities:
Red Oak-Basswood-Ironwood Forest*
Bur Oak-Basswood-Ironwood Forest*
Dry-Mesic Bur Oak Forest and Woodland*
Dry Upland Bur Oak Woodland*
Freshwater Seep

* Priority for conservation in this BUL
[1] This is the only BUL where the species is known to occur
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Willow Creek Prairies

Biologically Unique Landscape Description
This landscape includes the Willow Creek valley and surrounding uplands in Pierce County and small portions of neighboring Madison and Antelope counties. Willow Creek is a meandering prairie stream. Its floodplain contains many wet meadows dominated by big bluestem and prairie cordgrass. Cropland is also common in the valley. The majority of the meadows are hayed. These meadows are significant in that they contain one of the state's largest remaining populations of the federally and state threatened western prairie fringed orchid.

Sand dunes, supporting dry-mesic sand prairie, occupy much of the upland bordering the stream valley. Many of these prairies are hayed and in good condition, while some are grazed and more degraded. Cropland is also common on the dunes. There are currently no protected areas in this landscape.

Stresses Affecting Species and Habitats
- Conversion of native prairies to cropland
- Housing development
- Exotic plant invasion in native prairies, primarily leafy spurge, but also smooth brome, reed canary grass, timothy, and redtop
- Some livestock grazing practices that may reduce native plant diversity and promote uniform habitat structure
- Annual mid-summer haying of wet meadows, which impacts populations of the western prairie fringed orchid and native plant species diversity
- Center pivot development and wetland drainage, which could lower groundwater levels and degrade native prairies
- Poorly-sited utility-scale wind turbines

Conservation Strategies
- Support voluntary implementation of ecologically-sensitive grazing and haying strategies on private and public lands in combination with prescribed fire and rest
- Protect orchid meadows and other high-quality prairies through conservation easements or voluntary fee title acquisition
- Promote grassland conservation programs
- Develop and implement cooperative leafy spurge control methods, potentially using bio-control agents, in orchid meadows and other native grasslands. Work with county weed authority and use care to protect sensitive areas (e.g., small white lady's-slipper habitat)
- Restore ditched or otherwise degraded wetlands
- Implement research projects to determine best management practices for the western prairie fringed orchid

- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to native species. Avoid placing wind turbines in native prairies and woodlands and in close proximity to prairie grouse leks and nesting grounds. Turbines can be halted temporarily during peak migration periods for bats and birds. Pre- and post-construction monitoring should be implemented. See Nebraska Game and Parks Commission guidelines for wind energy development.

Tier I At-risk Species

Plants:
Western Prairie Fringed Orchid
Wolf Spikerush[4]

Animals:
Bell's Vireo
Burrowing Owl
Greater Prairie-Chicken
Regal Fritillary
Plains Topminnow
Plains Pocket Mouse[4]

Aquatic Communities:
Headwater Warm Water Stream

Terrestrial Communities:
Sandbar Willow Shrubland
Riparian Dogwood-False Indigobush Shrubland
Freshwater Seep
Eastern Cordgrass Wet Prairie*
Eastern Sedge Wet Meadow*
Eastern Bulrush Deep Marsh
Cattail Shallow Marsh
Reed Marsh
Lowland Tall-grass Prairie*
Eastern Sand Prairie*
Sandhills Dune Prairie
Perennial Sandbar
Sandbar/Mudflat

* Priority for conservation in this BUL
[1] This is the only BUL where the species is known to occur
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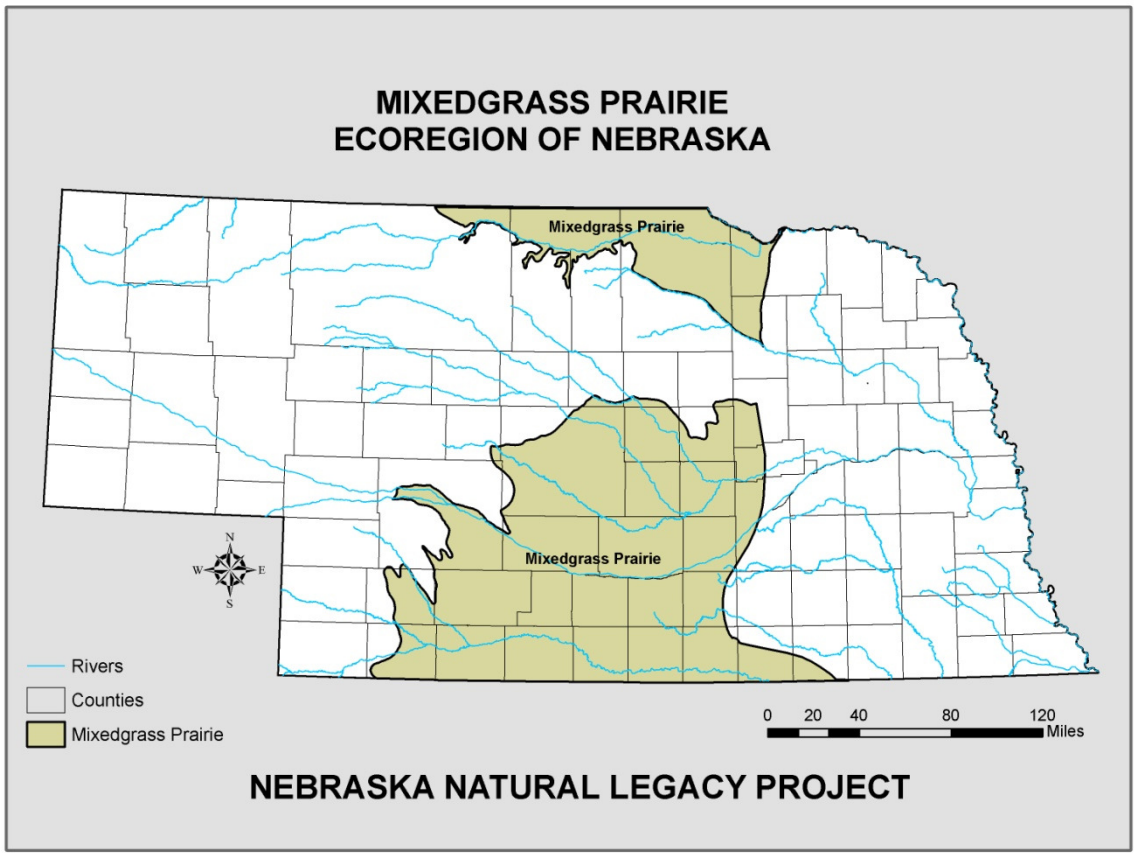
Chapter 6

Mixedgrass Prairie Ecoregion



Introduction

The Mixedgrass Prairie Ecoregion lies between the Tallgrass Prairie Ecoregion to the east and the Shortgrass Prairie Ecoregion to the west. As its name implies, the region is a transition zone where the tall-grass and short-grass prairie merge, taking on characteristics of both. Historically, the mixed-grass prairie expanded eastward into the tall-grass prairie region during prolonged drought and westward into the short-grass prairie region during wet periods. Plant composition varies considerably depending on soil type, topography, weather influences, and land use. Its highly diverse flora and fauna include a mix of species found also in the tall-grass and short-grass prairies.

Elevation increases gradually from east to west and ranges from 1,650 feet to 3,000 feet above sea level. Topography consists of nearly level broad plains in much of the Rainwater Basin region of south-central Nebraska and along river drainages, gently rolling hills in the north-central part of the region, and steep slopes with deeply incised drainages in the southwest. Most of the region is covered by loess, wind-blown silt. Perennial and intermittent streams transect most of the region and serve as tributaries to the Platte,

Republican, Loup, Niobrara and Blue Rivers. Stream and river valleys contain alluvial deposits of sand, silt, and/or loess. Bands of wind-deposited sand parallel parts of the Platte and Loup rivers, mimicking many of the characteristics of the larger Sandhills Ecoregion to the north.

The region's climate is semiarid with annual average precipitation ranging from 28 inches in the east to 20 inches in the west. Most precipitation occurs during the spring and early summer, often as the result of thunderstorms. The deep loess soils are fertile, but moderate precipitation and high evapo-transpiration rates limit vegetation growth. Temperatures average highs of approximately 87 degrees Fahrenheit in mid-summer and lows of approximately 13 degrees Fahrenheit in mid-winter. The frost-free period ranges from 150 to 190 days annually.

The Ogallala aquifer underlies a large portion of the ecoregion. Groundwater stored under the ecoregion ranges in depth and exceeds over 500 feet in places. Alluvial aquifers are present along rivers and streams and are recharged during high flows and contribute water to streams and rivers during lower hydroperiods. Artificial groundwater mounds have developed near the surface alongside irrigation delivery canals and downstream of irrigation reservoirs. The largest groundwater mound parallels the Tri-County Canal and is estimated to contain 6 to 8 million acre-feet of water.

The region contains hundreds of miles of rivers and streams which drain eastward into the Missouri River. The Platte River, originating in Colorado and Wyoming is the ecoregion's longest river. Spring snowmelt from mountain headwaters historically caused flood pulses that recharged alluvial aquifers, saturated floodplain wet-meadows, and scoured sandbars along the Platte. The Republican River begins in eastern Colorado and exits the state near Superior, NE. The South Loup, Middle Loup, and North Loup rivers derive their flow from groundwater discharge out of the southern Sandhills and provide a significant source of summer flow to the Platte River.

The Mixedgrass Prairie Ecoregion contains an abundance of wetlands, including playas, wet meadows, and floodplain and Sandhill wetlands. Playa wetlands are wind-formed, nearly circular depressions whose underlying clay pan holds water from rainfall and run-off. The Rainwater Basin playas in south-central Nebraska are of national importance for spring migrating waterfowl and once contained more than 4,000 major wetlands. Central Table Playa wetlands are found on the plains north of the Platte River, principally in Custer County. These basins are often perched on hilltops and resemble Rainwater Basin playas. The broad floodplain of the Platte and Loup rivers contain extensive sub-irrigated wet meadows. Former river channels, swales and sloughs are often found juxtaposed within wet meadows, providing for much plant and animal diversity. Riverine wetlands include oxbows and other semi-permanent wetlands that are found adjacent to rivers in the region. These floodplain wetlands provide important habitat for amphibians and reptiles and serve as spawning and nursery habitat for many types of fish. Sandhills wetlands are found in sandy areas in close proximity to the Platte and Loup rivers. These shallow wetlands formed where groundwater reaches the surface.

Vegetation
The Mixedgrass Prairie Ecoregion includes a variety of native plant communities. Tall-grass prairie species tend to dominate in the east and along river floodplains, and short-grass species dominate in the western part of the ecoregion. Most high quality grasslands contain a mix of tall-grass and short-grass prairie species. Prairie hilltops may be dominated by drought-resistant short-grass species such as blue grama and buffalo grass, side slopes by medium-statured grasses such as sideoats grama, little bluestem, western wheatgrass, and sand dropseed, and lower slopes and valleys by tall-grass prairie species such as big bluestem, Indian grass, switchgrass, and Canada wild-rye. Forbs may be common on high quality sites including prairie-clovers, alfalfa, deer vetch, leadplant, prairie-coneflower, stiff sunflower, and dotted gayfeather. Because of broadcast spraying for noxious weeds, invading cool-season grasses, and intensive grazing, plant diversity on most prairies is much lower today.

Historically, less than one percent of the ecoregion was covered with woodlands. Today most watercourses are lined with riparian forests. Taller trees include plains cottonwood, green ash, hackberry, and eastern red-cedar. Shrubs such as rough-leaf dogwood, false indigo-bush, and sandbar willow dominate the understory. Native stands of bur oak can still be found on some upland slopes, particularly in the eastern part of the ecoregion. Eastern red-cedar has become more prominent during the last few decades and it now dominates many prairies and woodlands in the ecoregion and some wet meadows along rivers. Planted woodlands and shelterbelts are common throughout the region, particularly in the more intensively farmed areas.

Wet meadows and wet prairies along river courses include a variety of plants such as woolly sedge, spike rush, and prairie cordgrass. The state listed white lady's-slipper orchid occurs in high quality meadows in the Loup River valleys. Playa wetlands found in the Rainwater Basin and the Central Tables area often contain dense stands of river bulrush, common cattail, or nodding smartweed on seasonally flooded sites and spikerush, flatsedge, and forbs such as plains coreopsis in more temporarily flooded wetlands. Deeper, more permanent wetlands in the Rainwater basins and in former river channels can also include submersed or floating plant communities consisting of bladderwort, pondweed, and duckweed. Riparian woodlands usually contain an understory of herbaceous plants such as switchgrass, scouring-rush, and bedstraw. Sandhill wetlands typically include cattail, bulrush, and smartweed.

Animals
More than 350 species of resident and migratory birds have been documented in the Mixedgrass Prairie Ecoregion. Common grassland birds include grasshopper sparrow, dickcissel, western meadowlark, bobolink, northern bobwhite, field sparrow, northern harrier, and greater prairie-chicken. The Platte River serves as an important stopover site for the endangered whooping crane and provides critical spring staging habitat to over 80% of the world's sandhill cranes. In total, over 300 bird species have been observed along the Platte River and 141 species are known to nest there. More than two-dozen species of waterfowl regularly use the Rainwater Basin wetlands during migration, including more than one-third of the continent's northern pintails, fifty percent of the continent's mallards, and over ninety percent of the mid-continent's greater white-fronted geese. Approximately

300,000 shorebirds comprising more than thirty species use the basins, including Baird's sandpiper, stilt sandpiper, lesser yellowlegs, and some of the largest concentrations of buff-breasted sandpipers observed anywhere. Thousands of Swainson's hawks migrate through the ecoregion each fall, and large bodies of water such as Harlan County and Sherman reservoirs provide rest areas for thousands of American white pelicans and Franklin's gulls.

The region is home to many species of mammals. Most occur widespread with no distinct affiliation to the mixed-grass prairie. Small mammals include the plains pocket gopher, prairie vole, North American least shrew, and eastern cottontail. Small populations of Ord's Kangaroo rat, white-tailed jackrabbit, eastern woodrat, and black-tailed prairie dog can be found in suitable habitat. Both white-tailed and mule deer are found in the ecoregion, with the latter mostly restricted to native grasslands in the western half. A small and growing elk herd is found in the loess canyons south of North Platte River. American beaver, river otter, muskrat, and American mink are associated with the region's watercourses. The most abundant large predator of the region is the coyote. Other common predators include American badger, bobcat, red fox, raccoon, long-tailed weasel, and striped skunk. The most frequently encountered bats are the eastern red bat, big brown bat, and silver-haired bat.

The region's streams and reservoirs are home to a diversity of fish species. River generalists that can tolerate wide environmental extremes are most common. Channel catfish, shortnose gar, flathead chub and river carpsucker are found in most of the larger rivers. Game fish including walleye, northern pike, largemouth bass, white bass, and bluegill, have been successfully introduced to reservoirs in the ecoregion. Most of the region's native fish species include the smaller minnows and chubs that are adapted to variable prairie stream environments. These include speckled chub, blacknose shiner, Topeka shiner, common shiner, pearl dace, finescale dace, plains topminnow, and brook stickleback.

Several reptile and amphibian species are found in the ecoregion. Aquatic environments host smooth and spiny softshell, northern painted, and common snapping turtles. Ornate box turtles can be found on native grasslands, and yellow mud turtles can be found in the Republican River valley. The northern water snake is the region's only aquatic snake and can be found near permanent bodies of water. The prairie rattlesnake is the only venomous snake found in the mixed-grass prairie and is most common on dry upland sites in the western part of the ecoregion. Bullsnakes, eastern yellow-bellied racers, and terrestrial and common garter snakes are all fairly common in the region in a variety of habitats. Western hognose snakes may be found in dry and sandy prairies. Smooth green snakes and redbelly snakes are two of the more rare snakes in the region; both may be found in open riparian areas and in wet meadows and prairies.

Four lizards are common in the ecoregion. The lesser earless lizard prefers open sandy soil with little or sparse vegetation; the six-lined racerunner can be found in a variety of habitats on both lowland and upland sites; the northern prairie lizard prefers sandy sites with weeds, brush, or mammal burrows; and the Great Plains skink prefers open habitat. The only common salamander in the region is the tiger salamander. The plains spadefoot toad is found in the dry grasslands, rarely using river bottoms or wetlands; while, Woodhouse's toad, Great Plains toad, Blanchard's cricket frog, boreal chorus frog, bullfrog, and plains leopard frog are common in wet areas.

Relatively little is known about the ecoregion's invertebrates. Perhaps the rarest insect is the Platte River caddisfly. To date, the only confirmed records of the Platte River caddisfly occur in a few channels of the Platte River near Grand Island. The regal fritillary butterfly, although rare over much of its range, appears to be relatively common throughout much of the ecoregion. The Mixedgrass Prairie Ecoregion hosts one of the largest known populations of the federally endangered American burying beetle. The white heelsplitter is one of the more common freshwater mussels and is found in many permanent bodies of water.

History and Dominant Land Use

One of the earliest sites with evidence of human presence in the Central Plains is La Sena Site, located on the edge of Medicine Creek Reservoir. It dates to about 16,440 B.C. Pawnee Indians made their first known settlements in the region in the late 13th and 14th centuries. They resided along the Platte, Loup, and Republican rivers where they raised corn, squash, beans, and sunflowers and gathered wild turnips, grapes, plums, and acorns. Most of their meat was derived from bison, elk, pronghorn, deer, rabbit, and waterfowl.

Although hundreds of thousands of immigrants traveled through the area on the Oregon and Mormon trails during the mid 1800's, European settlement was sparse until the transcontinental railroad was completed in the late 1860's. The region's population saw episodes of growth and decline that corresponded to periods of ample precipitation and drought. Land speculators bolstered by erroneous scientific claims promised that if more sod were broken then "rain would follow the plow." By 1900, there were many settlers in the ecoregion and corn, alfalfa and wheat were important crops. By the 1920's, most readily farmable land was in dry land farm production.

World War I brought increased demand for agricultural products and a rapid expansion of agriculture into the western part of the ecoregion. A nationwide depression in the early 1930's coupled with a devastating drought brought wide-scale hardship to the area. Since most farms were not irrigated, corn yields dropped from twenty-four bushels per acre to just two or three. The dry conditions resulted in an eruption of grasshoppers that further reduced rangeland forage. Frequent dust storms added to the misery of the region's settlers. The population in the region dropped by nearly twenty percent during the mid 1930's.

The severe drought of the 1930's lead to the construction of Kingsley Dam on the North Platte River. The reservoir was completed in 1943, and at the time was the second largest earthen dam in the world. It was designed to hold two million acre-feet of water and provide a source of irrigation for 200,000 acres of farmland in the ecoregion. The construction of other large reservoirs in the region followed, providing a source of irrigation, flood control, and recreation.

The 1940's and 1950's saw an increase in agricultural efficiency and an increase in population for the region. From 1940 - 1970, the amount of land under irrigation increased. The advent of commercially available fertilizers, more efficient farm machinery, and the use of herbicides and insecticides led to increases in corn production. During this time, government policies were put in place to subsidize and facilitate conversion of marginal land

such as playa wetlands to cropland. By the early 1970's, the population in the ecoregion rose but the number of individual farms dropped. The trend for fewer and larger farms continues today.

Center pivot irrigation began to be put into widespread use in the 1970's and facilitated cultivation of steeper slopes and lands isolated from surface irrigation sources. Currently about two-thirds of the land in the ecoregion is in cropland production, with most of the remaining lands in grasslands for livestock grazing. There has been a recent trend for the region's largest cities to gain population at the expense of smaller towns. The four largest cities - Grand Island, Kearney, Hastings, and North Platte - provide the majority of the total population. In addition to the principal crops of corn, soybeans and wheat — alfalfa and grain sorghum are important crops.

Nature-based Recreation

The Mixedgrass Prairie Ecoregion offers a plethora of outdoor and nature-oriented recreation. The area is recognized worldwide for premiere wildlife viewing spectacles. Each spring more than 500,000 sandhill cranes stage in south central Nebraska on their way to breeding grounds as far away as Siberia. An estimated 80,000 nature enthusiasts visit the area each spring to view cranes and waterfowl. National Audubon's Rowe Sanctuary and the Nebraska Nature and Visitor Center provide viewing-blind tours, visitor services, and educational programming to more than 25,000 visitors annually. Roadside viewing sites constructed by Central Platte Natural Resources District provide additional crane viewing sites.

Although less known, spring waterfowl viewing in the Rainwater Basin region is also top caliber. Approximately seven to nine million waterfowl and over three million geese stage here each spring. Concentrations of more than one million snow and Ross's geese congregate on larger basins. More than two-dozen species of waterfowl can be observed in the region. Many acres of public lands are available for viewing, although viewing infrastructure is limited to a few sites. A waterfowl observation tower at Massie Waterfowl Production Area near Clay Center and handicapped accessible blinds at Funk Waterfowl Production Area and Sacramento-Wilcox Wildlife Management Area are notable exceptions.

Bald eagle viewing is available at Central Nebraska Public Power and Irrigation District's J-2 power return near Lexington, at Harlan County Reservoir, Sherman Reservoir, and Rowe Sanctuary. More than 200 bald eagles have been observed at one time at Harlan County Reservoir. A large number of bald eagles winter in the ecoregion. Other unique opportunities include viewing of prairie-chickens, prairie dogs, piping plovers, least terns, and other shorebirds.

There is a strong tradition of hunting and fishing in the ecoregion. More than 100,000 Canada geese winter along stretches of the Platte River, making it one of the top goose hunting sites in the country. The Rainwater Basin wetlands provide quality waterfowl hunting with ample free public hunting sites. Large numbers of hunters come to the region in the late winter and early spring for the snow goose conservation hunt.

The ecoregion is known as a place where hunters can routinely harvest both white-tailed and mule deer. White-tailed deer numbers are high along riparian corridors such as the Platte, Republican, and Loup rivers. Mule deer are plentiful in the Loess Hills grasslands. The area offers opportunity for pheasant, quail, turkey, prairie-chicken, and rabbit hunting. The Republican River below Harlan County Dam, Cedar River, Platte River and other rivers are used by canoeists and kayakers. The major limitations for canoeists are a lack of outfitters, access sites, and seasonally unreliable water.

Anglers take to the region's reservoirs in search of walleye, largemouth bass, catfish, white bass, and bluegill. Harlan County, Sherman County, Johnson Lake, and Swanson Reservoirs are the most highly visited bodies of water. Harlan County Reservoir is known for its trophy-sized wipers and for ranking amongst the top providers of master angler awards each year in the state. Publicly owned sandpits in the region provide quality fishing from shore or boat. The region's rivers and streams provide opportunities for cat-fishing.

Nature-based trails in the ecoregion are limited, but there is potential for more development. The Nebraska Nature and Visitor Center offers an extensive interpretive trail system through a Platte River wet meadow. Rowe Sanctuary has miles of developed trails along the Platte River, and Harlan County Reservoir also has an extensive nature trail. There are walking trails at Funk, Harvard, and Massie Waterfowl Production Areas and the city-owned Lake Seldom near Holdrege in the Rainwater Basin. Hike-bike trails run through Ft. Kearny State Recreation Area and the city of Kearney. Most of the region's larger cities have trails associated with city parks that offer access to natural environments.

The principal challenge to expanding and conserving nature-based recreational resources in the ecoregion is involving a larger and more diverse cross-section of citizens in activities. Key individuals from the business, economic development, and agricultural sectors should be involved in planning, promotion, and development of nature and wildlife tourism. There is no centralized clearinghouse of wildlife-viewing information and a significant lack of wildlife-viewing infrastructure in the ecoregion. Although there are many quality opportunities for nature-based recreation, access points are limited or obscured, interpretive information is lacking, and promotion of viewing opportunities is limited. A greater number of individuals who are knowledgeable about wildlife viewing are needed to help inform community leaders and the public about the region's wildlife viewing potential.

Education

The current capacity for quality education in the ecoregion is limited and the lack of integration of biodiversity concepts into existing educational programs needs to be addressed. Major hurdles such as curriculum constraints in schools, a lack of ecologically-trained educators, and insufficient teaching resources need to be overcome. Landowners, conservation organizations, school boards, students and teachers are just some of the groups with opportunities for sharing information. There are many existing partners engaged in agriculture education including the Cooperative Extension, which reaches out to agricultural producers and post-secondary education administration to provide curriculum for new professionals on disturbance techniques compatible with agricultural operations. There are many groups working on invasive species, with potential for collaboration including the

Nebraska Invasive Species Project, housed at the University of Nebraska at Lincoln, Cooperative Extension, Weed Science Team at the University of Nebraska, Crop Watch publications, Crop Protection Clinics and Pesticide Applicator programs. Landowners are increasingly seeking alternative avenues to support their operations including eco-tourism, hunting, and fishing. There is additional potential to collaborate with partners such as the Nebraska Department of Economic Development to develop education programs.

There is a strong interest by conservation groups, agencies, schools, and others to better meet the large demand for biodiversity education in the ecoregion. There are many groups already invested in and contributing to conservation education in area. Prairie Plains Resource Institute developed the successful "Summer Orientation About Rivers" program to introduce students to the biodiversity of the Platte River. Rowe Sanctuary and the Nebraska Nature and Visitor Center engage thousands of children annually in activities designed to stimulate interest in and raise literacy about the natural environment. Imperial Middle School uses a local lake for inquiry-based science education. Most of the region's Natural Resource Districts sponsor environmental festivals like the Earth Jamboree organized by Little Blue Natural Resource District and the Eighth Grade Conservation Day held by Tri-Basin Natural Resource District each spring. The Children's Groundwater Festival held annually in Grand Island has educated thousands of children about the importance of conserving scarce water resources.

In addition to students, there is a need for increased education for the general adult population and professional conservation community. Educational needs include increased awareness and appreciation of the interconnections between native ecosystems and processes, water resources and agriculture, and the need for sustainable land use methods. Currently, a relatively small proportion of interested adults has access to or takes part in natural history education. The demand for educational resources is demonstrated by the large numbers of individuals who seek information about sandhill crane and waterfowl during the spring migration period.

The Rainwater Basin Joint Venture hosts an informational seminar each spring that provides natural resource professionals and landowners with opportunities to learn about wetlands. An elder hostel program sponsored by the University of Nebraska-Kearney has instructed hundreds of adults in natural history study.

Organizations and Partnerships

The Mixedgrass Prairie Ecoregion has partnerships, coalitions, and grassroot efforts formed to conserve the region's biodiversity values. Groups include, but are not limited to, the following:

The Rainwater Basin Joint Venture (RWBJV) is one of the longest standing and effective partnerships in the region and state. The RWBJV coordinates wetland restoration, research, and management activities in a 4,200 square mile region in south-central Nebraska. It was formed in 1991 to help meet the objectives of the North American Waterfowl Management Plan. The RWBJV aims "to restore and permanently protect 37,000 acres of high-quality wetlands and 25,000 acres of associated uplands with adequate water and distribution to meet

the habitat needs of waterfowl and other migratory birds." The activities undertaken by the RWBJV are directed by an implementation plan, best management practices handbook, water options handbook, and a research needs document. The partnership is using state-of-the-art geographical information system technologies to guide wetland conservation. Landowner support for wetland conservation in the region has risen substantially after outreach efforts and innovative undertakings, such as the annual informational seminar held each spring. Major partners include the US Fish and Wildlife Service, Natural Resources Conservation Service, Nebraska Game and Parks Commission, local Natural Resource Districts, Ducks Unlimited, The Nature Conservancy, Pheasants Forever, Nebraska Environmental Trust, and private landowners.
www.rwbjv.org

National Wild Turkey Federation (NWTF) was founded in 1973. They are a non-profit organization dedicated to upland bird habitat conservation and our hunting heritage. They contribute funds towards conservation, research, education, and other projects. The Nebraska State Chapter of NWTF has worked well with landowners, the Nebraska Game and Parks Commission, and other organizations to remove invasive plant species, restore riparian corridor, support prescribed burning, and implement many other projects for habitat conservation.
www.nwtf.org

* * *

There are a number of Central Platte River conservation initiatives that are related but unique. These initiatives and partnerships share a common vision of improving habitat for the region's unique fish and wildlife species. These include but are not limited to the following:

Crane Trust, Inc. (originally Platte River Whooping Crane Maintenance Trust) was formed in 1978 as part of a court-approved settlement over the Gray Rocks Dam on a tributary of the Platte River in Wyoming. The organization is directed by a board consisting of representatives from the National Wildlife Federation, Missouri Basin Power Project, and the state of Nebraska. A $7.5 million endowment provides funding to The Crane Trust to protect and manage habitat along the central Platte River. The non-profit organization has acquired over 10,000 acres of habitat to benefit whooping cranes and other wildlife. Each year, staff conducts maintenance activities (e.g., disking, tree clearing) on numerous acres of sandbars and accretion lands on Trust properties and adjacent private lands. The organization also serves as a research center for biologists conducting research and monitoring on cranes, grassland birds, and other wildlife. Partners include the US Fish and Wildlife Service, US Geological Service, Nebraska Game and Parks Commission, Prairie Plains Resource Institute, The Nature Conservancy, Nebraska Wildlife Federation, and Audubon Nebraska.
www.cranetrust.org

Nebraska Nature and Visitors Center is a convenient place to visit with easy access from the interstate at the Alda I-80 exit. The nature center's education room was developed around information about the Nebraska Natural Legacy Project and discusses the state's different ecoregions. The nature center also showcases habitat along the Platte River, over 200 acres of prairie and an elevated observation tower with the opportunity for a perspective of habitat management.
nebraskanature.org

Platte Habitat Partnership (PHP) was formed in 2001 by the Nebraska Game and Parks Commission and The Nature Conservancy with funding support from the US Fish and Wildlife Service. The purpose of the partnership is to restore native grasslands and wet meadows along the central Platte River to benefit wildlife and producers. The partnership covers a broad area bounded by Gothenburg on the west and Columbus on the east. To date, more than 200 landowners have been contacted and a large number of projects completed with benefits to wildlife. The partnership is helping to identify and overcome barriers to prescribed burning in the region. Additional partners include the Natural Resources Conservation Service, Central Platte Natural Resources District, Audubon Nebraska, and The Crane Trust.
www.plattehabitat.org

The Prairie Plains Resource Institute located in Aurora, is a non-profit organization with an emphasis on promoting the sustainable balance of social, economic and environmental concerns in the Platte River valley and elsewhere. Prairie Plains focuses on people and the processes by which they learn, prioritize, and act on conservation programs/practices based on their definitions and desires. Participants define their own geographic scope, issues, and interest and participation level. Prairie Plains places priority on process over content with the following foci: 1) How do participants construct and prioritize the conservation issues before them? and 2) How does one develop networks of people with similar interests and objectives and enable them to make content-based decisions about conservation and natural resource management based on mutual interests?
www.prairieplains.org

Platte River Recovery Implementation Program (PRRIP) is a partnership between the states of Nebraska, Wyoming, Colorado, and the US Fish and Wildlife Service and seeks a basin-wide approach to management of water resources and four listed species, the least tern, piping plover, whooping crane, and pallid sturgeon. The goals of the cooperative initiative are to implement a program that will 1) secure improvements to Platte River habitat for the target species so current and future water use in the Platte will not likely jeopardize the species, 2) provide compliance with Endangered Species Act for existing and new water uses, 3) help prevent additional species in the Platte River from becoming threatened or endangered, and 4) ensure that any impacts on the central Platte River habitat from future water development in each state are prevented or offset within that state.
www.platteriverprogram.org

Ecoregion-specific Stresses

Key Stresses

In addition to the stresses and conservation actions identified in this chapter for the Mixedgrass Prairie Ecoregion, statewide concerns are identified also in chapter four. Conservation practitioners identified the following stresses as the top threats in the ecoregion.

Altered hydrology and channel degradation of rivers and streams: Historically, the Platte and Republican rivers experienced spikes in flows during the spring and early summer. These spikes caused large-scale sediment movement and prevented the establishment of perennial vegetation on sandbars, islands, and accretion ground. Groundwater and surface water withdrawals and storage in upstream reservoirs have significantly reduced flow peaks and caused water tables adjacent to rivers to decline, affecting animal and plant diversity and abundance. Many of the region's streams now go dry; reduced inflows, stream channelization, and bank stabilization projects have altered natural geomorphic and hydrologic processes.

Spread of invasive species: Over 100 non-native plant and animal species are known to occur in the ecoregion. Some species such as smooth brome, Kentucky bluegrass, leafy spurge, and musk thistle have caused significant declines in plant diversity in native prairies. Many of the region's playa wetlands, wet meadows, and riparian habitats have become dominated by exotic plants such as reed canary grass, hybrid cattail, Russian-olive, purple loosestrife, tall wheatgrass, phragmites, etc. The introduction of carp, mosquitofish, European starlings, and other invasives has impacted the region's biological diversity directly through competition and indirectly through habitat alterations.

Conversion and fragmentation of natural habitats: Most of the ecoregion's level, productive soils have already been converted from prairie to cropfields. However, center pivots have made conversion of steeper prairie sites more feasible, resulting in the conversion of thousands of additional acres of native prairie during the last several decades. The expansion of urban areas into surrounding rural communities and second home development are accelerating conversion of prairies and fragmenting riverine habitats in many parts of the ecoregion.

Altered natural frequency of burning and grazing: Most of the mixed-grass prairie that remains in the ecoregion has reduced floral and faunal diversity. Season-long intensive grazing has reduced or eliminated many sensitive species that are intolerant of prolonged grazing and has favored the spread of disturbance-tolerant species. Fire occurs much less frequently today than it did historically. This has led to a decrease in grassland vigor and the invasion of fire-intolerant species such as eastern red-cedar. Historically, grazing patterns likely were driven in part by fire occurrences (ungulates likely grazed on recently burned patches). Today, the opportunity for fire and ecologically-sensitive grazing is seldom realized.

Lack of awareness and knowledge about the region's biological diversity and ecological processes: Although the region's native grasslands, rivers, and wetlands are unique and of high value, most of the ecoregion's residents lack an awareness of the importance of these habitats to biological diversity. Citizens have limited knowledge and opportunities to learn about the ecoregion's biological diversity. Many private landowners have a desire to increase their knowledge and understanding of ecological processes and management that can help maintain biological diversity, but educational resources are often not available.

Loss of lands enrolled in conservation programs: Lands enrolled in programs such as the Conservation Reserve Program provide significant benefits to some species. Changing economic conditions and reduced support for these programs may result in large tracts of conservation lands being converted to agricultural cropland in the coming years. The loss of even a modest percentage of these lands will result in impacts to aquatic and terrestrial species.

Wetland drainage: Past drainage of many of the ecoregion's playa wetlands, wet meadows, and riverine wetlands continues to impact wetland-dependent species. Temporary and seasonal wetlands were perhaps the most common wetland types historically but proportionally few have been restored.

Lack of trust and collaboration between the agricultural and conservation communities: Past conflicts between the agriculture and conservation communities on issues related to water and threatened and endangered species have sometimes left deep divisions. Although there is often common ground on many issues related to conserving biological diversity, there may be a lack of trust and resolve to collaborate on issues important to all stakeholders.

Sedimentation of rivers, streams, and wetlands: The close proximity of agricultural fields to rivers, streams, and wetlands has resulted in large volumes of sediment entering the ecoregion's waters. Sedimentation increases stream turbidity and changes bottom substrates degrading habitat for fish and other aquatic species. Sedimentation of wetlands alters storage capacity and changes plant composition, reducing habitat available to waterfowl and other species.

Poorly-sited utility-scale wind turbines: Wind energy development is a growing industry in the Great Plains. There are many benefits to cleaner and renewable energy sources; nevertheless, in order to conserve biodiversity in the ecoregion, it is important to carefully consider the placement of wind turbines and transmission lines in order to minimize wildlife habitat fragmentation. Areas to avoid include native prairies and woodlands, and wetlands and riverine habitat that are used by millions of birds during their migration through the Central Flyway in Nebraska. The federally endangered whooping crane migrates through central mixed-grass prairie and may be particularly vulnerable to wind farms. Focus on siting turbines in already disturbed areas (e.g., cultivated lands, old railway/road corridors).

Biologically Unique Landscapes of the Mixedgrass Prairie Ecoregion

A goal of the Nebraska Natural Legacy Project is to identify priority landscapes that, if properly managed, would conserve the majority of the state's biological diversity. These landscapes, referred to as Biologically Unique Landscapes (BULs), were selected based on the occurrences of at-risk species and natural communities. See Chapter 3 for a description of the methods used to select the landscapes.

The map on following page shows the BULs for the Mixedgrass Prairie Ecoregion. Following the map are brief descriptions of each BUL including stresses affecting species and habitats, proposed conservation actions, and lists of the Tier I at-risk species and natural communities found in the landscape. In order to help prioritize conservation in each BUL, we denoted species that occur in only one or a few BULs with superscripts.

In the Mixedgrass Prairie Ecoregion, some BULs are truncated by the Nebraska state boundary. We suggest opportunities for wildlife conservation in these areas based on review of corresponding adjacent state wildlife action plans.

Mixedgrass Biologically Unique Landscapes

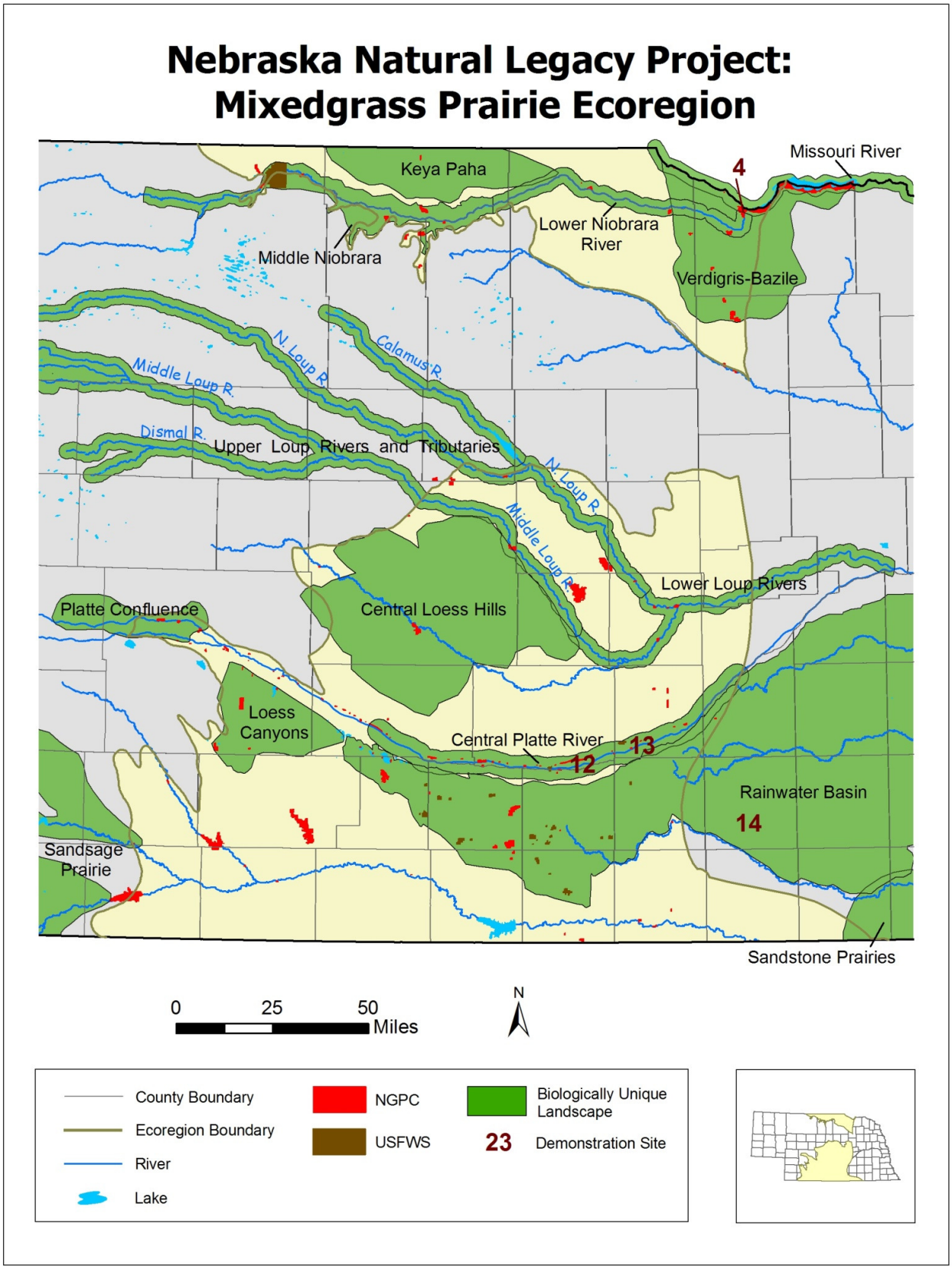
Central Loess Hills
Central Platte River
Keya Paha
Loess Canyons
Lower Loup River
Lower Niobrara River
Middle Niobrara (see Sandhills Ecoregion for description)
Platte Confluence
Rainwater Basin
Verdigris-Bazile

Demonstration Sites of the Mixedgrass Prairie Ecoregion

Demonstration sites are locations across the state with potential for showcasing conservation projects and the results of sustainable management to the public. They provide opportunities for learning about the site's unique qualities and importance to at-risk species. See Chapter 4 for information on selecting demonstration sites. The Mixedgrass Prairie Ecoregion map shows the location of demonstration sites in the area.

Site name	# on map	BUL
Kissinger Basin WMA	14	Rainwater Basin
Lillian Annette Rowe Bird Sanctuary	12	Central Platte River
Niobrara River State Park	4	Verdigris – Bazile
Platte River Prairies	13	Central Platte River

Descriptions of each site are found in the write-up for the BUL in which the site is found. The write-up for Kissinger Basin WMA can be found in this chapter along with the Rainwater Basin BUL description, although the site is actually located in the Tallgrass Prairie Ecoregion.


Nebraska Natural Legacy Project:
Mixedgrass Prairie Ecoregion
Keya Paha
Missouri River
4
Lower Niobrara River
Middle Niobrara
Verdigris-Bazile
N. Loup R.
Calamus R.
Middle Loup R.
Dismal R.
Upper Loup Rivers and Tributaries
N. Loup R.
Middle Loup R.
Lower Loup Rivers
Platte Confluence
Central Loess Hills
Loess Canyons
Central Platte River
13
12
Rainwater Basin
14
Sandsage Prairie
Sandstone Prairies
0
25
50
Miles
N
County Boundary
Ecoregion Boundary
River
Lake
NGPC
USFWS
Biologically Unique Landscape
23
Demonstration Site

Central Loess Hills

Biologically Unique Landscape Description

This landscape occupies the loess hills region of central Nebraska. The landscape consists of rolling to steep loess hills, dissected by the valleys of the Loup rivers. The hills are now a mosaic of mixed-grass prairie and cropland. Lack of grazing managed for biological diversity values, exotic plant invasion, and herbicide spraying have degraded the majority of prairies. The flatter tablelands of this landscape contain playa wetlands that are used by whooping cranes and numerous other waterbirds during migration. The largest protected areas in the landscape are Sherman Reservoir WMA and Davis Creek WMA.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Invasive plants species in upland prairies, meadows, and woodlands including eastern red-cedar, smooth brome, cheatgrass, Kentucky bluegrass, leafy spurge, phragmites, Russian-olive, and musk thistle
- Broadcast herbicide application to prairies
- Sedimentation and drainage of the playa wetlands
- Reduced stream flows
- Increased sedimentation and nutrients in streams
- Conversion of grasslands to cropland
- Housing and cabin development
- Poorly-sited utility-scale wind turbines

Conservation Strategies

- Implement planned grazing strategies on private lands to reduce exotic cool-season grasses and improve native plant diversity and vigor. Spring burning and spring grazing, sometimes used in combination, can be implemented as initial management practices to reduce exotic grass dominance. When exotics are under control, other grazing systems can be implemented.
- Seek and implement methods of musk thistle control that do not require broadcast spraying of pastures.
- Restore the hydrology of playa wetlands
- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to native species. Avoid placing wind turbines in native prairies and woodlands, and on bluff tops where they cause higher bird and bat mortality than on open, flat ground. Wind farms should not be located within the recommended radius of prairie grouse leks and nesting grounds. Turbines can be halted temporarily during peak migration periods for bats and birds. Pre- and post-construction monitoring should be implemented. See Nebraska Game and Parks Commission guidelines for wind energy development.

Tier I At-risk Species

Plants:
None

Animals:
Northern River Otter
Bell's Vireo
Burrowing Owl
Greater Prairie-Chicken
Loggerhead Shrike
Trumpeter Swan
Whooping Crane
Regal Fritillary
Married Underwing
Whitney Underwing

Aquatic Communities:
Headwater, Warm Water Stream
Mid-order, Warm Water River

Terrestrial Communities:
Cottonwood-Peachleaf Willow Riparian Woodland
Dry Upland Bur Oak Woodland
Sandbar Willow Shrubland
Riparian Dogwood-False Indigobush Shrubland
Buckbrush Shrubland
Freshwater Seep
Playa Wetland*
Cattail Shallow Marsh
Reed Marsh
Loess Mixed-grass Prairie*
Perennial Sandbar
Sandbar/Mudflat

* Priority for conservation in this BUL

Central Platte River

Biologically Unique Landscape Description
This landscape includes the Platte River channel and the floodplain from central Dawson County eastward to central Hamilton County. The central Platte River is a large, shallow, braided stream. Sandbars and wooded islands are common within the channel. Much of the stream-bank is also wooded, with cottonwood and eastern red-cedar as dominants. Sand pits are common along the river, many with housing developments. Most of the river floodplain is in cropland, though there are scattered wet meadows in areas. Sand dune grasslands occur on the south side of the river in areas.

The spring staging of sandhill cranes on the Platte River is a world-renowned phenomenon. Each spring more than 500,000 cranes concentrate on the central Platte, roosting in the tens of thousands at scattered sites and foraging in adjacent cornfields and meadows. The loss of Platte River staging habitat is the most significant threat to the mid-continental crane population. The central Platte River is also an important spring waterfowl and shorebird migration stopover point in the central flyway. Five federal and/or state listed species occur along the Central Platte, including the whooping crane, interior least tern, piping plover, bald eagle, and river otter. This reach of the Platte is designated as critical habitat for whooping cranes. The Platte River Whooping Crane Maintenance Trust, the Audubon Society, The Nature Conservancy, and the Nebraska Game and Parks Commission own and manage a number of protected areas within this BUL.

Natural Legacy Demonstration Sites

12. Lillian Annette Rowe Bird Sanctuary - National Audubon Society
Rowe Sanctuary is approximately 1900 acres in size and is located on the Platte River. It is dedicated to the conservation of sandhill cranes, whooping cranes and other migratory birds and their habitat along the Platte River in south central Nebraska. Nature-based education is a major focus at the Iain Nicolson Audubon Center. Recent channel restoration has resulted in nesting of several at-risk bird species. Rowe Sanctuary has two tracts of native prairie and two areas that have been restored using haying, grazing, and prescribed burns.

13. Platte River Prairies - The Nature Conservancy
The Platte River Prairies include approximately 2400 acres along a 10 mile stretch of river with public access and trails on a 1,200 acres prairie tract. The Platte River Prairies encompass a wide range of habitat types including riparian, aquatic and wetland, wet meadow, grassland and woodland. Most of the site is restored prairie which has lowland tall-grass prairie and other cordgrass wet prairie. Grassland diversity is enhanced using prescribed fire, grazing, and seeding. In addition to habitat management, this location has research plots which function as a laboratory for professors and students to examine the role that plant diversity plays in maintaining ecological resilience and ecological processes.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure (e.g., season-long grazing, annual mid-summer haying)
- Invasive plant species in sandbars, meadows and woodlands, including reed canary grass, saltcedar, Eurasian phragmites, purple loosestrife, tall wheatgrass, smooth brome, and garlic mustard
- Eastern red-cedar, and other invasive shrub and tree encroachment of river sandbars, woodlands and meadows
- Altered natural hydrology, particularly lack of high spring flows, low summer flows, and reduced sediment transport to maintain sandbars and fish habitat and to prevent channel degradation

- Sedimentation and drainage of backwater sloughs
- Continued cabin and home development on the Platte River banks
- Sandpit development, which eliminates native meadows, woodlands, and river channel
- Excessive recreational use of river (e.g., air boats, ATVs), which disturbs tern and plover nesting and other wildlife
- Conversion of wet meadows to cropland

Conservation Strategies

- Implement planned grazing strategies on private and public lands to reduce exotic cool-season grasses and improve native plant diversity and vigor. Spring burning and spring grazing, sometimes used in combination, should be implemented as initial management practices to reduce exotic grass dominance. When exotics are under control, other grazing systems can be implemented.
- Restore additional grassland habitat in the valley on private and public lands through high-diversity, local ecotype restorations
- Undertake eastern red-cedar and other tree clearing to maintain open meadow habitat for sandhill cranes, whooping cranes, and grassland birds. Initiate programs to control other invasive species.
- Restore and/or maintain Platte River hydrology necessary to sustain biological diversity and ecosystem function
- Facilitate sediment augmentation to restore the river channel
- Acquire through voluntary fee title acquisition or place conservation easements on undeveloped reaches of the river, wet meadows, and woodlands to protect them from development
- Work with sand and gravel companies to site gravel pits away from ecologically-sensitive areas of the floodplain and to restore sandpits to wetland communities once mining is completed
- Expand shrub and herbaceous vegetation clearing on the river sandbars for water bird roosting and loafing habitat
- Develop and implement best management practices to control and manage invasive plant species.
- Restore wetland hydrology and connect backwater habitats to the river
- Conduct wildlife and plant surveys to track status and trends of Platte River caddisfly and other at-risk species

Tier I At-risk Species

Plants:
Western Prairie Fringed Orchid

Animals:
Northern River Otter
Henslow's Sparrow
Interior Least Tern
Piping Plover
Whooping Crane

Platte River Caddisfly[2]
Regal Fritillary
Married Underwing
Whitney Underwing
Plains Topminnow

Aquatic Communities:
Mid-order, Warm Water River

Terrestrial Communities:
Cottonwood-Peachleaf Willow Riparian Woodland
Cottonwood Riparian Woodland
Sandbar Willow Shrubland
Riparian Dogwood-False Indigobush Shrubland
Buckbrush Shrubland
Freshwater Seep
Northern Cordgrass Wet Prairie*
Cattail Shallow Marsh
Reed Marsh
Eastern Pondweed Aquatic Wetland
Loess Mixed-grass Prairie
Eastern Sand Prairie*
Sandhills Mesic Tall-grass Prairie*
Sandhills Dune Prairie*
Perennial Sandbar
Sandbar/Mudflat*

* Priority for conservation in this BUL
[1] This is the only BUL where the species is known to occur
[2] Known to occur in only one other BUL
[3] Known to occur in only two other BULs
[4] Known to occur in only three other BULs

Keya Paha

Biologically Unique Landscape Description
This landscape occupies the watershed of the Keya Paha River in Keya Paha and Boyd counties. The watershed is a mosaic of cropland and mixed-grass prairie. The Keya Paha River is a rather narrow river whose flows are unmodified. Meadows, woodlands and cropland occupy its floodplain. Numerous small streams are tributaries to the Keya Paha and their floodplains support large expanses of wet meadows. These streams have significant assemblages of rare fish species including the pearl dace, finescale dace, northern redbelly dace, and the state-listed blacknose shiner. A population of the federally and state endangered American burying beetle occurs in the landscape. The prairies and meadows support a diversity of butterflies. Currently, there are no protected areas within this landscape.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Invasive plants species in meadows, upland prairies and woodlands including eastern red-cedar, smooth brome, cheatgrass, Kentucky bluegrass, leafy spurge, Russian-olive, and sweet-clovers
- Modification of headwater streams in wet meadows through ditching or channelization
- Excessive recreational use of river bed (e.g., ATVs)

Conservation Strategies

- Implement ecologically-sensitive grazing and haying strategies on wet meadows and upland prairies on both private and public lands, in combination with prescribed fire and rest
- Work with interested landowners to place conservation easements on critical reaches of streams
- Restore specific areas of cropland to grassland.
- Restore the natural hydrology to important wet meadows
- Install fences to discourage ATV access, install signage with information about the local landscape impacts associated with ATV use, and inform law enforcement of problematic areas
- For high-quality streams with rare fish populations, replace culverts with bridges
- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to native species. Avoid placing wind turbines in native prairies and woodlands and in close proximity to prairie grouse leks and nesting grounds. Turbines can be halted temporarily during peak migration periods for bats and birds. Pre- and post-construction monitoring should be implemented. See Nebraska Game and Parks Commission guidelines for wind energy development.

Collaborative Conservation Opportunities across State Borders

Coordinate with South Dakota conservation organizations to implement projects to improve habitat for at-risk species shared by both states including the burrowing owl, greater prairie-chicken, American burying beetle, Iowa skipper, regal fritillary, and blacknose shiner within the NE Keya Paha Watershed BUL and SD Great Plains Steppe Ecoregion (i.e., Tripp and Gregory counties in SD). South Dakota Game, Fish and Parks sponsored a research project through South Dakota State University to examine glacial relict fishes in the spring-fed headwater streams of South Dakota's Sandhills region. Their findings may help in identifying conservation needs. Species lists may be modified as new information becomes available.

Coordinated habitat management actions (e.g., grazing strategies) should mirror medium to high priority conservation goals identified in the South Dakota Comprehensive Wildlife Conservation Plan. Collaborative conservation efforts across state borders should include researchers, federal and non-profit environmental program coordinators, and landowners, particularly those with properties extending over state lines. For example, the Nebraska Grazing Lands Coalition works across borders. Additionally, USDA programs may have

goals in common with Natural Legacy. In order to implement Natural Legacy conservation actions beyond state boundaries, it will be necessary to identify and develop staffing and funding sources. Funding that is not specific to any one state will provide more flexibility in project scope.

Tier I At-risk Species

Plants:
Prairie Moonwort[4]

Animals:
Bell's Vireo
Burrowing Owl
Greater Prairie-Chicken
Loggerhead Shrike
Bailey's Eastern Woodrat[3]
American Burying Beetle
Iowa Skipper
Regal Fritillary
Blacknose Shiner[4]
Finescale Dace
Plains Topminnow
Northern Redbelly Dace

Aquatic Communities:
Headwater, Cold Water Stream*
Headwater, Warm Water Stream*
Mid-order, Warm Water River*

Terrestrial Communities:
Cottonwood-Peachleaf Willow Riparian Woodland
Dry Upland Bur Oak Woodland*
Green Ash-Eastern Red-cedar Scarp Woodland
Sandbar Willow Shrubland
Buckbrush Shrubland
Buffaloberry Shrubland
Chokecherry-Plum Shrub Thicket
Freshwater Seep
Northern Cordgrass Wet Prairie*
Cattail Shallow Marsh
Reed Marsh
Eastern Sand Prairie*
Sandhills Dune Prairie
Great Plains Gravel-Cobble Prairie*
Perennial Sandbar
Sandbar/Mudflat

* Priority for conservation in this BUL
[1] This is the only BUL where the species is known to occur
[2] Known to occur in only one other BUL
[3] Known to occur in only two other BULs
[4] Known to occur in only three other BULs

Loess Canyons

Biologically Unique Landscape Description
This landscape consists of steep loess hills and canyons south of the Platte River in Lincoln, Dawson, and northern Frontier counties. These hills support mixed-grass prairie and scattered cropland. The mixed-grass prairies have been highly invaded by eastern red-cedars in recent decades. Most have also been heavily grazed in the past and are infested with cheatgrass and Japanese brome. This BUL is significant because it contains one of the largest known populations of the federally and state endangered American burying beetle. This landscape contains few protected areas, the largest being the Wapiti WMA.

Stresses Affecting Species and Habitats
- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Invasive plants species in upland prairies, primarily eastern red-cedar, smooth brome, cheatgrass, Kentucky bluegrass
- Broadcast herbicide application to prairies
- Light pollution from acreage developments which impacts the American burying beetle
- Poorly-sited utility-scale wind turbines

Conservation Strategies
- Implement planned grazing strategies on private lands to reduce exotic cool-season grasses and improve native plant diversity and vigor
- Increase the use of prescribed fire and invasive tree cutting on private lands to reduce cedars, improve native plant diversity, and improve grassland wildlife habitat
- Promote use of outdoor lighting that will not interfere with American burying beetle habits
- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to native species. Avoid placing wind turbines in native prairies and woodlands, and on bluff tops where they cause higher bird and bat mortality than on open, flat ground. Wind farms should not be located within the recommended radius of prairie grouse leks and nesting grounds. Turbines can be halted temporarily during peak migration periods for bats and birds. Pre- and post-construction monitoring should be implemented. See Nebraska Game and Parks Commission guidelines for wind energy development.

Tier I At -risk Species

Plants:
None

Animals:
Northern River Otter
Bell's Vireo
Burrowing Owl
Greater Prairie-Chicken
Loggerhead Shrike
American Burying Beetle
Regal Fritillary
Married Underwing
Whitney Underwing

Aquatic Communities:
Headwater, Warm Water Stream

Terrestrial Communities:
Buckbrush Shrubland
Freshwater Seep
Loess Mixed-grass Prairie*

* Priority for conservation in this BUL

Lower Loup Rivers

Biologically Unique Landscape Description
This BUL includes the lower reaches of the Middle Loup River (north-central Custer County southeastward), North Loup River (southwest Garfield County southeastward), and the Loup River from its origin to the Nance/Platte county line. The landscape includes the rivers' channels and a two-mile buffer on each side of the rivers. The Loup rivers in these reaches are medium-sized with broad, braided, and somewhat shallow channels. The channels often have open sandbars and wooded islands. The flows on the North Loup River have been modified by the upstream Taylor Dam and irrigation diversions. The flows on the Middle Loup and Loup rivers have been modified by several diversions. Though somewhat modified, the Loup rivers maintain a fairly constant year-round flow of water because they receive the majority of their inputs from groundwater and little from run-off in their upper reaches.

The valley bottoms are mainly cropland, though some areas support cottonwood woodlands, wet meadows and marshes. The valley bluffs are for the most part shallow-sloped and covered by mixed-grass prairie with oak woodlands in areas.

Sandbars on the lower reaches of the Loup River support nesting colonies of the federally and state listed interior least tern and piping plover. The federally and state endangered whooping crane uses sandbars and wet meadows in the Loup floodplains as migratory stopover habitat. Bald eagles are also known to nest along the Loups. Nebraska's most extensive populations of the state threatened small white lady's-slipper occur in wet meadows in the Middle Loup River floodplain. Protected areas in this BUL include the Don Dworak, George Syas, and Leonard Koziol Wildlife Management Areas.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Invasive herbaceous plant species in sandbars, meadows and woodlands, primarily reed canary grass, Eurasian phragmites, purple loosestrife, smooth brome, and potentially garlic mustard
- Eastern red-cedar and Russian-olive encroachment of river sandbars, woodlands and meadows
- Additional water diversions
- Point and non-point source pollution
- Shoreline stabilization
- Drainage and sedimentation of wetlands
- Wet meadow and sand prairie conversion to cropland
- Continued cabin and home development on river banks
- Dairy and hog-confinement development

Conservation Strategies

- Implement ecologically-sensitive grazing strategies on wet meadows on both private and public lands, in combination with prescribed fire and rest
- Develop and implement best management practices to control and manage invasive plant communities
- Implement invasive tree clearing projects on privately owned meadows, prairies and woodlands
- Implement measures to site dairy and hog confinements away from sensitive habitats and watersheds
- Coordinate with landowners interested in using conservation easements and voluntary acquisitions to protect undeveloped reaches of the river, wet meadows, and woodlands from development
- Restore and/or maintain river hydrology necessary to sustain biological diversity and ecosystem function
- Restore wetland hydrology and connect backwater habitats to the river
- Maintain stream flows and hydrology needed to meet biological and ecological conservation goals
- Interact with urban planning and zoning commissions to address development concerns

Tier I At-risk Species

Plants:
Small White Lady's-slipper[3]

Animals:
Northern River Otter
Plains Pocket Mouse[4]
Bell's Vireo
Interior Least Tern
Piping Plover
Whooping Crane
Blanding's Turtle
Ottoe Skipper
Platte River Caddisfly[2]
Regal Fritillary
Lake Sturgeon[3]
Plains Topminnow

Aquatic Communities:
Mid-order, Warm Water Stream*

Terrestrial Communities:
Eastern Riparian Forest
Cottonwood-Peachleaf Willow Riparian Woodland
Cottonwood Riparian Woodland
Cottonwood-Diamond Willow Woodland*
Dry Upland Bur Oak Woodland*
Sandbar Willow Shrubland
Riparian Dogwood-False Indigobush Shrubland
Buckbrush Shrubland
Freshwater Seep*
Eastern Cordgrass Wet Prairie*
Northern Cordgrass Wet Prairie*
Eastern Bulrush Deep Marsh*
Cattail Shallow Marsh*
Reed Marsh
Eastern Pondweed Aquatic Wetland*
Loess Mixed-grass Prairie*
Eastern Sand Prairie*
Sandhills Mesic Tall-grass Prairie*
Sandhills Dune Prairie
Perennial Sandbar
Sandbar/Mudflat

* Priority for conservation in this BUL
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Lower Niobrara River

Biologically Unique Landscape Description
This BUL includes the Niobrara River channel and a two-mile buffer on each side of the river from central Brown County eastward to its confluence with the Missouri River in Knox County. The river in this reach has a broad, braided, and somewhat shallow channel. The channel has many open sandbars and wooded islands. This reach of the Niobrara River has fairly natural flows, with the only obstruction on the river being the low Spencer Dam in Boyd County. Much of the valley bottom is in cropland, though some areas support cottonwood woodlands and bur oak woodlands. Some wet meadows and marshes still remain in the floodplain. The bluff slopes are mainly mixed-grass prairie with some oak woodlands and ponderosa pine woodlands in the west.

Sandbars on the lower stretch of the Niobrara River from western Holt County eastward support numerous colonies of the federally and state listed interior least tern and piping plover. Bald eagles are also known to nest along this reach of the Niobrara River. Protected areas within the landscape include Red Bird, Bohemia Prairie and Greenvale WMAs and Niobrara State Park.

Stresses Affecting Species and Habitats
- Invasive herbaceous plant species in sandbars, meadows, marshes, and woodlands, primarily reed canary grass, Eurasian phragmites, narrow-leaf cattail, purple loosestrife, smooth brome, and potentially garlic mustard
- Eastern red-cedar and Russian-olive encroachment of meadows, prairies, and woodlands
- Additional water diversions
- Spencer dam blocking fish movement on the river
- Continued cabin and home development on river banks

Conservation Strategies
- Implement invasive tree-clearing projects on privately-owned meadows, prairies and woodlands
- Develop and implement best management practices to control and manage invasive plant species
- Build a fish bypass on Spencer Dam
- Maintain stream flows and hydrology needed to meet biological and ecological conservation goals

- Coordinate with landowners interested in using conservation easements and voluntary acquisitions to protect undeveloped reaches of the river, wet meadows, and woodlands from development
- Restore and/or maintain river hydrology necessary to sustain biological diversity and ecosystem function
- Restore wetland hydrology and connect backwater habitats to the river

Tier I At-risk Species

Plants:
Prairie Moonwort[4]

Animals:
Northern River Otter
Bell's Vireo
Interior Least Tern
Long-billed Curlew
Piping Plover
Whooping Crane
Wood Thrush
Iowa Skipper
Ottoe Skipper
Regal Fritillary
Pallid Sturgeon

Aquatic Communities:
Headwater, Cold Water Stream*
Headwater, Warm Water Stream*
Mid-order, Warm Water River*

Terrestrial Communities:
Cottonwood-Peachleaf Willow Riparian Woodland*
Dry Upland Bur Oak Woodland*
Green Ash- Elm- Hackberry Canyon Bottom Woodland
Sandbar Willow Shrubland
Buffaloberry Shrubland
Freshwater Seep
Cattail Shallow Marsh*
Reed Marsh*
Upland Tall-grass Prairie*
Eastern Sand Prairie*
Great Plains Gravel-Cobble Prairie*
Perennial Sandbar
Sandbar/Mudflat
Northern Chalk Bluff and Cliff*

* Priority for conservation in this BUL
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Platte Confluence

Biologically Unique Landscape Description
This BUL includes the South Platte River valley and North Platte River valley and the uplands lying between them in Keith and Lincoln counties. It also includes a small area of Sandhills to the north of the North Platte River valley through which Whitetail, Birdwood, and White Horse creeks flow.

Both the North Platte and South Platte rivers in this reach are shallow streams, with braided, mostly wooded channels. However, open sandbars and wet meadows are more common in the floodplain here than in other reaches of the Platte in western Nebraska. Sandhill cranes use these open habitats for spring staging. River flows have been greatly depleted from upstream diversion, and Russian-olive and eastern red-cedar have become invasive in the floodplain woodlands and meadows. Cropland is common in the valley.

Whitetail, Birdwood, and White Horse creeks headwater in the Sandhills, their flows derived from the extensive aquifer below the dunes, and flow southward into the North Platte River. In their upper reaches, they are fairly pristine, coldwater streams with wet meadows in their floodplains. These streams are unique in that they support several species of rare, cold-water fish, including the northern redbelly dace and finsecale dace. The streams also support submergent wetland plants that feed over-wintering trumpeter swans. There are few protected lands within this landscape.

Stresses affecting Species and Habitats
- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Invasive plant species in sandbars, meadows and woodlands, including reed canary grass, salt cedar, Eurasian phragmites, purple loosestrife, Canada thistle, and smooth brome
- Eastern red-cedar, Russian-olive, and other invasive shrub and tree encroachment of river sandbars, woodlands and meadows
- Altered natural hydrology, particularly lack of high spring flows, low summer flows, and reduced sediment transport to maintain sandbars and fish habitat and to prevent channel degradation
- Sedimentation and drainage of backwater sloughs
- Conversion of wet meadows to cropland

Conservation Strategies

- Implement ecologically-sensitive grazing strategies on wet meadows on both private and public lands, in combination with prescribed fire and rest
- Undertake eastern red-cedar and other tree clearing to maintain open meadow habitat for sandhill cranes, whooping cranes, and grassland birds. Initiate programs to control other invasive species.
- Expand shrub and herbaceous vegetation clearing on the river sandbars for water bird roosting and loafing habitat
- Restore and/or maintain Platte River hydrology necessary to sustain biological diversity and ecosystem function
- Facilitate sediment augmentation to restore the river channel
- Restore additional grassland habitat in the valley on private lands through high-diversity, local ecotype restorations
- Restore wetland hydrology and connect backwater habitats to the river

Tier I At-risk Species

Plants:
None

Animals:
Northern River Otter
Bell's Vireo
Greater Prairie-Chicken
Long-billed Curlew
Whooping Crane
Iowa Skipper
Regal Fritillary
Married Underwing
Whitney Underwing
Ghost Tiger Beetle
Finescale Dace
Northern Redbelly Dace
Plains Topminnow

Aquatic Communities:
Headwater, Cold Water Stream*
Mid-order, Warm Water River*

Terrestrial Communities:
Cottonwood-Peachleaf Willow Riparian Woodland
Cottonwood Riparian Woodland
Sandbar Willow Shrubland
Buckbrush Shrubland
Buffaloberry Shrubland
Chokecherry-Plum Shrub Thicket
Freshwater Seep

Western Alkaline Meadow*
Cattail Shallow Marsh*
Reed Marsh
Sandhills Dune Prairie
Perennial Sandbar*
Sandbar/Mudflat*
Riverine Gravel Flats*

* Priority for conservation in this BUL
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Rainwater Basin

Biologically Unique Landscape Description
The Rainwater Basin landscape occupies parts of 17 counties in south-central Nebraska. The topography is flat to gently rolling loess plain. The surface water drainage system is poorly developed and many watersheds drain into low-lying wetlands. Soil survey maps from the early 1900s indicate that approximately 4,000 larger wetlands totaling nearly 100,000 acres occurred in the region prior to Euro-american settlement. By the beginning of the 20th Century most uplands in the landscape had been converted to cropland. A 1983 survey indicated that only ten percent of the original wetlands had not been drained or filled. Nearly all remaining Rainwater Basin wetlands have been farmed at some time in the last century.

The Rainwater Basin has been recognized as a significant migratory bird area. The wetlands have been identified by the North American Waterfowl Management Plan as waterfowl habitat of major concern in North America. The basins are a concentration point in the central flyway for spring migrating ducks, geese, and shorebirds. They also provide important migration habitat for whooping cranes, bald eagles, and many other bird species. It is estimated that nearly the entire North American population of buff-breasted sandpipers stage in the eastern Rainwater basins during their spring migration. In fact, the Western Hemisphere Shorebird Reserve Network (WHSRN) designated the Rainwater Basin as its first landscape of hemispheric importance.

These wetlands are also important to taxonomic groups besides birds. Muskrats thrive in the basin marshes. And, wetlands in the Rainwater Basin serve as breeding sites for amphibian species.

Natural Legacy Demonstration Site

14. Kissinger Basin Wildlife Management Area – Nebraska Game and Parks Commission

The Kissinger Basin Wildlife Management Area is located one mile north of Fairfield, Clay County in the Rainwater Basin Biologically Unique Landscape. This site has a wetland that was restored by filling a pit and removing a berm and sediment. The site has installed fencing and a well to facilitate grazing as a management tool. Local managers target grazing of uplands and wetlands seasonally to improve wildlife habitat. Kissinger Basin WMA is visited regularly by migrating waterfowl and shorebirds.

Stresses affecting Species and Habitats

- Invasive plant species in wetlands, primarily reed canary grass, narrow-leaf cattail, smooth brome, Kentucky bluegrass and potentially Eurasian phragmites
- Lack of fire on the landscape and fire departments not regularly issuing burn permits
- Drainage or filling of wetlands and creation of water storage pits to convert to a non-wetland for development
- Sedimentation and chemical run-off into wetlands from adjacent cropland
- Excessive plant litter accumulation in wetlands which limits available open water and mudflats
- Limited resources influence habitat management on public lands
- Inadequate protection and conservation of isolated, temporary wetlands
- An increase in the number of transmission lines through bird migration routes and potential wind farm development.
- Localized opposition to wetland conservation easements

Conservation Strategies

- Protect and restore priority wetland acres and adjacent upland habitat
- Provide a reliable water source when necessary for priority wetland acres to assure sufficient water quantity, quality, and distribution
- Develop and implement best management practices to control and manage invasive plant communities
- Offer training about prescribed fire to increase comfort levels and awareness of the needs for prescribed burn plans and permits to address both safety and liability concerns
- Coordinate with willing landowners to protect important habitats with a variety of conservation methods, while taking into consideration conservation costs and benefits, landowner acceptance, and potential local impacts
- Work with public and private landowners to develop an efficient system to conduct ecologically appropriate cattle grazing in the basins
- Create grassland buffers around basins and in uplands to reduce sedimentation and chemical run-off (e.g., promotion of CRP and other similar programs)
- Take measures to reduce the negative impacts to migrating birds resulting from power lines (e.g., “fireflies”)

- Work with wind energy companies to select turbine sites that minimize impacts to wildlife. See Nebraska Game and Parks Commission guidelines for wind energy development.

Tier I At-risk Species

Plants:
None

Animals:
Buff-breasted Sandpiper[2]
Burrowing Owl
Henslow's Sparrow
Whooping Crane
Regal Fritillary
Pimpleback

Aquatic Communities:
Headwater, Warm Water Stream

Terrestrial Communities:
Buckbrush Shrubland
Cattail Shallow Marsh*
Eastern Cordgrass Wet Prairie
Eastern Bulrush Deep Marsh*
Freshwater Seep
Wheatgrass Playa Grassland*
Playa Wetland*
Eastern Bulrush Deep Marsh*
Cattail Shallow Marsh*
Loess Mixed-grass Prairie
Lowland Tall-grass Prairie
Upland Tall-grass Prairie

* Priority for conservation in this BUL
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[4] Known to occur in only three other BULs

Verdigris - Bazile

Biologically Unique Landscape Description
This landscape occupies the watersheds of Verdigris Creek and Bazile Creek in Cedar, Knox, Holt, and Antelope counties. This area in northeast Nebraska consists primarily of a mosaic of cropland, restored native grasslands, native tall-grass and mixed-grass prairie, and exotic cool-season grasslands. Many of the native prairies are degraded from lack of fire and specific livestock grazing practices that reduce native plant species diversity and promote exotic plants. Many of the streams are spring-fed coldwater streams that have unique fish assemblages. Oak woodlands are common along the streams and in ravines.

The northern portion of the landscape includes the Missouri River bluffs and breaks. These areas support northern loess/shale bluff prairie, tall-grass prairie, and deciduous woodlands. The Santee Sioux Indian Reservation is located within this portion of the landscape. The Verdigris-Bazile watershed is also of cultural significance to the Ponca Tribe. Protected areas within the landscape include Niobrara State Park, Lewis and Clark State Recreation Area, Bazile Creek, John O. Emerson, Greenvale, Bohemia Prairie, and Grove Lake Wildlife Management Areas.

Natural Legacy Demonstration Site

4. Niobrara River State Park - Nebraska Game and Parks Commission
Niobrara State Park overlooks the confluence of the Niobrara and Missouri Rivers. It has over 1200 acres that include grasslands, riparian forest, and wetlands. Managers work with local students to combat invasive species such as purple loosestrife. In this location, the Missouri River is un-channelized, so the braided river provides nesting habitat for interior least terns and piping plovers.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Invasive herbaceous plant species in meadows, prairies, and woodlands, primarily reed canary grass, Eurasian phragmites, purple loosestrife, smooth brome, Kentucky bluegrass, and potentially garlic mustard
- Eastern red-cedar, Russian-olive, and other woody species encroachment of floodplains, woodlands, and prairies
- High-grade logging, especially harvest of mature cottonwoods
- Dairy and hog confinement development with potential for waste run-off
- Drainage and sedimentation of wetlands
- Conversion of native prairies to cropland
- Deer over-browsing
- Poorly-sited utility-scale wind turbines

Conservation Strategies

- Implement planned grazing strategies on private lands to reduce exotic cool-season grasses and improve native plant diversity and vigor
- Increase the use of prescribed fire and invasive tree cutting on private lands to reduce cedars, improve native plant diversity and improve grassland wildlife habitat.
- Implement measures to site dairy and hog confinements away from sensitive habitats and watersheds
- Protect important stretches of Verdigris Creek and Bazile Creek through conservation easements
- Restore selected cropland to grassland, including expansion of stream buffer programs
- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to native species. Avoid placing wind turbines in native prairies and woodlands, and on bluff tops where they cause higher bird and bat mortality than on open, flat ground. Wind farms should not be located within the recommended radius of prairie grouse leks and nesting grounds. Turbines can be halted temporarily during peak migration periods for bats and birds. Pre- and post-construction monitoring should be implemented. See Nebraska Game and Parks Commission guidelines for wind energy development.

Collaborative Conservation Opportunities across State Borders

Coordinate with South Dakota conservation agencies and tribes, to improve habitat for at-risk species shared by both states including bald eagle, burrowing owl, greater prairie-chicken, interior least tern, piping plover, whooping crane, Ottoe skipper, and regal fritillary, within the NE Verdigris-Bazile and SD Eastern Prairie Ecoregion (i.e., Charles Mix and Bon Homme counties in SD). Species lists may be modified as new information becomes available.

Coordinated habitat management actions (e.g., grazing strategies) should mirror medium to high priority conservation goals identified in the South Dakota Comprehensive Wildlife Conservation Plan. Collaborative conservation efforts across state borders should include researchers, federal and non-profit environmental program coordinators, and landowners, particularly those with properties extending over state lines. It will be necessary to identify and develop staffing and funding sources for implementation of conservation actions beyond state boundaries.

Tier I At-risk Species

Plants:
Prairie Moonwort[4]

Animals:
Bell's Vireo
Buff-breasted Sandpiper[2]
Burrowing Owl
Greater Prairie-Chicken

Interior Least Tern
Piping Plover
Whooping Crane
Wood Thrush
American Burying Beetle
Iowa Skipper
Ottoe Skipper
Regal Fritillary
Plains Topminnow
Plains Pocket Mouse[4]

Aquatic Communities:
Headwater, Cold Water Stream*
Headwater, Warm Water Stream*

Terrestrial Communities:
Cottonwood-Peachleaf Willow Riparian Woodland
Dry-Mesic Bur Oak Forest and Woodland*
Dry Upland Bur Oak Woodland*
Sandbar Willow Shrubland
Riparian Dogwood-False Indigobush Shrubland
Buffaloberry Shrubland
Freshwater Seep*
Eastern Cordgrass Wet Prairie
Eastern Sedge Wet Meadow
Cattail Shallow Marsh
Reed Marsh
Upland Tall-grass Prairie*
Lowland Tall-grass Prairie
Northern Loess/Shale Bluff Prairie*
Great Plains Gravel-Cobble Prairie*
Perennial Sandbar
Sandbar/Mudflat
Northern Chalk Bluff and Cliff*

* Priority for conservation in this BUL
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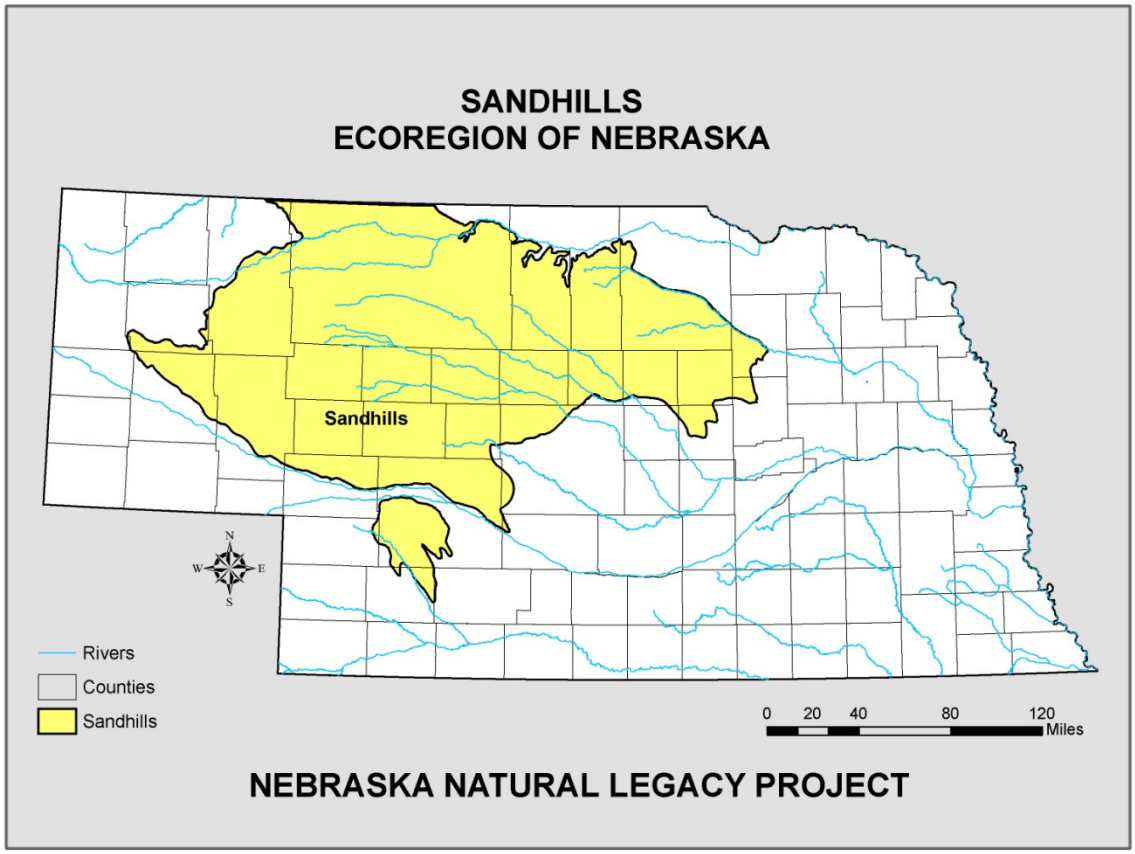
Chapter 7

Sandhills Ecoregion



Introduction

It's easy to be awestruck by the magnitude of the Nebraska Sandhills and its unspoiled natural condition. Covering 19,300 square miles in north-central Nebraska, the Sandhills Ecoregion includes the largest stabilized dune system in the Western Hemisphere and one of the largest, intact native grasslands in North America. The Sandhills remain as one of the last large vestiges of the Great American Plains.

Geologically, the Sandhills are young. Several major episodes of major dune formation have occurred over the last 13,000 years and several periods of drought-induced sand movement have occurred during the last 1,000 years. Scientists speculate that, at times in its history, the Sandhills were a sea of blowing sand, similar to today's Sahara desert. Dunes of the Sandhills are aligned primarily in a northwesterly to southeasterly direction in accordance with prevailing winds and some reach over 400 feet in height.

The Sandhills climate is semiarid with precipitation ranging from 23 inches per year in the east to less than 17 inches per year in the west. Temperatures average highs of approximately 88 degrees Fahrenheit in mid-summer and average lows of approximately 9 degrees Fahrenheit in mid-winter. The sandy dune soils are poorly developed with a thin layer of topsoil containing little organic matter because of their geologically young age. High infiltration rates, up to 10 feet per day, allow rainwater and snowmelt to percolate rapidly downward. Extensive aquifers, up to 900 feet thick, have formed below the dunes, mainly in sand and gravel deposits. The underground reservoir is part of the Ogallala aquifer and contains an estimated 700-800 million acre-feet of groundwater, nearly double the amount of water found in Lake Erie.

Where the region's high water table intersects the ground surface in Sandhill valleys, nearly 2,000 shallow lakes and over a million acres of wetlands have formed. Most lakes and large marshes are clustered near stream headwaters and in the western portion of the Sandhills. Only a few are over 1,000 acres in size and all are shallow, with the greatest depth less than fourteen feet. The wetlands cycle water from the aquifer to the atmosphere through evapo-transpiration. This moisture later falls as rainfall, creating an environment on the sandy dunes conducive to grassland establishment.

Most Sandhill lakes, marshes, and wet meadows are near neutral pH, though alkaline wetlands and lakes are common in the western Sandhills where salts and carbonates have accumulated in wetland soils. The Sandhills region contains some of the Great Plains' largest fens, groundwater-fed wetlands with peat or muck soils. They are found generally at the headwaters of streams and the upper end of Sandhill lakes and marshes where groundwater discharge is abundant. Their organic soils can be up to 21-feet thick, formed from the buildup of undecomposed plant material over thousands of years.

Southeasterly flowing streams, such as the North Loup, Middle Loup, Calamus, Cedar, and Dismal rivers, drain much of the central and eastern Sandhills. Their flows are derived almost entirely from groundwater discharge with little from run-off. The flow of these rivers is remarkably consistent, with few high or low flows. The Niobrara River is the only Sandhills river that originates outside the ecoregion. Its headwaters are in eastern Wyoming and it flows easterly through the northern Sandhills before entering the Missouri River in northeastern Nebraska. The Sandhills contains many smaller streams including the Minnechaduza, Pine, Boardman, and Birdwood creeks.

Vegetation

The Sandhills contain a variety of native plant communities ranging from wetlands to dry upland prairie. Nearly 700 native plant species have been documented in the Sandhills, including several at-risk species. Two principal plant community types are found in the Sandhills Ecoregion: dune prairie and valley wetlands.

The Sandhills dune prairie community consists of a mixture of sand-adapted grasses including sand bluestem, prairie sandreed, little bluestem, and hairy grama. Representative forbs include stiff sunflower, bush morning glory, gilia, annual buckwheat, and Plains gayfeather. Common shrubs include sand cherry, leadplant, prairie rose, and yucca. Blowouts, wind-excavated depressions in dune tops, are habitat for the federal and state-

threatened blowout Penstemon. This rare species grows only in the Nebraska Sandhills and a few sand dune complexes in Wyoming. Blowouts are uncommon today because of decreased frequency of fire on the landscape and range management practices that limit the effects of wind on erosion.

Tall grasses, including big bluestem, Indian grass, and switchgrass are abundant in moist prairie in dune valleys. Forbs found here include asters, white sage, and prairie-coneflower. Common shrubs include leadplant, dwarf prairie rose, and western wild rose.

Native woodlands are uncommon in the Sandhills and are found only in fire-protected river valleys and bluffs. Plains cottonwood, peachleaf willow, and coyote willow dominate riparian woodlands along many Sandhill streams. Native shrub thickets of chokecherry, wild goose plum and snowberry found in prairies of the Sandhills are important habitats for some native bird species. The Middle Niobrara River valley contains the most extensive woodlands in the Sandhills. Eastern deciduous woodlands containing bur oak, basswood, black walnut, and green ash grow on south-facing bluffs. Cool, moist, spring-fed canyons along the south bluff contain glacial relict woodlands dominated by paper birch and quaking aspen-trees characteristic of more northern environments. These species have been in decline in recent decades. The steep, rocky, north river bluff supports ponderosa pine dominated woodlands characteristic of the Rocky Mountains. Both Sandhills prairie and northern mixed-grass prairie are also found along the bluffs. The Middle Niobrara river valley has been referred to as a biological crossroads of the Midwest because of the diverse mixture of plant communities and animal species found there.

Wet meadows occur in Sandhill valleys where the water table remains near the surface throughout the year. The sandy to fine sandy loam soils of freshwater meadows support lush vegetation dominated by sedges, spikerushes, prairie cordgrass, and switchgrass. Shrubs, such as sandbar willow and false indigo-bush also occur in this community. Alkaline wet meadows are dominated by inland saltgrass, foxtail barley, alkali sacaton, bluegrass, and scratchgrass. Fens of the Sandhills are dominated by a meadow-like vegetation of grasses, sedges and shrubs. Their saturated organic soils support nearly twenty at-risk plant species.

Freshwater marshes in the Sandhills have shallow standing water most of the year and occur in isolation, as zones around lakes, or as borders to streams. Common marsh plants include ripgut sedge, common reed, smartweeds, hard-stem bulrush, broad-leaf cattail, duckweeds, and coontail. Alkaline marshes of the Sandhills support sparse vegetative cover of species such as Nevada bulrush, saltmarsh bulrush, and other alkaline-tolerant plants.

Animals

More than 300 species of resident and migratory birds have been documented in the Sandhills. The region is a stronghold for sharp-tailed grouse and greater prairie-chicken and is considered to be an important breeding site for the world's largest sandpiper, the long-billed curlew. The Sandhills contain substantial breeding populations of upland sandpiper, vesper sparrow, lark bunting, grasshopper sparrow, and western meadowlark. The American Bird Conservancy has described the Nebraska Sandhills as the "best grassland bird place in the United States." The Sandhills host the highest concentrations of northern harriers in the state, and ferruginous hawks are common breeders in the western Sandhills. Over a quarter

million waterfowl have been recorded during May surveys and the area is the most important breeding area for mallards, blue-winged teal, and northern pintails south of the prairie pothole region. Other waterbirds that are common breeders in the Sandhills include Wilson's phalarope, American avocet, western grebe, and black tern. Although woodlands are mostly confined to stream corridors, woodland species such as black-billed magpie, Bell's vireo, black-and-white-warbler, and rose-breasted grosbeak are known to nest in the Sandhills.

The Sandhills are home to 55 species of mammals. Many mammals found in the Sandhills Ecoregion are widespread with no distinct affiliation to the region. Small mammals include upland species such as the plains pocket gopher, white-tailed jackrabbit, Ord's kangaroo rat, and prairie voles. Species such as the masked shrew, jumping mouse, and meadow vole can be found associated with wet meadows and other wetlands. The most abundant large mammals include mule deer and white-tailed deer. The Sandhills support a few elk and relatively small numbers of pronghorn, particularly in the west. Although free-roaming bison no longer occur in the Sandhills, The Nature Conservancy's Niobrara Valley Preserve manages a pseudo-natural bison herd on their 56,000-acre preserve along the Niobrara River. A few Sandhill ranches owned by local residents manage bison as well. Coyotes are common throughout the ecoregion, and bobcats can be found in many riparian areas. In recent years, biologists have confirmed several sightings of mountain lions in the region. One of the rarest mammals of the Sandhills is the Bailey's eastern woodrat – a subspecies found only in north central Nebraska.

Streams and lakes of the Sandhills are home to 75 species of fish. Many common species are big river generalists, which can withstand a wide variation of environmental extremes. Among these are the channel catfish, flathead chub, and river carpsucker. Most rare Sandhills fish species, including the blacknose shiner, pearl dace, northern redbelly dace, and finescale dace are northern species with their Sandhills populations being disjunct from their principal range. These species are less tolerant of habitat disturbance and are now restricted to fairly stable headwater streams. Game fish, primarily yellow perch, northern pike, largemouth bass, bluegill, and carp, have been introduced into many lakes in the Sandhills, and trout have been introduced into several coldwater streams.

Twenty-seven species of amphibians and reptiles are found in the Sandhills, including one salamander, three toads, four frogs, six turtles, four lizards, and nine snakes. The Great Plains toad, plains spadefoot, and Woodhouse's toad use Sandhills wetlands for breeding while spending most of their adult life in the uplands. The ornate box turtle is probably the most well known Sandhills reptile. Blanding's turtle, a northern species whose range extends to New England is rare over much of its range but is fairly abundant in lakes and marshes of the Sandhills. Three small lizards are common on the sand dunes. The six-lined race runner prefers dense vegetation, while the lesser earless lizard prefers more sparely-vegetated open sand habitats. The northern prairie lizard commonly forages in blowouts. The bullsnake and western hognose snake are probably the Sandhills' most common snakes. The prairie rattlesnake is the region's only venomous snake and lives primarily in the Niobrara River valley and prairie dog towns.

Insects are important to the ecology and economy of the Sandhills; they serve vital functions as pollinators, decomposers, grazers, and food for other wildlife. They are also the most

diverse, abundant, and least-studied animal group in the Sandhills. Seventy species of scarab beetles have been documented for Thomas County alone, and numerous species of butterflies are known to inhabit the Sandhills. Possibly the rarest insect in the Sandhills is the federally and state endangered American burying beetle. The Sandhills are one of the last known strongholds for this species that once ranged over much of the eastern United States.

Rich in flora and fauna, the Nebraska Sandhills remain one of the highest-quality, intact prairie landscapes in the country. Although the region has not completely escaped the impacts of the modern world, it will likely continue as a hotspot of Great Plains biological diversity well into the future.

History and Dominant Land Use

Relatively little is known about Native American use of the Sandhills. Few cultural resource surveys have been conducted and this extensive undisturbed grassland has limited archeological discovery. Human use of the Sandhills likely dates back at least 10,000 years. The first human inhabitants were probably nomadic and used primitive weapons to hunt mammoth, horse, camel, and other now extinct species. The first year-round settlements likely occurred along lakes and streams beginning 1,000 - 2,000 years ago. Like most native plains people, they subsisted using a mixed economy of agriculture (corn, beans, squash), hunting, and gathering. Nearly a dozen tribes are known to have lived or hunted in the Sandhills around the time of Euro-american exploration of the region. Tribes present included the Plains Apache, Pawnee, Comanche, Ponca, Omaha, Teton Sioux, Oglala and Cheyenne.

The first Euro-american visitors to the Sandhills are believed to be trappers and hunters who traveled along streams in search of game. James McKay was the first known non-indigenous explorer to venture into the heart of the Sandhills and write an account of his journey. During his 1796 expedition, he remarked that the region was “a great desert of drifting sand…” In 1854, the Corps of Topographical Engineers assigned Lieutenant G. K. Warren the task of surveying for a map of the trans-Mississippi West. His travels from 1855 to 1857 included the Nebraska territory. He traveled through the Sandhills and later commented that permanent settlement in the region was unlikely because of its unfavorable climate and lack of soil fertility.

It was not until the 1870’s that early cattlemen began discovering the Sandhills’ potential as rangeland. One of the first ranches in the Sandhills was organized in 1877 by E.S. Newman on the Niobrara River to provide cattle to Native Americans living on the Pine Ridge reservation. Cattle were kept from grazing the more rugged sandhills south of the river until a spring blizzard in 1879 scattered more than 6,000 cattle into the adjacent lands. Hoping to salvage a small portion of the lost stock, cowboys not only found the lost cattle but also large herds of well-fattened and watered cattle which had been thriving on Sandhill grasses. By the late 1880s, the Sandhills had become an important cattle-raising region.

Most early ranches were large, and cattle were left unfenced to graze freely. In the early 1900’s, Moses Kinkaid, a Congressman from O’Neill secured passage of the Kinkaid Act. This act encouraged settlement in the Sandhills by increasing the maximum land claim from

160 acres to 640 acres. Between 1910 and 1917, nearly nine million acres were claimed by "Kinkaiders." Most attempts at farming failed, but ranching succeeded and the population in the Sandhills grew from about 67,000 in 1900 to over 95,000 by the 1930's. In the mid-1930's, severe drought gripped the Great Plains. During this time, some ranchers discovered that the impacts of drought could be partially mitigated by switching to a rotational grazing system.

Many feel that these small ranches helped foster a close personal relationship between ranchers and the Sandhill grasslands, a relationship that still exists today. Early ranchers learned about the fragile nature of the Sandhills and the inextricable connection between conserving the region's grasslands and economic viability. Ranchers of the Sandhills were some of the first groups to widely accept the use of planned rotational grazing, a technique that, if used properly, is compatible with biological diversity conservation. Some ranchers manage their property in a way that benefits grouse and other wildlife. The ranchers are widely credited with helping to maintain the area's rich biological diversity through their commitment to sound stewardship.

Today, approximately 95 percent of the Sandhills are maintained as native grasslands, primarily for livestock production. Ranch sizes vary widely and cattle outnumber people in the Sandhills by 20:1. Overall, more than a half million head of cattle are supported in the Sandhills annually.

Crop production peaked in the 1970's when center pivot irrigation technology was refined. Much of the native grassland on the periphery of the Sandhills was converted to cropland at this time in what turned out to be a misguided and a largely unsuccessful attempt to farm large portions of the Sandhills. Many ranchers still view this as one of the low points in Sandhills history. Numerous formerly cropped lands have now been reseeded to grass and put into the Conservation Reserve Program. However, there is always a risk that history will repeat itself, particularly when crop prices peak.

Nature-based Recreation

The Nebraska Sandhills are ideally suited for nature-based recreation. As one of the largest remaining grassland landscapes in the United States, the Sandhills have a unique allure to those wishing to gain a glimpse of America's prairie past. The Sandhills are well known to upland game hunters and birdwatchers alike. The region sports some of the nation's best sharp-tailed grouse and prairie-chicken hunting in the fall and premier prairie grouse courtship viewing in the spring. Many species of waterfowl and shorebirds can be seen in the spring, including large concentrations of pintails, grebes, and phalaropes. Great Plains endemics like long-billed curlew, chestnut-collared longspur, Le Conte's sparrow, and rare species like trumpeter swan also inhabit the Sandhills. In all, more than 300 species of birds have been recorded in the Sandhills.

Big game, upland game, and waterfowl hunting in the Sandhills offer an unparalleled experience of panoramic views of native landscapes and solitude made possible by low hunter density. Abundant populations of mule deer, white-tailed deer, wild turkey, and even an occasional pronghorn provide pleasure to nature enthusiasts. Natural Sandhills lakes are

regarded for their bluegill, northern pike, perch, and largemouth bass fishing. Merritt and Calamus reservoirs provide excellent fishing, as well as spectacular scenery. The region's rivers, although often overlooked, can provide quality fishing for catfish and other game species.

There are thousands of acres of public land in the Sandhills, including three national wildlife refuges, two national forests, and numerous state wildlife management areas and state recreation areas. The 56,000 acre Niobrara Valley Preserve, owned by The Nature Conservancy, is one of the organization's larger preserves. Seventy-six miles of the central Niobrara River are part of the National Wild and Scenic River system and comprise one of the top canoeing destinations in the country, attracting over 20,000 river users each year. There are over 10 outfitters in the Valentine area who provide canoe, kayak, and inner-tube rentals. Other rivers such as the Dismal and Loup, provide quality canoeing and kayaking but are relatively unused. The Dismal River is the most difficult river to canoe in Nebraska and offers a challenge to thrill seekers. A growing number of private businesses cater to nature enthusiasts by providing lodging, canoe/kayak rentals, horseback riding, and access to large tracts of private lands for wildlife viewing, hunting, and fishing.

State highways and secondary roads provide easy access to the most popular nature-recreation sites in the region. The Sandhills Scenic Byway (State Highway 2) that cuts through the heart of the Sandhills is considered one of the top ten scenic byways in the country. Access to some areas requires driving on hard-packed sand roads. The sparsely populated Sandhills offers one of the last accessible places in the continental US to observe celestial objects free from light pollution. Once completed, the Cowboy Trail, a biking trail that spans the entire northern Sandhills, will be the nation's longest rails-to-trails conversion. It provides hikers and bicyclists a unique way to view the Sandhills.

Education

Many Sandhills residents have a close affiliation with the land. Ranchers are often eager to share their knowledge of Sandhills' wildlife and plants and the role ranching has played in conservation. North of Taylor, a local group of ranchers have created a roadside rest area with interpretive signage that provides information on native plants, Sandhills ecology, and ranching. Currently, there is no single organization or educational institution that is devoted specifically to natural history and environmental education in the Sandhills. Instead, there are many distinct and loosely connected entities involved in wildlife education in the Sandhills.

The U.S. Fish and Wildlife Service operates a visitor center at the Fort Niobrara National Wildlife Refuge that explains the fort's history, local wildlife, and refuge management. The Nebraska Game and Parks Commission's Smith Falls State Park, located in the Niobrara River valley, has an interpretive, self-guided nature trail. The Calamus Fish Hatchery includes a small visitor center that describes the area's fish and wildlife. The Gundmunson and Barta Brothers ranches provide learning opportunities about ranching in the Sandhills. The Niobrara Valley Outdoor Education Partnership is a coalition of natural resources professionals and educators working collectively to provide environmental education focused on the Niobrara River valley. Partners include the National Park Service, US Fish and

Wildlife Service, Natural Resource Conservation Service, Nebraska Game and Parks Commission, Nebraska Forest Service, Middle and Lower Niobrara NRDs, Niobrara Council, Northern Prairies Land Trust, and public school educators in Boyd, Brown, Cherry, Holt, Keya Paha, and Rock counties.

The Nebraska state 4-H camp located within the Halsey Unit of the Nebraska National Forest provides a unique setting for educational activities in the Sandhills. The camp includes lodging and dining facilities, an auditorium, hiking trails, and access to canoeing. A summer youth camp, the Becoming an Outdoors Woman program, outdoor skills camps, and meetings of organizations such as the Nebraska Ornithologist Union take place at the camp each year exposing hundreds of individuals to the Sandhills.

Each year, a Sand Hills Discovery Experience conference is held in Ainsworth, Nebraska. Natural history themes are selected based on topics of interest in the Sandhills ecoregion. Agenda items have included talks on vegetation, geology, hydrology, wildlife, and paleontology. Experts in each of the areas of interest present information and lead discussions on the various subjects.

A number of schools in the Sandhills already offer curriculum involving study of the ecoregion and experiential educational opportunities. Yet, the need and interest for increased environmental education in the region is strong. Formal educators of both early childhood and K-12 students request more training on both environmental education in general, and ecoregion-specific knowledge.

Post-secondary education, however has been underutilized to teach agricultural and ranching philosophies and techniques that are better for the environment but also productive. Educational programming, in cooperation with Cooperative Extension, can be used to reach out to agricultural producers and post-secondary education administration to provide curriculum for new professionals on habitat management techniques compatible with agricultural operations.

Organizations and Partnerships

The Sandhills ecoregion has partnerships, coalitions, and grass roots efforts formed to conserve the region's biodiversity values. Groups include, but are not limited to, the following:

The Sandhills Task Force was created in 1991. It's a non-profit with 16 board members comprised of local ranchers and representatives from Nebraska Game and Parks Commission, U.S. Fish and Wildlife Service, The Nature Conservancy, Natural Resources Conservation Service, and Nebraska Cattlemen Association. Its goal is to enhance the natural resources in the Sandhills by supporting wildlife and profitable private ranching. The Task Force has been successful in bringing landowners and conservation groups together to complete projects involving grassland enhancement, wetlands and stream restoration, research, technical assistance, education, outreach, and a few conservation easements. The organization works with willing landowners and government agencies to develop conservation strategies that benefit both ranching and wildlife. The Sandhills Task Force

publishes an annual accomplishment report that details positive impacts on tens of thousands of acres each year. www.sandhillstaskforce.org

The Niobrara Council is a grassroots-driven organization formed in 1997 to assist the National Park Service in managing and protecting Niobrara National Scenic River resources. It was formed by local individuals who wished to have an active voice in Niobrara River management issues and to help preserve the rural characteristics, scenic qualities, and private ownership of land in the area. The council was originally formed by an inter-local agreement between Brown, Cherry, Keya Paha, and Rock counties. In 2000, the Council was strengthened when legislation made it a state-recognized organization with river management responsibility, development coordination authority, and the ability to hold conservation easements and title to land. Currently, the council has 16 members consisting of representatives from local, state, and federal agencies, local landowners, county commissioners, businesses, outfitters, the wood-products industry, and the environmental community. The diverse makeup of the council provides a wealth of knowledge, experience, and new perspectives regarding river management issues. Although the "Niobrara Council" concept was a departure from conventional approaches to natural resource management, the cooperative experiment has proven to be extremely effective and now serves as a model for others throughout the nation.
www.niobraracouncil.org

The Middle Niobrara Weed Awareness Group was formed in 2001 to better coordinate weed management activities along the Niobrara River corridor. The purpose of the organization is to help local landowners become aware of the potential threat of noxious weeds and to facilitate communication amongst agencies, organizations and the public. The group is involved in mapping occurrences of noxious weeds and identifying effective control measures. Members include The Nature Conservancy, National Park Service, Niobrara Council, Brown County Weed Control, Rock County Weed Control, Cherry County Weed Control, Keya Paha Weed Control, Nebraska Dept. of Agriculture, Nebraska Board of Education Land and Funds, U.S. Fish and Wildlife Service (Ft. Niobrara NWR), U.S. Geological Survey, and private landowners.
mnwag.org

The Niobrara Valley Prescribed Fire Association aids private landowners within the Niobrara River drainage area of Nebraska in gaining the skills necessary to implement prescribed burns. Workshops, seminars, and post-burn tours educate landowners on the benefits of prescribed fire and how to implement it safely. The organization provides support, specialized tools, and equipment to participants.
www.nvpfa.org

Ecoregion-specific Stresses

Key Stresses

In addition to the stresses and conservation actions identified in this chapter for the Sandhills Ecoregion, statewide concerns are identified also in chapter four. Conservation practitioners identified the following stresses as the top threats in the ecoregion.

Altered natural frequency of grazing and burning: Although the predominance of ranching in the Sandhills is responsible for sustaining a rich complement of biological diversity, grazing patterns do not exactly mirror grazing by native herbivores. Historically, grazing intensity varied seasonally and from year-to-year. As a result there is now less diversity in vegetation composition and structure, resulting in an overall reduction in biological diversity. Grazing strategies that are promoted should be appropriate to the enhancement of local plant communities. Fire frequency was much higher prior to settlement and there were likely beneficial synergistic relationships between fire and grazing. Woody vegetation has increased along rivers and streams because of reduced fire frequency, with eastern red-cedar being a primary species of concern.

Wetland and wet meadow drainage: Past ditching and drainage of wetlands has impacted aquatic resources in the Sandhills. Wet meadows are biologically diverse communities but composition changes when natural hydrology is altered. Unique wetlands such as fens are often highly degraded when ditched.

Spread of invasive species: Invasive species are a threat to biological diversity in the Sandhills. The introduction of carp has degraded many lakes, wetlands and streams. Purple loosestrife and reed canary grass threaten riparian areas and wetlands. Musk thistle and leafy spurge are threats to prairie communities. Eastern red-cedars need to be controlled to limit their spread. However, as we work to combat invasives, it is best to implement control measures carefully in order to avoid devastating native shrub and forb habitat.

Excess deer browsing: Excess browsing by deer can degrade native woodlands and impact agricultural production in areas.

Interbasin water transfer: Large-scale export of Sandhills groundwater would significantly alter the region's natural hydrology by lowering the water table, impacting wetlands, and reducing flows in streams and rivers. Although inter-basin transfer of water is not currently being done in the Sandhills, it looms as a future threat.

Oil pipelines: There are concerns that efforts to construct a pipeline for crude oil across the Sandhills could pollute the Ogallala aquifer if leakage occurs. Construction of this type that bypasses the Sandhills, rather than goes through the ecoregion, reduces the threat to the water and wildlife resources there.

Lack of knowledge about the region's biological diversity: The Sandhills are unique biologically and ecologically. However, many of the ecoregion's residents have limited opportunities to learn about the plant and animal species that are found there. Ranchers of the region have much knowledge about the Sandhills but often do not have a chance to share this information with others. Lack of understanding and appreciation of the Sandhills could negatively impact future conservation in the ecoregion.

Ranching economics: Increases in property taxes, economic hardships, and other factors are changing ownership patterns (e.g., more nonresident owners), which could affect management decisions and ultimate stewardship of the land.

Conversion and fragmentation of natural habitats: Although most of ecoregion's natural communities are intact, center pivot agricultural development on the eastern and southern border of the Sandhills is accelerating, resulting in a loss of native communities and a decline in biological diversity. Fragmentation of large unbroken tracts of Sandhills prairie by tree plantings, home development, utility-scale wind turbines, roads etc. represent both current and future stresses on the region's biological diversity.

Poorly-sited utility-scale wind turbines: Wind energy development is a growing industry in the Great Plains. There are many benefits to cleaner and renewable energy sources; nevertheless, in order to conserve the biodiversity of the Sandhills, it is important to carefully consider the placement of wind turbines and transmission lines in order to minimize wildlife habitat fragmentation. Areas to avoid include intact grassland and other native habitats. Focus on siting turbines in already disturbed areas (e.g., cultivated lands, old railway/road corridors). Turbines can be halted temporarily during peak migration periods for bats and birds. Pre- and post-construction monitoring should be implemented. See Nebraska Game and Parks Commission guidelines for wind energy development.

Biologically Unique Landscapes of the Sandhills Ecoregion

A goal of the Nebraska Natural Legacy Project is to identify priority landscapes that, if properly managed, will conserve the majority of the state's biological diversity. These landscapes, referred to as Biologically Unique Landscapes (BULs), were selected based on the occurrences of at-risk species and natural communities. See Chapter 3 for a description of the methods used to select the landscapes.

The map on following page shows the BULs for the Sandhills Ecoregion. Following the map are brief descriptions of each BUL, including stresses affecting species and habitats, proposed conservation actions, and lists of the Tier I at-risk species and natural communities found in the landscape. In order to help prioritize conservation in each BUL, we denoted species that occur in only one or a few BULs with superscripts.

Sandhills Biologically Unique Landscapes
Cherry County Wetlands
Dismal River Headwaters
Elkhorn River Headwaters

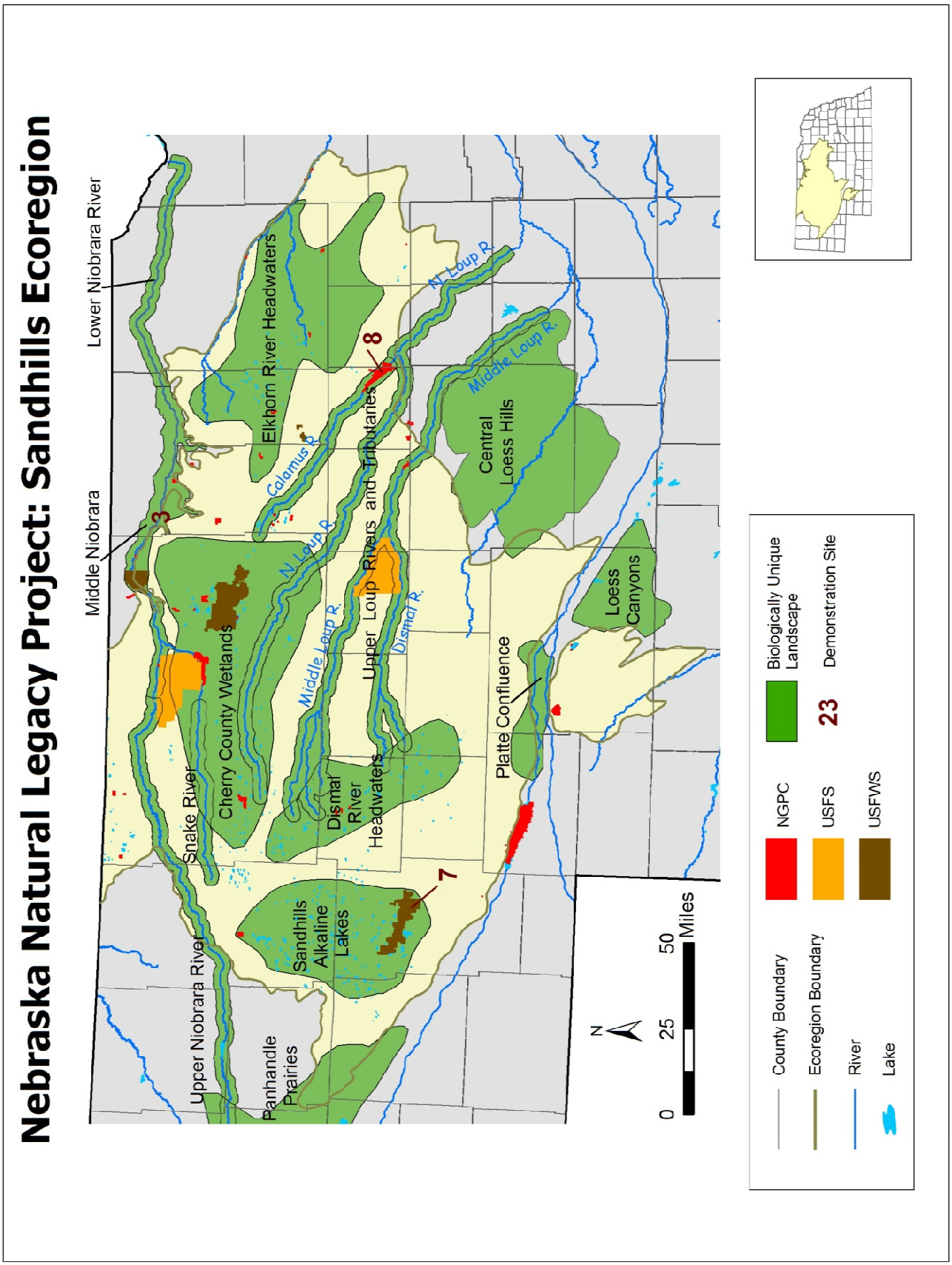
Middle Niobrara
Platte Confluence (see Mixedgrass Ecoregion for description)
Sandhills Alkaline Lakes
Snake River
Upper Loup Rivers and Tributaries (includes Calamus, Middle Loup and North Loup landscapes)

Demonstration Sites of the Sandhills Ecoregion

Demonstration sites are locations across the state with potential for showcasing conservation projects and the results of sustainable management to the public. They provide opportunities for learning about the site's unique qualities and importance to at-risk species. See Chapter 4 for information on selecting demonstration sites. The Sandhills Ecoregion map shows the location of demonstration sites in the area.

Site name	# on map	BUL
Calamus WMA and SRA	8	Upper Loup Rivers and Tributaries
Crescent Lake NWR	7	Sandhills Alkaline Lakes
Niobrara Valley Preserve	3	Middle Niobbrara

Descriptions of each site are found in the write-up for the BUL in which the site is found.


Nebraska Natural Legacy Project: Sandhills Ecoregion
Lower Niobrara River
Middle Niobrara
Upper Niobrara River
Panhandle Prairies
Snake River
Cherry County Wetlands
Sandhills Alkaline Lakes
Dismal River Headwaters
Upper Loup Rivers and Tributaries
Platte Confluence
Elkhorn River Headwaters
Central Loess Hills
Loess Canyons
Calamus R.
N. Loup R.
Middle Loup R.
Dismal R.
3
7
8
N
0
25
50
Miles
County Boundary
Ecoregion Boundary
River
Lake
NGPC
USFS
USFWS
Biologically Unique Landscape
23
Demonstration Site

Cherry County Wetlands

Biologically Unique Landscape Description
This landscape occurs in Cherry County in the northern Sandhills. The area consists of high, mostly long linear dunes, with interdunal valleys. Many valleys contain numerous lakes, marshes, wet meadows, and fens that form one of the Sandhills largest wetland complexes. The upland dune grasslands are intact with only limited cropland, primarily center pivot irrigated, in drier valleys.

The North Loup River and its tributaries headwater in this region. The Snake River flows through the northern portion of the landscape. This BUL is important for nesting and migratory water birds, and the wetlands support large populations of reptiles and amphibians. Wet meadows support a large population of the federally and state threatened western prairie fringed orchid. The area is also habitat for several other federal and state listed species including the American burying beetle and whooping crane. The area's numerous high-quality smaller streams support assemblages of rare fish including the pearl dace, the state and federally listed Topeka shiner, the state listed northern redbelly dace, blacknose shiner, and finescale dace. The Valentine National Wildlife Refuge is one of the largest protected areas.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure (e.g., season-long grazing, annual mid-summer haying)
- Invasive species, primarily reed canary grass, smooth brome, Eurasian phragmites, Garrison creeping-foxtail, narrow-leaf cattail, purple loosestrife, and carp
- Loss of active blowouts on dunes as habitat for the blowout Penstemon. Lack of fire and some present-day range management practices have greatly reduced blowouts.
- Wetland drainage, which can also lead to lowered groundwater levels and stream channel down-cutting
- Stream channelization and in-stream structures barring fish movement
- Stocking of exotic and game fish in streams with rare fish species
- Loss of native riparian vegetation from excessive grazing leads to increased run-off, sedimentation, and a lack of stream shading that results in altered water temperatures harmful to fish
- Poorly-sited utility-scale wind turbines and cellular/television towers

Conservation Strategies

- Improve implementation of biodiversity management, including increased use of prescribed fire and planned livestock grazing, on wildlife management areas and federal lands. This is especially critical in meadows and wetlands where excessive thatch accumulation causes exotic cool-season grass dominance and loss of diversity.
- Work with private landowners to develop and implement creative methods of forage utilization on wet meadows that avoid ditching to facilitate haying. Also, work with private landowners to implement strategic grazing on uplands.

- Restore the natural hydrology of wet meadows and other wetlands through ditch plugging and water control structures (ensure that in-stream structures allow for fish passage)
- Maintain the natural hydrology of Sandhills streams
- Reduce the number of culverts on small streams containing rare fish populations by installing bridges
- Implement integrated noxious weed control strategies that do not negatively impact western prairie fringed orchid populations nor wetland plant diversity
- Work with extension and agronomy groups to prevent the promotion and planting of exotic forage grasses, such as Garrison creeping-foxtail and reed canary grass, and forbs in Sandhills wet meadows
- Where feasible, create and maintain blowout complexes on public lands as habitat for the blowout Penstemon through use of prescribed fire and intense livestock grazing
- Work with the USDA to ensure that wetlands enrolled in their programs allow occasional moderate grazing, burning, or haying to reduce vegetative litter accumulation and to promote biodiversity. Presently, some program wetlands are fenced and not actively managed.
- Discontinue game fish stocking in streams with rare fish species
- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to native species. Avoid placing wind turbines in native prairies or sites used or inhabited recently by threatened and endangered species (e.g., American burying beetle, whooping crane). Wind farms should not be located within the recommended radius of prairie grouse leks and nesting grounds. Turbines can be halted temporarily during peak migration periods for bats and birds. Pre- and post-construction monitoring should be implemented. See Nebraska Game and Parks Commission guidelines for wind energy development.

Tier I At-risk Species

Plants:
Blowout Penstemon
Western Prairie Fringed Orchid
Wolf Spikerush[4]

Animals:
Bell's Vireo
Burrowing Owl
Greater Prairie-Chicken
Loggerhead Shrike
Long-billed Curlew
Short-eared Owl
Trumpeter Swan
Whooping Crane
Blanding's Turtle
American Burying Beetle
Finescale Dace
Regal Fritillary

Married Underwing
Whitney Underwing
Mottled Duskywing[4]
Blacknose Shiner[4]
Northern Redbelly Dace
Plains Topminnow
Topeka Shiner[2]
Ghost Tiger Beetle

Aquatic Communities:
Alkaline Lake*
Freshwater Lake*
Headwater, Cold Water Stream*
Headwater, Warm Water Stream
Mid-order, Warm Water Stream
Mid-order, Cold Water Stream

Terrestrial Communities:
Chokecherry-Plum Shrub Thicket
Freshwater Seep
Sandhills Fen*
Sandhills Wet Meadow*
Spikerush Vernal Pool*
Cattail Shallow Marsh*
Sandhills Hardstem Bulrush Marsh*
Reed Marsh*
Western Alkaline Marsh
Northern Pondweed Aquatic Wetland*
Water-lily Aquatic Wetland*
Saline/Alkaline Aquatic Wetland
Eastern Sand Prairie
Sandhills Mesic Tall-grass Prairie*
Sandhills Dune Prairie
Sandhills Dry Valley Prairie
Perennial Sandbar
Sandbar/Mudflat

* Priority for conservation in this BUL
[1] This is the only BUL where the species is known to occur
[2] Known to occur in only one other BUL
[3] Known to occur in only two other BULs
[4] Known to occur in only three other BULs

Dismal River Headwaters

Biologically Unique Landscape Description
This landscape includes the Dismal River and the area near its headwaters that occur in Cherry, Grant, Arthur, McPherson, and Hooker counties in the west-central Sandhills. The area consists of high, prairie-covered dunes with interdunal valleys. The high water table in the BUL supports numerous lakes, marshes, wet meadows, and fens. Cropland, primarily center pivot irrigated, occurs only occasionally in the valleys.

The Middle Loup River and the North and South Forks of the Dismal Rivers headwater in this region. Birds use the rivers, surrounding floodplain, and marshes of this landscape for nesting and migration habitat. The landscape also supports large populations of reptiles and amphibians and includes populations of the federally and state endangered blowout Penstemon. The only protected areas within the landscape are the Frye Lake and De Fair Lake Wildlife Management Areas.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Invasive plants, primarily reed canary grass, smooth brome, narrow-leaf cattail, Eurasian phragmites, Garrison creeping-foxtail, eastern red-cedar, and purple loosestrife
- Loss of active blowouts on dunes as habitat for the blowout Penstemon. Lack of fire and some present-day range management practices have greatly reduced blowouts.
- Wetland ditching, which can also lead to lowered groundwater levels and stream channel down-cutting
- Stream channelization and in-stream structures barring fish movement
- Stocking of exotic and game fish in streams with rare fish
- Conversion of prairie and groundwater depletions resulting from center pivot irrigation development
- Loss of native riparian vegetation from excessive grazing leads to increased run-off, sedimentation, and a lack of stream shading that results in altered water temperatures harmful to fish
- Poorly sited utility-scale wind turbines

Conservation Strategies

- Improve implementation of biodiversity management, including increased use of prescribed fire and strategic livestock grazing, on wildlife management areas in the landscape. This is especially critical in meadows and wetlands where excessive thatch accumulation causes exotic cool-season grass dominance and loss of diversity.
- Work with private landowners to develop and implement creative methods of forage utilization on wet meadows that avoid ditching to facilitate haying. Also, work with private landowners to implement strategic grazing on uplands.
- Restore the natural hydrology of wet meadows and other wetlands through ditch plugging and water control structures (ensure that in-stream structures allow for fish passage).
- Maintain the natural hydrology of Sandhills streams

- Reduce the number of culverts on small streams containing rare fish populations by installing bridges
- Implement integrated noxious weed control strategies that do not negatively impact western prairie fringed orchid populations nor wetland plant diversity
- Work with extension and agronomy groups to prevent the promotion and planting of exotic forage grasses, such as Garrison creeping-foxtail and reed canary grass, and forbs in Sandhills wet meadows
- Where feasible, create and maintain blowout complexes on public lands as habitat for the blowout Penstemon through use of prescribed fire and intense livestock grazing
- Offer environmental education programs about prescribed fire to increase public support
- Work with the USDA to ensure that wetlands enrolled in their programs allow occasional moderate grazing, burning, or haying to reduce vegetative litter accumulation and to promote biodiversity. Presently, some program wetlands are fenced and not actively managed.
- Discontinue game fish stocking in streams with rare fish species
- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to native species. Avoid placing wind turbines in native prairies or sites used or inhabited recently by threatened and endangered species. Wind farms should not be located within the recommended radius of prairie grouse leks and nesting grounds. Turbines can be halted temporarily during peak migration periods for bats and birds. Pre- and post-construction monitoring should be implemented. See Nebraska Game and Parks Commission guidelines for wind energy development.

Tier I At-risk Species

Plants:
Blowout Penstemon

Animals:
Burrowing Owl
Greater Prairie-Chicken
Loggerhead Shrike
Long-billed Curlew
Short-eared Owl
Trumpeter Swan
Blanding's Turtle
Finescale Dace
Plains Topminnow
Regal Fritillary
Ghost Tiger Beetle

Aquatic Communities:
Freshwater Lake*
Alkaline Lake*
Headwater, Cold Water Stream*
Headwater, Warm Water Stream

Mid-order, Warm Water River
Mid-order, Cold Water River

Terrestrial Communities:
Chokecherry-Plum Shrub Thicket
Freshwater Seep
Sandhills Fen*
Sandhills Wet Meadow*
Spikerush Vernal Pool*
Cattail Shallow Marsh*
Reed Marsh*
Western Alkaline Marsh
Northern Pondweed Aquatic Wetland*
Water-lily Aquatic Wetland*
Saline/Alkaline Aquatic Wetland
Sandhills Dune Prairie
Sandhills Dry Valley Prairie
Perennial Sandbar
Sandbar/Mudflat

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Elkhorn River Headwaters

Biologically Unique Landscape Description
This landscape occurs in the northeastern Sandhills and includes large areas of Brown, Rock, Holt, Garfield, and Wheeler counties. The area consists mainly of level sand plain with a regionally high water table and extensive wet meadows and shallow marshes. Rolling sand dunes and Sandhill marshes and lakes are scattered through the region. Center pivot crop fields are common in areas.

The South Fork and North Fork of the Elkhorn River headwater in the region. The BUL's meadows support the state's largest populations of the federally and state threatened western prairie fringed orchid. The area is also habitat for several other federal and state listed species including the small white lady's-slipper orchid, American burying beetle, and whooping crane. Waterfowl and other waterbirds make extensive use of the region's wetlands. Protected areas in the BUL include several Wildlife Management Areas, among them Goose Lake, South Pine, Swan Lake, and Dry Creek.

Stresses Affecting Species and Habitats

- Livestock (and horses) grazing heavily in riparian zones may lead to soil compaction, erosion, and increased sediment and nutrient loads in the stream
- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Invasive species, primarily reed canary grass, smooth brome, Kentucky bluegrass, leafy spurge, narrow-leaf cattail, Eurasian phragmites, Garrison creeping-foxtail, eastern red-cedar, purple loosestrife, and carp
- Die-off of mature cottonwoods
- Herbicide application in meadows to control leafy spurge is a threat to western prairie fringed orchid populations and plant diversity
- Wetland drainage, which can also lead to lowered groundwater levels and stream channel down-cutting
- Stream channelization and in-stream structures, including culverts, that bar fish movement
- Conversion of prairie and groundwater depletions resulting from center pivot irrigation development
- Loss of native riparian vegetation from excessive grazing leads to increased run-off, sedimentation, and a lack of stream shading that results in altered water temperatures harmful to fish
- ATV use in waterway
- Poorly-sited utility-scale wind turbines

Conservation Strategies

- Improve implementation of biodiversity management, including increased use of prescribed fire and strategic livestock grazing, on wildlife management areas in the landscape. This is especially critical in meadows and wetlands where excessive thatch accumulation causes exotic cool-season grass dominance and loss of diversity.
- Work with private landowners to develop and implement creative methods of forage utilization on wet meadows that avoid ditching to facilitate haying. Also, work with private landowners to implement strategic grazing on uplands.
- Restore the natural hydrology of wet meadows through ditch plugging and water control structures (ensure that in-stream structures allow for fish passage)
- Maintain the natural hydrology of Sandhills streams
- Implement integrated noxious weed control strategies that do not negatively impact western prairie fringed orchid populations nor plant diversity
- Work with the USDA to ensure that wetlands enrolled in their programs allow occasional moderate grazing, burning, or haying to reduce vegetative litter accumulation and to promote biodiversity. Presently, some program wetlands are fenced and not actively managed.
- Work with extension and agronomy groups to prevent the promotion and planting of exotic forage grasses, such as Garrison creeping-foxtail and reed canary grass, and forbs in Sandhills wet meadows
- Restore native riparian flora
- Place stock tanks for livestock away from stream channel and promote programs that fund riparian buffer strips
- Promote citizen-science stream-quality monitoring

- Discontinue game fish stocking in streams with rare fish
- Install fences to discourage ATV access to stream beds. Also, install signage detailing the impacts ATV use has on biodiversity, and inform law enforcement of problematic areas
- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to native species. Avoid placing wind turbines in areas used or inhabited recently by threatened and endangered species. Wind farms should not be located within the recommended radius of prairie grouse leks and nesting grounds. Turbines can be halted temporarily during peak migration periods for bats and birds. Pre- and post-construction monitoring should be implemented. See Nebraska Game and Parks Commission guidelines for wind energy development.

Tier I At-risk Species

Plants:
Blowout Penstemon
Hall's Bulrush[2]
Small White Lady's-slipper[3]
Western Prairie Fringed Orchid
Wolf Spikerush[4]

Animals:
Northern River Otter
Bell's Vireo
Burrowing Owl
Greater Prairie-Chicken
Loggerhead Shrike
Trumpeter Swan
Whooping Crane
Blanding's Turtle
American Burying Beetle
Ghost Tiger Beetle
Regal Fritillary
Bucholz Black Dash
Plains Topminnow
Pimpleback
Plain Pocketbook

Aquatic Communities:
Freshwater Lake*
Headwater, Warm Water Stream
Mid-order, Warm Water Stream

Terrestrial Communities:
Cottonwood-Peachleaf Willow Riparian Woodland
Cottonwood-Diamond Willow Woodland*
Sandbar Willow Shrubland*

Chokecherry-Plum Shrub Thicket
Freshwater Seep
Sandhills Fen*
Sandhills Wet Meadow*
Spikerush Vernal Pool
Cattail Shallow Marsh*
Sandhills Hardstem Bulrush Marsh*
Reed Marsh*
Northern Pondweed Aquatic Wetland*
Water-lily Aquatic Wetland
Eastern Sand Prairie*
Sandhills Mesic Tall-grass Prairie*
Sandhills Dune Prairie
Perennial Sandbar
Sandbar/Mudflat

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Middle Niobrara

Biologically Unique Landscape Description
The Middle Niobrara BUL includes a 76-mile reach of the river in Cherry, Keya Paha, Rock, and Brown counties. This stretch of river has been designated as a National Wild and Scenic River. The Middle Niobrara River valley is deeply incised, and is the intersection of five diverse plant communities: northern mixed-grass prairie, Sandhills prairie, Rocky Mountain pine woodland, northern boreal woodland, and eastern deciduous woodland. The valley, with its diverse mix of plant communities, is home to an incredible diversity of native animal and plant species, including many glacial relict species. The landscape is often referred to as the biological crossroads of the Midwest. The Nature Conservancy's 56,000 acre Niobrara Valley Preserve alone contains 581 species of plants, 213 birds, 86 lichens, 44 mammals, 25 fish, 17 reptiles, and 8 amphibians. The Middle Niobrara River valley also provides habitat for many at-risk species including whooping crane, bald eagle, piping plover, interior least tern, and Bailey's eastern woodrat, a subspecies endemic to the area. The primary protected areas within the landscape include The Nature Conservancy's Niobrara Valley Preserve, Fort Niobrara National Wildlife Refuge, Smith Falls State Park, and several state wildlife management areas and state recreation areas.

Natural Legacy Project Demonstration Site

3. Niobrara Valley Preserve - The Nature Conservancy
The valley is a mosaic of mixed-grass, tall-grass and sandhills prairie. The steep canyons and slopes lining the river contain a mix of three woodland types: northern boreal, western coniferous and eastern deciduous. The Niobrara Valley Preserve is one of the few locations where bison are used to manage the prairies, in addition to cattle. The Nature Conservancy also uses prescribed fire as a management tool. This site has most of the natural communities of the BUL.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Interruption of natural fire frequency leading to increased tree densities, primarily eastern red-cedar and Ponderosa pine, excess litter accumulation and exotic plant invasion in the valley
- Invasive plants in stream channel, wetlands, woodlands, and grasslands; the primary species of concern include reed canary grass, narrow-leaf cattail, Eurasian phragmites, purple loosestrife, leafy spurge, Kentucky bluegrass, and smooth brome.
- Upstream dams and water diversion
- Development of homes, cabins, ranchettes, roads, and recreational facilities

Conservation Strategies

- Implement planned grazing strategies on private lands
- Conduct integrated weed control efforts to control invasive species
- Increase tree thinning and use of prescribed fire in the valley on private and public lands
- Work with interested landowners to use conservation easements or voluntary fee title acquisition to protect important habitats within the valley from development
- Work with local government agencies to implement zoning in the valley to limit development
- Promote the use of conservation buyers in the valley

Tier I At-risk Species

Plants:
Prairie Moonwort[4]
Large-spike Prairie-clover
Small White Lady's-slipper Orchid[3]

Animals:
Northern River Otter
Bailey's Eastern Woodrat[3]
Bell's Vireo
Burrowing Owl
Interior Least Tern

Long-billed Curlew
Piping Plover
Whooping Crane
Wood Thrush
Blanding's Turtle
American Burying Beetle
Iowa Skipper
Ottoe Skipper
Regal Fritillary
Mottled Duskywing[4]
Northern Redbelly Dace
Plains Topminnow

Aquatic Communities:
Headwater, Cold Water Stream*
Headwater, Warm Water Stream
Mid-order, Warm Water River*

Terrestrial Communities:
Cottonwood-Peachleaf Willow Riparian Woodland
Dry Upland Bur Oak Woodland*
Paper Birch Springbranch Canyon Forest*
Basswood-Ironwood Springbranch Canyon Forest*
Green Ash-Elm-Hackberry Canyon Bottom Woodland
Green Ash-Eastern Red-cedar Scarp Woodland
Dry Ponderosa Pine Open Woodland and Savanna*
Sandbar Willow Shrubland
Buckbrush Shrubland
Buffaloberry Shrubland
Chokecherry-Plum Shrub Thicket
Freshwater Seep*
Northern Cordgrass Wet Prairie
Sandhills Wet Meadow
Cattail Shallow Marsh*
Reed Marsh
Eastern Sand Prairie
Sandhills Mesic Tall-grass Prairie
Sandhills Dune Prairie*
Sandhills Dry Valley Prairie
Threadleaf Sedge Western Mixed-grass Prairie
Great Plains Gravel-Cobble Prairie*
Perennial Sandbar*
Sandbar/Mudflat*

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Sandhills Alkaline Lakes

Biologically Unique Landscape Description
This landscape occurs in Sheridan, Morrill, and Garden counties in the western Sandhills. The area consists of prairie-covered high dunes and interdunal valleys. The area has a poorly-developed drainage system, and many of the region's wetlands and lakes are alkaline.

This is the largest alkaline wetland complex in the state and a vital nesting and migratory habitat for shorebirds and other waterbirds, including American avocets and black-necked stilts. This landscape includes the largest populations of the federally and state endangered blowout Penstemon in the state. Conservation lands in the BUL include the Crescent Lake National Wildlife Refuge, the Nature Conservancy's Graves Ranch Preserve, and Smith Lake Wildlife Management Area.

Natural Legacy Demonstration Site

> **7. Crescent Lake National Wildlife Refuge - U.S. Fish and Wildlife Service**
> This Refuge, located in the Nebraska Panhandle, has over 45,000 acres of rolling sandhills and numerous wetlands. The refuge grasslands range from the densely-vegetated meadows to the sparsely-covered "choppies" dune tops. Managers are challenged with management of several at-risk species, including those that need open sand blowouts. Natural communities at this Refuge include sandhills wet meadow, sandhills hardstem bulrush marsh, reed marsh, western alkaline meadow, western alkaline marsh, and sandhill dune prairie.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure (e.g., season-long grazing, annual mid-summer haying)
- Invasive species, primarily reed canary grass, smooth brome, Eurasian phragmites, Garrison creeping-foxtail, narrow-leaf cattail, purple loosestrife, and carp
- Loss of active blowouts on dunes as habitat for the blowout Penstemon. Lack of fire and some present-day range management practices have greatly reduced blowouts.
- Wetland drainage, which can also lead to lowered groundwater levels and stream channel down-cutting
- Stream channelization and in-stream structures barring fish movement
- Stocking of exotic and game fish in streams with rare fish species
- Conversion of prairie and groundwater depletions resulting from center pivot irrigation development

- Increased water alkalinity
- Poorly-sited utility-scale wind turbines

Conservation Strategies

- Improve implementation of biodiversity management, including increased use of prescribed fire and strategic livestock grazing, on wildlife management areas and federal lands. This is especially critical in meadows and wetlands where excessive thatch accumulation causes exotic cool-season grass dominance and loss of diversity.
- Work with private landowners to develop and implement creative methods of forage utilization on wet meadows that avoid ditching to facilitate haying. Also, work with private landowners to implement strategic grazing on uplands.
- Restore the natural hydrology of wet meadows through ditch plugging and water control structures
- Maintain the natural hydrology of Sandhills streams
- Reduce the number of culverts on small streams containing rare fish populations by installing bridges
- Implement integrated noxious weed control strategies that have minimum impacts to meadow and wetland plant diversity. Work with extension and agronomy groups to prevent the promotion and planting of exotic forage grasses, such as Garrison creeping-foxtail and reed canary grass, and forbs in Sandhills wet meadows.
- Where feasible, create and maintain blowout complexes on public lands as habitat for the blowout Penstemon through use of prescribed fire and intense livestock grazing
- Promote and implement increased shorebird research and increase management of wetlands as shorebird habitat
- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to native species. See Nebraska Game and Parks Commission guidelines for wind energy development.

Tier I At-risk Species

Plants:
Blowout Penstemon

Animals:
Bell's Vireo
Burrowing Owl
Loggerhead Shrike
Long-billed Curlew
Piping Plover
Short-eared Owl
Trumpeter Swan
Regal Fritillary

Aquatic Communities:
Alkaline Lake*
Freshwater Lake*
Headwater, warm water stream
Mid-order, warm water river

Terrestrial Communities:
Chokecherry-Plum Shrub Thicket
Freshwater Seep
Western Alkaline Meadow*
Cattail Shallow Marsh
Reed Marsh
Western Alkaline Marsh*
Northern Pondweed Aquatic Wetland
Water-lily Aquatic Wetland
Saline/Alkaline Aquatic Wetland*
Sandhills Dune Prairie*
Sandhills Dry Valley Prairie

* Priority for conservation in this BUL

Snake River

Biologically Unique Landscape Description
This landscape includes the upper reaches of the Snake River from the western end of Merritt Reservoir westward to the stream's headwaters. The landscape includes the river channel and a two-mile buffer on each side of the river. The Snake River begins as a small spring-fed stream flowing through Sandhills meadows. As the stream gains flow, its valley becomes deeply incised. Here, the stream bluffs support pine woodlands and Sandhills prairies. The Snake River is a pristine coldwater stream with a narrow channel that maintains a near constant flow rate throughout the year because of its spring-fed nature. It supports an assemblage of rare fish including the plains topminnow, pearl dace, northern redbelly dace, and finescale dace. Merritt dam on the lower Snake River blocks fish movement into the upper reaches. There are no permanently protected areas in this landscape.

Stresses Affecting Species and Habitats
- Specific grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Ditching and channel straightening in the upper reaches of the Snake River that lead to stream down-cutting and lowered groundwater levels
- Stocking exotic game fish into the river and tributary streams with rare fish species
- Golf course and housing development
- Invasive species, including, reed canary grass, purple loosestrife, Eurasian phragmites, smooth brome, eastern red-cedar, Garrsion creeping-foxtail, and carp

- Conversion of prairie and water depletions from center pivot irrigation development
- Poorly-sited utility-scale wind turbines

Conservation Strategies

- Work with private landowners to develop and implement creative methods of forage utilization on wet meadows that avoid repeated annual mid-summer haying and do not require ditching to facilitate haying. Also, work with private landowners to implement strategic grazing on uplands.
- Implement integrated invasive weed control strategies that have minimum impacts to meadow and wetland plant diversity
- Restore hydrology of wet meadows through ditch plugging and water control structures (ensure that in-stream structures allow for fish passage)
- Reduce the number of culverts on small streams containing rare fish by installing bridges
- Maintain the natural hydrology of the river and tributary streams
- Protect important stretches of the Snake River valley through zoning and conservation easements
- Discontinue exotic and game fish stocking in the river and tributary streams
- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to native species. See Nebraska Game and Parks Commission guidelines for wind energy development.

Tier I At-risk Species

Plants:
None

Animals:
Finescale Dace
Northern Redbelly Dace
Plains Topminnow
Regal Fritillary
Bailey's Eastern Woodrat[3]

Aquatic Communities:
Headwater, Cold Water Stream*

Terrestrial Communities:
Green Ash-Elm-Hackberry Canyon Bottom Woodland
Sandbar Willow Shrubland
Chokecherry-Plum Shrub Thicket
Freshwater Seep
Northern Cordgrass Wet Prairie*
Sandhills Wet Meadow*
Cattail Shallow Marsh
Reed Marsh
Eastern Sand Prairie

Sandhills Dune Prairie
Sandhills Dry Valley Prairie
Perennial Sandbar
Sandbar/Mudflat

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Upper Loup Rivers and Tributaries

Biologically Unique Landscape Description
This landscape includes the upper reaches of the Middle Loup, Dismal, North Loup and Calamus rivers from their headwaters in the central Sandhills southeastward to where the rivers enter the loess hills. The landscape includes the river channels and a two-mile buffer on each side of the channels. These rivers start as spring-fed, narrow streams in Sandhills meadows. Here, many of the meadows have been ditched and the streams channelized. The streams gain flow throughout their journey, taking on a meandering and braided characteristic. The valley bottoms are occupied by wet meadows with some cottonwood woodlands, marshes, and isolated cropland. The bluffs are mainly Sandhills dune prairie. The steep bluffs of the North Fork and the South Fork of the Dismal's rivers support groves of eastern red-cedar woodland.

The river flows are nearly constant throughout the year because their primary source comes from consistent groundwater seepage. The only mainstem impoundment in the region is on the Calamus River, forming Calamus Reservoir. Downstream diversions on the Loup rivers, within the loess hills, block fish movement into the upper reaches of these streams. Many small, colder-water tributary streams flow into these rivers.

The upper reaches of the rivers and some tributaries support assemblages of rare fish, including the Topeka shiner, blacknose shiner, and finescale dace. The federally and state endangered whooping cranes use braided channels and adjacent meadows as migratory stopover roosts. The federally and state threatened western prairie fringed orchid occurs in wet meadows within the valleys. The American burying beetle is found within this landscape. Protected areas within the landscape include portions of the Nebraska National Forest and a few smaller wildlife management areas.

Natural Legacy Demonstration Site

> **8. Calamus Wildlife Management Area and State Recreation Area – Nebraska Game and Parks Commission**
> Calamus Reservoir and the adjacent Calamus Wildlife Management Area exhibit a variety of habitats including Sandhills dune prairie, Sandhills freshwater marsh, and wet meadows. Visitation rates are high in this relative central location in the state, making it beneficial for demonstrating habitat projects.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Ditching and channel straightening in the upper stream reaches that often lead to channel degradation and reduced groundwater levels
- Stocking exotic and game fish into tributary streams with rare fish
- Golf course and housing development, particularly along the Calamus River
- Invasive species, including reed canary grass, purple loosestrife, narrow-leaf cattail, Eurasian phragmites, smooth brome, eastern red-cedar, Garrsion creeping-foxtail, Russian-olive, and carp
- Dam building and water diversion on the rivers
- Conversion of grasslands and groundwater depletion from center pivot irrigation
- Poorly-sited utility-scale wind turbines

Conservation Strategies

- Work with private landowners to develop and implement creative methods of forage utilization on wet meadows that avoid repeated annual mid-summer haying and do not require ditching to facilitate haying. Also, work with private landowners to implement strategic grazing on uplands.
- Implement integrated invasive weed control strategies that have minimum impacts to meadow and wetland plant diversity, including programs to reduce eastern red-cedar encroachment into grasslands
- Restore the hydrology of wet meadows and fens through ditch-plugging and water control structures (ensure that in-stream structures allow for fish passage)
- Reduce the number of culverts on small streams containing rare fish by installing bridges
- Remove non-functional in-stream structures that form barriers to aquatic species movement (e.g., water diversion structures)
- Protect important stretches of the river valley through zoning and conservation easements
- Discontinue exotic and game fish stocking in the river and tributary streams
- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to native species. See Nebraska Game and Parks Commission guidelines for wind energy development.

Tier I At-risk Species

Plants:

Blowout Penstemon
Hall's Bulrush[2]
Western Prairie Fringed Orchid
Wolf Spikerush[4]

Animals:
Northern River Otter
Bell's Vireo
Burrowing Owl
Interior Least Tern
Long-billed Curlew
Piping Plover
Trumpeter Swan
Whooping Crane
Blanding's Turtle
American Burying Beetle
Iowa Skipper
Regal Fritillary
Married Underwing
Ghost Tiger Beetle
Blacknose Shiner[4]
Finescale Dace
Northern Redbelly Dace
Plains Topminnow
Topeka Shiner[2]

Aquatic Communities:
Headwater, cold water stream
Headwater, warm water stream*
Mid-order, warm water river*

Terrestrial Communities:
Cottonwood-Peachleaf Willow Riparian Woodland
Cottonwood-Diamond Willow Woodland*
Cottonwood Riparian Woodland
Dry Upland Bur Oak Woodland*
Green Ash-Elm-Hackberry Canyon Bottom Woodland
Green Ash-Eastern Red-cedar Scarp Woodland*
Sandbar Willow Shrubland*
Riparian Dogwood-False Indigobush Shrubland*
Buckbrush Shrubland
Buffaloberry Shrubland
Chokecherry-Plum Shrub Thicket
Freshwater Seep*
Northern Cordgrass Wet Prairie*
Sandhills Wet Meadow
Eastern Bulrush Deep Marsh
Cattail Shallow Marsh
Sandhills Hardstem Bulrush Marsh*
Reed Marsh*
Northern Pondweed Aquatic Wetland*
Water-lily Aquatic Wetland*

Loess Mixed-grass Prairie
Eastern Sand Prairie
Sandhills Mesic Tall-grass Prairie*
Sandhills Dune Prairie
Sandhills Dry Valley Prairie
Perennial Sandbar*
Sandbar/Mudflat*

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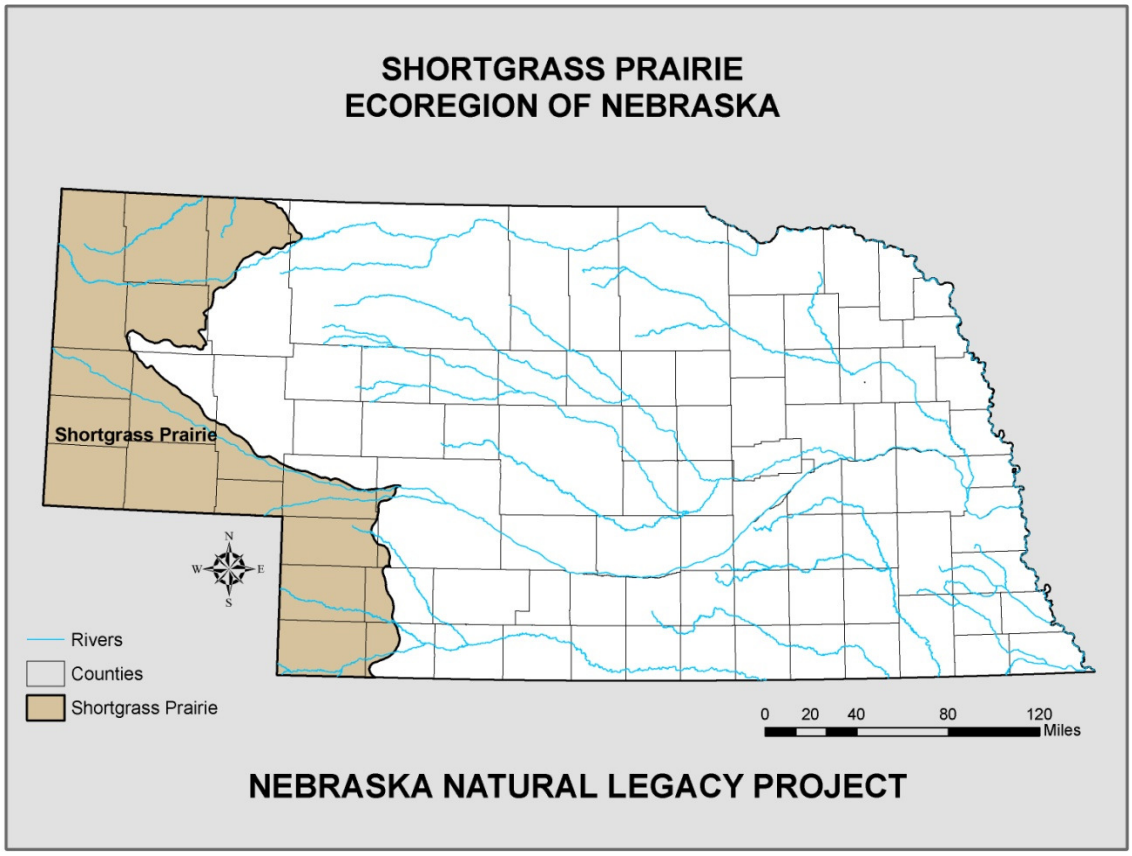
Chapter 8

Shortgrass Prairie Ecoregion



Introduction

Though referred to as the Shortgrass Prairie Ecoregion, much of western Nebraska supports dry mixed-grass prairie in addition to areas of short-grass, sandsage prairie, sand prairie, pine woodlands, badlands, and other vegetation types. The ecoregion features diverse topography, including several areas of rocky escarpments. Soils range from sands to clays, with a greater variety of soil types than other ecoregions of the state. Annual precipitation ranges from 12 to 17 inches. Temperatures average highs of 90 degrees Fahrenheit in mid-summer and average in the low teens in mid- winter. Humidity is generally low.

Threadleaf sedge western mixed-grass prairie is the predominant vegetation type in the ecoregion, though northwestern mixed-grass prairie dominates on the shale-derived soils north of the Pine Ridge. True short-grass prairie is limited to dry knobs and areas with very clayey soils. Sandsage prairie is most common in Dundy, Chase, and Perkins counties and sand prairies are scattered throughout the ecoregion. Ponderosa pine woodlands occur on rocky escarpments, primarily the Pine Ridge and Wildcat Hills. Badlands and rock outcrop communities are also present on escarpments.

The North Platte River bisects the ecoregion and has wet meadows, deciduous woodlands, and numerous tributary streams, many of which are coldwater. Other streams in the ecoregion include Lodgepole Creek in the southern panhandle and the upper Niobrara and White Rivers in the north. Natural wetlands are somewhat limited in the ecoregion, though playa wetlands are abundant in areas of the southwest and are scattered northward. Five large reservoirs and a number of smaller artificial lakes provide additional habitat for game fish, amphibians, invertebrates, and waterbirds. The ecoregion contains numerous small streams, many of which are ephemeral (may or may not be wet year-round).

Vegetation

Short-grass prairies are dominated by grasses such as buffalo grass and blue grama. Common forbs in this prairie type include milk-vetches, scarlet gaura, cutleaf ironplant, prickly pear, purple locoweed, slender-flower scurf-pea, prairie-coneflower, and scarlet globe-mallow. The low precipitation in the Shortgrass Prairie Ecoregion, in conjunction with grazing, causes most short-grass vegetation to rarely exceed 10 inches in height.

Mixed-grass prairie is also common in the ecoregion. Northwestern mixed-grass prairie is prevalent north of the Pine Ridge and threadleaf sedge western mixed-grass prairie is most common south of the Pine Ridge. Mixed-grass prairies in the ecoregion are typically dominated by blue grama, prairie sandreed, threadleaf sedge, needle-and-thread grass, green needle grass, little bluestem, and western wheatgrass. Some of the mid-grass species can reach 18 to 24 inches in height, but they are often shorter because of local management and precipitation. Shrubs found in mixed-grass prairies include skunkbush sumac, rubber rabbit-brush, sagebrushes, snowberry, yucca, and broom snakeweed. Numerous forbs can be found in these prairies, with common species including scarlet gaura, dotted gayfeather, skeletonplant, cutleaf ironplant, lemon scurf-pea, and scarlet globe-mallow.

Sandsage prairie is distinguished from other sand prairie types by its high cover of sand sagebrush. Other common plants in sandsage prairie include blue grama, prairie sandreed, needle-and-thread, yucca, sand-lily, desert goosefoot, plains sunflower, bush morning-glory, and showy ipomopsis. Additional sand prairie types in the ecoregion include Sandhills dune prairie and western sand prairie. These communities share many common species with sandsage prairie but lack the characteristic cover of sandsage brush. Western alkaline meadows are common in stream valleys of the ecoregion. They can be found along the North Platte, Niobrara River, and Pumpkin Creek. Common plants in these meadows include inland saltgrass, alkali sacaton, clustered field sedge, foxtail barley, and bluegrass, spearscale, rayless alkali aster, viscid camphor-daisy, and entire-leaf thelypody. Freshwater meadows and marshes are also relatively common in stream valleys. These wetlands are dominated by a variety of grasses, sedges, bulrushes, and cattails.

Open canopies of tall cottonwoods and shorter peachleaf willows dominate riparian woodlands in many stream valleys of the ecoregion. Sub-canopies often consist of green ash, box-elder, Russian-olive, and junipers. Sandbar willow is a common shrub, but wild goose plum, chokecherry and silver buffalo-berry are also present on higher terraces and banks. The herbaceous layer is sparse and may include field horsetail, Emory's sedge, woolly sedge,

marsh muhly, and prairie cordgrass. Riparian woodlands and shrublands have become more prevalent on the North Platte River over the last half century because of dams reducing scouring flows.

Pine woodlands are dominated almost solely by Ponderosa pine, though limber pine occurs in a small area of Kimball County. Saskatoon serviceberry, chokecherry, dwarf juniper, skunkbush sumac, mountain-mahogany, and wolfberry are common shrubs in the pine communities. Common grasses and forbs under the pines include sun sedge, needlegrasses, prairie sandreed, bog buckbean, fragile fern, white sage, and yucca.

Badlands are largely unvegetated but often have a sparse cover of low shrubs such as saltbush and rubber rabbit-brush and forbs such as silver orache, poverty-weed, and Russian-thistle. Mixed-grass prairie often occupies gentle slopes and flat border badlands. Rock outcrop communities are common on escarpments in the ecoregion. Plant species diversity can be high on the outcrops with common species including milk-vetches, Hood's phlox, stemless tetraneuris, grama grasses, and thick-spike wheatgrass.

Animals

More than 300 species of resident and migratory birds have been recorded in the short-grass prairie ecoregion. Common short-grass prairie species include McCown's and chestnut-collared longspurs, Brewer's sparrow, horned lark, burrowing owl and the state threatened mountain plover. Species commonly found in the mixed-grass prairie community include western meadowlark, grasshopper sparrow, and lark bunting. The pine ridge region includes many forest species such as Lewis's woodpecker, pygmy nuthatch, ovenbird, and mountain bluebird. The region's wetlands support many species of waterfowl including Canada goose, mallard, and northern pintail, and shorebirds such as western sandpiper and greater yellowlegs.

A variety of mammals are known to occur in the ecoregion. Ungulates include both white-tailed and mule deer, elk, pronghorn, and bighorn sheep. Coyotes and bobcats are the most common large predators but in recent years, mountain lions have also been recorded in the Panhandle. The ecoregion serves as one of the remaining strongholds for the diminutive swift fox, a state endangered species. Prairie dogs are locally abundant, and the federally endangered black-footed ferret (*Mustela nigripes*) was once present in the ecoregion. Other mammals include the river otter, black-tailed jackrabbit, American badger, plains pocket gopher, and northern grasshopper mouse.

The aquatic habitats of Nebraska's Panhandle support numerous species of fish. The region's lakes and reservoirs have been stocked with game fish such as walleye, largemouth bass, white bass and bluegill. River-associated species include channel catfish, river carpsucker, the state-threatened finescale dace, state-endangered blacknose shiner, shovelnose sturgeon, western silvery minnow, plains minnow, suckermouth minnow, flathead chub, blacknose dace, plains topminnow, and Iowa, Johnny, and orange-throat darters. Brown trout and rainbow trout have been stocked in cold water streams in the ecoregion.

Many species of amphibians and reptiles are known to occur in the Shortgrass Prairie Ecoregion. Amphibians include boreal chorus frog and Woodhouse's toad. Reptiles include bullsnake, prairie rattlesnake, lesser earless lizard, mountain short-horned lizard, ornate box turtle, and northern painted turtle.

History and Dominant Land Use

At the time of settlement**,** nomadic tribes of Pawnee, Sioux and Northern Cheyenne used the region for hunting bison and other game. The Oregon and Mormon Trails, which crossed the region, carried thousands of settlers westward during the western expansion of the 1840's and 1850's, but relatively few individuals settled in the ecoregion during this time.

The Homestead Act of 1864 spurred settlement by providing 160 acres to homesteaders who could "improve" their land claim within five years. An additional 160 acres could be acquired if a sufficient number of trees were planted on the claim site. Completion of the transcontinental railroad brought an increasing number of settlers to this part of Nebraska in the late 1860s. Tracts of grassland as far as the eye could see were very enticing to cattlemen. Vast ranches were established, primarily on public land. Cattle thrived on the short, warm-season grasses such as buffalo grass and blue grama which were rich in protein even after dormancy. The Kincaid Act of 1904 allowed homesteaders to increase their land claim to 640 acres, making farming the dry prairies less risky. Section-sized farms started springing up and large ranchers who formerly ran cattle freely across the open plains, faced new difficulties.

The Reclamation Act of 1902 proved to be the impetus for irrigating the arid lands and encouraging crop production in the ecoregion. A few farmers along the Owl and Winter Creeks in Scotts Bluff County dug canals by hand to bring river water to their crops in 1887. Canal associations soon followed allowing accelerated development of irrigation systems. By 1909, enough sugar beets were being produced to support Scottsbluff's first sugar factory. At the height of sugar beet production in the 1920's to early 1930's, there were five factories in the Scottsbluff area.

Land that did not have access to irrigation water grew primarily winter wheat. This crop did very well with limited rainfall, especially under a summer fallowing rotation (resting the land every other year to preserve subsoil moisture). Dry beans were another prominent crop of the region. One-hundred acres of dry bean crop were first planted in the region in 1927. In subsequent years, the area became one of the major dry edible bean-producing regions of the nation.

During the 1920's, the Shortgrass Prairie Ecoregion saw dramatic changes as conversion of prairie to cropland intensified. Nineteen twenty-nine marked the onset of a seven-year drought – the Dust Bowl. Below average precipitation combined with high temperatures and driving winds created the worst drought in the region's recorded history. The drought, coupled with the nation's economic depression, left many farmers and ranchers in the region in economic ruin.

The 1940's saw a recovery in the ecoregion and many farms and ranches once again prospered. Improvements in farming efficiency in the 1950's through 1960's lead to dramatic increases in crop production. The wide-scale use of center pivot irrigation systems in the 1970's and 1980's brought previously un-farmed land into crop production. In the late 1990's, severe drought returned to the area and the amount of land under cultivation began to decline. Moratoriums on new groundwater development were put in place to help safeguard depleted water resources. No-till farming and dry land crops such as sunflowers received wider acceptance during the late 1990's.

Currently, almost 87 percent of the land in the northwest portion of the ecoregion is in grass and used for grazing and nearly 88 percent of the land in the southeast part of the ecoregion is under crop production. Of the 5.6 million acres of land in the Shortgrass Prairie Ecoregion, 2.28 million acres are cropland, half of which are irrigated. Approximately 2.75 million acres are in grassland and used principally for grazing. A very small portion of the ecoregion is native woodland.

The Conservation Reserve Program (CRP) and the Conservation Reserve Enhancement Program (CREP) have taken tens of thousands of acres of cropland out of production and returned it to grassland. Because of declining groundwater and surface water resources in the ecoregion, many CRP and CREP lands will likely remain in grassland even after contracts expire.

The current trend is towards fewer but larger farms and ranches in the ecoregion. This trend is being driven by economics and a loss of residents in rural areas to more populated towns and cities. Many landowners have concerns about future land acquisitions for public use and its impact on sustaining a ranching tradition. The northern portion of the Panhandle has a much higher percentage of land area in public ownership than in other parts of the state. Recent efforts to promote agri-tourism have stimulated the local economy. Promoting the region's biological diversity and unique landscape could likewise lead to increased economic sustainability.

Nature-based Recreation

The Shortgrass Prairie Ecoregion has a wealth of natural amenities. The region is a well-known destination for the natural history enthusiast, hunters and anglers, hikers, and the casual visitor interested in varied scenery. Six of the top ten tourist attractions in Nebraska are found in the ecoregion and all are based at least in part on natural amenities. Tourism is the second largest industry in the Panhandle, generating $40 million in retail dollars in Scotts Bluff County alone.

The ecoregion is home to Lake McConaughy, the largest reservoir in the state and a well-known destination for anglers, bird watchers, hunters, and campers. The reservoir supports trophy-sized striped bass and walleye, and the adjacent Lake Ogallala is one of the best rainbow trout fisheries in the Great Plains. Over 340 species of birds have been observed at

Lake McConaughy, more than any other site in Nebraska. Several hundred eagles can be seen during the winter from a heated eagle viewing facility below the dam.

Nebraska's Pine Ridge offers some of the most scenic vistas in the state. The 22,000-acre Fort Robinson State Park provides opportunities to observe bighorn sheep and bison. A small but growing elk herd in the Pine Ridge provides hunting and wildlife-viewing opportunities. Anglers can enjoy quality trout fishing in the area's coldwater streams, and wild turkey and deer hunting opportunities abound. Fort Robinson offers several trail types, including equestrian trails. In addition to Fort Robinson and Chadron State Parks, numerous state wildlife management areas, the Nebraska National Forest (Pine Ridge District) and Soldier Creek Wilderness Area also occur on Pine Ridge. Oglala National Grassland and Toadstool Geologic Park, both administered by the U.S. Forest Service are located north of Pine Ridge and provide their own unique habitats and outdoor recreation opportunities.

A second prime recreational area in the ecoregion is the Wildcat Hills located south of the North Platte River in Scotts Bluff and Banner Counties. The Wildcat Hills Nature Center is the region's leading environmental education center. A variety of programs are offered to adults and children about the region's unique flora and fauna and a trail system accommodates wildlife viewers. The nearby Scotts Bluff National Monument has a three-mile scenic trail that leads to the summit of the monument. There are currently plans for a 26-mile network of trails and greenways that generally follow the North Platte River and link Scottsbluff and Gering with Scotts Bluff National Monument.

Recently, economic development in the ecoregion is becoming more entwined with the natural amenities of the area. Declining rural populations and diminished agricultural opportunities are changing the make-up of the ecoregion and may be contributing to the new economic direction. Nature-based recreation is providing new opportunities in the Shortgrass Prairie Ecoregion.

A challenge to expanding nature-based recreation and conserving biological diversity in the region is the need to involve a greater portion of the area's citizens in these activities. Individuals from the business, economic development, and agricultural sectors need to be involved in planning, promotion, and development of nature and wildlife tourism. There is no centralized clearinghouse of wildlife-viewing information, and there is a significant lack of wildlife-viewing infrastructure in the ecoregion. Although there are many quality opportunities for nature-based recreation, access points are limited or obscured, interpretive information is lacking, and promotion of viewing opportunities is minimal. More individuals knowledgeable about wildlife-viewing are needed to help inform community leaders and the public about the ecoregion's potential.

Education

Environmental education has long been viewed as a critical element of conservation in the Shortgrass Prairie Ecoregion, with efforts to bring wildlife education into the classroom ongoing for several decades. Educational Service Unit #13 in Scottsbluff has been a model for working collaboratively with agencies and private organizations to facilitate environmental education in the region's schools. The Wildcat Hills Nature Center in Gering

was built to help students and adults learn about natural history of the area. Small classroom size in schools of the Panhandle affords opportunities for student-centered learning but often requires that a larger number of teachers be trained in environmental education. Rural schools sometimes have more space available for outdoor classrooms or may even be located close to natural areas that can be used for field trips.

The region's larger schools are experiencing increases in enrollment. In addition, constraints on teachers to meet new and existing curriculum requirements often leaves little time for environmental education. Understanding and addressing cultural differences in environmental education programming is also important as the student population becomes more ethnically-diverse. Another challenge is that western Nebraska teachers are often not able to travel to the eastern part of the state for environmental education training because of the distance.

Regardless of the challenges, surveys indicate that interest in wildlife education is high in the region and nearly all schools incorporate wildlife themes in the classroom. In addition, several environmental education programs take place in the ecoregion each year. These include but are not limited to "Water Education for Tomorrow," "Branch Out," "Panhandle Eco Extravaganza about Prairie (PEEP)," "Educational Bird Banding Stations," "Let's Rock," and "Environ-Art." The Riverside Discovery Center in Scottsbluff offers a zoo and a natural history and children's museum for locals and visitors to the region. Rocky Mountain Bird Observatory conducts landowner workshops, pre-service training, PEEP, and participates in environmental education programs about the ecoregion. More specific details about these programs and more are available by contacting the Project WILD Coordinator at the Nebraska Game and Parks Commission.

Despite the rich natural heritage of the ecoregion, there is often a lack of understanding and awareness of the ecoregion's biological diversity. Some ranchers and farmers who have a unique understanding of the region and relevant wildlife experiences are willing to share their knowledge can help rectify this problem. Increased collaboration amongst environmental educators, resource professionals, teachers, farmers and ranchers, and community leaders could lead to increased understanding of various viewpoints and increase education capacity.

Potential actions include educational programming to reach out to agricultural producers and working with post-secondary education administration to provide curriculum for new professionals on habitat management techniques compatible with agricultural operations. Targeted education efforts can teach individuals how to recognize invasive species, prevent their spread, and implement control measures. Education programs could also demonstrate alternative land uses (e.g., tourism, hunting, fishing) that could supplement landowner incomes without any additional loss of wildlife habitats.

Organizations and Partnerships

The Shortgrass Prairie Ecoregion has partnerships, coalitions, and grass-roots efforts to conserve the region's biodiversity values. Groups include, but are not limited to, the following:

In 2001, **Nebraska Prairie Partners (NPP)** was formed in cooperation with the Rocky Mountain Bird Observatory (RMBO) and Nebraska Game and Parks Commission (NGPC). These groups recognized a need for bird population monitoring and landowner outreach in western Nebraska to facilitate avian conservation. RMBO has expertise in bird conservation, field monitoring, and landowner outreach. NGPC has local infrastructure, funding, and a proven private lands incentive program. The project's objective is to conserve and enhance prairie habitat on private lands by implementing grassland bird monitoring and research and providing outreach, technical expertise, and financial incentives to landowners. Target species include burrowing owl, ferruginous hawk, and mountain plover. To date, approximately 500 private landowners have been involved in the program. NPP projects are supported by grants from the Nebraska Game and Parks Commission, U.S. Fish and Wildlife Service, the Nebraska Environmental Trust Fund, and Playa Lakes Joint Venture.
www.rmbo.org

Platte River Basin Environments, Inc. (PRBE) was organized officially in 1991. This organization seeks to acquire and manage North Platte River Valley and Wildcat Hills lands for conservation, recreation, and education. Led by avid sportsmen and conservation enthusiasts, its members also have expertise in hydrology, geology, range management, and wildlife biology. Since its formation, PRBE has secured over $20 million in grants and donations for conservation from groups such as the Nebraska Environmental Trust, North American Wetlands Conservation Act, Oregon Trail Community Foundation, Ducks Unlimited, Pheasants Forever, National Wild Turkey Federation, Peter Kiewit Foundation, and the Private Stewardship Grant Program. PRBE efforts earned them the 2004 National Wetlands Conservation Award. Properties PRBE has helped acquire and protect include: Wildcat Hills Nature Center, Cedar Canyon Wildlife Management Area (WMA), Kiowa WMA, Faucus Springs WMA, Chadron Creek WMA, and PRBE's Mitchell Valley Units, Spotted Tail Units, Horse Creek Units, Bead Mountain Ranch, Montz Ranch, and Carter Canyon Ranch.
nebwild.org

The Playa Lakes Joint Venture was formed in 1989 to conserve playas and associated habitats for birds and other wildlife in parts of six states in the western Great Plains. Since its inception, the PLJV has raised millions to conserve more than 100,000 acres of playas, other wetlands, and associated habitats in the High Plains. The activities of the PLJV are guided by a master plan that provides direction for conservation activities at the regional level. The Joint Venture is a regional partnership of federal and state wildlife agencies, conservation groups, industry and private landowners. Partners include: the U.S. Fish and Wildlife Service, U.S. Forest Service, Ducks Unlimited, The Nature Conservancy, Pheasants Forever, Conoco-Phillips, and state wildlife agencies of Colorado, Kansas, Nebraska, New Mexico, Oklahoma and Texas – and via these partners numerous landowners.
www.pljv.org

Ecoregion-specific Stresses

Key Stresses

In addition to the stresses and conservation actions identified in this chapter for the Shortgrass Prairie Ecoregion, statewide concerns are identified also in chapter four. Conservation practitioners identified the following stresses as the top threats in the ecoregion.

Altered frequency, duration, and intensity of natural disturbances: Short-grass and mixed-grass prairies in the ecoregion historically were subject to intensive short-duration grazing by native herbivores followed by periods of rest. Constant season-long grazing by cattle has changed plant and animal composition by favoring a relatively small proportion of species adapted to prolonged grazing. Periodic fires historically burned through expansive areas of prairie and Ponderosa pine forest. The lack of fire has altered species composition and structure of grasslands, forest, and wetlands.

Altered hydrology and channel degradation of rivers and streams: Rivers, streams, and wetlands in the ecoregion are being stressed by surface water diversions and groundwater withdrawals. The loss of water in aquatic communities jeopardizes many species. A lowering of the water table along rivers and streams changes plant composition and often promotes the spread of invasive species. For example, reduced flows to the Platte and Republican rivers have contributed to a shift from a grass/forb-dominated community to trees and shrubs.

Spread of invasive species: Invasive species are a major threat to the ecoregion's biological diversity. Cheatgrass, Russian-olive, reed canary grass, saltcedar, eastern red-cedar, narrow-leaf cattails, and other species have competitively excluded native plants and degraded habitat for fish and wildlife. Mountain pine beetles have also recently entered the region and may become problematic in pine woodlands.

Excess deer browsing: Over-browsing by deer can degrade native woodlands and impact agricultural production in areas.

Lack of knowledge about the region's biological diversity and ecological processes: Residents have limited opportunity to learn about the region's native plant and animal species. Most school-aged children and adults know little about the area's species and threats to biological diversity. Landowners have limited access to information on management methods that can be used to sustain natural communities and biological diversity on their land.

Conversion and fragmentation of natural habitats: Although large areas of the ecoregion are still intact, sub-division of larger ranches into ranchettes and smaller acreages is resulting in loss and fragmentation of natural communities. Second-home construction along rivers, native forests, and near recreational areas is also leading to fragmentation of native plant communities. Agricultural conversion of grassland continues in the ecoregion.

Agricultural economics: The agricultural community in the ecoregion is driven by a high level of pride and personal responsibility for sustaining the region's unique natural resources. Economic hardships are changing ownership patterns (e.g., more non-resident owners, larger corporate farming operations), which could affect management decisions and ultimate stewardship of the land.

Poorly-sited utility-scale wind turbines: Wind energy development is a growing industry in the Great Plains. There are many benefits to cleaner and renewable energy sources; nevertheless, in order to conserve the biodiversity of the Shortgrass Prairie Ecoregion, it is important to carefully consider the placement of wind turbines in order to minimize negative impacts to wildlife. Whenever possible, turbines and their associated power lines and access should be sited in areas that have already been significantly disturbed (e.g., cropland, old railway/road corridors). See Nebraska Game and Parks Commission guidelines for wind energy development.

Biologically Unique Landscapes of the Shortgrass Prairie Ecoregion

A goal of the Nebraska Natural Legacy Project is to identify priority landscapes that, if properly managed, will conserve the majority of the state's biological diversity. These landscapes, referred to as Biologically Unique Landscapes (BULs), were selected based on the occurrences of at-risk species and natural communities. See Chapter 3 for a description of the methods used to select the landscapes.

The map on the following page shows the BULs for the Shortgrass Prairie Ecoregion. Following the map are brief descriptions of each BUL, including stresses affecting species and habitats, proposed conservation actions, and lists of the Tier I at-risk species and natural communities found in the landscape. In order to help prioritize conservation in each BUL, we denoted species that occur in only one or a few BULs with superscripts.

In the Shortgrass Prairie Ecoregion, some BULs are truncated by the Nebraska state boundary. We suggest opportunities for wildlife conservation in these areas based on review of corresponding adjacent state wildlife action plans.

Shortgrass Biologically Unique Landscapes

Kimball Grasslands
North Platte River
Oglala Grasslands
Panhandle Prairies
Pine Ridge
Platte Confluence (see Mixedgrass Ecoregion for description)
Sandsage (North and South combined)
Upper Niobrara River
Wildcat Hills (North and South combined)

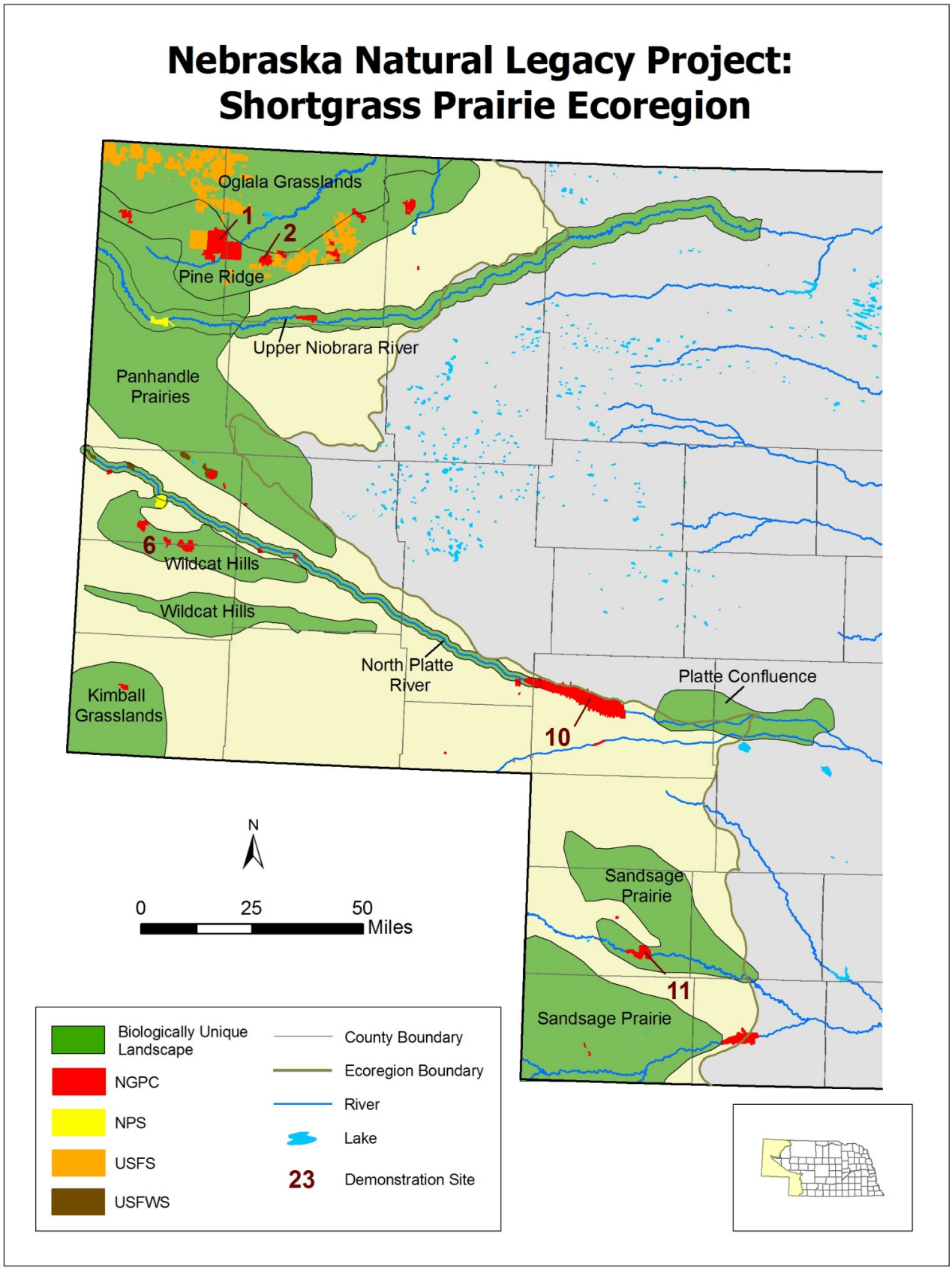
Demonstration Sites of the Shortgrass Prairie Ecoregion

Demonstration sites are locations across the state with potential for showcasing conservation projects and the results of sustainable management to the public. They provide opportunities for learning about the site's unique qualities and importance to at-risk species. See Chapter 4 for information on selecting demonstration sites. The Shortgrass Prairie Ecoregion map shows the location of demonstration sites in the area.

Site name	# on map	BUL
Enders Reservoir	11	Sandsage Prairie
Fort Robinson State Park	1	Pine Ridge
Lake McConaughy	10	N/A
Ponderosa Pine WMA	2	Pine Ridge
Wildcat Hills	6	Wildcat Hills

Descriptions of each site are found in the write-up for the BUL in which the site is found. The Lake McConaughy site is not within a BUL and the description is included here.

10. Lake McConaughy - Nebraska Game and Parks Commission
Lake McConaughy is the largest property in the Parks system, but over 80% of this property is lake. Uplands bordering the lake are Sandhills dune prairie and loess mixed-grass prairie. There are wetlands present at the Spring Park area. The lake attracts many resident and migrating birds, including many considered at-risk. This location has a visitor's center that attracts many people from Nebraska and from other states as well.


Nebraska Natural Legacy Project:
Shortgrass Prairie Ecoregion
Oglala Grasslands
1
2
Pine Ridge
Upper Niobrara River
Panhandle Prairies
6
Wildcat Hills
Wildcat Hills
North Platte River
Platte Confluence
Kimball Grasslands
10
N
0
25
50
Miles
Sandsage Prairie
11
Sandsage Prairie
Biologically Unique Landscape
NGPC
NPS
USFS
USFWS
County Boundary
Ecoregion Boundary
River
Lake
23
Demonstration Site

Kimball Grasslands

Biologically Unique Landscape Description
This landscape occupies level to rolling hills and breaks of southwest Kimball County. Most level ground is in dry-land crops, primarily wheat. Native mixed-grass prairie still occupies the shallow-soiled breaks bordering Lodgepole Creek and other stream valleys.

The landscape is unique in that it supports the state's only population of the federally and state listed Colorado butterfly plant, within the Lodgepole Creek valley. The state-listed mountain plover nests in heavily-grazed native grasslands and cropland such as short wheat stubble. Playa wetlands are found on level plains in the northern portion of the BUL.

Stresses Affecting Species and Habitats

- Invasive plant species in native grasslands; the primary species of concern is cheatgrass
- Canada thistle invasion, herbicide spraying, and lowered groundwater levels in meadows where the Colorado butterfly plant occurs
- Tillage in fallow wheat fields that destroys mountain plover nests
- Sedimentation and hydrological alteration of playa wetlands
- Conversion of native prairie to cropland
- Decline in CRP enrollment
- Infrastructure development (e.g., roads, utility-scale wind turbines) in native grasslands

Conservation Strategies

- Work with private landowners whose meadows contain the Colorado butterfly plant to develop and implement forms of Canada thistle control that do not damage populations of the butterfly plant
- Restore and maintain the hydrology of Lodgepole Creek needed to sustain floodplain biodiversity and ecosystem function
- Conduct voluntary nest clearing of wheat fields to prevent damage to mountain plover nests
- Restore selected crop fields and CRP lands to short-grass prairie for mountain plover nesting habitat
- Prevent sedimentation and restore the hydrology of the playa wetlands
- Develop management agreements with landowners to implement grazing and burning strategies on native grasslands that favor mountain plover and native plant diversity
- Re-enrollment of CRP lands
- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to native species. Avoid placing wind turbines in native prairies. See Nebraska Game and Parks Commission guidelines for wind energy development.

Collaborative Conservation Opportunities across State Borders
Coordinate with Colorado and Wyoming conservation organizations, particularly efforts to benefit shared species of greatest conservation need on the NE Kimball Grasslands/CO Midgrass Prairie and Dry Crop/WY borders (i.e., Weld County in CO and Laramie County in WY). Nebraska Tier I at-risk species identified also in the Colorado Wildlife Action Plan as

priority species include the swift fox, ferruginous hawk, McCown's longspur, and mountain plover. Nebraska Tier I species identified also in the Wyoming Wildlife Action Plan include the swift fox, burrowing owl, ferruginous hawk, McCown's longspur, and plains topminnow. Species lists may be updated as new information becomes available. Innovative methods for sufficient information exchange could aid the collaborative process.

Coordinated conservation actions should mirror priorities as identified in Colorado's Comprehensive Wildlife Conservation Strategy and/or conservation actions as identified in the Wyoming State Wildlife Action Plan (e.g., cheatgrass control measures). Collaborative conservation efforts across state borders should include also researchers, federal and non-profit environmental program coordinators, and landowners, particularly those with properties extending over state lines. Continuation and expansion of the Conservation Reserve Program (CRP) is a potential multi-state collaboration that can benefit mountain plovers, as well as other species. Additionally, USDA programs may have goals in common with Natural Legacy. In order to implement other conservation actions beyond state boundaries, it will be necessary to identify and develop staffing and funding sources. Funding that is not specific to any one state will provide more flexibility in project scope.

Tier I At-risk Species

Plants:
Colorado Butterfly Plant[1]
Matted Prickly-phlox[2]
Short's Milkvetch[1]

Animals:
Swift Fox
Burrowing Owl
Ferruginous Hawk
Loggerhead Shrike
Chestnut-collared Longspur[3]
McCown's Longspur[3]
Mountain Plover[1]
Plains Topminnow
Cheyenne Northern Pocket Gopher[1]
Regal Fritillary
Colorado Rita Dotted-blue[1]

Aquatic Communities:
Headwater, Warm Water Stream

Terrestrial Communities:
Pine-Juniper Scarp Woodland
Sandbar Willow Shrubland
Buckbrush Shrubland
Chokecherry-Plum Shrub Thicket
Freshwater Seep

Wheatgrass Playa Grassland
Cattail Shallow Marsh
Western Sand Prairie
Threadleaf Sedge Western Mixed-grass Prairie*
Wheatgrass Western Mixed-grass Prairie
Western Floodplain Terrace Grassland
Perennial Sandbar
Sandbar/Mudflat
Rock Outcrop*

* Priority for conservation in this BUL
[1] This is the only BUL where the species is known to occur
[2] Known to occur in only one other BUL
[3] Known to occur in only two other BULs
[4] Known to occur in only three other BULs

North Platte River

Biologically Unique Landscape Description
This landscape includes the North Platte River channel and associated freshwater and alkaline wetlands and riparian woodlands within the valley from the upper end of Lake McConaughy to the Wyoming/Nebraska border. The North Platte River valley has a braided, mainly tree-lined channel. Cottonwood, eastern red-cedar and Russian-olive are the dominant floodplain trees. The majority of the river floodplain is farmed. However, both alkaline and freshwater wetland complexes remain. Many of the freshwater meadows are heavily invaded by exotic grasses. The alkaline meadows tend to be in better condition. These meadows support unique assemblages of insects including tiger beetles, dragonflies and butterflies. North Platte valley wetlands are an essential migratory stopover point for waterfowl and shorebirds. Major protected areas in this landscape include Kiowa and Chet and Jane Fleisbach Wildlife Management Areas and lands owned by Platte River Basin Environments, Inc.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Invasive plant species in sandbars, meadows, and woodlands, including tall wheatgrass, Russian-olive, cheatgrass, Eurasian phragmites, narrow-leaf cattail, Canada thistle, and reed canary grass
- Ditching and drainage of wetlands
- Altered natural hydrology, particularly lack of high spring flows, low summer flows, and reduced sediment transport to maintain sandbars and fish habitat and to prevent channel degradation.
- Groundwater pumping and reduced in-stream flows that impact water levels in valley wetlands
- Sedimentation and drainage of backwater sloughs
- Conversion of meadows to cropland
- Urban and second home development

Conservation Strategies

- Implement planned grazing and haying strategies on public and private lands, in combination with prescribed fire and rest, to improve native plant diversity and vigor.
- Clear eastern red-cedar and undertake other tree clearings to maintain open meadow habitat for waterbirds and grassland birds
- Develop and implement best management practices to control and manage invasive plant communities
- Work with agronomists to discontinue use of tall wheatgrass, reed canary grass, and Garrison creeping-foxtail in plantings
- Acquire through voluntary fee title acquisition or place conservation easements on undeveloped reaches of the river and wet meadows to protect them from development
- Restore and/or maintain North Platte River hydrology necessary to sustain biological diversity and ecosystem function. Also, restore natural hydrology to important streams in the BUL.
- Restore wetland hydrology and connect backwater habitats to the river
- Facilitate the establishment of prescribed burn associations

Tier I At-risk Species

Plants:
Large-spike Prairie-clover
Platte River Dodder[1]

Animals:
Northern River Otter
Bell's Vireo
Burrowing Owl
Trumpeter Swan
Regal Fritillary
Plains Topminnow

Aquatic Communities:
Headwater, Warm Water Stream
Mid-order, Warm Water River

Terrestrial Communities:
Cottonwood-Peachleaf Willow Riparian Woodland
Cottonwood Riparian Woodland
Sandbar Willow Shrubland
Buckbrush Shrubland
Buffaloberry Shrubland
Chokecherry-Plum Shrub Thicket
Freshwater Seep
Western Alkaline Meadow*
Western Subirrigated Alkaline Meadow*
Western Sedge Wet Meadow*
Cattail Shallow Marsh

Reed Marsh
Western Alkaline Marsh*
Perennial Sandbar*
Sandbar/Mudflat*
Riverine Gravel Flats*

* Priority for conservation in this BUL
[1] This is the only BUL where the species is known to occur
[2] Known to occur in only one other BUL
[3] Known to occur in only two other BULs
[4] Known to occur in only three other BULs

Oglala Grasslands

Biologically Unique Landscape Description
This landscape occupies the plains and rolling hills in the northwestern Panhandle north of the Pine Ridge. Mixed-grass prairie covers most of the plains and hills. Rock outcrops and badlands are dispersed among the prairie, as are small stream valleys. The soils are predominantly clays derived from Pierre Shale, and the prairie is dominated by blue grama, green needle grass, and western wheatgrass.

This landscape is one of the larger, intact grasslands remaining in Nebraska and contains extensive badlands. Several plant communities including the western floodplain terrace grassland, silver sagebrush shrub prairie, greasewood shrub prairie, and northwestern mixed-grass prairie occur nowhere else in the state. Scattered playas occur in the landscape. These grasslands support extensive prairie dog towns, swift fox populations, and extensive habitat for grassland birds. Prairie dog towns within the BUL may be suitable for colonization of black-footed ferrets migrating from established colonies in southwestern South Dakota. The Oglala National Grassland occupies a large portion of this landscape.

Stresses Affecting Species and Habitats
- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Invasive plant species, primarily cheatgrass
- Potential disease in prairie dog populations

Conservation Strategies
- Work with private landowners and the U.S. Forest Service to implement ecologically-sensitive grazing strategies that reduce cheatgrass and promote native plant diversity and diverse wildlife habitats.
- Restore sagebrush communities on selected sites
- Manage public lands to maintain black-tailed prairie dog towns at an ecologically-functional level

Collaborative Conservation Opportunities across State Borders
Coordinate with South Dakota and Wyoming conservation agencies and tribes, particularly efforts to benefit shared species of greatest conservation need on the NE Oglala Grasslands/WY/SD Great Plains Steppe Ecoregion borders (i.e., Fall River and Shannon counties in SD and Niobrara County in WY). Nebraska Tier I at-risk species identified also in the South Dakota wildlife action plan include the swift fox, burrowing owl, ferruginous hawk, and long-billed curlew. And, species identified also in the Wyoming wildlife action plan include the swift fox, burrowing owl, ferruginous hawk, and long-billed curlew. Species lists may be updated as new information becomes available. Innovative methods for sufficient information exchange could aid the collaborative process.

Coordinated wildlife management actions (e.g., working with landowners; rotational burning, mowing, and grazing) should mirror medium to high priority conservation goals identified in the South Dakota Comprehensive Wildlife Conservation Plan and/or conservation actions identified in the Wyoming State Wildlife Action Plan (e.g., cheatgrass control measures). Collaborative conservation efforts across state borders should include researchers, federal and non-profit environmental program coordinators, and landowners, particularly those with properties extending over state lines. It will be necessary to identify and develop staffing and funding sources for implementation of conservation actions beyond state boundaries.

Tier I At-risk Species

Plants:
Barr's Milkvetch[1]
Dog-parsley[3]
Gordon's Wild Buckwheat[3]
Rocky Mountain Bulrush[1]

Animals:
Pierre Northern Pocket Gopher[2]
Swift Fox
Baird's Sparrow
Bell's Vireo
Brewer's Sparrow
Burrowing Owl
Chestnut-collared Longspur[3]
McCown's Longspur[3]
Ferruginous Hawk
Loggerhead Shrike
Long-billed Curlew
Regal Fritillary

Aquatic Communities:
Headwater, Warm Water Stream
Mid-order, Warm Water River*

Terrestrial Communities:
Cottonwood-Peachleaf Willow Riparian Woodland
Cottonwood Riparian Woodland
Sandbar Willow Shrubland
Buckbrush Shrubland
Buffaloberry Shrubland
Chokecherry-Plum Shrub Thicket
Freshwater Seep
Western Alkaline Meadow
Western Sedge Wet Meadow*
Playa Wetland
Spikerush Vernal Pool
Cattail Shallow Marsh
Threadleaf Sedge Western Mixed-grass Prairie*
Northwestern Mixed-grass Prairie*
Western Floodplain Terrace Grassland*
Silver Sagebrush Shrub Prairie*
Greasewood Shrub Prairie*
Perennial Sandbar
Sandbar/Mudflat
Rock Outcrop*
Badlands*

* Priority for conservation in this BUL
[1] This is the only BUL where the species is known to occur
[2] Known to occur in only one other BUL
[3] Known to occur in only two other BULs
[4] Known to occur in only three other BULs

Panhandle Prairies

Biologically Unique Landscape Description
This landscape occupies the plains and rolling hills of the northern Panhandle from the Pine Ridge south to the North Platte River valley. It includes the rough breaks and rocky outcrops associated with the Niobrara River in central Sioux County and the North Platte River in Scotts Bluff and Morrill counties. The plains include isolated sand dunes in west-central Sioux County. These dunes support Sandhills dune prairie and sandsage prairie. The landscape is occupied primarily by native prairie with only scattered cropland.

This BUL supports extensive, intact native prairie inhabited by swift fox, prairie dogs, and grassland birds. The North Platte National Wildlife Refuge and a couple of small wildlife management areas are the only protected lands in this landscape.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Invasive plant species, primarily cheatgrass
- Potential disease in prairie dog populations that can quickly kill an entire colony
- Conversion of prairie to cropland (e.g., in the Niobrara River valley)
- Fence type and placement that significantly hinders wildlife
- Potential losses in CRP enrollment
- De-watering of the Niobrara River
- Infrastructure development (e.g., roads, utility-scale wind turbines) in native grasslands

Conservation Strategies

- Implement ecologically-sensitive grazing and haying strategies on native prairies on private lands, in combination with prescribed fire and rest. In appropriate areas, these strategies can be designed to benefit mountain plover nesting.
- Coordinate with interested landowners to protect high-quality sites through conservation easements or voluntary fee title acquisition
- Re-enrollment of CRP lands and/or establishment of grazing strategies appropriate to the local flora on lands coming out of CRP enrollment
- Facilitate the establishment of prescription burn associations
- Promotion of fencing methods that are less detrimental to pronghorn antelope and other wildlife
- Environmental education to address water conservation strategies
- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to native species. Avoid placing wind turbines in native prairies. See Nebraska Game and Parks Commission guidelines for wind energy development.

Collaborative Conservation Opportunities across State Borders

Coordinate with Wyoming conservation agencies and organizations, particularly efforts to benefit like species of greatest conservation need on the NE Panhandle Prairies/WY border (i.e., Goshen County in WY). Identified species include swift fox, burrowing owl, ferruginous hawk, long-billed curlew, and McCown's longspur. Species lists may be modified as new information becomes available. Innovative methods for sufficient information exchange could aid the collaborative process.

Coordinated wildlife management actions should mirror conservation actions (e.g., financial incentives to landowners for grassland conservation) identified in the Wyoming State Wildlife Action Plan. Collaborative conservation efforts across state borders should include researchers, federal and non-profit environmental program coordinators, and landowners, particularly those with properties extending over state lines. It will be necessary to identify and develop staffing and funding sources for implementation of conservation actions beyond state boundaries.

Tier I At-risk Species

Plants:
Blowout Penstemon
Gordon's Wild Buckwheat[3]
Large-spike Prairie-clover
Animals:
Swift Fox
Brewer's Sparrow
Burrowing Owl
Ferruginous Hawk
Loggerhead Shrike
Long-billed Curlew
Chestnut-collared Longspur[3]
Mccown's Longspur[3]
Nine-spotted Ladybird Beetle[1]
Regal Fritillary
Finescale Dace
Northern Redbelly Dace
Plains Topminnow
Sagebrush Lizard[2]

Aquatic Communities:
Headwater, Warm Water Stream

Terrestrial Communities:
Pine-Juniper Scarp Woodland
Rocky Mountain Juniper Woodland
Buckbrush Shrubland
Buffaloberry Shrubland
Chokecherry-Plum Shrub Thicket
Freshwater Seep
Western Alkaline Meadow
Western Sedge Wet Meadow*
Cattail Shallow Marsh
Sandsage Prairie
Western Sand Prairie*
Threadleaf Sedge Western Mixed-grass Prairie*
Wheatgrass Western Mixed-grass Prairie*
Western Floodplain Terrace Grassland
Rock Outcrop*

* Priority for conservation in this BUL
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[2] Known to occur in only one other BUL
[3] Known to occur in only two other BULs
[4] Known to occur in only three other BULs

Pine Ridge

Biologically Unique Landscape Description

The Pine Ridge is a rocky escarpment that rises several hundred feet from the surrounding plains in Sioux, Dawes, and Sheridan counties in northwest Nebraska. The escarpment is composed of sandstone, siltstones, and volcanic ash. Ponderosa pine woodlands and forest occupy many of the north- and east-facing slopes, and bottoms. Pine woodlands and mixed-grass prairie occupy the south- and west-facing slopes. Several streams, including the White River, Hat Creek, and Soldier Creek, originate in the Pine Ridge. The valleys of these northward flowing streams support deciduous woodlands and meadows in their floodplains.

Being a pine-dominated escarpment within the Great Plain's grassland, the Pine Ridge supports many at-risk species at the edge of their range, including two of the state's three populations of the Rocky Mountain bighorn sheep. There are several large protected areas within this landscape, including the Nebraska National Forest (Pine Ridge District), Fort Robinson State Park and several wildlife management areas.

Natural Legacy Demonstration Sites

1. Fort Robinson State Park - Nebraska Game and Parks Commission
The majority of Fort Robinson is rolling prairie uplands, but this large park has riparian areas and towering buttes and rock outcrops. Pine woodlands characteristic of the Pine Ridge provide habitat for the bighorn sheep and other at-risk species. A large part of the park was burned in 1989. Areas of the Pine Ridge have western mixed-grass prairie, ponderosa pine forest, dry-mesic ponderosa pine woodland, dry ponderosa pine open woodland and savanna. There is much potential for a variety of management types at the park.

2. Ponderosa Pine Wildlife Management Area - Nebraska Game and Parks Commission
The Ponderosa WMA is adjacent to U.S. Forest Service Property. There is potential for demonstration sites at a variety of state and federal properties in the Pine Ridge. Ponderosa has primarily coniferous forest cover with Squaw Creek running through it with associated deciduous forest. Western mixed-grass prairie, ponderosa pine forest, dry-mesic ponderosa pine woodland, dry ponderosa pine open woodland, and savanna can be found in the area. Prescribed fire and other management techniques are conducted on Ponderosa Pine WMA and other nearby properties.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure.
- Invasive plant species, including cheatgrass, smooth brome, Kentucky bluegrass, eastern red-cedar, leafy spurge, and Canada thistle
- Lack of grazing and prescribed fire on many public lands
- Increased densities of ponderosa pine and to a lesser extent eastern red-cedar, because of a lack of fire.
- Housing and ranchette development

- Commercial logging practices that take old-growth trees, disturb groundcover, and create logging roads
- Catastrophic crown fires resulting from excess fuel accumulation.
- Pine bark beetle infestations
- Transmission of diseases between domestic sheep, goats, and Rocky Mountain bighorn sheep
- Poorly-sited utility-scale wind turbines

Conservation Strategies

- Implement planned grazing strategies on public and private lands to improve native plant diversity and vigor.
- Coordinate with landowners interested in using conservation easements to protect important areas for conservation
- Work with public and private landowners to implement prescribed, low-intensity surface fires to control exotic plants, reduce Ponderosa pine and eastern red-cedar densities, and reduce threat of crown fires. Dense stands of trees may require mechanical thinning prior to burning to reduce fuel loads.
- Conduct ecologically-sensitive tree thinning on private and public land
- Implement biodiversity management on public lands, including increased use of prescribed, low-intensity surface fire and planned grazing systems. A fire return interval of 5-10 years should be appropriate for public lands within the Pine Ridge.
- Treat pine infestations of pine bark beetles
- Support the development of local industries for pine wood products
- To avoid disease transmission, work with private landowners to limit domestic sheep and goats in areas used by bighorn sheep
- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to species. See Nebraska Game and Parks Commission guidelines for wind energy development.

Tier I At-risk Species

Plants:
Dog-parsley[3]

Animals:
Rocky Mountain Bighorn Sheep[2]
Swift Fox
Fringe-tailed Myotis[2]
Pierre Northern Pocket Gopher[2]
Bell's Vireo
Brewer's Sparrow
Ferruginous Hawk
Pinyon Jay[2]
Mottled Duskywing[4]
Regal Fritillary
Tawny Crescent[1]

Aquatic Communities:
Headwater, Coldwater Stream*
Headwater, Warmwater Stream*

Terrestrial Communities:
Cottonwood-Peachleaf Willow Riparian Woodland
Cottonwood Riparian Woodland
Peachleaf Willow Woodland
Green Ash-Elm-Hackberry Canyon Bottom Woodland*
Ponderosa Pine Forest*
Dry-Mesic Ponderosa Pine Woodland*
Dry Ponderosa Pine Open Woodland and Savanna*
Pine-Juniper Scarp Woodland*
Buckbrush Shrubland
Buffaloberry Shrubland
Skunkbrush Sumac Shrubland
Chokecherry-Plum Shrub Thicket
Mountain Mahogany Shrubland
Freshwater Seep*
Western Sedge Wet Meadow*
Cattail Shallow Marsh
Western Sand Prairie*
Threadleaf Sedge Western Mixed-grass Prairie*
Northwestern Mixed-grass Prairie
Wheatgrass Western Mixed-grass Prairie
Western Floodplain Terrace Grassland
Northern Chalk Bluff and Cliff*
Western Sandstone Cliff*
Rock Outcrop*

* Priority for conservation in this BUL
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Sandsage Prairie

Biologically Unique Landscape Description
This landscape is composed of low rolling sand dunes and stream breaks in a four county area in far southwest Nebraska. Loess mixed-grass prairie and western mixed-grass prairie occur on the breaks and bluffs of the Republican and Frenchman rivers, while sandsage prairie occurs on rolling sand dunes. The mixed-grass prairies are partially fragmented by cropland and degraded in some areas from some livestock grazing practices that reduce plant species diversity. Center pivot development has highly fragmented the sandsage prairies. The landscape is significant because it contains some of the last remnants of sandsage prairie and some of the highest quality loess mixed-grass prairies in the state. Historically, the

Sandsage Prairie BUL contained lakes and wetlands, but these have disappeared in recent decades as the groundwater table has lowered, primarily because of center pivot irrigation. If the groundwater were restored, these wetland areas may reappear. Several higher quality small streams flow into the Republican River, including Buffalo Creek and Rock Creek. The stretch of the Republican River above Swanson Reservoir is not as degraded as lower reaches and still contains a braided channel and open sandbars. The largest protected areas in the landscape are Enders Reservoir and Swanson Reservoir Wildlife Management Areas.

Natural Legacy Demonstration Site

11. Enders Reservoir - Nebraska Game and Parks Commission
Enders Reservoir includes nearly 4000 acres of woodlands, short-grass, mixed-grass, and sagebrush prairie surrounding a large reservoir. This property has a prairie dog town and is one of the larger public properties with sandsage prairie. Sandsage prairie has proved to be a challenging habitat type to manage on private lands, so Enders Reservoir will be a valuable demonstration site for showcasing sandsage prairie management.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure in prairies, which can lead to exotic plant invasion and over-abundance of sandsage brush
- Spraying of sandsage prairies to reduce sandsage abundance which greatly reduces native plant diversity and degrades wildlife habitat
- Invasive plant species, primarily smooth brome and cheatgrass, in prairie
- Conversion of native grasslands to cropland, especially conversion of sandsage prairie to center pivot irrigation
- Groundwater withdrawal for center pivot irrigation, which affects water levels in wetlands and streams
- Poorly-sited utility-scale wind turbines

Conservation Strategies

- Implement ecologically-sensitive grazing strategies and prescribed fire on native prairies, specifically sandsage prairie. The use of prescribed fire and specific grazing methods in sandsage prairies can likely reduce sandsage brush densities and eliminate the need to spray these sites to reduce brush.
- Work with landowners and others to restore groundwater levels and potentially restore wetlands in the sandsage prairie
- Work with the Natural Resource Conservation Service to eliminate the practice of herbicide spraying on private lands as a method of reducing sandsage abundance
- Implement prescribed burning on private lands as a method of reducing sandsage in sandsage prairies and controlling exotic cool-season grasses in mixed-grass prairies
- Remove invasive woody species, restore wetlands, and implement ecologically-sensitive grazing within the Republican River valley upstream from Swanson Reservoir

- Work with wind energy companies to select turbine sites that minimize fragmentation and impacts to native species. Wind farms should not be located within the recommended radius of prairie grouse leks and nesting grounds. Wind turbines should be placed in cropland or old fields where possible. Turbines can be halted temporarily during peak migration periods for bats and birds. Pre- and post-construction monitoring should be implemented. See Nebraska Game and Parks Commission guidelines for wind energy development.

Collaborative Conservation Opportunities across State Borders
Coordinate with Colorado and Kansas conservation agencies and organizations, particularly efforts to benefit shared species of greatest conservation need on NE Sandsage Prairie BUL/CO Midgrass Prairie, Sand Dune/Shrub Complex and Dry Crop/KS Shortgrass Prairie Conservation Region, especially Sandsage Shrubland borders (i.e., Yuma County in CO and Cheyenne County in KS). Nebraska Tier I at-risk species identified also in the Colorado wildlife action plan as priority species include ferruginous hawk, Brewer's sparrow, greater prairie-chicken and short-eared owl. And, species identified also in the Kansas wildlife action plan include burrowing owl, ferruginous hawk, and short-eared owl. Species lists may be modified as new information becomes available. Novel methods for sufficient information exchange could aid the collaborative process.

Coordinated wildlife management actions (e.g., minimization of habitat fragmentation, increased plant biodiversity) should mirror priorities identified in Colorado's Comprehensive Wildlife Conservation Strategy and/or strategies identified in Kansas' Comprehensive Wildlife Conservation Plan. Collaborative conservation efforts across state borders should include researchers, federal and non-profit environmental program coordinators, and landowners, particularly those with properties extending over state lines. One such partnership is the Republican River Riparian Project (RRRP): a tri-state conservation initiative; its goal is to enhance the water quality and quantity within the Republican River Basin (www.swrcd.org/RRRPP.html). In order to implement successful conservation actions beyond state boundaries, it will be necessary to identify other potential partners, as well as develop staffing and funding sources.

Tier I At-risk Species

Plants:
Large-spike Prairie-clover
Sandhill Goosefoot[1]

Animals:
Bell's Vireo
Brewer's Sparrow
Burrowing Owl
Ferruginous Hawk
Greater Prairie-Chicken
Loggerhead Shrike

Short-eared Owl
Ghost Tiger Beetle
Regal Fritillary
Plains Topminnow

Aquatic Communities:
Headwater, Cold Water Stream*
Headwater, Warm Water Stream*
Mid-order, Warm Water River

Terrestrial Communities:
Cottonwood-Peachleaf Willow Riparian Woodland
Cottonwood Riparian Woodland
Sandbar Willow Shrubland
Buckbrush Shrubland
Chokecherry-Plum Shrub Thicket
Freshwater Seep
Western Sedge Wet Meadow
Cattail Shallow Marsh
Loess Mixed-grass Prairie*
Sandhills Dune Prairie
Sandsage Prairie*
Wheatgrass Western Mixed-grass Prairie
Perennial Sandbar
Sandbar/Mudflat
Rock Outcrop

* Priority for conservation in this BUL
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Upper Niobrara River

Biologically Unique Landscape Description
This landscape occupies the Niobrara River channel, and a two-mile wide buffer on each side of the river, from eastern Cherry County westward to the Nebraska/Wyoming border. In the far west the Niobrara River is a narrow, coldwater stream with an open, gently sloping valley with few trees. Rocky outcrops are also common along the valley bluffs and mixed-grass prairie occurs on most of the bluffs. Eastward as the river gains flows, the valley becomes entrenched. Where the river enters the Sandhills in western Cherry County, the valley is several hundred feet deep. Ponderosa pine woodlands occupy portions of the bluff and cottonwood dominated-woodlands occupy portions of the floodplain. Portions of the valley bottom are in cropland.

The only dam on this reach of the Niobrara River is the one that forms Box Butte Reservoir in Dawes County, otherwise flows on the river are fairly natural. The upper Niobrara River supports a unique assemblage of cold-water fish including the pearl dace and the state-listed blacknose shiner and finescale dace. Wet meadows in the Niobrara River valley in western Sioux County support the state's only known population of Ute lady's-tresses orchid. Protected areas on the upper Niobrara include Agate Fossil Beds National Monument, The Nature Conservancy's Cherry Ranch, and Prairie Plains Resource Institute's Guadalcanal Memorial Prairie.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure in both uplands and riparian areas
- Invasive plant species, including hound's-tongue, reed canary grass, Garrison creeping-foxtail, quackgrass, Russian-olive, and narrow-leaf cattails
- Reduced river flows resulting from irrigation development. This threat is most prevalent in the western reaches of the river.
- Housing and ranchette development
- Conversion of valley bottom and terrace meadows to cropland
- Erosion and contamination from livestock watering in the river
- Aquatic nuisance species, especially zebra mussel

Conservation Strategies

- Implement ecologically-sensitive grazing and haying strategies on native prairies on private lands, in combination with prescribed fire and rest.
- In meadows containing the Ute lady's-tresses orchid, implement haying and grazing strategies that benefit the orchid
- Removal of invasive plant species such as Russian-olive
- Maintain the natural hydrology of the Niobrara River and implement conservation strategies necessary to sustain biological diversity and ecosystem function (e.g., restoring center pivot lands to native grassland)
- Work with landowners to install livestock watering facilities in uplands to avoid having cattle water from the stream
- Coordinate with interested landowners to protect high-quality sites through conservation easements
- Restrict stocking of exotic fish in the Niobrara river
- Modify culverts that impede fish moving upstream in the river
- Education about aquatic nuisance species control methods

Collaborative Conservation Opportunities across State Borders

Coordinate with Wyoming conservation agencies and organizations, particularly efforts to benefit shared species of greatest conservation need on the NE Upper Niobrara River BUL/WY border (i.e., Niobrara County in WY). Identified species include the plains topminnow, finescale dace, burrowing owl, ferruginous hawk, long-billed curlew, and swift fox. Species lists may be modified as new information becomes available. Innovative methods for sufficient information exchange could aid the collaborative process.

Tier I At-risk Species

Plants:
Blowout Penstemon
Gordon's Wild Buckwheat[3]
Large-spike Prairie-clover
Meadow Lousewort[1]
Ute Lady's-tresses[1]

Animals:
Northern River Otter
Swift Fox
Bell's Vireo
Brewer's Sparrow
Burrowing Owl
Ferruginous Hawk
Long-billed Curlew
Trumpeter Swan
Regal Fritillary
Blacknose Shiner
Finescale Dace
Northern Redbelly Dace
Plains Topminnow

Aquatic Communities:
Headwater, Cold Water Stream*
Headwater, Warm Water Stream
Mid-order Warm Water River*

Terrestrial Communities:
Cottonwood-Peachleaf Willow Riparian Woodland
Cottonwood Riparian Woodland
Green Ash-Elm-Hackberry Canyon Bottom Woodland
Sandbar Willow Shrubland
Buckbrush Shrubland
Buffaloberry Shrubland
Chokecherry-Plum Shrub Thicket
Freshwater Seep
Western Alkaline Meadow
Western Subirrigated Alkaline Meadow*
Western Sedge Wet Meadow*
Cattail Shallow Marsh
Reed Marsh
Western Sand Prairie*
Threadleaf Sedge Western Mixed-grass Prairie*
Wheatgrass Western Mixed-grass Prairie
Western Floodplain Terrace Grassland*

Perennial Sandbar
Sandbar/Mudflat
Rock Outcrop*

* Priority for conservation in this BUL
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[4] Known to occur in only three other BULs

Wildcat Hills

Biologically Unique Landscape Description
The Wildcat Hills is a rocky escarpment that rises several hundred feet on the south side of the North Platte River in Scotts Bluff, Banner, and Morrill counties. The escarpment is composed primarily of sandstone, siltstone and volcanic ash. The north bluff of the escarpment is steep and deep canyons cut into the bluff. The canyons support stands of mountain-mahogany, eastern red-cedar and Rocky Mountain juniper. The north-facing slopes of the escarpment support Ponderosa pine woodlands. Mixed-grass prairie, rock outcrops, and scattered patches of sandsage prairie occupy the remainder of the Wildcat Hills.

The Wildcat Hills are significant in supporting an intact mosaic of pine woodlands and mixed-grass prairie and the largest stands of mountain-mahogany shrubland in the state. The Wildcat Hills also are home to one of three Rocky Mountain bighorn sheep populations in the state. Protected lands within the Wildcat Hills include Scotts Bluff National Monument; Platte River Basin Environment's Bead Mountain, Carter Canyon, and Montz ranches; The Nature Conservancy's Murphy Ranch; and the Nebraska Game and Parks Commission's Cedar Canyon and Buffalo Creek Wildlife Management Areas and Wildcat Hills State Recreation Area.

Natural Legacy Demonstration Site

6. Wildcat Hills
The Wildcat Hills contains several properties that are open to the public: Buffalo Creek Wildlife Management Area (WMA), Cedar Canyon WMA, Wildcat Hills WMA, Platte River Basin Environments, Inc. Bead Mountain, Montz Point, and Carter Canyon ranches, Scotts Bluff National Monument, and The Nature Conservancy's Murphy Ranch. The entire wildlands complex encompasses approximately 30,000 acres, including rugged topography with ravines separated by steep, eroded rocky outcrops. A nature center provides education opportunities. Managers have recently found evidence of the invasive mountain pine beetle and are taking steps to slow its spread. This complex contains all the plant communities of the BUL.

Stresses Affecting Species and Habitats

- Specific livestock grazing and haying practices that may reduce native plant diversity and promote uniform habitat structure
- Lack of grazing and prescribed fire on many public lands
- Invasive plant species, including, cheatgrass, smooth brome, Kentucky bluegrass, eastern red-cedar, and Canada thistle
- Increased densities of Ponderosa pine and to a lesser extent eastern red-cedar because of a lack of fire
- Housing and ranchette development
- Potential for catastrophic crown fires resulting from excess fuel accumulation
- Pine bark beetle infestations
- Transmission of diseases between domestic sheep, goats, and Rocky Mountain bighorn sheep
- Poorly-sited utility-scale wind turbines and oil drilling

Conservation Strategies

- Implement strategic grazing strategies on public and private lands to improve native plant diversity and vigor
- Work with public and private landowners to implement prescribed, low-intensity surface fires to control exotic plants, reduce Ponderosa pine and eastern red-cedar densities, and reduce the threat of crown fires. Dense stands of trees may require mechanical thinning prior to burning to reduce fuel loads. A fire return interval of 5-10 years should be appropriate for lands within the Wildcat Hills.
- Support the development of local industries for pine wood products
- Treat pine infestations of pine bark beetles
- Coordinate with landowners interested in using conservation easements and voluntary acquisitions to protect important areas for conservation
- To avoid disease transmission, work with private landowners to limit domestic sheep and goats in areas used by bighorn sheep
- Promotion of fencing methods that are less detrimental to wildlife
- Environmental education programs to increase awareness towards wildlife, and reach out to the growing number of residents and many visitors in the Wildcat Hills
- Work with energy companies to select turbine and oil drilling sites that minimize fragmentation and impacts to wildlife. See Nebraska Game and Parks Commission guidelines for wind energy development.

Tier I At-risk Species

Plants:
Dog-parsley[3]
Matted Prickly-phlox[2]

Animals:
Fringe-tailed Myotis[2]
Rocky Mountain Bighorn Sheep[2]
Swift Fox
Bell's Vireo

Brewer's Sparrow
Burrowing Owl
Long-billed Curlew
Pinyon Jay[2]
Short-eared Owl
Regal Fritillary
Plains Topminnow
Sagebrush Lizard[2]

Aquatic Communities:
Headwater, Warm Water Stream

Terrestrial Communities:
Ponderosa Pine Forest*
Dry Ponderosa Pine Open Woodland and Savanna*
Pine-Juniper Scarp Woodland*
Rocky Mountain Juniper Woodland
Buckbrush Shrubland
Chokecherry-Plum Shrub Thicket
Mountain Mahogany Shrubland*
Freshwater Seep*
Western Alkaline Meadow
Western Sedge Wet Meadow
Sandsage Prairie*
Western Sand Prairie*
Threadleaf Sedge Western Mixed-grass Prairie*
Wheatgrass Western Mixed-grass Prairie*
Western Floodplain Terrace Grassland
Western Sandstone Cliff*
Rock Outcrop*
Badlands*
Riverine Gravel Flats

Chapter 9

Adaptive Management, Monitoring, Inventory and Research

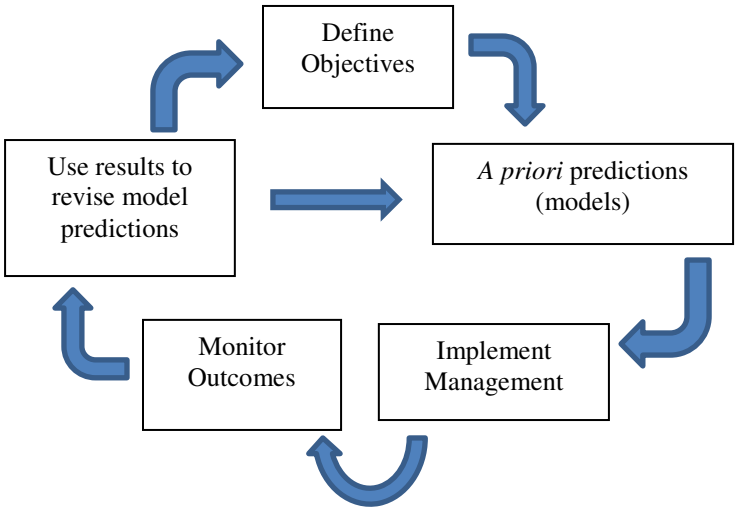
In this chapter, we present a framework for adapting our conservation actions in response to new information and changing conditions. The Nebraska Natural Legacy Project's adaptive management framework strives to improve our understanding of how systems in Nebraska work. Management objectives should be achieved through a process that involves stakeholders, is transparent and inclusive, acknowledges uncertainty about the system and the potential impacts of conservation actions, makes use of management actions and follow-up monitoring to promote understanding and improve subsequent decisions, and improves the consistency of implementing conservation actions. Our approach will involve exploring alternative ways to meet management objectives, predicting the outcomes of alternatives based on the current status of knowledge, implementing one or more of these alternatives, monitoring to learn about the impacts of the actions, and using the results to update knowledge and adjust management actions. In addition to maximizing our implementation efficiency, we are striving to make the best choices given our financial resources.

An integral component of adaptive management is monitoring to assess species and habitat responses to management actions (Figure 1). We present a number of components that should be included in a monitoring plan, the development of which is one of the priorities in implementing the Nebraska Natural Legacy Project. In addition, we list priority inventory and research needed to fill critical data gaps, provide baseline information for monitoring, and provide the knowledge needed to develop more effective conservation actions.

Adaptive Management

Adaptive management is the process of continually improving management policies and practices by learning from the outcome of management actions. Broadly, adaptive management requires defining specific objectives, making a priori predictions (i.e., constructing models) about the effects of one or more management actions on those objectives, implementing management actions, monitoring outcomes, using results to revise model predictions and management actions, and then repeating the process in an iterative loop. Adaptive management seeks to speed up the learning process about cause-and-effect relations between management actions and outcomes thus, allowing managers to make more effective decisions in a shorter time.

Figure 1.



The fundamental motivation for using adaptive management is that the impact of management actions on resources is uncertain, and the reduction of that uncertainty will accelerate progress in meeting management objectives over time. Not all decisions can or should be adaptive. In some cases there is no opportunity to apply learning. In other cases, there is little uncertainly about which action to choose. Several conditions must apply:

1. The action must be important enough such that action will occur.
2. There must be institutional capacity and commitment to undertake and sustain an adaptive program.
3. Application of adaptive management must involve a real choice among management alternatives.
4. It must be possible to acquire understanding quickly enough to apply it to subsequent management decisions.
5. The resource management decision must be such that it can be re-visited over time and modified.

In its simplest form, adaptive management can involve applying a conservation action at a site, observing the results and adjusting the action in the future if warranted. However, it has its widest applicability when components of experimental design are incorporated into the monitoring process including replication, random assignment of treatments (including controls) and sites, and statistical analysis of results. Monitoring and evaluation provide the critical links between implementing conservation actions and revising management objectives and actions to be more effective. A feedback information loop will connect habitat work with species and/or habitats and links existing literature, research, and researchers with conservation practitioners.

Adaptive management can be a powerful tool for adapting to climate change because the current levels of uncertainty, the potentially rapid rate of change, and the rate of increase in knowledge will necessitate frequent evaluation and adjustment in conservation actions. Any strategy for managing the effects of climate change on species and ecosystems should be deployed within an adaptive management framework to enable managers to learn from previous management activities and to respond quickly and creatively to the challenges posed by climate change.

The mountain plover *(Charadrius montanus)* nest marking program is an example of an adaptive management project that identifies the issues that negatively impact a specific species, identifies and conducts priority research, and improves conservation actions accordingly. The mountain plover is a threatened species in Nebraska. The first conservation action for the mountain plovers was to survey the panhandle of Nebraska to estimate the abundance and location of nesting pairs. After this initial survey, many more pairs were detected than anticipated, but nests were primarily in agriculture fields on private lands. In neighboring states, this species typically nests in short-stature grasslands and prairie dog towns. An identified threat in the first addition of the Natural Legacy Project for mountain plovers was "agriculture practices" and a research question was to evaluate "the impact of nesting in agriculture fields vs. native grasslands on mountain plover productivity." Action was taken to reduce the threat of nests being destroyed by tillage, through a nest marking program developed in cooperation with the Rocky Mountain Bird Observatory. The nest marking program works with willing landowners to detect and mark nests in agriculture fields and provides landowners incentives to till around the marked nests. From 2005 to 2007, the nest marking program was evaluated and was successful, with less than 3% (7/246) of marked nests failing because of tillage (20% total nest failure rate). In 2007, 65% (34/52) of unmarked artificial nests (i.e., scrapes with similar-sized eggs painted to look like mountain plover eggs) failed (no eggs survived) because of tillage. The program was also a success because landowners became knowledgeable of mountain plovers and were interested in continuing the program. The next phase is to understand if chick survival in "nest marked" crop field is high enough to sustain or increase the resident population. Initial results of this study suggest that chick survival is high in crop fields participating in the nest marking program relative to native habitats, but another survey year is needed to determine if the nest marking program should be continued.

The next steps for integrating adaptive management principles into implementation of the Natural Legacy Project include:

- Development of plans that identify the goals and objectives at local and/or regional scales
- Identify priority questions appropriate for the application of adaptive management
- Collaborate with resource managers for implementation of adaptive management

Monitoring

During the initial development of the Nebraska Natural Legacy Project, we did not have the resources necessary to develop a detailed monitoring plan. Below we have identified a framework for developing such a plan, which is important to implementation. Because of limitations of human, financial and information resources, we must be strategic in selecting both what to monitor and how to monitor it. Monitoring of management actions is typically conducted at two levels: 1) response of individual species and 2) response of habitats or natural communities. In addition to monitoring biotic responses, one can monitor whether proposed conservation actions were carried out (implementation monitoring), the public/stakeholder understanding, acceptance and support of conservation actions, and/or the abatement of key threats to species or communities. To be successful, a monitoring strategy needs to be affordable, provide credible information that assesses effectiveness and is usable by decision makers.

There is a need to develop long-term monitoring systems that are strategically designed to evaluate climate change impacts and species and ecosystem responses. With so much uncertainty surrounding the impacts of climate change and how species and ecosystems will respond, it is vital to design and implement monitoring programs that can provide the best science-based information possible. Results can be used to better inform decision makers and habitat managers on the best adaptation strategies. Monitoring for climatic change and associated impacts can be carried out as a stand-alone effort or by integrating relevant variables into existing monitoring efforts.

Implementation Monitoring

An important component of the monitoring strategy will be to track the implementation of conservation actions that are proposed in the Nebraska Natural Legacy Project. These can be used to evaluate how well the goals set for conservation of natural communities and species are being met. Information collected would include the location, types of conservation actions, agencies and organizations involved, species and communities affected, acres or miles of stream, cost of project, funding sources, etc. The use and effectiveness of tools such as incentives, easements, voluntary acquisitions, management agreements, and restorations should also be monitored and analyzed, not only in terms of accomplishments but also cost-effectiveness.

Species Monitoring

Population monitoring is currently being conducted on a regular basis, mostly annually, for a handful of at-risk species including bald eagle (Jorgensen et al. 2010), piping plover (Baasch 2011, Brown & Jorgensen 2010, Elliott-Smith et al. 2009, Tacha et al. 2011), interior least tern (Baasch 2011, Brown & Jorgensen 2010, Tacha et al. 2011), greater prairie-chicken (Lusk 2011), pallid sturgeon (Drobish 2008, Welker & Drobish 2010), and Salt Creek tiger beetle (Spomer and Fritz 2011). This type of monitoring allows researchers to determine if populations are increasing, stable, or decreasing and can alert staff to the need for action in the case of declining populations. This type of monitoring is most effectively conducted prior to and following management actions to assess the impacts of these actions and modify the actions to maximize the desired effect on species

of interest. Given the expense of detailed population monitoring, a careful evaluation will need to be conducted to determine which additional at-risk species should be monitored, as well as if the currently monitored species warrant continued evaluation.

Standardized monitoring protocols exist for some well-studied species and should be used in order to maintain the compatibility of data gathered here with that gathered in other states. If no established protocols exist, they should be developed from what is known about the species. Monitoring protocols need to be specifically tailored to the species and management actions being evaluated. Monitoring should be designed to quantify population change and to understand the potential causes of the change.

Monitoring factors might include direct measurements of populations or indirect measures such as habitat. Direct measures might include population size, density, growth/condition, productivity, or survival. Habitat can be used as a surrogate for direct population measures if the relationship between habitat and population is well defined. In many cases, a combination of direct and indirect measures will be appropriate. In addition, habitat data are critical to the understanding of causes of population change.

The overall conservation status of species will also be monitored. The Tier I and Tier II at-risk species lists will be periodically reviewed and revised by taxon experts. This revision will occur on an ongoing basis as new information on abundance, distribution, and population trends becomes available.

Habitat Monitoring

Habitat monitoring can occur at two main levels: monitoring trends in abundance, distribution, and condition of individual community types and 2) monitoring the response of community examples to management action, including restoration.

Monitoring trends in abundance and distribution of different habitat types can be used to detect land use changes and can help direct conservation action toward those types that are showing the steepest decline. A map of historic vegetation (Kaul and Rolfsmeier 1993) can be used to evaluate the change in abundance since pre-Euro-american settlement, while more recent trends can be examined using current surveys. This type of monitoring over a large scale is best accomplished using remote sensing techniques. There is a need to develop a set of best management practices for natural communities that maintain and enhance their biodiversity value. Monitoring responses of individual community types to various management practices will be a key component in developing those guidelines. Both formal experimentation testing different management practices, as well as monitoring existing practices on managed lands, will be needed. Floristic quality assessment is one approach that may be used for evaluating responses to treatments. One could also monitor responses of indicator species or exotic species within the community.

Databases

The Nebraska Natural Heritage Program maintains the most comprehensive, statewide database on at-risk species and natural communities. Information on at-risk species from other Nebraska Game and Park Commission databases (Fisheries, Nongame Bird Progam, Nongame Mammal Program) has been added to this database. Currently, there are more than 11, 000 species records and 1,700 community records in the Natural Heritage database. This database is updated annually with new survey information from agency staff, university researchers, and biologists from conservation organizations. The Heritage database is linked to the Biologically Unique Landscapes layer (see Chapter 3) and will automatically update information on the landscapes as new survey information becomes available.

All data added to the Heritage database are quality controlled and converted to a standard format. The quality control process ensures that the data are accurate and reliable, while the standard format allows data from many sources to be easily queried, summarized, and distributed. In addition, because the same standard format is used by programs in the Natural Heritage network (all 50 states, all Canadian provinces and several Latin American countries), the data can be easily combined into large datasets that allow for analyses across state and national boundaries. These multi-jurisdictional datasets allow for effective broad-scale conservation planning. Data standards as well as multi-jurisdictional datasets are developed and maintained by NatureServe in conjunction with its member Heritage Programs and Conservation Data Centres.

Additional databases can be used to help track progress towards meeting the goals of the Natural Legacy Project. One recently developed database tracks implementation of conservation actions on an annual basis. Information tracked includes conservation goals, type of action(s), species and habitats affected, location, number of acres or miles of stream affected, project cost, and funding sources.

Inventory and Research

Development of the Nebraska Natural Legacy Project was hampered by lack of information in a variety of areas including species and natural community data, appropriate conservation strategies, and best management practices. In addition to inventory and research that may be conducted as a part of monitoring, there is a need to fill critical information gaps on the distribution, abundance, conservation status, threats, biology and ecology of at-risk species and natural communities. Below is a list of priority inventory and research projects that are needed to fill critical data gaps, provide baseline information for monitoring, and provide the knowledge needed to develop more effective conservation actions.

Biological Inventory

Species

- For a number of the Tier I species, there were not enough documented occurrences of populations to fully meet the goals set for those species. Inventory of additional populations of these species should be a priority. There is also a strong need to assess the condition/viability of each population during inventory work. Appendix 8 identifies inventory and research needs for individual Tier I species.

- Conduct inventory work to better document the distribution and abundance of Tier II at-risk species. Inventory work should be prioritized based on gaps in knowledge and the imperilment status of the species. In general, our inventory needs are greatest for invertebrates (both terrestrial and aquatic) and non-vascular plants.

- Develop predictive models of species distribution for at-risk species to guide survey work and increase inventory efficiency.

- Inventory the distribution and spread of key invasive species including garlic mustard, purple loosestrife, Eurasian phragmites, Russian-olive, saltcedar, and zebra mussel.

- Conduct long-term monitoring studies to evaluate changes in distribution and abundance of selected Tier I species that have been assessed to be highly vulnerable to climate change.

Natural Communities

- There were insufficient documented occurrences of some of the natural community types to fully meet the goals set for those communities. Inventories identifying high-quality examples of each of these types should be a high priority.

- Develop a classification for aquatic systems (lakes, rivers, streams). Conduct inventories to identify high-quality examples of each type.

Landscapes

- Inventory priority landscapes for additional high-quality examples of Tier I species and natural communities. Identifying other occurrences at these existing sites will increase the efficiency of the conservation effort. For example, the Central Loess Hills BUL has been identified as a high priority for inventory work.

Biological Research

Species

- Conduct research to better understand the biology/ecology of at-risk species. Appendix 8 lists research needs for individual Tier I species.

- Evaluate the habitat requirements of at-risk species including the size, condition and landscape context of habitat(s) needed to sustain viable populations.

- Evaluate the feasibility and efficacy of captive rearing. Develop captive rearing techniques for highly imperiled species that will require re-introduction efforts to recover the species (e.g., Salt Creek tiger beetle).

- Conduct studies to evaluate the impact of invasive species on native flora and fauna.

- Evaluate the invasive threat potential of candidate invasive species.

- Develop control mechanisms for invasive species that have a high impact on at-risk species and natural communities.

- Conduct climate change vulnerability assessments for selected Tier II species.

Natural Communities

- Increase understanding of ecological processes influencing communities; investigate grazing, fire, and hydrology, and the natural mosaic of disturbance and patch types in a landscape.

- Identify thresholds for ecosystem-function impairment that affect the viability of at-risk species and biological diversity.

- Conduct studies to evaluate the effects of management practices (e.g., burning, grazing, haying, hydrologic manipulation) on the composition, structure and function of natural communities.

- Develop best management practices to promote native species diversity and maintain ecological processes in different community types.

- Develop habitat restoration techniques for those community types for which there is the greatest need of restoration and the least known about restoration (e.g., saline wetlands, freshwater streams).

- Conduct studies to evaluate the success of habitat restoration projects.

- Conduct climate change vulnerability assessments for selected natural community types.

Conservation and Environmental Education Research

- Determine the most critical and requested education materials and develop a priority listing for areas of needs.

- Determine the need for additional educators who are trained in nature education.

- Conduct an inventory of outdoor education and nature centers in Nebraska and identify areas of the state that would benefit from new centers.

Nature-based Recreation Research

- Conduct statewide and regional economic impact studies of hunting, fishing, wildlife viewing, and other nature-based recreation to determine the economic benefits of these activities. Conduct a marketing assessment of current and potential nature-based tourism clients to identify user needs and wants.

- Conduct studies to determine the wants/needs/satisfaction level of constituents that participate in non-consumptive, wildlife-dependent recreation and determine the availability of sites/facilities to support that recreation.

- Inventory sites on public and private lands currently providing opportunities and access for wildlife viewing, nature and wildlife interpretation, and evaluate the potential and need for enhancing existing opportunities and access.

- Identify and inventory sites that would provide new opportunities and access for wildlife viewing and nature and wildlife interpretation.

Economic Research

- Conduct studies to evaluate the economic importance of nature tourism in Nebraska.

- Conduct research on trends in economic development and population demographics in the state and assess their potential impact on biodiversity conservation.

- Conduct research to assess the economic viability of habitat restoration. For example, evaluate the economic benefits of grazing restored wetlands compared to cropping flood-prone land.

Human Dimensions Research

- Conduct surveys to determine public attitudes towards biological diversity, conservation and management practices.

- Assess the success of methods of outreach to landowners and land managers in engaging them in wildlife-friendly practices and conservation programs.

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Appendix 1: Membership of the teams involved with the development of the Nebraska Natural Legacy Project. See Chapter 2 for descriptions of the role of each team.

Nebraska Natural Legacy Project representation as of June 2011:

Natural Legacy Partnership Team

Julia	Sage	*Ponca Tribe of Nebraska*
Pete	Berthelsen	*Pheasants Forever, Inc.*
Kenny	Dinan	*USFWS - Partners for Fish and Wildlife*
Tim	McCoy	*Nebraska Game and Parks Commission*
Patrick	O'Brien	*Nebraska Association of Resources Districts*
Gloria	Erickson	*Nebraska Bird Partnership*
Craig	Head	*Nebraska Farm Bureau*
Steve	Donovan	*Ducks Unlimited, Inc.*
Scott	Josiah	*Nebraska Forest Service, University Rep*
Duane	Hovorka	*Nebraska Wildlife Federation*
Carl	Wolfe	*Nebraska Wildlife Society*
Kelly	Brunkhorst	*Nebraska Corn Board*
Lindsey	Salestrom	*Nebraska Department of Agriculture*
Amy	Sandeen	*Nebraska Alliance for Conservation and Environment Education*
Andy	Bishop	*Rainwater Basin Joint Venture of Nebraska*
Ritch	Nelson	*Natural Resource Conservation Service*
Jeff	Abegglen	*US Forest Service*
Mace	Hack	*The Nature Conservancy*
Roy	Stoltenberg	*Farmers Union*
Dave	Sands	*Nebraska Land Trust*
Marian	Langan	*Nebraska Audubon*
Kristen	Hassebrook	*Nebraska Cattlemen*
Barb	Cooksley	*Sandhills Task Force*

Natural Legacy Science Team

Kent	Pfeiffer	*NPLT - Regional Program Manager*
Joel	Jorgensen	*NGPC - Nongame Bird Program Manager*
Mike	Fritz	*NGPC - Natural Heritage Zoologist*
Scott	Taylor	*NGPC - Wildlife Research Assistant Division Administrator*
Rick	Holland	*NGPC - Fisheries Assistant Division Administrator*
Kristal	Stoner	*NGPC - Wildlife Diversity Program Manager**
Rachel	Simpson	*NGPC - Natural Heritage Data Manager*
T.J.	Walker	*NGPC - Habitat Partners District Manager*
Tim	McCoy	*NGPC - Ag Program Manager*
Rick	Schneider	*NGPC - Natural Heritage Program Manager**
Gerry	Steinauer	*NGPC - Natural Heritage Botanist*
Melissa	Panella	*NGPC - Natural Legacy Biologist*
Jeff	Lusk	*NGPC - Upland Game Program Manager*
Craig	Allen	*University of Nebraska - Lincoln*
T.J.	Fontaine	*University of Nebraska - Lincoln*
Andy	Bishop	*Rainwater Basin Joint Venture Coordinator*
Jill	Liske-Clark	*Nebraska Bird Partnership*
Chris	Helzer	*The Nature Conservancy*

Nebraska Game and Parks Commission (NGPC)

* Nebraska Natural Legacy Project Co-Coordinator

Natural Legacy Wildlife Education and Recreation Team

Lindsay	Rogers	*Nebraska Game and Parks Commission*
Kristal	Stoner	*Nebraska Game and Parks Commission*
Melissa	Panella	*Nebraska Game and Parks Commission*
Julie	Anderson	*Omaha Henry Doorly Zoo*
Jamie	Bachmann	*Nebraska Game and Parks Commission*
Amanda	Filipi	*Nebraska Prairie Partners*
Betty	Grennon	*Fontenelle Nature Association*
Marcia	Lee	*Central Platte NRD*
Keanna	Leonard	*Rowe Sanctuary*
Valerie	Newman	*National Park Service, Scottsbluff National Monument*
Amy	Sandeen	*Prairie Loft Center for Outdoor and Agricultural Learning*
Rick	Schmidt	*Fontenelle Nature Association*
Kirsten	Smith	*Lincoln Public Schools*

Natural Legacy Core Team

Kristal	Stoner	*NGPC – Natural Legacy Co-Coordinator*
Rick	Schneider	*NGPC – Natural Legacy Co-Coordinator*
Melissa	Panella	*NGPC – Natural Legacy Biologist*
Rachel	Simpson	*NGPC – Natural Heritage Data Manager*

Participants in the Species Expert Workshops

Reptiles and Amphibians

Dennis	Ferraro	*University of Nebraska - Lincoln*
Dan	Fogell	*Southeast Community College*
Mike	Fritz	*NGPC - Natural Heritage Zoologist*

Insects

Matt	Brust	*Chadron State College*
Mike	Fritz	*NGPC - Natural Heritage Zoologist*
Wyatt	Hoback	*University of Nebraska - Kearney*
Steve	Spomer	*University of Nebraska - Lincoln*

Mammals

Patricia	Freeman	*University of Nebraska - Lincoln*
Mike	Fritz	*NGPC – Natural Heritage Zoologist*
Hugh	Genoways	*University of Nebraska - Lincoln*
Keith	Geluso	*University of Nebraska - Kearney*
Jeremy	White	*University of Nebraska - Omaha*

Fish

George	Cunningham	*University of Nebraska - Omaha*
Mike	Fritz	*NGPC - Natural Heritage Zoologist*
Robert	Hrabik	*Missouri Department of Conservation*
Steve	Schainost	*NGPC - Rivers and Stream Program Manager*
Richard	Stasiak	*University of Nebraska - Omaha*

Mollusks

Mike	Fritz	*NGPC - Natural Heritage Zoologist*
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Participants in the Species Expert Workshops (cont.)

Plants

Chris	Helzer	*The Nature Conservancy*
Kent	Pfeiffer	*Northern Prairies Land Trust*
Steve	Rolfsmeier	*Chadron State College*
Gerry	Steinauer	*NGPC - Natural Heritage Botanist*

Birds

Bart	Bly	*Rocky Mountain Bird Observatory*
Mary	Bomberger-Brown	*Tern and Plover Conservation Partnership*
Mark	Brogie	*NOU Records Committee Chair*
T.J.	Fontaine	*University of Nebraska - Lincoln*
Mike	Fritz	*NGPC - Natural Heritage Zoologist*
Joseph	Gubanyi	*Concordia University*
Tim	Hajda	*Breeding Bird Atlas Volunteer*
Joel	Jorgensen	*NGPC - Nongame Bird Program Manager*
Jill	Liske-Clark	*Nebraska Bird Partnership*
John	McCarty	*University of Nebraska - Omaha*
Wayne	Mollhoff	*Breeding Bird Atlas Coordinator*
Larkin	Powell	*University of Nebraska - Lincoln*
Ross	Silcock	*Professional Bird Guide*
Jerry	Toll	*Audubon Society of Omaha*
T.J.	Walker	*NGPC - Habitat Partners District Manager*

NGPC - Nebraska Game and Parks Commission

Addditional Acknowledgements: Sandy Benson, Shaun Dunn, Rebekah Jessen, Brad McKinney, and Gene Zuerlein

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Kenny	Dinan	*USFWS-Partners for Fish and Wildlife*
Jim	Douglas	*Nebraska Game and Parks Commission*
Dean	Edson	*Nebraska Association of Resources Districts*
Gloria	Erickson	*Nebraska Bird Partnership*
Craig	Head	*Nebraska Farm Bureau*
Ryan	Heiniger	*Ducks Unlimited*
Gary	Hergenrader	*Nebraska Forest Service, University Rep*
Duane	Hovorka	*Nebraska Wildlife Federation*
Scott	Josiah	*Nebraska Forest Service, University Rep*
Larry	Klimek	*USFWS De Soto Refuge*
Bobbie	Kriz-Wickham	*Nebraska Department of Agriculture*
Brooke	Levey	*Nebraska Alliance for Conservation and Environment Education*
John	McFadden	*Nebraska Farm Bureau*
Steve	Moran	*Rainwater Basin Joint Venture of Nebraska*
Ritch	Nelson	*Natural Resources Conservation Service*
Greg	Schenbeck	*US Forest Service*
Al	Steuter	*The Nature Conservancy*
Roy	Stoltenberg	*Farmers Union*
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Craig	Utter	*Nebraska Cattlemen*

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Ted	Blume	*NGPC - Law Enforcement Division Administrator*
Jim	Douglas	*NGPC - Wildlife Division Administrator*
Bill	Grewcock	*Nebraska Game and Parks Commissioner*
Mace	Hack	*NGPC - Wildlife Research Assistant Division Administrator*
Rick	Holland	*NGPC - Fisheries Assistant Division Administrator*
Mark	Humpert	*NGPC – Natural Legacy Co-Coordinator*
Larry	Hutchinson	*NGPC - Fisheries Fish and Wildlife Program Manager*
Kirk	Nelson	*NGPC - Assistant Director*
Mark	Pinkerton	*Nebraska Game and Parks Commissioner*
Phil	Richmond	*NGPC - Publications Editor*
Steve	Riley	*NGPC - Wildlife Habitat Partners Assistant Division Administrator*
Rick	Schneider	*NGPC - Natural Legacy Co-Coordinator*
Kristal	Stoner	*NGPC - Natural Legacy Planning Assistant*

Natural Legacy Science Team

Richard	Bischof	*NGPC - Nongame Mammal Program Manager*
John	Dinan	*NGPC - Nongame Bird Program Manager*
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Rick	Holland	*NGPC - Fisheries Assistant Division Administrator*
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Kristal	Stoner	*Nebraska Game and Parks Commission*
Michelle	Stryker	*Nebraska Game and Parks Commission*
Chris	Thody	*Tern and Plover Conservation Partnership*
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Natural Legacy Wildlife Education and Recreation Team

Andrea	Cade	*Nebraska Game and Parks Commission*
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Jim	Woodland	*Nebraska Department of Education*

Natural Legacy Core Team

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Writing Teams

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Rick	Schneider	*Nebraska Game and Parks Commission*
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Mixedgrass Ecoregion Team

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Chris	Helzer	*The Nature Conservancy*
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Tim	McCoy	*Nebraska Game and Parks Commission*
Rich	Walters	*Nebraska Game and Parks Commission*
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Shortgrass Ecoregion Team

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Participants in the Species Expert Workshops

Reptiles and Amphibians

Dennis	Ferraro	*University of Nebraska - Omaha*
Dan	Fogell	*University of Nebraska - Omaha*
Mike	Fritz	*NGPC - Natural Heritage Zoologist*

Insects

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Wyatt	Hoback	*University of Nebraska - Kearney*
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Mammals

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Participants in the Species Expert Workshop (cont.)

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Mike	Fritz	*NGPC – Natural Heritage Zoologist*
Ed	Peters	*University of Nebraska - Lincoln*
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Birds

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John	Dinan	*NGPC - Nongame Bird Program Manager*
Mike	Fritz	*NGPC - Natural Heritage Zoologist*
Paul	Johnsgard	*University of Nebraska - Lincoln*
Joel	Jorgensen	*University of Nebraska - Omaha*
Wayne	Mollhoff	
Ross	Silcock	

NGPC - Nebraska Game and Parks Commission

Appendix 2: National guidance on fulfilling the eight required elements.

National Advisory Acceptance Team (NAAT) Review Reference Guide for the Members

Congress identified eight required elements for a State Wildlife Action Plan, with the expectation that "species in greatest need of conservation" will be identified, while addressing the full array of wildlife and wildlife-related issues.

The NAAT believes it must make an affirmative finding that all of the eight required elements are satisfactorily fulfilled in order for an "approval" recommendation to be made to the Director of the U.S. Fish and Wildlife Service (Director). Strategy reviews will first occur at the regional level, by NAAT member-teams, prior to full discussion and voting by the entire NAAT.

Below follows a template the NAAT uses as it reviews the Strategies. There are eight major topic headings, which correspond to the eight elements prescribed by Congress. Under each element heading is a series of statements to help NAAT members think about whether or not the requirements of a particular element have been satisfactorily addressed. These statements, in effect, are examples of what the NAAT expects may be helpful in evaluating the merits of a Strategy. Strategy authors may want to offer additional reasons or factors as to why they believe they satisfactorily meet the requirements of a particular element, above or beyond the examples provided.

The NAAT expects that Strategies will describe or identify sources of information, as well as critical information gaps, and plans for acquiring critical information for species in greatest need of conservation. The NAAT will consult the "Guiding Principles," developed by the International Association of Fish and Wildlife Agencies, when reviewing the Strategies. While this guide includes language regarding expectations that sections of the Strategies will provide sufficient information, the NAAT has not described or quantified the level of information expected, as each State or Territory will have different levels and sources of information available. The NAAT generally expects that Strategies will provide clear explanations of how information was used to reach conclusions. Strategies should explicitly draw logical connections between the problems that affect priority species and habitats, the conservation actions proposed to address those problems, and the indicators and monitoring approaches that will be used to measure the success of the conservation strategy.

It is anticipated that the Strategy will include an executive summary, synopsis or appendix that highlights where in the document reviewers can find information about each of the elements.

1st Element. Information on the distribution and abundance of species of wildlife, including low and declining populations as the State fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the State's wildlife.

A. The Strategy indicates sources of information (e.g., literature, databases, 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.

2nd Element. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in the 1st element.

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.

3rd Element. Descriptions of problems which may adversely affect species identified in the 1st element or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and 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 projects after the strategy is approved.

4th Element. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such 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 agencies 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.

5th Element. Descriptions of the proposed plans for monitoring species identified in the 1st element and their habitats, for monitoring the effectiveness of the conservation actions proposed in the 4th element, and for adapting these conservation actions to respond appropriately 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 the status of species or species groups and the effectiveness of conservation actions.

G. The Strategy is adaptive in that it allows for evaluation of conservation actions and implementing new actions accordingly.

6th Element. Descriptions of procedures to review the Strategy/Plan at intervals not to exceed ten years.

A. The State describes the process that will be used to review the Strategy every ten years or less.

7th Element. Descriptions of the plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with Federal, State and local agencies and Indian tribes that manage significant land and water areas within the State or administer programs that significantly affect the conservation of identified species and habitats.

A. The State describes the extent of its coordination with and efforts to involve Federal, State and 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.

8th Element. Descriptions of the necessary public participation in the development, revision and implementation of the 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 3: State Wildlife Grants and Natural Legacy Project implementation.

Since the inception of the Nebraska Natural Legacy Project, numerous projects totaling millions of dollars have contributed towards achieving its mission. Funding has come from many sources including the State Wildlife Grants (SWG) program, the Landowner Incentive Program (LIP), Nebraska Environmental Trust Fund, NRCS Special EQIP, and many landowners.

The Nebraska Game and Parks Commission developed a granting program to make a portion of its annual SWG allotment available to organizations and individuals wanting to help implement the Nebraska Natural Legacy Project. Proponents of projects that benefit at-risk species and their habitats submitted applications for SWG funding following a request for proposals. Proposals were evaluated using criteria that assess ability to meet the goals of the Nebraska Natural Legacy Project. Funds were awarded on a competitive basis. Past projects have been awarded to a variety of sponsors, including private landowners, non-profit organizations, university researchers, and more. SWG-funded projects have benefited migratory and resident birds, northern river otter, plains topminnow, prairie ecosystems, and riparian habitats to name a few.

The Game and Parks Commission has also developed the Natural Legacy Implementation Database to track Natural Legacy projects. Data include general project information, objectives, species of concern, natural communities affected, BUL(s) positively impacted, site information, funding and partners, and conservation activities. Summaries of this information are available from the Natural Heritage Program Manager at the Nebraska Game and Parks Commission. The summary information below is from the database. It should be noted that to date, the database primarily contains information on projects funded by U.S. Fish and Wildlife Service, Nebraska Environmental Trust Fund, Natural Resource Conservation Service Special EQIP, Nebraska Game and Parks Commission, and landowners. Legacy projects funded by other sources are not included in this summary.

From 2005 – 2011, 939 projects have impacted approximately 500,000 acres under the umbrella of the Nebraska Natural Legacy Project. Projects have occurred on the properties of more than 500 private landowners as well as land managed by state and federal agencies and non-profit conservation organizations. Thirty Biologically Unique Landscapes and many of their associated at-risk species and natural communities have benefited from such projects.

Nebraska Natural Legacy Projects (2005 - 2011)	**Number**
Habitat Restoration/Habitat Management	939
Research/Inventory/Monitoring	46

Amount of financial contribution (cash or in-kind) by each of the following:	
Nebraska Game and Parks Commission	$ 224,477
U.S. Fish and Wildlife Service*	$9,710,383
Natural Resources Conservation Service	$3,523,740
Nebraska Environmental Trust	$1,319,014
Non-Government Organizations	> $1,896,778
Private Landowners	> $2,000,000

*This includes funds from the following USFWS programs: State Wildlife Grants, Landowner Incentive Program, Section 6, and Partners for Fish and Wildlife

For a list of projects supported with competitive SWG funds, please visit NebraskaNaturalLegacy.org.

State Wildlife Grant Recipients

Audubon Nebraska
Crane Trust, Inc.
Ducks Unlimited, Inc.
Gracie Creek Landowners
Iowa State University
National Wild Turkey Federation
Nebraska Alliance for Conservation and Environment Education
Nebraska Cooperative Fish and Wildlife Research Unit
Nebraska Game and Parks Commission
Nebraska Land Trust
Nebraska Nature and Visitor Center
Nebraska Ornithologists' Union
Oklahoma State University
Pheasants Forever
Platte River Basins Environments, Inc.
Platte Valley Weed Management Area
Prairie Plains Resource Institute
Quail Forever
Rainwater Basin Joint Venture
Rocky Mountain Bird Observatory
Sandhills Task Force
Southern Illinois University
Tern and Plover Conservation Partnership
The Nature Conservancy
University of Central Arkansas
University of Nebraska - Kearney
University of Nebraska - Lincoln
University of Nebraska - Omaha
University of Nebraska – Panhandle Research and Extension Center
Wachiska Audubon Chapter
Wayne State College

Appendix 4: Definitions of Natural Heritage conservation status ranks.

Global Ranks (GRANK)

GRANK refers to numeric ranks (G1 through G5) of the conservation status or relative endangerment globally of species or ecological communities. Primary factors used in determining rank for species are population size, number of occurrences, viability of occurrences, population trend, and threats. Secondary factors are geographic distribution, environmental specificity, protection and management, and intrinsic vulnerability.

G1 = Critically imperiled globally because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction (typically 5 or fewer occurrences or very few remaining individuals or acres).

G2 = Imperiled globally because of rarity or because of some factor(s) making it very vulnerable to extinction throughout its range (6 to 20 occurrences or few remaining individuals or acres).

G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single western state, a physiographic region in the East) or because of other factors making it vulnerable to extinction throughout its range (21 to 80 occurrences).

G4 = Widespread, abundant, and apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery. Thus, the Element is of long-term concern (81 to 300 occurrences).

G5 = Demonstrably widespread, abundant, and secure globally, though it might be quite rare in parts of its range, especially at the periphery (more than 300 occurrences).

G#G# = Numeric range rank: A range between two of the numeric ranks. Denotes a range of uncertainty about the exact rarity of the Element.

GU = Unrankable: Status is uncertain; needs more information.

GH = Historical: Of historical occurrence throughout its range (i.e., formerly part of the established biota, with the expectation that it may be rediscovered).

GX = Extinct: Believed to be extinct throughout its range, with virtually no likelihood that it will be rediscovered.

Subrank:

T = Taxonomic subdivision: rank applies to a subspecies or variety.

Qualifiers:

? = Inexact: denotes inexact numeric rank.

Q = Questionable taxonomy: taxonomic status is questionable; numeric rank may change with taxonomy.

State Ranks (SRANK)

SRANK refers to numeric ranks (S1 through S5) of conservation status or relative endangerment within the state of species or ecological communities. Primary factors used in determining rank for species are population size, number of occurrences, viability of occurrences, population trend, and threats. Secondary factors are geographic distribution, environmental specificity, protection and management, and intrinsic vulnerability.

S1 = Critically imperiled in the state because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from the state (typically 5 or fewer occurrences or very few remaining individuals or acres).

S2 = Imperiled in the state because of rarity or because of some factor(s) making it very vulnerable to extirpation from the state (6 to 20 occurrences or few remaining individuals or acres).

S3 = Rare and uncommon in the state (21 to 80 occurrences).

S4 = Widespread, abundant, and apparently secure in the state, with many occurrences, but the Element is of long-term concern (81 to 300 occurrences).

S5 = Demonstrably widespread, abundant, and secure in the state, and essentially ineradicable under present conditions (more than 300 occurrences).

S#S# = Numeric range rank: A range between two of the numeric ranks. Denotes a range of uncertainty about the exact rarity of the Element.

SA = Accidental: Accidental or casual in the state (i.e., infrequent and far outside usual range).

SE = Exotic, established in the state. May be native elsewhere in North America.

SH = Historical: Element occurred historically in the state, (with the expectation that it may be rediscovered), perhaps having not been verified in the past 20 years and suspected to be still extant.

SNR = Unranked: state conservation status not yet assessed.

SR = Reported from the state, but without persuasive documentation which would provide a basis for either accepting or rejecting the report.

SRF = Reported falsely: Element erroneously reported in the state and the error has persisted in the literature.

SSYN = Synonym: Element reported as occurring in the state, but state does not recognize the taxon; therefore the Element is not ranked by the state.

SU = Unrankable: Status is uncertain, needs more information.

SX = Extirpated: Element is believed to be extirpated from the state.

S#? = Current rank is uncertain.

B = Breeding.

N = Non-breeding, regularly occurring, usually migratory.

Appendix 5: SPOT: The Spatial Portfolio Optimization Tool analysis.

The Spatial Portfolio Optimization Tool (SPOT) is a generalized computer tool for selecting a portfolio of potential conservation areas, using a flexible approach to automatically design an efficient portfolio around specific conservation goals (Shoutis 2003). SPOT analyzes a region (in this case Nebraska) by dividing it into small parcels called analysis units, then forming a portfolio by marking individual units as included or excluded from the portfolio. During the process known as simulated annealing, SPOT forms and analyzes millions of portfolios while searching for the most efficient portfolio. Each is evaluated according to three criteria:

Conservation goals. These are goals that were set for the number of occurrences of ecological communities and Tier I species populations to be included in the portfolio (see Chapter 3).

Area of portfolio. This is the total land area of the portfolio. The process works to minimize the total area by selecting analysis units with more than one occurrence of species or communities.

Fragmentation. The amount of dispersal of the analysis units selected for a portfolio. The process works to minimize the amount of fragmentation by selecting adjacent analysis units when possible.

The user can set the criteria to put more weight on different criteria. For our analyses, we put the greatest weight on meeting the conservation goals.

In a GIS, we divided the state into 13,781 equal-area hexagonal analysis units. Each unit contained 3,685 acres (~ 5.75 square miles). These units were then attributed with data from the Heritage database on known occurrences of Tier I species and ecological communities. Only records dated 1980 or later were used and for those records which had an estimated viability rating (EORank), we selected only records with an A (excellent estimated viability) or B (good estimated viability) rank. A total of 4,562 community and Tier I species records were used in the analyses.

We did a series of three runs of the analysis. In each run, there were 50 iterations and in each iteration, the program evaluated 1,000,000 different portfolios and selected the best fit to the criteria (i.e., met the most goals in the least amount of area with the least amount of fragmentation). Then the program would select from those 50 best fits the overall best fit as the output. We used the three overall best fits together in selecting the biologically unique landscapes.

Shoutis, D. 2003. SPOT: The Spatial Portfolio Optimization Tool. 55pp., The Nature Conservancy.

Appendix 6: Natural Heritage Hotspot analysis.

Process

Each Heritage tracked element (species and natural community) was given a weight of 1-5 based on its rarity and priority in the Nebraska Natural Legacy Project planning process. The GIS theme of Section boundaries was used as the planning grid. Each Section (square mile) was assigned the summed weights of all the occurrences of species and communities within that section. Only occurrences with a date of 1980 or later were used in the analysis. Scores were classified into 5 categories and each assigned a different color in GIS to visually depict areas with the highest concentrations of highly weighted elements.

Number of species in the analysis: 491
Species occurrence records used: 6,194
Number of community types in the analysis: 67
Community occurrence records used: 1,385

Weights:

5 Tier I species (G1-G3, Listed, declining, endemic), S1-S3 communities

4 S1 species (G4 or G5, not included above), S4-S5 communities

3 S2 species (G4 or G5, not included above)

2 S3 species (G4 or G5, not included above)

1 S4 species (G4 or G5, not included above)

Map classes:

Score	Color	Comment
1-3	blue	One S2-S4 species occurrence (no Tier I species or communities)
4-5	green	Typically one Tier I or S1 species or one community occurrence
6-15	yellow	At least two elements
16-25	orange	At least four elements
26-83	red	At least six elements

Appendix 7: Terrestrial natural communities of Nebraska.

The following is the list of terrestrial natural communities for Nebraska used in developing the Nebraska Natural Legacy project. The 83 terrestrial community types include wetland and upland types (any habitat with rooted vegetation) and are part of the National Vegetation Classification (NVC) system (Grossman et al. 1998) which is the standard classification used by federal agencies (see NatureServe.org for information on the NVC). Full descriptions of each community type are found in Rolfsmeier and Steinauer (2010). The sections on biologically unique landscapes within the ecoregion chapters list the community types known from each landscape. Unfortunately, there is currently no statewide classification system for open water habitats (lakes, rivers, streams), though there is an urgent need for such a system.

Fields in the descriptions below include:

G-Rank, S-Rank: Explanation of these ranks is found in Appendix 4.

Goal: The minimum number of occurrences or examples to be conserved in Nebraska.

Distribution: The distribution of the community type in Nebraska relative to its entire range. This was a factor used in setting the goal for each type (see Chapter 3).

Endemic:	community types that are found only in Nebraska or generally have more than 90% of their range within the state.
Limited:	community types that occur primarily within one region (e.g., Great Plains).
Widespread:	community types that are common in a number of regions and widespread in Nebraska.
Peripheral:	community types that are found mainly in other regions, generally less than 10% of their range in Nebraska.

Patch Size: Refers to the amount of area a typical example of a community type would have covered prior to Euro-american settlement. This factor was also used in setting the goal for each type (see Chapter 3).

Matrix: > 1,000 acres
Large Patch: 100-1,000 acres
Small Patch: < 100 acres

TERRESTRIAL NATURAL COMMUNITIES

(Upland and wetland systems with rooted vegetation)

WETLAND FOREST AND WOODLAND COMMUNITIES

Cottonwood-Diamond Willow Woodland
G-Rank: G? S-Rank: S2? Goal: 10 Distribution: Limited
Patch size: Small patch
Range in NE: Missouri River, Middle Loup River and Elkhorn River floodplains

Cottonwood-Peachleaf Willow Riparian Woodland
G-Rank: G3G4 S-Rank: S3 Goal:5 Distribution: Limited
Patch size: Large patch
Range in NE: Mostly along streams in central and western Nebraska

Cottonwood Riparian Woodland
G-Rank: G2 S-Rank: S2? Goal: 10 Distribution: Limited
Patch size: Small patch/large patch
Range in NE: Mostly in the western 2/3 of state

Eastern Cottonwood – Dogwood Riparian Woodland
G-Rank: GNR S-Rank: S2? Goal: 5 Distribution: Limited
Patch size: Large patch
Range in NE: Missouri River floodplain from Washington County northward; may also be present on the lower Platte River

Eastern Riparian Forest
G-Rank: G3G5 S-Rank: S3 Goal: 5 Distribution: Limited
Patch size: Large patch
Range in NE: Floodplains in eastern Nebraska

Peachleaf Willow Woodland
G-Rank: G3 S-Rank: S1 Goal: 1 Distribution: Limited
Patch size: Small patch
Range in NE: Pine Ridge

UPLAND FOREST AND WOODLAND COMMUNITIES

Basswood-Ironwood Spring Branch Canyon Forest
G-Rank: G3 S-Rank: S2 Goal: 10 Distribution: Limited
Patch size: Small patch/large patch
Range in NE: Central Niobrara River Valley in northeast Cherry County; Brown, Keya Paha, and Rock counties

Bur Oak – Basswood – Ironwood Forest
G-Rank: G3 S-Rank: S2S3 Goal: 2 Distribution: Peripheral
Patch size: Large patch
Range in NE: Missouri River bluffs from Dakota County west to Knox County, south side of the Niobrara River to Brown County; may be present south to Omaha

Dry-Mesic Bur Oak Forest and Woodland
G-Rank: G4 S-Rank: S2S3 Goal: 5 Distribution: Limited
Patch size: Large patch
Range in NE: Eastern 1/4 of the state, and westward along the lower Niobrara, lower Loup, and Elkhorn rivers; most common on the Platte, Blue and Nemaha river bluffs

Dry-Mesic Ponderosa Pine Woodland
G-Rank: G3G4 S-Rank: S2 Goal: 10 Distribution: Limited
Patch: Small patch/large patch
Range in NE: Pine Ridge escarpment and possibly the Wildcat Hills and central Niobrara River Valley

Dry Ponderosa Pine Open Woodland and Savanna
G-Rank: G3G4 S-Rank: S3S4 Goal: 5 Distribution: Limited
Patch size: Large patch
Range in NE: Pine Ridge, central Niobrara River, and Wildcat Hills

Dry Upland Bur Oak Woodland
G-Rank: GNR S-Rank: S3? Goal: 5 Distribution: Limited
Patch size: Large patch
Range in NE: East half of Nebraska, usually in stream valleys

Green Ash- Eastern Red-cedar Scarp Woodland
G-Rank: GNR S-Rank: S3? Goal:10 Distribution: Limited
Patch size: Small patch
Range in NE: Unglaciated mixed-grass plains in central and north-central Nebraska

Green Ash – Elm – Hackberry Canyon Bottom Woodland
G-Rank: G2G3 S-Rank: S2 Goal: 10 Distribution: Limited
Patch size: Small patch
Range in NE: Northwest and north-central Nebraska

Mesic Bur Oak Forest and Woodland
G-Rank: G? S-Rank: S1? Goal: 5 Distribution: Limited
Patch size: Large patch
Range in NE: Southeast Nebraska on terraces of Salt Creek, Big Blue, and Big Nemaha rivers

Oak – Hickory – Ironwood Forest
G-Rank: G3 S-Rank: S2 Goal: 2 Distribution: Peripheral
Patch size: Large patch
Range in NE: Occurs along the Missouri River south of Omaha, and small patches may be scattered northward to Dakota County and westward along some major tributaries

Paper Birch Springbranch Canyon Forest
G-Rank: G2? S-Rank: S1 Goal: 10 Distribution: Endemic
Patch size: Small patch
Range in NE: Central Niobrara River in springbranch canyons

Pine-Juniper Scarp Woodland
G-Rank: G4 S-Rank: S3 Goal: 5 Distribution: Limited
Patch size: Large patch
Range in NE: Wildcat Hills and southward in Panhandle on north side of escarpments, areas of the Pine Ridge

Ponderosa Pine Forest
G-Rank: G3G4 S-Rank: S2 Goal: 2 Distribution: Peripheral
Patch size: Large patch
Range in NE: Pine Ridge, central Niobrara Valley, and Wildcat Hills

Red Oak – Basswood – Ironwood Forest
G-Rank: G3G4 S-Rank: S2 Goal: 2 Distribution: Peripheral
Patch size: Large patch
Range in NE: Missouri River bluffs from Washington County southward, may be present north to Dakota County and westward along the Platte River

Rocky Mountain Juniper Woodland
G-Rank: G3G4 S-Rank: S4 Goal: 5 Distribution: Widespread
Patch size: Small patch
Range in NE: Nebraska Panhandle, primarily on escarpments

Sandstone Upland Bur Oak Woodland
G-Rank: GNR S-Rank: S2? Goal: 10 Distribution: Limited
Patch size: Small patch/large patch
Range in NE: Rose Creek drainage in Jefferson County

WETLAND SHRUBLAND COMMUNITIES

Riparian Dogwood – False Indigobush Shrubland
G-Rank: G4? S-Rank: S4? Goal: 5 Distribution: Widespread
Patch size: Small patch
Range in NE: Streams and rivers in eastern 1/2 of Nebraska on high banks and raised islands

Sandbar Willow Shrubland
G-Rank: G5 S-Rank: S4S5 Goal: 5 Distribution: Widespread
Patch size: Small patch
Range in NE: Along streams and rivers throughout the state; on sandbars, islands, and stream banks

UPLAND SHRUBLAND COMMUNITIES

Buckbrush Shrubland
G-Rank: G4G5 S-Rank: S4 Goal: 10 Distribution: Limited
Patch size: Small patch
Range in NE: West 1/2 of the state in mesic swales and depressions

Buffaloberry Shrubland
G-Rank: G3G4 S-Rank: S2? Goal: 10 Distribution: Limited
Patch size: Small patch
Range in NE: Primarily in northern and western Nebraska

Chokecherry-Plum Shrub Thicket
G-Rank: G4? S-Rank: S3? Goal: 10 Distribution: Limited
Patch size: Small patch
Range in NE: Wide distribution in northern Nebraska

Mountain Mahogany Shrubland
G-Rank: G5 S-Rank: S3 Goal: 5 Distribution: Widespread
Patch size: Small patch
Range in NE: Wildcat Hills and, to a lesser extent, other escarpments in the west; upper slopes and canyon sides

Skunkbush Sumac Shrubland
G-Rank: GNR S-Rank: S2? Goal: 10 Distribution: Limited
Patch size: Small patch
Range in NE: Pine Ridge in Sioux County

WETLAND HERBACEOUS COMMUNITIES

American Lotus Aquatic Wetland
G-Rank: G4? S-Rank: S1? Goal: 5 Distribution: Widespread
Patch size: Small patch
Range in NE: Missouri River valley

Cattail Shallow Marsh
G-Rank: G5 S-Rank: S2 Goal: 5 Distribution: Widespread
Patch size: Small patch/large patch
Range in NE: Statewide

Eastern Bulrush Deep Marsh
G-Rank: G4G5 S-Rank: S3 Goal: 5 Distribution: Widespread
Patch size: Small patch/large patch
Range in NE: Banks and backwaters of river and large streams in the eastern 1/2 of the state

Eastern Cordgrass Wet Prairie
G-Rank: G3? S-Rank: S1 Goal: 10 Distribution: Limited
Patch size: Small patch/large patch
Range in NE: Tallgrass prairie region of eastern Nebraska on floodplains

Eastern Pondweed Aquatic Wetland
G-Rank: G4G5 S-Rank: S3? Goal: 10 Distribution: Limited
Patch size: Small patch
Range in NE: Shallow, freshwater basins, floodplain backwaters of large rivers in the southern 1/2 of the state

Eastern Saline Marsh
G-Rank: G1G2 S-Rank: S1 Goal: 10 Distribution: Limited
Patch size: Small patch
Range in NE: Salt Creek drainage, in floodplain depressions with standing water most of the year

Eastern Saline Meadow
G-Rank: G2G3 S-Rank: S1 Goal: 5 Distribution: Limited
Patch size: Large patch
Range in NE: Salt Creek drainage, in shallow depressions and level ground of floodplains. This community contains meadow areas and salt flats

Eastern Sedge Wet Meadow
G-Rank: GNR S-Rank: S1 Goal: 10 Distribution: Limited
Patch size: Small patch
Range in NE: Floodplain of the Missouri River and its tributaries

Freshwater Seep
G-Rank: G3 S-Rank: S3 Goal: 5 Distribution: Widespread
Patch size: Small patch
Range in NE: Throughout the state but best developed in the Sandhills, Smokey Hills, and Pine Ridge; slope of hills, base of bluffs, and valleys where groundwater discharge is present

Northern Cordgrass Wet Prairie
G-Rank: G2G3 S-Rank: S2 Goal: 5 Distribution: Limited
Patch size: Large patch
Range in NE: Platte River valley and northward in central Nebraska; on upland depressions and stream floodplains and terraces

Northern Pondweed Aquatic Wetland
G-Rank: G4G5 S-Rank: S4 Goal: 20 Distribution: Endemic
Patch size: Small patch/large patch
Range in NE: Lakes and backwaters from Platte River northward, best developed in the Sandhills

Playa Wetland
G-Rank: G2G4 S-Rank: S1 Goal: 10 Distribution: Limited
Patch size: Small patch
Range in NE: Throughout the state but most common in the Rainwater Basin region; shallow depressions on level ground that is temporarily flooded

Prairie Fen
G-Rank: G1 S-Rank: S1 Goal: 5 Distribution: Limited
Patch size: Small patch
Range in NE: Little Blue River valley in Jefferson County; associated with sandstone slopes and groundwater discharge

Reed Marsh
G-Rank: G4 S-Rank: S4 Goal: 5 Distribution: Widespread
Patch size: Small patch
Range in NE: Northern 1/2 of the state, from Platte River valley northward

Saline/Alkaline Aquatic Wetland
G-Rank: G2 S-Rank: S3 Goal:10 Distribution: Limited
Patch size: Small patch
Range in NE: Closed Basin region of the western Sandhills and Salt Creek drainage

Sandhills Fen

G-Rank: G1G2 S-Rank: S1S2 Goal:14 Distribution: Endemic
Patch size: Large patch
Range in NE: Sandhill valleys; areas with extensive groundwater discharge and peat and muck soils

Sandhills Hardstem Bulrush Marsh

G-Rank: G4 S-Rank: S4 Goal: 20 Distribution: Endemic
Patch size: Small patch/large patch
Range in NE: Eastern 1/2 of the Sandhills, possibly into the Elkhorn and Loup river drainages

Sandhills Wet Meadow

G-Rank: G3G4 S-Rank: S2? Goal: 5 Distribution: Limited
Patch size: Large patch
Range in NE: Sandhill valleys and sand flats, floodplains of Sandhills rivers, the Loup River and the Elkhorn River floodplains.

Spikerush Vernal Pool

G-Rank: G5 S-Rank: S1 Goal: 10 Distribution: Limited
Patch size: Small patch
Range in NE: Northwestern and north-central Nebraska; small, relatively deep (.5-1m) basin-like depressions in streambeds or adjacent to ponds and marshes

Water-Lily Aquatic Wetland

G-Rank: G5 S-Rank: S2 Goal: 10 Distribution: Limited
Patch size: Small patch /large patch
Range in NE: Lakes and ponds in the Sandhills

Western Alkaline Marsh

G-Rank: G3G4 S-Rank: S3 Goal: 10 Distribution: Limited
Patch size: Small patch/large patch
Range in NE: Most abundant in Closed Basin region of the western Sandhills, also in North Platte River valley; in depressions and basins

Western Alkaline Meadow

G-Rank: G3 S-Rank: S3 Goal: 5 Distribution: Limited
Patch size: Large patch
Range in NE: North Platte River valley and Closed Basin region of the Sandhills, level ground on river bottoms and interdunal valley bottoms in areas of alkaline lakes and marshes

Western Sedge Wet Meadow
G-Rank: G4 S-Rank: S2 Goal: 10 Distribution: Limited
Patch size: Small patch
Range in NE: Nebraska Panhandle; occurs on stream banks and streambeds that contain standing water much of the year

Western Sub-Irrigated Alkaline Meadow
G-Rank: G3 S-Rank: S2? Goal: 5 Distribution: Limited
Patch size: Large patch
Range in NE: Upper Niobrara River valley, North Platte River valley; may be present in Sandhills

Wheatgrass Playa Grassland
G-Rank: G2G3 S-Rank: S1 Goal: 10 Distribution: Limited
Patch size: Small patch/large patch
Range in NE: Most abundant in loess plains of south-central and southwest Nebraska, but is also apparently present in extreme northwest Nebraska and Todd Valley of east-central Nebraska

UPLAND HERBACEOUS COMMUNITIES

Dakota Sandstone Tall-grass Prairie
G-Rank: G3? S-Rank: S2 Goal: 3 Distribution: Limited
Patch size: Matrix
Range in NE: Smokey Hills region of southern Jefferson and southwestern Gage counties

Eastern Sand Prairie
G-Rank: G3 S-Rank: S4 Goal: 5 Distribution: Limited
Patch size: Large patch/matrix
Range in NE: Northern, eastern, and southern periphery of the Sandhills, outliers along Elkhorn, Loup, and Platte Rivers

Greasewood Shrub Prairie
G-Rank: G4 S-Rank: S2 Goal: 10 Distribution: Limited
Patch size: Small patch
Range in NE: Hat Creek Basin in northern Sioux County; level ground on upland terraces adjacent to stream valleys; poorly-drained alkaline clay and silty clay loam soils

Great Plains Gravel/Cobble Prairie

G-Rank: GNR S-Rank: S3 Goal: 10 Distribution: Limited
Patch size: Small patch/large patch
Range in NE: On shoulders of upland bluffs above stream valleys in the Niobrara River drainage from Cherry County to Knox County; also southwest Nebraska in Deuel and Keith counties

Loess Mixed-grass Prairie

G-Rank: G3? S-Rank: S3 Goal: 3 Distribution: Limited
Patch size: Matrix
Range in NE: Loess mantled hills and plains of central Nebraska and portions of southeastern and northeastern Nebraska

Lowland Tall-grass Prairie

G-Rank: G2G3 S-Rank: S1 Goal: 5 Distribution: Limited
Patch size: Large patch
Range in NE: Along river and stream valleys within the tall-grass region, primarily on floodplains and terraces; also ravines in uplands

Missouri River Floodplain Terrace Grassland

G-Rank: GNR S-Rank: S2? Goal: 5 Distribution: Endemic
Patch size: Small patch/large patch
Range in NE: High terraces of the Missouri River in northeast Nebraska on sands formed from alluvium

Missouri River Valley Dune Grassland

G-Rank: GNR S-Rank: S2 Goal: 5 Distribution: Endemic
Patch size: Small patch
Range in NE: Terraces of the Missouri River in northeast Nebraska on moderately sloping sand dunes

Northern Loess/Shale Bluff Prairie

G-Rank: G2 S-Rank: S2 Goal: 10 Distribution: Limited
Patch size: Small patch/large patch
Range in NE: South side of the Missouri River from Dixon County to Boyd County, may be westward along the Niobrara and Keya Paha Rivers to Boyd and Keya Paha counties; nearly level slopes and bluff tops of loess

Northwestern Mixed-grass Prairie
G-Rank: G4 S-Rank: S3 Goal: 3 Distribution: Limited
Patch size: Matrix
Range in NE: Occurs in the Hat Creek and White River basins in Dawes, Sheridan, and Sioux counties in extreme northwest Nebraska; uplands with clay soils

Sandhills Dry Valley Prairie
G-Rank: G3 S-Rank: S4 Goal: 14 Distribution: Endemic
Patch size: Large patch
Range in NE: Western 2/3 of Sandhills; broad to nearly level interdunal valleys and upland stream terraces; soils well drained,

Sandhills Dune Prairie
G-Rank: G4G5 S-Rank: S4S5 Goal: 3 Distribution: Limited
Patch size: Matrix
Range in NE: Sandhills and outlying dunes; uplands

Sandhills Mesic Tall-grass Prairie
G-Rank: G3 S-Rank: S2 Goal: 5 Distribution: Limited
Patch size: Large patch/Matrix
Range in NE: Eastern Sandhills west to Logan County and eastern Cherry County; mostly on low dune slopes and small sandy rises associated with wet meadows

Sandsage Prairie
G-Rank: G3 S-Rank: S3 Goal: 3 Distribution: Limited
Patch size: Matrix
Range in NE: Panhandle, western edge of the Sandhills, Wildcat Hills, Chase, Dundy, and Perkins counties; on rolling dunes, fine and loamy sands

Silver Sagebrush Shrub Prairie
G-Rank: G4 S-Rank: S2 Goal: 10 Distribution: Limited
Patch size: Small patch/large patch
Range in NE: White River and Hat Creek drainages in Dawes and Sioux counties; terraces and floodplains of intermittent streams; poorly drained soils

Southern Sand/Gravel Prairie
G-Rank: GNR S-Rank: S2? Goal: 10 Distribution: Limited
Patch size: Small patch
Range in NE: Uplands on the north side of the Little Blue River and Big Sandy Creek in southwestern Jefferson and Thayer counties and on the north side of the Republican River in Nuckolls and Webster counties

Threadleaf Sedge Western Mixed-grass Prairie
G-Rank: G5 S-Rank: S3S4 Goal: 3 Distribution: Limited
Patch size: Matrix
Range in NE: Most of the Nebraska Panhandle with the exception of extreme northwest and portions of southwest Nebraska in Keith and Chase counties; also occurs eastward along the Niobrara River; on gentle uplands, level to moderate slopes

Upland Tall-grass Prairie
G-Rank: G2 S-Rank: S1S2 Goal: 3 Distribution: Limited
Patch size: Matrix
Range in NE: Eastern 1/5 of the state but westward on loess hills to central Nebraska

Western Floodplain Terrace Grassland
G-Rank: G4 S-Rank: S3 Goal: 10 Distribution: Limited
Patch size: Small patch/large patch
Range in NE: Along river and stream valleys in the western 1/2 of the Panhandle; level ground in the floodplains

Western Sand Prairie
G-Rank: G3 S-Rank: S3? Goal: 10 Distribution: Limited
Patch size: Small patch/large patch
Range in NE: Within the range of the western mixed-grass prairie in the Panhandle, on slopes below sandstone outcrops and escarpments

Wheatgrass Western Mixed-grass Prairie
G-Rank: G5 S-Rank: S4 Goal: 2 Distribution: Widespread
Patch size: Large patch/matrix
Range in NE: Panhandle of western Nebraska, more common northward

WETLAND SPARSELY VEGETATED COMMUNITIES

Perennial Sandbar
G-Rank: G5 S-Rank: S3S4 Goal:5 Distribution: Widespread
Patch size: Small patch
Range in NE: Channels of streams throughout the state; sandbars, islands, and shorelines

Sandbar/Mudflat
G-Rank: G4G5 S-Rank: S5 Goal: 5 Distribution: Widespread
Patch size: Small patch
Range in NE: Within channels of larger streams and rivers throughout the state

UPLAND SPARSELY VEGETATED COMMUNITIES

Badlands

G-Rank: G4G5 S-Rank: S3 Goal: 10 Distribution: Limited
Patch size: Small patch/large patch
Range in NE: Occurs in Dawes, Scottsbluff, and Sioux counties, on eroded slopes of siltstone, clay and clay with cobbles; most sites bordered by mixed-grass prairie

Eastern Sandstone Bluff and Cliff

G-Rank: G4G5 S-Rank: S4 Goal: 5 Distribution: Widespread
Patch size: Small patch
Range in NE: Smoky Hills Region in Jefferson County and occasionally on the bluffs of the Missouri River, mostly in Dakota and Thurston counties

Northern Chalk Bluff and Cliff

G-Rank: GNR S-Rank: S5 Goal: 10 Distribution: Limited
Patch size: Small patch
Range in NE: Southside of Missouri River Valley in Knox and Cedar counties; northeastern Dawes and northwestern Sheridan counties

Riverine Gravel Flats

G-Rank: G? S-Rank: S2? Goal: 10 Distribution: Limited
Patch size: Small patch/large patch
Range in NE: Occurs along the Platte River in Dawson County westward; occurs as patches or bands on level ground, usually on the first terrace of rivers or in level canyon bottoms; also South Platte River in Deuel and Keith counties

Rock Outcrop

G-Rank: G4? S-Rank: S4 Goal: 10 Distribution: Limited
Patch size: Small patch
Range in NE: Escarpments in the Panhandle and southwest Nebraska; occurs on level to moderately steep (40% grade) upper and middle slopes on irregularly eroded sandstone and siltstone escarpments and ravines

Western Sandstone Cliff

G-Rank: G4G5 S-Rank: S5 Goal: 10 Distribution: Limited
Patch size: Small patch
Range in NE: Escarpments of the Panhandle; also central Niobrara River Valley

AQUATIC (Open water systems)

Below is a very basic classification of aquatic systems that was used to attribute the biologically unique landscapes. There is an urgent need to develop a more rigorous aquatic habitat classification system for Nebraska.

LAKES

Alkaline
Non-alkaline

RIVERS and STREAMS

Headwater, cold water stream
Headwater, warm water stream
Mid-order, cold water river
Mid-order, warm water river
Large, warm water river

Appendix 8: Tier I At-risk species.

Tier I species are those that are globally or nationally most at-risk of extinction and which occur in Nebraska. This list is used to help prioritize conservation planning and actions and does not have legal or regulatory ramifications. Conservation of these species is needed to prevent future state/federal listings and help listed species recover.

The Tier I at-risk species lists will be periodically reviewed and revised by taxon experts. This revision will occur on an on-going basis as new information on abundance, distribution, and population trends becomes available, with an overall review at least every five years. The Tier I list was reviewed and revised with input from taxon experts in workshops held in 2010.

Species were selected for the Tier I when they met one or more of the following criteria:

State and Federally Listed Species: Species listed as threatened or endangered under the federal Endangered Species Act or the Nebraska Non-game and Endangered Species Conservation Act. Recovery and de-listing of these species are goals of the plan.

Heritage Ranked Species: Species either 1) ranked by NatureServe and the Natural Heritage Network as globally critically imperiled (G1), imperiled (G2), or vulnerable (G3) or 2) species ranked as either state critically imperiled (S1), imperiled (S2), or vulnerable (S3) in all or nearly all states in their range.

Declining species: Species whose abundance and/or distribution has been declining across much of their entire range. For land birds, the Partners in Flight national watch list was used as a guide.

Endemic Species (or nearly so): Species whose entire range of distribution occurs within or primarily within Nebraska. Conservation actions in Nebraska would be critical to the conservation of the species.

Disjunct Species: Species whose populations in Nebraska are widely disjunct (200 miles +) from the species' main range of distribution. Species must be ranked as critically imperiled (S1) or imperiled (S2) within Nebraska. Such populations may contain genetic variations that could be important to the long-term survival of the species.

Following the list of Tier I species is information on each one. Fields that are not self-explanatory are described below.

G-Rank, S-Rank: Explanation of ranks is found in Appendix 4.

Goal: The minimum number of populations to be conserved in Nebraska (see Chapter 3).

Distribution: The species distribution in Nebraska relative to its entire range. This was a factor used in setting the goal for each species (see Chapter 3).

Endemic:	species occurs only within NE or generally have more than 90% of their range within the state.
Limited:	species occurs primarily within one region (e.g., Great Plains)
Widespread:	species is common in a number of regions and widespread in NE.
Peripheral:	species is found mainly in other regions; generally less than 10% of the range is within NE.

Estimated population in NE: Experts in the various taxa were queried as to their estimates of the current population sizes for Tier species. A few of the estimates are from statistically-based survey work and are published, while the majority are based on the opinion of experts with years of experience conducting field surveys for these species. The range of the estimate for a given species is an indication of the confidence in the estimate. For estimates based on publications, the publications are cited here and listed in the references section. Caution should be used when considering these estimates because most of them are not based on comprehensive and statistically based survey work. They are provided here to give an "order of magnitude" sense of the abundances among species, as understood by species experts. Additional survey work is needed for most Tier I species to better understand their distribution and abundance in Nebraska.

Trends since 2005 in NE: Based on data when available (primarily for birds) and on the consensus opinion of those attending the taxon experts workshops in 2010.

Threats: Climate Change Vulnerability Index: Climate change vulnerability assessments were conducted for all Tier I species using NatureServe's Climate Change Vulnerability Index tool (Young et al. 2010). The assessment evaluates a species' exposure to, sensitivity to, and capacity to adapt to climate change. Vulnerability assessments provide a scientific basis for developing climate adaptation strategies. The assessments were conducted during the taxon experts workshops, using group consensus to evaluate the criteria for each species. The tool is designed to be used for a specific geographic area (e.g., a state), thus the Index score may be incomplete for migratory bird species that spend part of the year outside of the state. However, if a species is vulnerable when outside the state, there may be little that conservation actions taken in Nebraska can do to address the vulnerability. Therefore, a "Not Vulnerable" assessment for a migratory species may still be useful information, for it may indicate that there are other conservation actions we should focus on for that species in Nebraska aside from climate change adaptation.

Landscapes: These are the Biologically Unique Landscapes for which there were known occurrences of populations (or migratory stopover sites) for the species.

Tier I At-risk Species

Information on each species is found on the page number indicated.

Tier I At-risk Species in each Ecoregion

		ECOREGIONS			
		Tallgrass Prairie	Mixedgrass Prairie	Shortgrass Prairie	Sandhills
	TIER I SPECIES				
BIRDS	Baird's Sparrow		x	x	x
	Bell's Vireo	x	x	x	x
	Brewer's Sparrow			x	
	Buff-breasted Sandpiper	x	x		
	Burrowing Owl	x	x	x	x
	Cerulean Warbler	x			
	Chestnut-collared Longspur			x	
	Ferruginous Hawk		x	x	x
	Greater Prairie-Chicken	x	x	x	x
	Henslow's Sparrow	x	x		
	Interior Least Tern	x	x	x	
	Loggerhead Shrike	x	x	x	x
	Long-billed Curlew		x	x	x
	McCown's Longspur			x	
	Mountain Plover			x	
	Pinyon Jay			x	
	Piping Plover	x	x		x
	Short-eared Owl	x	x	x	x
	Sprague's Pipit	x	x		x
	Trumpeter Swan	x	x	x	x
	Whooping Crane	x	x	x	x
FISH	Blacknose Shiner		x	x	x
	Blue Sucker	x			
	Finescale Dace		x		x
	Lake Sturgeon	x	x		
	Northern Redbelly Dace		x	x	x
	Pallid Sturgeon	x			
	Plains Topminnow	x	x	x	x
	Sicklefin Chub	x			
	Sturgeon Chub	x			
	Topeka Shiner	x			x
INSECTS	American Burying Beetle		x		x
	Bucholz Black Dash	x			
	Colorado Rita Dotted-blue			x	
	Ghost Tiger Beetle		x		x
	Iowa Skipper	x	x	x	x
	Married Underwing	x	x		
	Mottled Duskywing	x	x	x	

		ECOREGIONS			
		Tallgrass Prairie	Mixedgrass Prairie	Shortgrass Prairie	Sandhills
	TIER I SPECIES				
INSECTS (cont.)	Nine-spotted Ladybird Beetle			x	
	Ottoe Skipper	x	x	x	x
	Platte River Caddisfly		x		
	Regal Fritillary	x	x	x	x
	Salt Creek Tiger Beetle	x			
	Tawny Crescent			x	
	Whitney Underwing	x	x		
MAMMALS	Bailey's Eastern Woodrat		x		x
	Cheyenne Northern Pocket Gopher			x	
	Fringe-tailed Myotis			x	
	Northern River Otter	x	x	x	x
	Pierre Northern Pocket Gopher			x	
	Plains Harvest Mouse	x			
	Plains Pocket Mouse	x	x		
	Rocky Mountain Bighorn Sheep			x	
	Southern Flying Squirrel	x			
	Swift Fox		x	x	
MOLLUSKS	Flat Floater	x			
	Higgins Eye	x			
	Pimpleback	x			
	Pistolgrip	x			
	Plain Pocketbook	x			x
	Scaleshell	x			
REPTILES	Blanding's Turtle	x	x		x
	Massasauga	x			
	Sagebrush Lizard			x	
	Timber Rattlesnake	x			
PLANTS	American Ginseng	x			
	Barr's Milkvetch			x	
	Blowout Penstemon				x
	Colorado Butterfly Plant			x	
	Dog-parsley			x	
	Gordon's Wild Buckwheat			x	
	Hall's Bulrush				x
	Large-spike Prairie-clover		x	x	x
	Matted Prickly-phlox			x	
	Meadow Lousewort			x	
	Missouri Sedge	x			
	Nodding-pogonia	x			

		ECOREGIONS			
		Tallgrass Prairie	Mixedgrass Prairie	Shortgrass Prairie	Sandhills
	TIER I SPECIES				
PLANTS (cont.)	Platte River Dodder			x	
	Prairie Moonwort				x
	Rocky Mountain Bulrush		x	x	
	Saltwort	x			
	Sandhill Goosefoot			x	
	Short's Milkvetch			x	
	Small White Lady's-slipper	x	x		x
	Snow Trillium	x			
	Ute Ladies'-tresses			x	
	Western Prairie Fringed Orchid	x			x
	Wolf's Spikerush				x

BIRDS

Common Name Baird's Sparrow **Scientific Name** *Ammodramus bairdii*

G-Rank G4 **S-Rank** SNRN **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I Declining; PIF watch list

Estimated population in NE Unknown **Estimate based on**

Trends since 2005 in NE Unknown

Range in NE Poorly known, statewide migrant with possible exception of extreme east. Emerging information suggests native grasslands of northern Sioux County may be regular sparrow stop-over location

Habitat Probably native grassland during migration but has been observed in non-native habitats; spring and fall migrant, does not nest in Nebraska

Threats Not well known, loss of habitat

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Determine migration status, distribution and habitat use; evaluate possible threats

Landscapes Distribution not well known, likely occurs in a number of BULs

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Common Name Bell's Vireo **Scientific Name** *Vireo bellii*

G-Rank G5 **S-Rank** S4 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I Declining; PIF watch list

Estimated population in NE > 50,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Increasing

Range in NE Statewide

Habitat All shrub land types except buck brush; grasslands with shrubs; dependent on shrubs

Threats Encroachment of trees, habitat conversion, fire suppression, cowbirds, shrub spraying

Climate Change Vulnerability Index: Not Vulnerable, Increase likely

Research/Inventory Determine minimum patch size and ratio of shrub to grassland; determine habitat requirements; determine how to manage with fire control - killing cedars but not shrubs; conduct genetics study - understand contribution of NE population to species as a whole

Landscapes Central Loess Hills, Cherry County Wetlands, Elkhorn Confluence, Elkhorn River Headwaters, Keya Paha, Loess Canyons, Lower Loup Rivers, Lower Niobrara River, Lower Platte River, Middle Niobrara, Missouri River, North Platte River, Oglala Grasslands, Pine Ridge, Platte Confluence, Ponca Bluffs, Saline Wetlands, Sandhills

Alkaline Lakes, Sandsage Prairie, Upper Loup Rivers and Tributaries, Upper Niobrara River, Verdigris-Bazile, Wildcat Hills, Willow Creek Prairies

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Common Name Brewer's Sparrow **Scientific Name** *Spizella breweri*

G-Rank G5 **S-Rank** S4 **Goal** 1 **Distribution** Peripheral

Criteria for selection as Tier I Declining; PIF watch list

Trends since 2005 in NE Declining

Estimated population in NE 1,000 - 2,000 **Estimate based on** BBA field surveys

Range in NE Shortgrass Prairie ecoregion in the Panhandle

Habitat Sandsage prairie; short-grass; mixed-grass w/sandsage component; shrub associated species - low shrubs

Threats Sage removal (to improve rangeland), land conversion – pivots, habitat fragmentation

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Identify habitat requirements; continue surveys to assess distribution and abundance; survey for sagebrush

Landscapes Oglala Grasslands, Panhandle Prairies, Upper Niobrara River, Pine Ridge, Sandsage Prairie, Wildcat Hills

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Common Name Buff-breasted Sandpiper **Scientific Name** *Tryngites subruficollis*

G-Rank G4 **S-Rank** S2N **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I Declining, Shorebird Conservation Plan

Estimated population in NE 22,000 - 78,000 **Estimate based on** Published estimate, Jorgensen et al. 2008

Trends since 2005 in NE Unknown

Range in NE Rainwater Basin in east-central portion of state

Habitat Cropland associated with palustrine wetlands - open flats; very short stature grasslands; playa wetlands; require mixture of agriculture and wetlands; spring and fall migrant, does not nest in Nebraska

Threats Agricultural practices, contaminants, wind energy development

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Determine food sources, migratory stopover duration, roost sites, what agricultural practices favor them, effects of agricultural practices-contaminants, population trend, effects of wind energy development

Landscapes Rainwater Basin, Verdigris-Bazile

Common Name Burrowing Owl **Scientific Name** *Athene cunicularia*

G-Rank G4 **S-Rank** S3 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I Ranked as imperiled or vulnerable in nearly all states in its range

Estimated population in NE 4,000 – 10, 000 **Estimate based on** Field surveys

Trends since 2005 in NE Increasing

Range in NE Western two-thirds of state

Habitat Prairie dog towns, short-grass prairie, mixed-grass prairie, heavily grazed grasslands

Threats Prairie dog control, habitat conversion-pivots; loss of short, open grasslands; plague, wind energy development, insecticide impact on food source

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Expand surveys to assess distribution and abundance; determine productivity, cause of population variability (predators), status and trends of prairie dogs, effects of wind energy development; conduct genetics study

Landscapes Central Loess Hills, Cherry County Wetlands, Dismal River Headwaters, Elkhorn River Headwaters, Keya Paha, Kimball Grasslands, Loess Canyons, Middle Niobrara, North Platte River, Oglala Grasslands, Panhandle Prairies, Rainwater Basin, Sandhills Alkaline Lakes, Sandsage Prairie, Upper Loup Rivers and Tributaries, Upper Niobrara River, Verdigris-Bazile, Wildcat Hills, Willow Creek Prairies

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Common Name Cerulean Warbler **Scientific Name** *Setophaga cerulea*

G-Rank G4 **S-Rank** S2 **Goal** 1 **Distribution** Peripheral

Criteria for selection as Tier I Declining; PIF watch list

Estimated population in NE < 10 **Estimate based on** Field surveys, Silcock et al. 2005

Trends since 2005 in NE Unknown

Range in NE Missouri River bluffs from Thurston to Richardson counties, but only at a few locations

Habitat Deciduous forest with emergents, old forest with little undergrowth, eastern riparian forest, red oak-basswood-Ironwood forest, lowland hackberry forest, streams where bluff meets floodplain

Threats Logging, fragmentation, cowbirds, deer population preventing tree regeneration

Climate Change Vulnerability Index: Not Vulnerable, Increase likely

Research/Inventory Determine habitat requirements, particularly in relation to habitat alteration; survey for breeding birds

Landscapes Missouri River, Indian Cave Bluffs, Ponca Bluffs, Thurston-Dakota Bluffs

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Common Name Chestnut-collared Longspur **Scientific Name** *Calcarius ornatus*

G-Rank G5 **S-Rank** S3 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I Declining, PIF watch list

Estimated population in NE 200 - 1,000 **Estimate based on** BBA field surveys

Trend since 2005 Unknown

Range in NE Western and northern portions of the Nebraska Panhandle

Habitat Native short- and mixed-grass prairie. Prefers taller prairie than McCown's Longspur.

Threats Loss of habitat, conversion of habitat to agriculture, degradation because of tree planting or invasive species, lack of grazing.

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Breeds locally; identify additional breeding locations.

Landscapes Panhandle Prairies, Oglala Grasslands, Kimball Grasslands.

Common Name Ferruginous Hawk **Scientific Name** *Buteo regalis*

G-Rank G4 **S-Rank** S2 **Goal** 7 **Distribution** Widespread

Criteria for selection as Tier I Ranked as imperiled or vulnerable in nearly all states in its range

Estimated population in NE 200 - 400 **Estimate based on** Expert opinion

Trends since 2005 in NE Stable

Range in NE Western third of state - primarily Panhandle

Habitat Rock outcrop, shortgrass prairie, Sandhills dune prairie, prairie dog towns, trees for nesting

Threats Human activity (agriculture/farming), prairie dog control, habitat fragmentation, wind energy development

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Survey southwest NE, Sandhills, and southern Sioux County; identify range in Sandhills associated with prairie dogs; study long-range movement; Identify wind energy development impacts

Landscapes Kimball Grasslands, Oglala Grasslands, Panhandle Prairies, Pine Ridge, Sandsage Prairie, Upper Niobrara River

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Common Name Greater Prairie-Chicken **Scientific Name** *Tympanuchus cupido*

G-Rank G4 **S-Rank** S3S4 **Goal** 4 **Distribution** Limited

Criteria for selection as Tier I Declining; PIF watch list

Estimated population in NE 800,000 – 2,500,000 **Estimate based on** Annual lek surveys

Trends since 2005 in NE Increasing

Range in NE Primarily north-central sandhills, scattered eastern three-quarters of state

Habitat Sandsage prairie, tall-grass prairie, Sandhills dry valley prairie, loess mixed-grass prairie

Threats Habitat conversion and fragmentation, grassland management (loss of forbs), loss of some shrubs, wind energy development, woody species encroachment, loss of CRP in eastern NE

Climate Change Vulnerability Index: Not Vulnerable, Increase likely

Research/Inventory Continue surveys to assess distribution and abundance; study effects of wind turbines, habitat use and demographics; understand contribution of NE population to species as a whole

Landscapes Central Loess Hills, Cherry County Wetlands, Dismal River Headwaters, Elkhorn Confluence, Elkhorn River Headwaters, Keya Paha, Loess Canyons, Platte Confluence, Ponca Bluffs, Sandsage Prairie, Sandstone Prairies, Southeast Prairies, Verdigris-Bazile, Willow Creek Prairies

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Common Name Henslow's Sparrow **Scientific Name** *Ammodramus henslowii*

G-Rank G4 **S-Rank** S1 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I Declining; PIF watch list

Estimated population in NE Unknown **Estimate based on**

Trends since 2005 in NE Unknown

Range in NE SE portion of state

Habitat Tall-grass prairie; wet-mesic tall-grass prairie; will use CRP; prefers large open grasslands

Threats Annual burning or haying (lack of litter), habitat conversion, woody species invasion, haying during nesting period, loss of CRP, wind energy development

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct surveys to assess distribution and abundance: identify prairie size requirements; research potential use of patch- burn grazing system to manage for suitable habitat

Landscapes Central Platte River, Elkhorn Confluence, Rainwater Basin, Sandstone Prairies, Southeast Prairies

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Common Name Interior Least Tern **Scientific Name** *Sternula antillarum athalassos*

G-Rank G4T2Q **S-Rank** S2 **Goal** 10 **Distribution** Limited

Criteria for selection as Tier I State and federally listed, G2

Estimated population in NE 800 - 1500 **Estimate based on** Field surveys, Lott 2006

Trends since 2005 in NE Stable

Range in NE Platte River east of Lake McConaughy, lower reaches of major rivers north of Platte River

Habitat Bare sand bars and sandy shorelines of large rivers, lakes and sand pits, housing developments

Threats Loss of dynamic river flows to form and maintain bare macro-form sandbar and shoreline habitat, flooding of nests, loss of nests to vehicles and human disturbance, hydro-peaking, invasive plant species affecting nesting habitat

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct nesting surveys throughout breeding range in state; evaluate taxonomy, region-wide movements

Landscapes Central Platte River, Elkhorn Confluence, Lower Loup Rivers, Lower Niobrara River, Lower Platte River, Middle Niobrara, Missouri River, Upper Loup Rivers and Tributaries, Verdigris-Bazile

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Common Name Loggerhead Shrike **Scientific Name** *Lanius ludovicianus*

G-Rank G4 **S-Rank** S? **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I Declining, PIF watch list

Estimated population in NE 1,000 - 4,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Declining

Range in NE Statewide, although more common in areas with extensive grasslands

Habitat Grasslands with at least some scattered small trees or shrubs

Threats Loss of grassland habitats, depletion of food resources (due to pesticides), organochloride pesticide negatively impacts reproduction

Climate Change Vulnerability Index: Not Vulnerable, Increase likely

Research/Inventory Determine causes of population declines; determine conservation measures (habitat improvement) that can positively impact species

Landscapes Central Loess Hills, Cherry County Wetlands, Dismal River Headwaters, Elkhorn River Headwaters, Keya Paha, Kimball Grasslands, Loess Canyons, Oglala Grasslands, Panhandle Prairies, Sandhills Alkaline Lakes, Sandsage Prairie, Sandstone Prairies, Southeast Prairies

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Common Name Long-billed Curlew **Scientific Name** *Numenius americanus*

G-Rank G5 **S-Rank** S3 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I Ranked as imperiled or vulnerable in nearly all states in its range

Estimated population in NE 20,000 – 27,000 **Estimate based on** Published estimate, Gregory 2011

Trends since 2005 in NE Declining

Range in NE North-central through panhandle

Habitat Sandhills dune prairie, Sandhills valley prairie with mixed-grass, prairie dog towns, mixed-grass and short-grass prairie in the Panhandle

Threats Habitat conversion – pivots, fragmentation, wind energy development

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct more surveys to assess distribution and abundance; determine factors affecting nest success and chick survival; determine habitat needs, management impacts, and effects of wind energy development

Landscapes Cherry County Wetlands, Dismal River Headwaters, Lower Niobrara River, Middle Niobrara, Oglala Grasslands, Panhandle Prairies, Platte Confluence, Sandhills Alkaline Lakes, Upper Loup Rivers and Tributaries, Upper Niobrara River, Wildcat Hills

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Common Name McCown's Longspur **Scientific Name** *Rhynchophanes mccownii*

G-Rank G4 **S-Rank** S3 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I Declining, PIF watch list

Estimated population in NE 200 - 1,000 **Estimate based on** BBA field surveys

Trends since 2005 in NE Unknown

Range in NE Panhandle - primarily Sioux, Scotts Bluff, Banner and Kimball counties

Habitat Short-grass prairie with mixed-grass, short stature vegetation, and prairie dog colonies

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Threats Habitat fragmentation and conversion, management that maintains higher vegetation structure, prairie dog control

Research/Inventory Identify habitat requirements; continue surveys to assess distribution and abundance; evaluate use of agricultural fields

Landscapes Kimball Grasslands, Oglala Grasslands, Panhandle Prairies

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Common Name Mountain Plover **Scientific Name** *Charadrius montanus*

G-Rank G3 **S-Rank** S2 **Goal** 10 **Distribution** Limited

Criteria for selection as Tier I State listed, G2

Estimated population in NE 300 - 400 **Estimate based on** Field surveys, Bly et al. 2008

Trends since 2005 in NE Unknown

Range in NE Kimball, Banner and Cheyenne, possibly Sioux counties

Habitat Shortgrass, agricultural fields; prairie dog towns; very low stature vegetation; flat, rocky areas

Threats Agriculture practices, predation on range sites, grazing management that maintains higher vegetation structure; habitat conversion and fragmentation; fire suppression

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct surveys in native grassland; determine: productivity on field vs. native prairie, spatial requirements for prairie near fallow habitats for brood-rearing and migration, effects of agriculture practices on foraging, effects of fire and of agricultural practices (e.g., chemical spraying), chick survival

Landscapes Kimball Grasslands

Common Name Pinyon Jay **Scientific Name** *Gymnorhinus cyanocephalus*

G-Rank G5 **S-Rank** S3 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I Declining

Estimated population in NE 200 - 800 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Pine Ridge and Wildcat Hills

Habitat Open ponderosa pine woodlands

Threats Loss and degradation of open ponderosa pine forests

Climate Change Vulnerability Index: Not Vulnerable, Increase Likely

Research/Inventory Refine knowledge of breeding status; identify important breeding sites; determine relationship between forest management and species response

Landscapes Pine Ridge, Wildcat Hills

Common Name Piping Plover **Scientific Name** *Charadrius melodus*

G-Rank G3 **S-Rank** S2 **Goal** 10 **Distribution** Limited

Criteria for selection as Tier I State and federally listed, G3

Estimated population in NE 500 - 1,000 **Estimate based on** Five year census, IPPC report

Trends since 2005 in NE Unknown

Range in NE Platte River east of Lake McConaughy, lower reaches of major rivers north of Platte River

Habitat Bare sand bars and sandy shorelines of large rivers, lakes and sand pits

Threats Loss of dynamic river flows to form and maintain bare macro-form sandbar and shoreline habitat, flooding of nests (hydro-peaking), loss of nests to vehicles and human disturbance, invasive plant species affecting nesting habitat, loss of over-wintering habitat along the Gulf

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct nesting surveys throughout breeding range in state; evaluate meta-population issues

Landscapes Central Platte River, Lower Loup Rivers, Lower Platte River, Lower Niobrara River, Missouri River, Middle Niobrara, Upper Loup Rivers and Tributaries, Verdigris-Bazile

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Common Name Short-eared Owl **Scientific Name** *Asio flammeus*

G-Rank G5 **S-Rank** S2 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I Declining; PIF watch list

Estimated population in NE < 200 **Estimate based on** BBA field surveys

Trends since 2005 in NE Unknown

Range in NE Scattered statewide

Habitat Open grasslands with standing cover and little disturbance

Threats Habitat loss and fragmentation, disturbance of nesting habitat, barbed wire fences present collision danger

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Survey to identify location and extent of breeding activity; determine specific nesting habitat requirements

Landscapes Central Loess Hills, Cherry County Wetlands, Dismal River Headwaters, Sandhills Alkaline Lakes, Sandsage Prairie

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Common Name Sprague's Pipit **Scientific Name** *Anthus spragueii*

G-Rank G4 **S-Rank** SNR **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I Declining; PIF watch list

Estimated population in NE Unknown **Estimate based on**

Trends since 2005 in NE Unknown

Range in NE Statewide migrant, but rare in west and extreme east. More common in east-central and central part of state

Habitat Short to tall-grass prairies, grazed to 5-15 cm, pastures, harvested fields (alfalfa or wheat stubble); spring and fall migrant; does not nest in Nebraska

Threats Undetermined, loss of breeding habitat, but unclear if there are threats during migration

Climate Change Vulnerability Index: Not Vulnerable, Increase likely

Research/Inventory Refine knowledge of migration status, distribution, and habitat use; identify important stopover sites and habitats; evaluate possible threats

Landscapes Distribution not well known, likely occurs in a number of BULs

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Common Name Trumpeter Swan **Scientific Name** *Cygnus buccinator*

G-Rank G4 **S-Rank** S2 **Goal** 4 **Distribution** Limited

Criteria for selection as Tier I Ranked as imperiled or vulnerable in all states in its range

Estimated population in NE 200 - 600 **Estimate based on** USFWS and BBA field surveys

Trends since 2005 in NE Increasing

Range in NE Primarily Cherry, Sheridan and Garden counties

Habitat Deep water wetlands and marsh lakes with dense, emergent vegetation; spring-fed streams

Threats Wetland drainage/loss, disturbance, pollution, wind energy development

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Continue surveys to assess distribution and abundance

Landscapes Central Loess Hills, Cherry County Wetlands, Dismal River Headwaters, Elkhorn River Headwaters, North Platte River, Sandhills Alkaline Lakes, Upper Loup Rivers and Tributaries, Upper Niobrara River

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Common Name Whooping Crane **Scientific Name** *Grus americana*

G-Rank G1 **S-Rank** S1 **Goal** 10 **Distribution** Limited

Criteria for selection as Tier I State and federally listed, G1

Estimated population in NE ~ 300 **Estimate based on** 2011 field survey, Stehn 2011

Trends since 2005 in NE Slowly Increasing

Range in NE Platte River from Scottsbluff to Chapman; wetlands and major rivers in central flyway

Habitat Wetlands, wet meadows, sandbars and shallow water in rivers; spring and fall migrant, does not nest in Nebraska

Threats Loss of natural river flows to maintain wet meadows, bare sandbar and shallow water habitat, loss of wetland habitat, wind energy development, tree encroachment in wet meadows

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Continue migration surveys; increase surveys of Sandhills wetlands, southwest playas, Middle Loup River headwaters, and Custer County playas

Landscapes Central Loess Hills, Central Platte River, Cherry County Wetlands, Elkhorn River Headwaters, Lower Loup Rivers, Lower Niobrara River, Middle Niobrara, North Platte River, Oglala Grasslands, Panhandle Prairies, Platte Confluence, Rainwater Basin, Upper Loup Rivers and Tributaries, Verdigris-Bazile

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Common Name Wood Thrush **Scientific Name** *Hylocichla mustelina*

G-Rank G5 **S-Rank** S3 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I Declining; PIF watch list

Estimated population in NE 1,000 - 4,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Declining

Range in NE Along major river valleys in eastern Nebraska

Habitat Mature eastern deciduous forests; needs shrubby understory component

Threats Reduction/ degradation of habitat, forest fragmentation - area sensitive species, fragmentation that increases cowbird parasitism, deer over-browsing of forest/woodland understory, invasive species (garlic mustard)

Climate Change Vulnerability Index: Not Vulnerable, Increase likely

Research/Inventory Determine impacts of deer, invasive species, forest fragmentation, and cowbird parasitism

Landscapes Indian Cave Bluffs, Lower Niobrara River, Lower Platte River, Middle Niobrara, Ponca Bluffs, Thurston-Dakota Bluffs, Rulo Bluffs, Southeast Prairies, Verdigris-Bazile

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FISH

Common Name Blacknose Shiner **Scientific Name** *Notropis heterolepis*

G-Rank G4 **S-Rank** S1 **Goal** 10 **Distribution** Disjunct

Criteria for selection as Tier I State listed, disjunct

Estimated population in NE < 100 **Estimate based on** Expert opinion

Trends since 2005 in NE Stable

Range in NE North-central portion of state

Habitat Headwater streams, spring fed, clear water, pools, quiet waters

Threats De-watering, siltation, dams, channelization, exotic species, culverts, water control structures, introduced predator fish

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Determine age structure; study recruitment, population dynamics, seasonal movement and habitat use; conduct population monitoring

Landscapes Cherry County Wetlands, Keya Paha, Upper Loup Rivers and Tributaries, Upper Niobrara River

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Common Name Blue Sucker **Scientific Name** *Cycleptus elongatus*

G-Rank G3G4 **S-Rank** S1 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I G3

Estimated population in NE 5,000 – 15,000 **Estimate based on** Field surveys

Trends since 2005 in NE Stable

Range in NE Lower Platte and Missouri rivers - Boyd through Richardson counties

Habitat Large turbid rivers

Threats Channelization, alteration of flow, lack of sedimentation in some areas of Missouri River, interruption of movement, water quality

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Determine specific habitat requirements; study population dynamics and seasonal movement; compile information from research range-wide; conduct population monitoring

Landscapes Lower Platte River, Missouri River

Common Name Finescale Dace **Scientific Name** *Chrosomus neogaeus*

G-Rank G5 **S-Rank** S2 **Goal** 10 **Distribution** Disjunct

Criteria for selection as Tier I State listed, disjunct

Estimated population in NE 5,000 - 10,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Stable

Range in NE Sandhills of central portion of state

Habitat Headwater streams, spring fed, clear water, sandhill streams, beaver ponds, undercut banks, meandering streams, small pools

Threats Channel modification, de-watering, exotics, culverts, water control structures, introduced predator fish

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Understand basic biology; determine age structure, recruitment, population dynamics, seasonal movements, and habitat use; conduct genetic studies

Landscapes Cherry County Wetlands, Dismal River Headwaters, Keya Paha, Panhandle Prairies, Platte Confluence, Snake River, Upper Loup Rivers and Tributaries, Upper Niobrara River

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Common Name Lake Sturgeon **Scientific Name** *Acipenser fulvescens*

G-Rank G3G4 **S-Rank** S1 **Goal** 10 **Distribution** Peripheral

Criteria for selection as Tier I State listed, G3

Estimated population in NE < 100 **Estimate based on** Field surveys

Trends since 2005 in NE Slightly increasing

Range in NE Lower Platte and Missouri rivers - Boyd through Richardson counties

Habitat Shallow water, gravel/rocky substrate – for spawning, large rivers, lakes in other states

Threats Pollution, lack of spawning habitat, fragmentation of habitat (dams), interruption of movement, decreasing water levels in Platte River, channelization of Missouri River, illegal commercial fishing

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Increase surveys to assess distribution and abundance; determine specific spawning habitat and population dynamics; conduct genetic studies

Landscapes Lower Loup Rivers, Lower Platte River, Missouri River

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Common Name Northern Redbelly Dace **Scientific Name** *Chrosomus eos*

G-Rank G5 **S-Rank** S2 **Goal** 10 **Distribution** Disjunct

Criteria for selection as Tier I State listed, disjunct

Estimated population in NE 5,000 – 10,000 **Estimate based on** Field surveys

Trends since 2005 in NE Stable

Range in NE Sandhills of central portion of state

Habitat Headwater streams, spring fed, clear water, sandhill streams, beaver ponds, undercut banks, meandering streams, small pools

Threats Channel modification, de-watering, exotics, culverts, water control structures, introduced predator fish

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Determine age structure, recruitment, population dynamics, seasonal movement, and specific habitat use; study genetics relative to northern populations in Minnesota; conduct population monitoring

Landscapes Cherry County Wetlands, Keya Paha, Middle Niobrara , Panhandle Prairies, Platte Confluence, Snake River, Upper Loup Rivers and Tributaries, Upper Niobrara River

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Common Name Pallid Sturgeon **Scientific Name** *Scaphirhynchus albus*

G-Rank G2 **S-Rank** S1 **Goal** 10 **Distribution** Limited

Criteria for selection as Tier I State and federally listed, G1

Estimated population in NE 1,000 – 3,000 wild, 8,000 – 10,000 hatchery reared
Estimate based on Published estimate, Steffensen et al. 2011

Trends since 2005 in NE Unknown

Range in NE Lower Platte and Missouri rivers - Boyd through Richardson counties

Habitat Large turbid rivers, steep drop-offs at the edge of sandbars, sandy areas, downstream end of islands

Threats Manipulation of water flow, sediment transport, channelization, lack of low flow, habitat fragmentation, loss of spawning habitat, illegal commercial harvest, current manipulation of hydrology

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Determine specific spawning habitat requirements, population dynamics, and seasonal movement

Landscapes Lower Platte River, Lower Niobrara River, Missouri River

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Common Name Plains Topminnow **Scientific Name** *Fundulus sciadicus*

G-Rank G4 **S-Rank** S4 **Goal** 10 **Distribution** Endemic

Criteria for selection as Tier I Endemic, declining

Estimated population in NE 100,000 – 250,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Declining

Range in NE Northwest two-thirds of state

Habitat Vegetative backwaters and headwaters, shallow parts of rivers and streams

Threats Predation, competition from mosquito fish and other exotics, de-watering, habitat loss

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance; identify secure occurrence locations; determine competition dynamic with mosquito fish; conduct genetics study

Landscapes Central Platte River, Cherry County Wetlands, Dismal River Headwaters, Elkhorn River Headwaters, Keya Paha, Kimball Grasslands, Lower Loup Rivers, Lower Platte River, Middle Niobrara, North Platte River, Panhandle Prairies, Platte Confluence, Sandsage Prairie, Snake River, Upper Loup Rivers and Tributaries, Upper Niobrara River, Verdigris-Bazile, Wildcat Hills, Willow Creek

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Common Name Sicklefin Chub **Scientific Name** *Macrhybopsis meeki*

G-Rank G3 **S-Rank** S1 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I G3

Estimated population in NE 500 - 1,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Missouri River - Boyd through Richardson counties

Habitat Large turbid rivers - Missouri River

Threats Reduction of turbidity, channelization, modified water flows

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Determine specific habitat requirements, population dynamics, seasonal movement, and sensitivity to turbidity

Landscapes Missouri River

Common Name Sturgeon Chub **Scientific Name** *Macrhybopsis gelida*

G-Rank G3 **S-Rank** S1 **Goal** 10 **Distribution** Limited

Criteria for selection as Tier I State listed, G3

Estimated population in NE 500 – 2,500 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Lower Platte and Missouri rivers - Boyd through Richardson counties

Habitat Large turbid rivers with gravel

Threats Reduction of turbidity, channelization, modified water flows, loss of spawning habitat, de-watering, sediment transport; siltation

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Determine specific habitat requirements, population dynamics, seasonal movement, and basic biology

Landscapes Lower Platte River, Missouri River

Common Name Topeka Shiner **Scientific Name** *Notropis topeka*

G-Rank G3 **S-Rank** S1 **Goal** 10 **Distribution** Limited

Criteria for selection as Tier I State and federally listed, G3

Estimated population in NE < 200 **Estimate based on** Expert opinion

Trends since 2005 in NE Declining

Range in NE Very localized: Cherry, Madison, and Stanton counties

Habitat Cold/cool clear water streams with gravel, low gradient

Threats Sedimentation, exotics, channelization, stocking of sport fish, row crop agriculture, flow modification' de-watering, dams, loss of off-channel quiet-water habitats, degradation of riparian areas

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Determine age structure, recruitment, population dynamics, seasonal movements, and potential for reintroduction including identifying potential reintroduction sites

Landscapes Cherry County Wetlands, Upper Loup Rivers and Tributaries

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INSECTS

Common Name American Burying Beetle **Scientific Name** *Nicrophorus americanus*

G-Rank G2G3 **S-Rank** S1 **Goal** 10 **Distribution** Limited

Criteria for selection as Tier I State and federally listed, G2

Estimated population in NE 50,000 – 60,000 **Estimate based on** 2011 field surveys

Trends since 2005 in NE Fluctuating with drought

Range in NE North-central and southwest-central portion of the state

Habitat Wet meadows in Sandhills, open woodlands, loess prairie

Threats Woody encroachment, drought, land development, light pollution

Climate Change Vulnerability Index: Highly Vulnerable

Research/Inventory Determine specific habitat use, effects of land management practices, population sizes; conduct long-term monitoring of individual populations

Landscapes Cherry County Wetlands, Elkhorn River Headwaters, Keya Paha, Loess Canyons, Middle Niobrara, Upper Loup Rivers and Tributaries, Verdigris-Brazile

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Common Name Bucholz Black Dash **Scientific Name** *Euphyes conspicua bucholzi*

G-Rank G4T1 **S-Rank** S1 **Goal** 10 **Distribution** Endemic

Criteria for selection as Tier I G1, endemic

Estimated population in NE < 100 **Estimate based on** Expert opinion

Trends since 2005 in NE Stable

Range in NE North-eastern portion of state

Habitat Wet meadow and spring-fed marsh; larvae feed on wide-leaf sedge, adults in boggy areas

Threats Habitat conversion and fragmentation, exotics, drying up of "wet" areas, housing development, heavy grazing

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Conduct surveys to assess distribution, abundance and population dynamics; determine best management practices

Landscapes Elkhorn Confluence, Elkhorn River Headwaters

Common Name Colorado Rita Dotted-Blue **Scientific Name** *Euphilotes rita coloradensis*

G-Rank G3G4T2T3 **S-Rank** S1 **Goal** 1 **Distribution** Peripheral

Criteria for selection as Tier I G3

Estimated population in NE < 100 **Estimate based on** Expert opinion

Trends since 2005 in NE Stable

Range in NE Southwest portion of the panhandle

Habitat Sparse grasslands with rocky, gravelly soils of ridges, outcrops and bluffs. Specific to two species of wild buckwheat (*Eriogonum*).

Threats Heavy grazing, herbicide use, limited by host plant occurrence

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct surveys to determine distribution, abundance, and population dynamics

Landscapes Kimball Grasslands

Common Name Ghost Tiger Beetle **Scientific Name** *Cicindela lepida*

G-Rank G3G4 **S-Rank** S2 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I G3

Estimated population in NE 3,000 – 5,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Declining

Range in NE Statewide in localized populations

Habitat Sparsely-vegetated areas with open, sandy soils

Threats Habitat succession, trampling, lights, off-road vehicle traffic

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct species and habitat-type specific surveys to determine distribution, abundance, and conservation status

Landscapes Cherry County Wetlands, Dismal River Headwaters, Elkhorn River Headwaters, Indian Cave Bluffs, Platte Confluence, Sandsage Prairie, Upper Loup Rivers and Tributaries

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Common Name Iowa Skipper **Scientific Name** *Atrytone arogos iowa*

G-Rank G3T3 **S-Rank** S1 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I G3

Estimated population in NE < 500 **Estimate based on** Expert opinion

Trends since 2005 in NE Declining

Range in NE Eastern half of state

Habitat Tall-grass prairie, mixed-grass prairie along the Niobrara - bluestems likely host plant, requires native prairie with standing grass stems

Threats Management practices that remove all standing grass stem, vegetative litter and nectar sources, burning of entire grassland site can be detrimental, habitat fragmentation

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct surveys to assess distribution and abundance; determine best management practices

Landscapes Keya Paha, Lower Niobrara River, Middle Niobrara, Platte Confluence, Sandstone Prairie, Southeast Prairies, Upper Loup Rivers and Tributaries, Verdigris-Brazile

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Common Name Married Underwing **Scientific Name** *Catocala nuptialis*

G-Rank G3G4 **S-Rank** S2 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I G3

Estimated population in NE 1,000 – 5,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Declining to stable

Range in NE Primarily eastern half of the state

Habitat Tall-grass and mixed-grass prairie; larvae feed on lead plant (*Amorpha*)

Threats Habitat loss and fragmentation to prairie, management practices that remove all standing vegetation and are applied to an entire tract (high-intensity grazing, haying, prescribed burning)

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct surveys to assess distribution and abundance; determine best management practices

Landscapes Elkhorn Confluence, Central Loess Hills, Central Platte River, Cherry County Wetlands, Loess Canyons, Lower Platte River, Missouri River, Platte Confluence, Sandstone Prairies, Southeast Prairies, Upper Loup Rivers and Tributaries

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Common Name Mottled Duskywing **Scientific Name** *Erynnis martialis*

G-Rank G3 **S-Rank** S2 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I G3

Estimated population in NE 500 – 1,500 **Estimate based on** Expert opinion

Trends since 2005 in NE Declining

Range in NE Scattered across state (e.g., Pine Ridge, Niobrara River valley, National Forest at Halsey, Missouri River bluffs)

Habitat Hilly areas with prairie openings, host plant is New Jersey Tea (*Ceanothus*)

Threats Loss of habitat and host plants, grazing from over-abundant deer

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct surveys to determine distribution and abundance

Landscapes Cherry County Wetlands, Pine Ridge, Middle Niobrara, Missouri River

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Common Name Nine-spotted Ladybird Beetle **Scientific Name** *Coccinella novemnotata*

G-Rank GNR **S-Rank** S1 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I Severe decline throughout its historic range of the eastern half of North America

Estimated population in NE < 5,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Severe decline

Range in NE Historically statewide, currently only in the panhandle of Nebraska

Habitat Predator on aphids found in variety of habitats

Threats Predation by introduced parasitic wasp, insecticides

Climate Change Vulnerability Index: Not Vulnerable, Increase likely

Research/Inventory Conduct surveys to determine distribution and abundance

Landscapes Panhandle Prairies

Common Name Ottoe Skipper **Scientific Name** *Hesperia ottoe*

G-Rank G3G4 **S-Rank** S2 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I G3

Estimated population in NE < 1,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Declining

Range in NE Eastern half of state

Habitat Tall-grass prairie, rolling/hilly prairie, mixed-grass prairie - feed on bluestems

Threats Loss of native grasslands, management practices that remove all standing grass stems, vegetative litter, and nectar sources; burning of entire grassland site can be detrimental, exotics, habitat fragmentation

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct surveys to assess distribution and abundance; determine best management practices

Landscapes Lower Loup Rivers, Niobrara River, Sandstone Prairies

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Common Name Platte River Caddisfly **Scientific Name** *Ironoquia plattensis*

G-Rank G1G2 **S-Rank** S1S2 **Goal** 10 **Distribution** Endemic

Criteria for selection as Tier I G1, endemic

Estimated population in NE 7,500 – 10,000 **Estimate based on** Recent field surveys

Trends since 2005 in NE Declining

Range in NE Central Platte River: Kearney, Hall, and Merrick Counties

Habitat Sloughs, backwaters, wet meadows

Threats Loss of natural river hydrology to maintain sloughs, backwater, and wet meadow habitat, use of insecticides, habitat conversion

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance; determine population dynamics and specific habitat requirements; conduct genetic analysis

Landscapes Central Platte River

Common Name Regal Fritillary **Scientific Name** *Speyeria idalia*

G-Rank G3 **S-Rank** S3 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I G3

Estimated population in NE 50,000 – 150,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Stable

Range in NE Statewide, primarily in the eastern half of the state

Habitat Tall-grass and mixed-grass prairie with violets, wet meadows

Threats Habitat loss and fragmentation, exotics, drought, heavy grazing or herbicide use that eliminates violets, burning of entire prairie remnant

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct surveys to assess distribution and abundance; monitor population trends

Landscapes Found in all BULs

Common Name Salt Creek Tiger Beetle **Scientific Name** *Cicindela nevadica lincolniana*

G-Rank G5T1 **S-Rank** S1 **Goal** 10 **Distribution** Endemic

Criteria for selection as Tier I State and federally listed, endemic

Estimated population in NE ~ 300 **Estimate based on** Annual census

Trends since 2005 in NE Declining

Range in NE Lancaster County

Habitat Eastern Nebraska saline wetlands and their associated streams

Threats Habitat loss and degradation, urban development, impacts to natural hydrology - wetland drainage due to stream channelization and head-cutting, light pollution, heavy grazing

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Identify specific reproductive habitat parameters; determine best habitat restoration methods; develop captive-rearing techniques

Landscapes Saline Wetlands

Common Name Tawny Crescent **Scientific Name** *Phyciodes batesii*

G-Rank G4 **S-Rank** S1 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I Declining, ranked as possibly extirpated, imperiled or vulnerable in most states in its range

Estimated population in NE 500 – 1,500 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Pine Ridge- Sioux County

Habitat Canyon type habitat - close to water, between stream and dry pine wooded areas with grassland openings

Threats Limited by host plant availability (*Aster laevis*), heavy grazing

Climate Change Vulnerability Index: Moderately Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance; determine life-cycle and specific habitat requirements

Landscapes Pine Ridge

Common Name Whitney Underwing **Scientific Name** *Catocala whitneyi*

G-Rank G3G4 **S-Rank** S1 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I G3

Estimated population in NE 5,000 – 10,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Declining to stable

Range in NE Primarily eastern half of the state

Habitat Tall-grass and mixed-grass prairie; larvae feed on lead plant (*Amorpha*)

Threats Habitat loss and fragmentation of prairie, management practices that remove all standing vegetation and are applied to an entire tract (high-intensity grazing, haying, prescribed burning)

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct surveys to assess distribution and abundance; determine best management practices

Landscapes Central Loess Hills, Central Platte River, Cherry County Wetlands, Elkhorn Confluence, Loess Canyons, Lower Platte River, Missouri River, Platte Confluence, Sandstone Prairies, Southeast Prairies

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MAMMALS

Common Name Bailey's Eastern Woodrat **Scientific Name** *Neotoma floridana baileyi*

G-Rank G5T3 **S-Rank** S2 **Goal** 10 **Distribution** Endemic

Criteria for selection as Tier I Endemic

Estimated population in NE 1,000 – 3,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Increasing

Range in NE North-central Nebraska

Habitat Pines and bluffs, woodlands and rocks

Threats Habitat degradation, excessive fire

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct surveys to assess distribution and abundance

Landscapes Keya Paha, Middle Niobrara, Snake River

Common Name Cheyenne Northern Pocket Gopher **Scientific Name** *Thomomys talpoides cheyennensis*

G-Rank G5T3T4 **S-Rank** S1 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I Regional endemic

Estimated population in NE Unknown **Estimate based on**

Trends since 2005 in NE Decreasing

Range in NE Kimball, Cheyenne and Banner counties

Habitat Hard rocky soils, short-grass prairies

Threats Land conversion, *Geomys* range expansion

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance

Landscapes Kimball Grasslands

Common Name Fringe-Tailed Myotis **Scientific Name** *Myotis thysanodes pahasapensis*

G-Rank G4G5T2 **S-Rank** S1 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I G2

Estimated population in NE 500 – 1,500 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Pine forests in panhandle and Wildcat Hills

Habitat Ponderosa pine forest and woodland, green ash-elm bottom woodland, cliffs and buttes

Threats Unknown

Climate Change Vulnerability Index: Moderately Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance; identify maternal roost habitat requirements and winter hibernacula; track movement patterns using telemetry

Landscapes Pine Ridge, Wildcat Hills

Common Name Northern River Otter **Scientific Name** *Lontra canadensis*

G-Rank G5 **S-Rank** S2 **Goal** 10 **Distribution** Widespread

Criteria for selection as Tier I State listed

Estimated population in NE 800 – 5,000 **Estimate based on** Field surveys

Trends since 2005 in NE Increasing

Range in NE Statewide

Habitat Along rivers and streams with sloughs and backwater areas, marshes; will frequent lakes and ponds

Threats Accidental trapping, habitat loss, pesticides and pollution, vehicle mortality

Climate Change Vulnerability Index: Not Vulnerable, Increase likely

Research/Inventory Conduct inventory and monitoring surveys of Republican River population

Landscapes Central Loess Hills, Central Platte River, Elkhorn River Headwaters, Loess Canyons, Lower Loup Rivers, Lower Niobrara River, Lower Platte River, Middle Niobrara, Missouri River, North Platte River, Platte Confluence, Upper Loup Rivers and Tributaries, Upper Niobrara River

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Common Name Pierre Northern Pocket Gopher **Scientific Name** *Thomomys talpoides pierreicolus*

G-Rank G? **S-Rank** S? **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I Regional endemic

Estimated population in NE Unknown **Estimate based on**

Trends since 2005 in NE Unknown

Range in NE Northern Dawes and Sioux counties

Habitat Short-grass, hard soils

Threats Control

Climate Change Vulnerability Index: Highly Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance

Landscapes Oglala Grasslands, Pine Ridge

Common Name Plains Harvest Mouse **Scientific Name** *Reithrodontomys montanus griseus*

G-Rank G5TNR **S-Rank** S1 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I Regional endemic; declining?

Estimated population in NE < 200 **Estimate based on** Field surveys

Trends since 2005 in NE Unknown

Range in NE Eastern portion of state

Habitat Tall-grass prairie - heavily grazed, open prairies, salt marshes

Threats Loss of tall-grass prairie habitat, lack of heavy grazing/management issues

Climate Change Vulnerability Index: Not Vulnerable, Increase likely

Research/Inventory Conduct surveys to assess distribution and abundance (particularly in saline wetlands); determine specific habitat requirements;

Landscapes Elkhorn Confluence, Sandstone Prairies, Southeast Prairies, Saline Wetlands, Willow Creek Prairies

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Common Name Plains Pocket Mouse **Scientific Name** *Perognathus flavescens perniger*

G-Rank G5TNR **S-Rank** SNR **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I Regional endemic, declining?

Estimated population in NE < 200 **Estimate based on** Field surveys

Trends since 2005 in NE Declining?

Range in NE Eastern Nebraska

Habitat Sandy-loose soil prairies, loess bluff prairie, loess mixed-grass prairie, northern sand/gravel prairie

Threats Loss of open prairie habitat because of lack of grazing and fire

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct surveys to assess distribution and abundance; determine specific habitat requirements; conduct genetic analysis

Landscapes Elkhorn Confluence, Lower Loup Rivers, Verdigris-Brazile, Willow Creek Prairies

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Common Name Rocky Mountain Bighorn Sheep **Scientific Name** *Ovis canadensis canadensis*

G-Rank G4T4 **S-Rank** S2 **Goal** 1 **Distribution** Disjunct

Criteria for selection as Tier I Disjunct

Estimated population in NE ~ 300 **Estimate based on** NGPC monitoring

Trends since 2005 in NE Slight increase, reintroduction and augmentation in 2005 and 2007

Range in NE Buttes in Scottsbluff and Sioux counties

Habitat Rocky buttes of Pine Ridge and Wildcat Hills

Threats Parasites, hoof deformations, disease

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Monitor for parasites and disease; determine source of hoof deformities

Landscapes Pine Ridge, Wildcat Hills

Common Name Southern Flying Squirrel **Scientific Name** *Glaucomys volans*

G-Rank G5 **S-Rank** S1 **Goal** 5 **Distribution** Peripheral

Criteria for selection as Tier I State listed

Estimated population in NE < 200 **Estimate based on** Field surveys

Trends since 2005 in NE Stable?

Range in NE Missouri River bluffs - Washington to Richardson counties

Habitat Red oak-basswood-ironwood forest

Threats Loss of mature forest with old-growth trees with cavities for nesting

Climate Change Vulnerability Index: Highly Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance; conduct population monitoring

Landscapes Missouri River, Indian Cave Bluffs, Rulo Bluffs

Common Name Swift Fox **Scientific Name** *Vulpes velox*

G-Rank G3 **S-Rank** S2 **Goal** 10 **Distribution** Limited

Criteria for selection as Tier I State listed, G3

Estimated population in NE < 1,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Stable

Range in NE Panhandle and Southwest Nebraska

Habitat Short-grass prairie, western mixed-grass prairie

Threats Predator control, conversion to cropland, fragmentation of habitat, loss of prairie dog colonies

Climate Change Vulnerability Index: Not Vulnerable, Increase Likely

Research/Inventory Conduct surveys to assess distribution and abundance; conduct population monitoring

Landscapes Kimball Grasslands, Oglala Grasslands, Panhandle Prairies, Pine Ridge, Upper Niobrara River, Wildcat Hills

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MOLLUSKS

Common Name Flat Floater **Scientific Name** *Anodonta suborbiculata*

G-Rank G5 **S-Rank** S1 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I Declining; ranked as imperiled or vulnerable in nearly all states in its range

Estimated population in NE < 100 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Missouri River - Boyd through Richardson counties

Habitat Quiet water of sloughs, oxbows, and backwaters of Missouri River

Threats Drainage, filling and siltation of sloughs, oxbows, and backwaters; stream channelization, degradation of water quality

Climate Change Vulnerability Index: Highly Vulnerable

Research/Inventory Conduct surveys in river above Lewis and Clark Lake; determine specific habitat requirements

Landscapes Missouri River

Common Name Higgins Eye **Scientific Name** *Lampsilis higginsii*

G-Rank G1G2 **S-Rank** S1 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I G1

Estimated population in NE < 10 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Upper reaches of Missouri River

Habitat Large to medium rivers in mud and sand

Threats Stream channelization, siltation, degradation of water quality, agriculture and urban effluent

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance; determine specific habitat requirements; evaluate potential for reintroduction

Landscapes Missouri River

Common Name Pimpleback **Scientific Name** *Quadrula pustulosa*

G-Rank G5 **S-Rank** S2 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I Declining

Estimated population in NE < 1,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Streams in eastern quarter of state

Habitat Large streams to medium rivers in mud, sand, or gravel

Threats Habitat fragmentation because of dams and other barriers to fish movement, stream channelization, siltation, degradation of water quality, agriculture and urban effluent

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Conduct surveys in the Big Blue River; determine specific habitat requirements; develop culture techniques; identify reintroduction streams/sites

Landscapes Southeast Prairies, Elkhorn River Headwaters, Lower Platte River, Saline Wetlands, Sandstone Prairies, Rainwater Basin

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Common Name Pistolgrip **Scientific Name** *Tritogonia verrucosa*

G-Rank G4G5 **S-Rank** S1 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I Declining

Estimated population in NE < 50 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Missouri River and streams in southeast portion of state

Habitat Large streams to medium rivers in mud, sand, or gravel

Threats Habitat fragmentation because of dams and other barriers to fish movement, stream channelization, siltation, degradation of water quality, agriculture and urban effluent

Climate Change Vulnerability Index: Highly Vulnerable

Research/Inventory Conduct surveys in the Big Blue River; determine specific habitat requirements; develop culture techniques; identify reintroduction streams/sites

Landscapes Missouri River, Southeast Prairies

Common Name Plain Pocketbook **Scientific Name** *Lampsilis cardium*

G-Rank G5 **S-Rank** S2 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I Declining

Estimated population in NE 100 - 500 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Streams in eastern third of state

Habitat Small creeks to medium rivers in mud, sand, or gravel

Threats Habitat fragmentation because of dams and other barriers to fish movement, stream channelization, siltation, degradation of water quality, agriculture and urban effluent, accidental agricultural chemical spill

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance; determine specific habitat requirements; develop culture techniques; identify reintroduction streams/sites

Landscapes Elkhorn River Headwaters, Elkhorn Confluence, Southeast Prairies

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Common Name Scaleshell **Scientific Name** *Leptodea leptodon*

G-Rank G1G2 **S-Rank** S1 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I State and federally listed, G1

Estimated population in NE < 10 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Upper reaches of Missouri River

Habitat Large rivers in mud and sand

Threats Stream channelization, degradation of water quality

Climate Change Vulnerability Index: Highly Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance; determine specific habitat requirements

Landscapes Missouri River

REPTILES

Common Name Blanding's Turtle **Scientific Name** *Emydoidea blandingii*

G-Rank G4 **S-Rank** S4 **Goal** 4 **Distribution** Limited

Criteria for selection as Tier I Ranked as imperiled or vulnerable in all but one state in its range

Estimated population in NE > 150,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Stable

Range in NE Primarily Sandhills marshes, very locally in eastern portion of state

Habitat Requires proximity to water; Sandhills fens, Sandhills freshwater marsh, northern cordgrass wet prairie, small tributaries, Sandhills prairies (upland habitat), marshes and oxbows in eastern portion of state

Threats Vehicle mortality, habitat fragmentation and loss of wetlands in eastern part of range, collection for pet trade

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct surveys along eastern edge of range, population monitoring

Landscapes Cherry County Wetlands, Dismal River Headwaters, Elkhorn Confluence, Elkhorn River Headwaters, Lower Loup Rivers, Lower Platte River, Middle Niobrara, Upper Loup Rivers and Tributaries

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Common Name Massasauga **Scientific Name** *Sistrurus catenatus*

G-Rank G3G4 **S-Rank** S1 **Goal** 10 **Distribution** Widespread

Criteria for selection as Tier I State listed, G3

Estimated population in NE 1,000 - 2,500 **Estimate based on** Field surveys

Trends since 2005 in NE Stable

Range in NE Very southeast portion of state

Habitat Wet mesic tall-grass prairie, wet meadow/marsh/wet prairie, lower-middle tall-grass prairie, cordgrass wet prairie, crayfish burrows

Threats Loss/degradation of tall-grass prairie habitat, woody invasion, tilling for agriculture, ehicle mortality

Climate Change Vulnerability Index: Highly Vulnerable

Research/Inventory Determine size/extent of Colfax County population; conduct surveys to assess distribution and abundance; conduct population monitoring

Landscapes Lower Platte River, Sandstone Prairies, Southeast Prairies

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Common Name Sagebrush Lizard **Scientific Name** *Sceloporus graciosus*

G-Rank G5 **S-Rank** S1 **Goal** 1 **Distribution** Peripheral

Criteria for selection as Tier I Disjunct

Estimated population in NE < 500 **Estimate based on** Expert opinion

Trend since 2005 Unknown

Range in NE Central portion of the Panhandle

Habitat Open, rocky, short-grass prairie, usually associated with sagebrush, higher elevations

Threats Grassland management that increases vegetative cover, elimination of sagebrush, habitat fragmentation

Research/Inventory Conduct surveys to assess distribution and abundance; determine specific habitat requirements; conduct population monitoring

Landscapes Panhandle Prairies, Wildcat Hills

Common Name Timber Rattlesnake **Scientific Name** *Crotalus horridus*

G-Rank G4 **S-Rank** S1 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I Declining: ranked as imperiled or vulnerable in nearly all states in its range

Estimated population in NE < 1,000 **Estimate based on** Field surveys

Trends since 2005 in NE Declining

Range in NE Very southeast portion of state

Habitat Deciduous woodland, riparian woodland - both in conjunction with rock outcrops

Threats Cedar encroachment, malicious killing, limestone quarrying

Climate Change Vulnerability Index: Not Vulnerable, presumed stable

Research/Inventory Conduct surveys to assess distribution and abundance; determine life history dynamics; determine specific habitat management requirements

Landscapes Missouri River, Sandstone Prairies, Southeast Prairies, Indian Cave Bluffs, Rulo Bluff

PLANTS

Common Name American Ginseng **Scientific Name** *Panax quinquefolius*

G-Rank G3G4 **S-Rank** S1 **Goal** 10 **Distribution** Peripheral

Criteria for selection as Tier I State listed, G3

Estimated population in NE 500 - 800 **Estimate based on** Expert opinion

Trend since 2005 in NE Unknown

Range in NE Missouri River bluffs

Habitat Oak-hickory-ironwood forest, bur oak-basswood-ironwood forest, red oak-basswood-ironwood forest

Threats Over-collecting, grazing of woodlands, logging, housing development, invasive species, lack of woodland management, brush encroachment

Climate Change Vulnerability Index: Moderately Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance; conduct population monitoring- resurvey known sites

Landscapes Indian Cave Bluffs, Missouri River, Ponca Bluffs, Rulo Bluffs

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Common Name Barr's Milkvetch **Scientific Name** *Astragalus barrii*

G-Rank G3 **S-Rank** S1 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I G3

Estimated population in NE < 250 **Estimate based on** Expert opinion

Trend since 2005 in NE Stable

Range in NE Dawes County

Habitat Badland, rock outcrop

Threats Off-road vehicle use, erosion

Climate Change Vulnerability Index: Highly Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance; conduct population monitoring

Landscapes Oglala Grasslands

Common Name Blowout Penstemon **Scientific Name** *Penstemon haydenii*

G-Rank G1 **S-Rank** S1 **Goal** 10 **Distribution** Endemic

Criteria for selection as Tier I State and federally listed, G1

Estimated population in NE 15,000-20,000 **Estimate based on** Annual monitoring, Dr. Stubbendieck, UNL

Trend since 2005 in NE Wild (non-introduced) populations are declining

Range in NE Sandhills ecoregion

Habitat Sandhills dune prairie (blowouts)

Threats Loss of blowouts because of present range management practices, lack of fire, recent climatic conditions

Climate Change Vulnerability Index: Highly Vulnerable

Research/Inventory Determine methods for establishing and maintaining populations

Landscapes Central Platte River, Cherry County Wetlands, Dismal River Headwaters, Elkhorn River Headwaters, Panhandle Prairies, Sandhills Alkaline Lakes, Upper Niobrara River, Upper Loup Rivers and Tributaries

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Common Name Colorado Butterfly Plant **Scientific Name** *Gaura neomexicana coloradensis*

G-Rank G3T2 **S-Rank** S1 **Goal** 5 **Distribution** Limited

Criteria for selection as Tier I State and federally listed, G2

Estimated population in NE < 200 **Estimate based on** 2008 field survey

Trend since 2005 in NE Declining

Range in NE Kimball County

Habitat Western floodplain terrace grassland

Threats Canada thistle invasion of habitat, herbicide spraying, groundwater level decline, haying and heavy grazing of habitat

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Conduct population monitoring; re-survey in 2012 to evaluate effect of 2010 flooding; determine best management practices

Landscapes Kimball Grasslands

Common Name Dog-Parsley **Scientific Name** *Lomatium nuttallii*

G-Rank G3 **S-Rank** S2 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I G3

Estimated population in NE 1,000 - 5,000 **Estimate based on** Expert opinion

Trend since 2005 in NE Stable

Range in NE Sheridan, Scotts Bluff and Morrill counties

Habitat Rock outcrops

Threats Unknown, few if any

Climate Change Vulnerability Index: Moderately Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance

Landscapes Wildcat Hills, Oglala Grasslands, Pine Ridge

Common Name Gordon's Wild Buckwheat **Scientific Name** *Eriogonum gordonii*

G-Rank G4 **S-Rank** S1 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I Regional endemic; ranked imperiled or vulnerable in most states in its range

Estimated population in NE 500 - 1,500 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Dawes and Sioux counties

Habitat Rocky prairies (most likely western mixed-grass prairie); weathered and eroded Pierre shale in grasslands

Threats Unknown

Climate Change Vulnerability Index: Moderately Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance

Landscapes Oglala Grasslands, Panhandle Prairies, Upper Niobrara River

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Common Name Hall's Bulrush **Scientific Name** *Schoenoplectus hallii*

G-Rank G2G3 **S-Rank** S3 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I G2

Estimated population in NE 1,000 - 20,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Stable

Range in NE Eastern Sandhills ecoregion

Habitat Northern sedge wet meadow, northern cordgrass wet prairie, Sandhills freshwater marsh (open sand edge of wetlands)

Threats Wetland drainage, invasive species, pumping for irrigation

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Determine best management practices

Landscapes Elkhorn River Headwaters, Upper Loup Rivers and Tributaries

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Common Name Large-Spike Prairie-Clover **Scientific Name** *Dalea cylindriceps*

G-Rank G3G4 **S-Rank** S2 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I G3

Estimated population in NE 1.000 - 5,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Shortgrass Prairie ecoregion

Habitat Gravelly terrace prairies

Threats Invasive species, possibly heavy grazing

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct surveys to assess distribution and abundance

Landscapes North Platte River, Middle Niobrara, Sandsage Prairie, Panhandle Prairie, Upper Niobrara River

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Common Name Matted Prickly-phlox **Scientific Name** *Linanthus caespitosus*

G-Rank G4 **S-Rank** S1 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I Regional endemic, ranked as imperiled or vulnerable in most states in its range

Estimated population in NE 100 - 1,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Scotts Bluff County

Habitat Rock outcrop

Threats Unknown - not many likely

Climate Change Vulnerability Index: Highly Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance

Landscapes Wildcat Hills, Kimball Grasslands

Common Name Meadow Lousewort **Scientific Name** *Pedicularis crenulata*

G-Rank G4 **S-Rank** S1 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I Regional endemic, ranked as imperiled or vulnerable in most states in its range

Estimated population in NE 500 - 1,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Stable

Range in NE Sioux County

Habitat Western streamside wet meadow

Threats Annual haying, heavy grazing, exotic plant invasion, water depletion

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance

Landscapes Upper Niobrara River

Common Name Missouri Sedge **Scientific Name** *Carex missouriensis*

G-Rank G4 **S-Rank** S1 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I Regional endemic, ranked as imperiled or vulnerable in most states in its range

Estimated population in NE 100 - 5,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Johnson, Richardson, Saline, and Otoe counties

Habitat Eastern cordgrass wet prairie, eastern sedge wet meadow, wet-mesic tall-grass prairie

Threats Conversion of prairie to cropland, herbicide spraying, invasive species, heavy grazing, tree encroachment

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance

Landscapes Southeast Prairies

Common Name Nodding-pogonia **Scientific Name** *Triphora trianthophora var. trianthophora*

G-Rank G3G4T3T4 **S-Rank** S1 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I G3

Estimated population in NE 50 - 500 **Estimate based on** Expert opinion

Trend since 2005 in NE Unknown

Range in NE Southeast Nebraska, Missouri River bluffs

Habitat Red oak-basswood-ironwood forest, oak-hickory-ironwood forest

Threats Grazing of woodlands, logging, housing development, invasive species, lack of woodland management, brush encroachment

Climate Change Vulnerability Index: Highly Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance; conduct population monitoring

Landscapes Missouri River, Rulo Bluffs

Common Name Platte River Dodder **Scientific Name** *Cuscuta plattensis*

G-Rank G1Q **S-Rank** SNR **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I G1

Estimated population in NE 100 - 1,000 **Estimate based on** Expert opinion

Trend since 2005 Unknown

Range in NE Morrill County

Habitat Floodplains, possibly grasslands and woodland edge

Threats Invasive species, conversion of grasslands to cropland

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct surveys to assess distribution and abundance; conduct population monitoring

Landscapes North Platte River

Common Name Prairie Moonwort **Scientific Name** *Botrychium campestre*

G-Rank G3G4 **S-Rank** S1 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I G3

Estimated population in NE 1,000 - 100,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Brown County

Habitat Bur oak-basswood-ironwood forest

Threats Unknown

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct surveys to assess distribution and abundance

Landscapes Keya Paha, Lower Niobrara River, Middle Niobrara, Verdigris-Bazile

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Common Name Rocky Mountain Bulrush **Scientific Name** *Schoenoplectus saximontanus*

G-Rank G5 **S-Rank** S1 **Goal** 4 **Distribution** Widespread

Criteria for selection as Tier I Ranked imperiled or vulnerable in all states in its range

Estimated population in NE 500 - 1,500 **Estimate based on** Expert opinion

Trend since 2005 Unknown

Range in NE Northwest; historically known from Rainwater Basin, Perkins County, and northern Nebraska.

Habitat Ephemeral wetland shores, playas

Threats Siltation, wetland drainage, conversion of wetlands to cropland, invasive species

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct surveys to assess distribution and abundance

Landscapes Oglala Grasslands

Common Name Saltwort **Scientific Name** *Salicornia rubra*

G-Rank G5 **S-Rank** S1 **Goal** 10 **Distribution** Disjunct

Criteria for selection as Tier I State listed, disjunct

Estimated population in NE 1,000 - 20,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Likely declining

Range in NE Lancaster and southern Saunders counties

Habitat Eastern saline meadow

Threats Wetland drainage, development, reduced groundwater levels, loss of salinity in wetlands, invasive plants

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Research needed on how to restore and manage saline wetlands; determine methods for controlling narrowleaf cattail and reed canary grass in saline wetlands

Landscapes Saline Wetlands

Common Name Sandhill Goosefoot **Scientific Name** *Chenopodium cycloides*

G-Rank G3G4 **S-Rank** S1 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I G3, Disjunct

Estimated population in NE 1,500 - 20,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Perkins, Chase and Dundy counties

Habitat Sandsage prairie

Threats Heavy grazing, herbicide spraying, conversion of prairie to cropland

Climate Change Vulnerability Index: Not Vulnerable, Presumed Stable

Research/Inventory Conduct surveys to assess distribution and abundance

Landscapes Sandsage Prairie

Common Name Short's Milkvetch **Scientific Name** *Astragalus shortianus*

G-Rank G4 **S-Rank** S1 **Goal** 7 **Distribution** Limited

Criteria for selection as Tier I Regional endemic; ranked as imperiled or vulnerable in most states in its range

Estimated population in NE 50 - 1,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Kimball and Banner counties

Habitat Rocky and gravelly western mixed-grass prairie

Threats Unknown, wind energy development?

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Conduct surveys to assess distribution and abundance

Landscapes Kimball Grasslands

Common Name Small White Lady's-Slipper **Scientific Name** *Cypripedium candidum*

G-Rank G4 **S-Rank** S1 **Goal** 10 **Distribution** Widespread

Criteria for selection as Tier I State listed

Estimated population in NE 1,000 - 2,000 **Estimate based on** Field surveys

Trends since 2005 in NE Stable

Range in NE Loup River valleys in the Mixedgrass Prairie ecoregion and eastern Sandhills ecoregion

Habitat Northern sedge wet meadow, northern cordgrass wet prairie, wet-mesic tall-grass prairie

Threats Conversion of meadows to cropland and development, invasive species, reduced groundwater levels, annual mid-summer haying, herbicide spraying

Climate Change Vulnerability Index: Moderately Vulnerable

Research/Inventory Research to determine best management practices; Continue surveys to assess distribution and abundance

Landscapes Elkhorn River Headwaters, Lower Loup Rivers, Middle Niobrara

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Common Name Snow Trillium **Scientific Name** *Trillium nivale*

G-Rank G4 **S-Rank** S1 **Goal** 1 **Distribution** Peripheral

Criteria for selection as Tier I Ranked as imperiled or vulnerable in nearly all states in its range

Estimated population in NE 500 - 1,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Cass County

Habitat Oak-hickory-ironwood forest, bur oak-basswood-ironwood forest, red oak-basswood-ironwood forest

Threats Invasive species, logging, heavy grazing

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Re-inventory known site

Landscapes Only known occurrence is not in a BUL

Common Name Ute Ladies'-tresses **Scientific Name** *Spiranthes diluvialis*

G-Rank G2G3 **S-Rank** S1 **Goal** 2 **Distribution** Limited

Criteria for selection as Tier I State and federally listed, G2

Estimated population in NE 800 - 1,500 **Estimate based on** 2010 field survey

Trends since 2005 in NE Possibly declining

Range in NE Sioux County

Habitat Western alkaline meadow

Threats Reduced groundwater levels, invasive species, conversion of meadows to cropland, annual haying of meadows

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Determine best management practices

Landscapes Upper Niobrara River

Common Name Western Prairie Fringed Orchid **Scientific Name** *Platanthera praeclara*

G-Rank G3 **S-Rank** S3 **Goal** 10 **Distribution** Limited

Criteria for selection as Tier I State and federally listed, G3

Estimated population in NE 2,000 - 5,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Cyclical with weather; declined during dry years; may be increasing since 2005, but overall trend is decline

Range in NE Tallgrass Prairie and Sandhills ecoregions

Habitat Eastern cordgrass wet prairie, northern cordgrass wet prairie, wet-mesic tallgrass prairie, tallgrass prairie

Threats Invasive species, herbicide spraying, conversion of prairie to cropland and development, annual mid-summer haying, inappropriate grazing

Climate Change Vulnerability Index: Extremely Vulnerable

Research/Inventory Determine best management practices

Landscapes Central Platte River, Cherry County Wetlands, Elkhorn River Headwaters, Lower Platte River, Upper Loup rivers and Tributaries, Willow Creek Prairies

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Common Name Wolf's Spikerush **Scientific Name** *Eleocharis wolfii*

G-Rank G3G4 **S-Rank** S2? **Goal** 7 **Distribution** Widespread

Criteria for selection as Tier I G3

Estimated population in NE 10,000 - 50,000 **Estimate based on** Expert opinion

Trends since 2005 in NE Unknown

Range in NE Primarily Sandhills ecoregion

Habitat Northern cordgrass wet prairie, northern sedge wet prairie

Threats Wetland drainage, invasive species

Research/Inventory Conduct surveys to assess distribution and abundance

Landscapes Cherry County Wetlands, Elkhorn River Headwaters, Upper Loup Rivers and Tributaries, Willow Creek Prairies

Appendix 9: Tier II at-risk species.

Tier II species include those that did not meet the Tier I criteria but were ranked by the Nebraska Natural Heritage Program as either State Critically Imperiled (S1), State Imperiled (S2) or State Vulnerable (S3) (see appendix 4 for explanation of ranks). Because of the large number of at-risk plant species, only those species listed as S1 or S2 are included in the following list. The Tier II list is used to help prioritize conservation planning/actions and does not have legal or regulatory ramifications. Tier II species are typically those that are not at-risk from a global or national perspective but are rare or imperiled within Nebraska. Conservation of these species is needed to ensure they remain a part of Nebraska's flora and fauna.

During the development of the Nebraska Natural Legacy Project, the "S-Ranks" were reviewed and revised for amphibians, birds, mammals, fish, reptiles, mollusks, plants and a limited number of insects.

The Tier II at-risk species lists will be periodically reviewed and revised by taxon experts. This revision will occur on an on-going basis as new information on the abundance, distribution, and population trends becomes available, with an overall review at least every five years. The Tier II list was reviewed and revised with input from taxon experts in workshops held in 2010.

Common Name	Scientific Name	Grank	Srank
Amphibians			
American Toad	*Anaxyrus americanus*	G5	S1
Great Plains Narrowmouth Toad	*Gastrophryne olivacea*	G5	S2
Smallmouth Salamander	*Ambystoma texanum*	G5	S1
Birds			
Acadian Flycatcher	*Empidonax virescens*	G5	S2?
American Wigeon	*Anas americana*	G5	S2
American Woodcock	*Scolopax minor*	G5	S3
Bald Eagle	*Haliaeetus leucocephalus*	G5	S3
Barn Owl	*Tyto alba*	G5	S3
Black-and-white Warbler	*Mniotilta varia*	G5	S3
Black-billed Magpie	*Pica hudsonia*	G5	S3
Black-crowned Night-Heron	*Nycticorax nycticorax*	G5	S3
Black-necked Stilt	*Himantopus mexicanus*	G5	S3
Black Tern	*Chlidonias niger*	G4	S3
Brewer's Blackbird	*Euphagus cyanocephalus*	G5	S2
Brown Creeper	*Certhia americana*	G5	S2
Canvasback	*Aythya valisineria*	G5	S3
Carolina Wren	*Thryothorus ludovicianus*	G5	S2
Cassin's Kingbird	*Tyrannus vociferans*	G5	S3
Cassin's Sparrow	*Aimophila cassinii*	G5	S3
Chuck-will's-widow	*Caprimulgus carolinensis*	G5	S1
Cinnamon Teal	*Anas cyanoptera*	G5	S1S2
Clark's Grebe	*Aechmophorus clarkii*	G5	S2
Clark's Nutcracker	*Nucifraga columbiana*	G5	S1

Common Name	Scientific Name	Grank	Srank
Cordilleran Flycatcher	*Empidonax occidentalis*	G5	S1
Dark-eyed Junco	*Junco hyemalis*	G5	S1
Forster's Tern	*Sterna forsteri*	G5	S3
Golden Eagle	*Aquila chrysaetos*	G5	S3
Kentucky Warbler	*Geothlypis formosa*	G5	S3
King Rail	*Rallus elegans*	G4	S1
Lesser Scaup	*Aythya affinis*	G5	S3
Lewis's Woodpecker	*Melanerpes lewis*	G4	S1
Louisiana Waterthrush	*Parkesia motacilla*	G5	S1
Merlin	*Falco columbarius*	G5	S1
Mississippi Kite	*Ictinia mississippiensis*	G5	S1
Northern Saw-whet Owl	Aegolius acadicus	G5	SNR
Peregrine Falcon	*Falco peregrinus*	G4	S3
Pileated Woodpecker	*Dryocopus pileatus*	G5	S1
Pine Siskin	*Spinus pinus*	G5	S3
Plumbeous Vireo	*Vireo plumbeus*	G5	S2
Prairie Falcon	*Falco mexicanus*	G5	S1
Prothonotary Warbler	*Protonotaria citrea*	G5	S2
Pygmy Nuthatch	*Sitta pygmaea*	G5	S3
Red-shouldered Hawk	*Buteo lineatus*	G5	S1
Ruby-throated Hummingbird	*Archilochus colubris*	G5	S3
Savannah Sparrow	*Passerculus sandwichensis*	G5	S3
Sandhill Crane	*Grus canadensis*	G5	S3
Scissor-tailed Flycatcher	*Tyrannus forficatus*	G5	S3
Sedge Wren	*Cistothorus platensis*	G5	S3
Sharp-shinned Hawk	*Accipiter striatus*	G5	S1
Snowy Plover	*Charadrius nivosus*	G4	S1
Summer Tanager	*Piranga rubra*	G5	S4
Swainson's Hawk	*Buteo swainsoni*	G5	S3
Swamp Sparrow	*Melospiza georgiana*	G5	S3
Townsend's Solitaire	*Myadestes townsendi*	G5	S2
Tufted Titmouse	*Baeolophus bicolor*	G5	S3
Violet-green Swallow	*Tachycineta thalassina*	G5	S3
Western Grebe	*Aechmophorus occidentalis*	G5	S3
Whip-poor-will	*Caprimulgus vociferus*	G5	S3
White-eyed Vireo	*Vireo griseus*	G5	S2
White-faced Ibis	*Plegadis chihi*	G5	S3
White-throated Swift	*Aeronautes saxatalis*	G5	S3
Wilson's Snipe	*Gallinago delicata*	G5	S2
Yellow-throated Vireo	*Vireo flavifrons*	G5	S3
Yellow-throated Warbler	*Setophaga dominica*	G5	S1

Fish

American Eel	*Anguilla rostrata*	G4	SNR
Black Buffalo	*Ictiobus niger*	G5	S2
Blacknose Dace	*Rhinichthys atratulus*	G5	S2
Blackside Darter	*Percina maculata*	G5	S1
Bluntnose Minnow	*Pimephales notatus*	G5	S3
Bowfin	*Amia calva*	G5	S1

Common Name	Scientific Name	Grank	Srank
Burbot	*Lota lota*	G5	S1
Chestnut Lamprey	*Ichthyomyzon castaneus*	G4	S1
Common Shiner	*Luxilus cornutus*	G5	S2
Flathead Chub	*Platygobio gracilis*	G5	S5
Lake Chub	*Couesius plumbeus*	G5	S1
Paddlefish	*Polyodon spathula*	G4	S2
Pearl Dace	*Margariscus margarita*	G5	S3
Plains Minnow	*Hybognathus placitus*	G4	S4
Silver Lamprey	*Ichthyomyzon unicuspis*	G5	S1
Tadpole Madtom	*Noturus gyrinus*	G5	S3
Trout-Perch	*Percopsis omiscomaycus*	G5	S1
Western Silvery Minnow	*Hybognathus argyritis*	G4	S?

Mammals

Black-tailed Jackrabbit	*Lepus californicus*	G5	S?
Bushy-tailed Woodrat	*Neotoma cinerea*	G5	S3
Dwarf Shrew	*Sorex nanus*	G4	S1
Eastern Chipmunk	*Tamias striatus*	G5	S1
Eastern Gray Squirrel	*Sciurus carolinensis*	G5	S3
Eastern Pipistrelle	*Pipistrellus subflavus*	G5	S1
Eastern Spotted Skunk	*Spilogale putorius*	G5	S1
Eastern Woodrat	*Neotoma floridana*	G5	S3
Evening Bat	*Nycticeius humeralis*	G5	S3
Hispid Cotton Rat	*Sigmodon hispidus*	G5	S3
Least Chipmunk	*Tamias minimus*	G5	S3
Long-legged Myotis	*Myotis volans*	G5	S1
Long-tailed Weasel	*Mustela frenata*	G5	S2
Merriam's Shrew	*Sorex merriami*	G5	S1
Mountain Lion	*Felis concolor*	G5	S1
Northern Myotis	*Myotis septentrionalis*	G4	S3
Olive-backed Pocket Mouse	*Perognathus fasciatus*	G5	S3
Silky Pocket Mouse	*Perognathus flavus*	G5	S?
Townsend’s Big-eared Bat	*Corynorhinus townsendii*	G4	S1
White-tailed Jackrabbit	*Lepus townsendii*	G5	S?
Woodland Vole	*Microtus pinetorum*	G5	S3

Reptiles

Copperhead	*Agkistrodon contortrix*	G5	S2
Eastern Glossy Snake	*Arizona elegans*	G5	S1
Eastern Hognose Snake	*Heterodon platirhinos*	G5	S2?
Five-lined Skink	*Eumeces fasciatus*	G5	S1
Graham's Crayfish Snake	*Regina grahamii*	G5	S2
Mountain Short-horned Lizard	*Phrynosoma hernandesi*	G5	S3
Plains Blackhead Snake	*Tantilla nigriceps*	G5	S1
Prairie Kingsnake	*Lampropeltis calligaster*	G5	S2
Redbelly Snake	*Storeria occipitomaculata*	G5	S2
Red-eared Slider	*Trachemys scripta elegans*	G5T5	S?

Common Name	Scientific Name	Grank	Srank
Slender Glass Lizard	*Ophisaurus attenuatus*	G5	S1
Smooth Green Snake	*Liochlorophis vernalis*	G5	S1
Smooth Soft-shelled Turtle	*Apalone mutica*	G5	S3?
Speckled Kingsnake	*Lampropeltis holbrooki*	G5	S1
Terrestrial Garter Snake	*Thamnophis elegans*	G5	S2?
Western Ribbon Snake	*Thamnophis proximus*	G5	S2
Western Worm Snake	*Carphophis vermis*	G5	S2

Insects

A Grasshopper	*Encoptolophus subgracilis*	G5	S1
A Mayfly	*Apobaetis lakota*	G2G3	SNR
A Mayfly	*Paraleptophlebia gregalis*	G3G4	SNR
A Mayfly	*Brachycercus nasutus*	G3G4	SNR
A Mayfly	*Cercobrachys fox*	G3G4	SNR
A Scarab Beetle	*Rhyssemus neglectus*	GNR	S1
A Stonefly	*Perlesta golconda*	G2G3	SNR
Acadian Hairstreak	*Satyrium acadicum*	G5	S3
Acastus Checkerspot	*Chlosyne acastus*	G4G5	S1
Afranius Duskywing	*Erynnis afranius*	G5	S2
American Copper	*Lycaena phlaeas*	G5	S1S2
Anicia Checkerspot	*Euphydryas anicia*	G5	S3
Anise Swallowtail	*Papilio zelicaon*	G5	S3
Aphrodite Fritillary	*Speyeria aphrodite*	G5	S3
Arachne Checkerspot	*Poladryas arachne arachne*	G5TNR	S1
Arogos Skipper	*Atrytone arogos*	G3	S1S2
Arrowhead Blue	*Glaucopsyche piasus*	G5	S1
Badlands Tiger Beetle	*Cicindela decemnotata*	G4	SNR
Banded Hairstreak	*Satyrium calanus*	G5	S2S3
Beautiful Tiger Beetle	*Cicindela pulchra*	G4	S1
Broad-winged Skipper	*Poanes viator viator*	G5T4	S2
Byssus Skipper	*Problema byssus kumskaka*	G3G4	S1
Callippe Fritillary	*Speyeria callippe*	G5	S1
Cobweb Skipper	*Hesperia metea*	G4G5	S1
Common Branded Skipper	*Hesperia colorado*	G5	S3
Coral Hairstreak	*Satyrium titus*	G5	S3
Coronis Fritillary	*Speyeria coronis*	G5	S3
Creamy Marblewing	*Euchloe ausonides palaeoreios*	G5TNR	S1
Creeping Water Bug	*Ambrysus mormon*	GNR	S2
Crossline Skipper	*Polites origenes*	G5	S3
Delaware Skipper	*Atrytone logan*	G5	S3
Delilah Underwing	*Catocala delilah*	G3G4	SNR
Desert Forktail	*Ischnura barberi*	G4	S1
Dion Skipper	*Euphyes dion*	G4	S2
Dogface	*Colias cesonia*	G5	S3
Dotted Blue	*Euphilotes ancilla*	G5	S1S2
Dun Skipper	*Euphyes vestris*	G5	S3
Dusted Skipper	*Atrytonopsis hianna*	G4G5	S3
Elusive Clubtail	*Gomphus notatus*	G3	SNR

Common Name	Scientific Name	Grank	Srank
Field Crescentspot	*Phyciodes pratensis*	G5	S1
Fiery Skipper	*Hylephila phyleus*	G5	S3
Fulvia Checkerspot	*Thessalia fulvia*	G5	S2S3
Garita Skipperling	*Oarisma garita*	G5	S2
Gray Comma	*Polygonia progne*	G4G5	S3
Great Plains Giant Tiger Beetle	*Amblycheila cylindriformis*	G4G5	S1
Green Skipper	*Hesperia viridis*	G5	S1
Greenish Blue	*Plebejus saepiolus*	G5	S1
Grizzly Spur-throat Grasshopper	*Melanoplus punctulatus*	G4	S1
Habilis Underwing	*Catocala habilis*	G5	S1
Hairy Duskywing	*Erynnis persius fredericki*	G5TNR	S2
Harvester	*Feniseca tarquinius*	G4	S2
Henry's Elfin	*Incisalia henrici*	G5	S2
Hickory Hairstreak	*Satyrium caryaevorum*	G4	S1S2
Hoary Edge	*Achalarus lyciades*	G5	S1
Hobomok Skipper	*Poanes hobomok*	G5	S3S4
Horace's Duskywing	*Erynnis horatius*	G5	S3
Indra Swallowtail	*Papilio indra*	G5	S1S2
Juvenal's Duskywing	*Erynnis juvenalis*	G5	S2S3
Large Heath	*Coenonympha tullia*	G5	S2
Little Glassywing	*Pompeius verna*	G5	S3
Long Dash	*Polites mystic*	G5	S3
Mead's Wood Nymph	*Cercyonis meadii*	G5	S1
Milbert's Tortoiseshell	*Nymphalis milberti*	G5	S3
Mormon Fritillary	*Speyeria mormonia kimemela*	G5	S1
Mulberry Wing	*Poanes massasoit*	G4	S?
Mylitta Crescent	*Phyciodes mylitta*	G5	S1
Northern Broken Dash	*Wallengrenia egeremet*	G5	S3
Northern Crescent	*Phyciodes cocyta*	G5	S1S2
Northern Pearlyeye	*Enodia anthedon*	G5	S3
Olive Hairstreak	*Mitoura grynea*	G5	S3
Orange Roadside Skipper	*Amblyscirtes simius*	G4	S1
Oslar's Roadside Skipper	*Amblyscirtes oslari*	G4	S2
Pahaska Skipper	*Hesperia pahaska*	G5	S2
Painted Crescentspot	*Phyciodes pictus*	G5	S2
Pallid Crescentspot	*Phyciodes pallidus*	G5	S1
Pawnee Stone	*Perlesta xube*	G2	S2?
Phoebus' Parnassian	*Parnassius smintheus*	G5	S1
Plains Gray Skipper	*Polites rhesus*	G4	S2
Prairie Long-lipped Tiger Beetle	*Cicindela nebraskana*	G4	S1
Purplish Copper	*Lycaena helloides*	G5	S3
Queen Alexandra's Sulphur	*Colias alexandra*	G5	S3
Residua Underwing	*Catocala residua*	G5	S1
Riding's Satyr	*Neominois ridingsii*	G5	S2
Robinson's Underwing	*Catocala robinsoni*	G4	S1
Ruddy Copper	*Lycaena rubida*	G5	S3
Salt Creek Grasshopper	*Trimerotropis salina*	G5	S2?
Scalloped Sootywing	*Staphylus hayhurstii*	G5	S3
Serene Underwing	*Catocala serena*	G5	S1

Common Name	Scientific Name	Grank	Srank
Shasta Blue	*Icaricia shasta*	G5	S2
Silver-bordered Fritillary	*Boloria selene*	G5	S2
Silvery Blue	*Glaucopsyche lygdamus*	G5	S3
Silvery Checkerspot	*Chlosyne nycteis*	G5	S3
Sleepy Duskywing	*Erynnis brizo*	G5	S2
Sleepy Orange	*Eurema nicippe*	G5	S2N
Small Wood Nymph	*Cercyonis oetus*	G5	S1
Smoky-eyed Brown	*Satyrodes eurydice fumosa*	G5T3T4	S3
Southern Cloudywing	*Thorybes bathyllus*	G5	S2
Strecker's Giant Skipper	*Megathymus streckeri*	G5	S3
Striped Hairstreak	*Satyrium liparops*	G5	S2
Tawny Emperor	*Asterocampa clyton*	G5	S2S3
Taxiles Skipper	*Poanes taxiles*	G5	S2S3
Uhler's Arctic	*Oeneis uhleri*	G5	S3
Uncas Skipper	*Hesperia uncas*	G5	S2
Weidemeyer's Admiral	*Limenitis weidemeyerii*	G5	S3
Western Black Swallowtail	*Papilio bairdii*	G5T5	S3
Western Green Hairstreak	*Callophrys affinis homoperplexa*	G5TNR	S1S2
Western Tailed Blue	*Everes amyntula*	G5	S1
Western White	*Pontia occidentalis*	G5	S2
White-cloaked Tiger Beetle	*Cicindela togata*	G5	S1
Widow Underwing	*Catocala vidua*	G5	S1
Wild Indigo Duskywing	*Erynnis baptisiae*	G5	S3
Yellow-grey Underwing	*Catocala luctuosa*	G4	S1
Yucca Skipper	*Megathymus yuccae coloradensis*	G5T5	S3S4
Zabulon Skipper	*Poanes zabulon*	G5	S2
Zebra Swallowtail	*Eurytides marcellus*	G5	S3
Zerene Fritillary	*Speyeria zerene*	G5	S1S2

Mollusks

A Freshwater Snail	*Fossaria techella*	G3G4	SNR
Black Sandshell	*Ligumia recta*	G5	SNR
Fatmucket	*Lampsilis siliquoidea*	G5	SNR
Niobrara Ambersnail	*Oxyloma haydeni*	G3	SNR
Pondmussel	*Ligumia subrostrata*	G5	S1
Threeridge	*Amblema plicata*	G5	SNR
Wabash Pigtoe	*Fusconaia flava*	G5	SNR
Yellow Sandshell	*Lampsilis teres*	G5	SNR

Plants

Alkali Blite	*Chenopodium rubrum* var. *humile*	G5T5	S1
Alyssum-leaf Phlox	*Phlox alyssifolia*	G5	S1
American Dragon's-head	*Dracocephalum parviflorum*	G5	S1
American Eelgrass	*Vallisneria americana*	G5	S1
American False-pennyroyal	*Hedeoma pulegioides*	G5	S1
American Lotus	*Nelumbo lutea*	G4	S1S3
American Pillwort	*Pilularia americana*	G5	S1

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American Sweetflag	*Acorus americanus*	G5	S2
Antelope-Horns	*Asclepias asperula* var. *decumbens*	G5TNR	S1
Arrowfeather Three-awn	*Aristida purpurascens* var. *purpurascens*	G5T5	S1
Ashy Sunflower	*Helianthus mollis*	G4G5	S1
Autumn Coral-root	*Corallorhiza odontorhiza* var. *odontorhiza*	G5	S1S3
Awned Slender Wheatgrass	*Elymus trachycaulus* var. *andinus*	G5T5	S1
Bay Forget-me-not	*Myosotis laxa*	G5	S1
Beaked Spikerush	*Eleocharis rostellata*	G5	S1
Bearberry	*Arctostaphylos uva-ursi*	G5	S1
Bearded Short-husk	*Brachyelytrum erectum*	G5	S2
Bebb's Sedge	*Carex bebbii*	G5	S1S3
Berlandier's Flax	*Linum berlandieri* var. *berlandieri*	G5T5?	S1
Big-fruit Dodder	*Cuscuta umbrosa*	G5	S1S3
Bigroot Morning-glory	*Ipomoea pandurata*	G5	S1
Birdfoot Violet	*Viola pedata* var. *pedata*	G5TNR	S1
Black-foot Quillwort	*Isoetes melanopoda* ssp. *melanopoda*	G5TNR	S1
Blackjack Oak	*Quercus marilandica* var. *marilandica*	G5T4T5	S1
Black-seed Ricegrass	*Piptatherum racemosum*	G5	S2
Blue Cohosh	*Caulophyllum thalictroides*	G4G5	S1
Blue Larkspur	*Delphinium nuttallianum*	G5	S1
Bluebunch Wheatgrass	*Pseudoroegneria spicata*	G5	S1
Bodin's Milk-vetch	*Astragalus bodinii*	G4	S1
Bog Rush	*Juncus biflorus*	G5	S1
Bog White Violet	*Viola lanceolata* var. *lanceolata*	G5T5	S2
Bouquet Mud-plantain	*Heteranthera multiflora*	G4	S1
Branched Noseburn	*Tragia ramosa*	G5	S1
Brazilian Watermeal	*Wolffia brasiliensis*	G5	S1
Britton's Skullcap	*Scutellaria brittonii*	G4G5	S2
Broad-leaf Milkweed	*Asclepias latifolia*	G5	S1S3
Broad-leaf Spring-Panicum	*Dichanthelium latifolium*	G5	S1
Broom Groundsel	*Senecio spartioides*	G5	S1
Brown Bog Sedge	*Carex buxbaumii*	G5	S2
Buckley's Penstemon	*Penstemon buckleyi*	G4G5	S1
Buff Fleabane	*Erigeron ochroleucus*	G5	S2
Buffalo Clover	*Trifolium reflexum*	G3G4	S1
Bulblet Bladder Fern	*Cystopteris bulbifera*	G5	S1
Bush's Sedge	*Carex bushii*	G4	S1S2
Bushy Seedbox	*Ludwigia alternifolia*	G5	S1?
Butterweed	*Packera glabella*	G5	S1
Buttonbush	*Cephalanthus occidentalis*	G5	S1S3
Button-snakeroot	*Eryngium yuccifolium* var. *yuccifolium*	G5T5	S1
California Amaranth	*Amaranthus californicus*	G4	S2
Camphor-weed	*Heterotheca latifolia*	GNR	S1S2
Canada Hawkweed	*Hieracium kalmii* var. *canadense*	G5T5	S1
Canada Lousewort	*Pedicularis canadensis* var. *canadensis*	G5T5	S1
Canada Nailwort	*Paronychia canadensis*	G5	S1
Capitate Spikerush	*Eleocharis geniculata*	G5	S1
Cardinal Flower	*Lobelia cardinalis*	G5	S1
Carolina False Dandelion	*Pyrrhopappus carolinianus*	G5	S1

Common Name	Scientific Name	Grank	Srank
Carruth's Sagewort	*Artemisia carruthii*	G4?	S1
Chaffweed	*Lysimachia minima*	G5	S1
Chapman's Bluegrass	*Poa chapmaniana*	G5	S1
Chickasaw Plum	*Prunus angustifolia*	G5	S1
Clammy Hedge-hyssop	*Gratiola neglecta*	G5	S1
Clasping-leaf Milkweed	*Asclepias amplexicaulis*	G5	S1
Coreopsis Beggar-ticks	*Bidens polylepis*	GNR	S2
Creeping Juniper	*Juniperus horizontalis*	G5	S1
Creeping Lovegrass	*Eragrostis reptans*	G5	S1
Creeping Polemonium	*Polemonium reptans*	G5	S1
Crested Wood Fern	*Dryopteris cristata*	G5	S1
Culver's Root	*Veronicastrum virginicum*	G4	S1
Curly Three-awn	*Aristida desmantha*	G5	S1
Cursed Crowfoot	*Ranunculus sceleratus* var. *multifidus*	G5T5	S1S3
Cut-leaf Cyclanthera	*Cyclanthera dissecta*	G5	S1
Cut-leaf Toothwort	*Cardamine concatenata*	G5	S1
Cut-leaf Water-milfoil	*Myriophyllum pinnatum*	G5	S1
Desert Centaury	*Zeltnera exaltata*	G5	S1
Douglas' Knotweed	*Polygonum douglasii*	G5	S2
Downy Ground-cherry	*Physalis missouriensis*	G5?	S1
Drummond's Wild Onion	*Allium drummondii*	G5	S1
Dusty-maiden	*Chaenactis douglasii* var. *douglasii*	G5T5	S1
Dwarf Ground-cherry	*Physalis pumila*	G5	S1
Dwarf Indigo-bush	*Amorpha nana*	G5	S1
Dwarf Larkrspur	*Delphinium tricorne*	G5	S1S3
Dwarf Locoweed	*Oxytropis multiceps*	G5	S2
Dwarf Skullcap	*Scutellaria parvula*	G4	S1
Dwarf Spikerush	*Eleocharis coloradoensis*	GNR	S1
Dwarf St. John's-wort	*Hypericum mutilum* var. *mutilum*	G5TNR	S1
Dwarf Swamp Raspberry	*Rubus pubescens*	G5	S1
Dwarf-dandelion	*Krigia cespitosa*	G5	S1
Ear-leaf Toothcup	*Ammannia auriculata*	G5	S1
Early Blue-top Fleabane	*Erigeron vetensis*	G4	S1
Early Buttercup	*Ranunculus fascicularis*	G5	S1
Eastern Star Sedge	*Carex radiata*	G4	S1
Eastern Toothed Spurge	*Euphorbia dentata*	G5	S1
Ebony Spleenwort	*Asplenium platyneuron*	G5	S1
Engelmann's Flatsedge	*Cyperus engelmannii*	GNR	S2
Erect Knotweed	*Polygonum erectum*	G5	S1S3
False Dragon's-head	*Physostegia parviflora*	G4G5	S1
False Lily-of-the-valley	*Maianthemum canadense* var. *interius*	G5	S1
False-garlic	*Nothoscordum bivalve*	G4	S1
Fendler's Aster	*Symphyotrichum fendleri*	G4?	S1
Few-flower Spikerush	*Eleocharis quinqueflora*	G5	S1
Field Milk-vetch	*Astragalus agrestis*	G5	S1
Field Thistle	*Cirsium discolor*	G5	S1S2
Finger Coreopsis	*Coreopsis palmata*	G5	S1S3
Fireweed	*Chamerion angustifolium* var. *canescens*	G5T5	S1?
Flat-top Aster	*Doellingeria umbellata* var. *pubens*	G5T5	S2

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Floating Primrose-willow	*Ludwigia peploides* var. *glabrescens*	G5T5	S1
Forest Muhly	*Muhlenbergia sylvatica*	G5	S1S3
Foxglove Penstemon	*Penstemon digitalis*	G5	S1
Frank's Sedge	*Carex frankii*	G5	S1S2
Fraser's Wild Onion	*Allium canadense* var. *fraseri*	G5T4T5	S2
Fremont's Evening-primrose	*Oenothera macrocarpa* ssp. *fremontii*	G5T3	S1
Fremont's Leather-flower	*Clematis fremontii*	G5	S1
Fries' Pondweed	*Potamogeton friesii*	G4	S2
Frost Grape	*Vitis vulpina*	G5	S1
Gardner's Saltbush	*Atriplex gardneri* var. *gardneri*	G5TNR	S1
Georgia Bulrush	*Scirpus georgianus*	G5	S1S3
Geyer's Larkspur	*Delphinium geyeri*	G5	S1
Giant St. John's-wort	*Hypericum pyramidatum*	G4	S1S3
Gilia Beardtongue	*Penstemon ambiguus* var. *ambiguus*	G4G5T4T5	S1
Glade Blue Curls	*Trichostema brachiatum*	G5	S1
Golden Fumewort	*Corydalis aurea*	G5	S1
Golden-fruit Sedge	*Carex aureolensis*	GNR	S1
Golden-glow	*Rudbeckia laciniata* var. *ampla*	G5T3T5	S1
Goldenweed	*Grindelia ciliata*	G4G5	S1
Graceful Buttercup	*Ranunculus inamoenus* var. *inamoenus*	G5T5	S1
Graham's Rock Cress	*Boechera grahamii*	GNR	S1S3
Grass-leaf Arrowhead	*Sagittaria graminea* var. *graminea*	G5T5	S2
Graybark Grape	*Vitis cinerea* var. *cinerea*	G4G5TNR	S1
Great Basin Wild-rye	*Leymus cinereus*	G5	S1
Great Plains Flatsedge	*Cyperus lupulinus* ssp. *macilentus*	G5T5?	S1
Great Plains Twin-pod	*Physaria brassicoides*	G5	S1
Greater Straw Sedge	*Carex normalis*	G5	S1
Green Dragon	*Arisaema dracontium*	G5	S2
Green-flower Hedgehog Cactus	*Echinocereus viridiflorus*	G5	S2
Green-flower Wintergreen	*Pyrola chlorantha*	G5	S1
Green-fruit Bur-reed	*Sparganium emersum*	G5	S2
Gronovius' Dodder	*Cuscuta gronovii*	G5	S1S3
Gunnison's Mariposa-lily	*Calochortus gunnisonii* var. *gunnisonii*	G5TNR	S1
Hairy Bugseed	*Corispermum villosum*	G4?	S1
Hairy Gayfeather	*Liatris hirsuta*	G4?	S1S3
Hairy Goldenaster	*Heterotheca villosa* var. *minor*	G5T4T5	S1
Hairy Mountain-mint	*Pycnanthemum verticillatum* var. *pilosum*	G5T5	S1
Hairy Pinweed	*Lechea mucronata*	G5	S1?
Hairy Wood Sedge	*Carex hirtifolia*	G5	S1
Hairy-stem Gooseberry	*Ribes hirtellum*	G5	S1
Hispid Hedge-nettle	*Stachys hispida*	GNR	S1
Hoary-aster	*Dieteria canescens* var. *glabra*	G5T4T5	S1
Hoary-pea	*Tephrosia virginiana*	G5	S1
Hooded Ladies'-tresses	*Spiranthes romanzoffiana*	G5	S1
Hooked Buttercup	*Ranunculus recurvatus* var. *recurvatus*	G5TNR	S2
Hooker's Townsendia	*Townsendia hookeri*	G5	S1
Hook-spur Violet	*Viola adunca* var. *adunca*	G5T5	S1?
Hop Sedge	*Carex lupulina*	G5	S1
Hudson Bay Anemone	*Anemone multifida* var. *multifida*	G5TNR	S1

Common Name	Scientific Name	Grank	Srank
Indian Blanket-flower	*Gaillardia pulchella* var. *pulchella*	G4G5T4T5	S1S3
Indian-pipe	*Monotropa uniflora*	G5	S1
Indian-tobacco	*Lobelia inflata*	G5	S1
Inflated Duckweed	*Lemna gibba*	G4G5	S2
Inflated Sedge	*Carex vesicaria* var. *monile*	G5T4	S1
Inland Serviceberry	*Amelanchier interior*	G5	S1
Intermountain Aster	*Symphyotrichum ascendens*	G5	S1
Iowa Crab Apple	*Malus ioensis* var. *ioensis*	G4G5T4T5	S1S3
James' Nailwort	*Paronychia jamesii* var. *jamesii*	G4T4	S1S3
James' Rush-pea	*Pomaria jamesii*	G5	S1
Joint-leaf Rush	*Juncus articulatus*	G5	S1
Kiss-me-quick	*Portulaca pilosa*	G5	S1
Lace Grass	*Eragrostis capillaris*	G5	S1
Lance-leaf Cottonwood	*Populus ×acuminata*	GNA	S1?
Large-leaf Pondweed	*Potamogeton amplifolius*	G5	S1
Lavender Giant-hyssop	*Agastache foeniculum*	G4G5	S1
Least Duckweed	*Lemna minuta*	G4	S1
Least Muhly	*Muhlenbergia minutissima*	G5	S1
Leopard-lily	*Fritillaria atropurpurea*	G5	S2
Lesser Bladderwort	*Utricularia minor*	G5	S1
Limber Pine	*Pinus flexilis*	G4	S1
Limestone Adder's-tongue	*Ophioglossum engelmannii*	G5	S1
Limestone Wild-petunia	*Ruellia strepens*	G4G5	S2
Loesel's Twayblade	*Liparis loeselii*	G5	S1
Long-barb Arrowhead	*Sagittaria longiloba*	G5	S1
Long-beak Willow	*Salix bebbiana*	G5	S1
Long-bract Green Orchid	*Dactylorhiza viridis*	G5	S1
Long-leaf Tick-clover	*Desmodium cuspidatum* var. *longifolium*	G5T5?	S1S3
Low Pussytoes	*Antennaria dimorpha*	G5	S1
Low Sedge	*Carex umbellata*	G5	S1
Mare's-tail	*Hippuris vulgaris*	G5	S1
Marsh Arrow-grass	*Triglochin palustris*	G5	S1
Marsh Vetchling	*Lathyrus palustris*	G5	S1S3
Marsh-St. John's-wort	*Triadenum fraseri*	G5	S2
Mat Muhly	*Muhlenbergia richardsonis*	G5	S1
May-apple	*Podophyllum peltatum*	G5	S2
Menzies' Catchfly	*Silene menziesii*	G5	S1
Midwestern Summer Bluets	*Houstonia purpurea* var. *calycosa*	G5T5	S1
Missouri Spurge	*Euphorbia missurica* var. *missurica*	G5TNR	S1S3
Montana Wild-rye	*Elymus albicans*	G5?	S1
Moss Phlox	*Phlox bryoides*	GNR	S2
Mountain White-camas	*Anticlea elegans* var. *elegans*	G5T5	S1
Mountain Birch	*Betula occidentalis*	G4G5	S1
Mountain Bladder-pod	*Physaria montana*	G5	S2
Mountain Brome	*Bromus marginatus*	G5	S1S3
Mud Sedge	*Carex limosa*	G5	S1
Mullein-foxglove	*Dasistoma macrophylla*	G4	S1
Muttongrass	*Poa fendleriana* ssp. *fendleriana*	G5T5	S1
Nannyberry	*Viburnum lentago*	G5	S1

Common Name	Scientific Name	Grank	Srank
Narrow-leaf Cottonwood	*Populus angustifolia*	G5	S1
Narrow-leaf False Foxglove	*Agalinis tenuifolia* var. *macrophylla*	G5T4T5	S1S3
Narrow-leaf Hawkweed	*Hieracium umbellatum*	G5	S1?
Narrow-leaf Mountain-mint	*Pycnanthemum tenuifolium*	G5	S1
Narrow-leaf Paleseed	*Leucospora multifida*	G5	S1
Narrow-leaf Pinweed	*Lechea tenuifolia*	G5	S1
Narrow-leaf Vervain	*Verbena simplex*	G5	S1
Nevada Bulrush	*Amphiscirpus nevadensis*	G4	S2
New Mexico Checker-mallow	*Sidalcea neomexicana* var. *neomexicana*	G4?TNR	S1
Nodding Brome	*Bromus porteri*	G5	S2?
Nodding Mouse-ear Chickweed	*Cerastium nutans* var. *nutans*	G5T5?	S1
Nodding Wild Onion	*Allium cernuum*	G5	S2
Nodding Wild-buckwheat	*Eriogonum cernuum*	G5	S1
Northern Adder's-tongue	*Ophioglossum pusillum*	G5	S2
Northern Dewberry	*Rubus flagellaris*	G5	S1
Northern Manna Grass	*Glyceria borealis*	G5	S2
Northern Marsh Buttercup	*Ranunculus caricetorum*	G5	S1
Northern Shooting-star	*Primula pauciflora* var. *pauciflora*	G5TNR	S1
Northern Water-starwort	*Callitriche hermaphroditica*	G5	S2
Northwest Territory Sedge	*Carex utriculata*	G5	S1
Northwestern Lady Fern	*Athyrium filix-femina* var. *cyclosorum*	G5T5	S1
Notch-bract Waterleaf	*Hydrophyllum appendiculatum*	G5	S1
Ohio Buckeye	*Aesculus glabra* var. *arguta*	G5T4?Q	S1S2
Old-field Cinquefoil	*Potentilla simplex*	G5	S1
One-flower Broomrape	*Orobanche uniflora*	G5TNR	S1
One-sided Wintergreen	*Orthilia secunda*	G5	S1
Ostrich Fern	*Matteuccia struthiopteris* var. *pensylvanica*	G5TNR	S1
Pale False-dandelion	*Agoseris glauca* var. *glauca*	G5T5	S1
Pale Fumewort	*Corydalis flavula*	G5	S1
Pale Gentian	*Gentiana alba*	G4	S1
Pale Goosefoot	*Chenopodium pallescens*	G5	S1
Pale Indian-plantain	*Arnoglossum atriplicifolium*	G4G5	S2
Pale Purple Coneflower	*Echinacea pallida*	G4	S1
Panicled Bulrush	*Scirpus microcarpus*	G5	S1
Pearly Everlasting	*Anaphalis margaritacea*	G5	S1
Pennslyvania Bitter Cress	*Cardamine pensylvanica*	G5	S1
Perennial Bursage	*Ambrosia tomentosa*	G4	S1
Perennial Gumweed	*Grindelia perennis*	G5	S1
Persimmon	*Diospyros virginiana*	G5	S1
Pine-drops	*Pterospora andromedea*	G5	S2
Pinesap	*Monotropa hypopitys*	G5	S1
Pinnate Tansy Mustard	*Descurainia pinnata* var. *osmiarum*	G5T5?	S1
Pitcher's Leather-flower	*Clematis pitcheri* var. *pitcheri*	G4G5TNR	S1
Plains Blackberry	*Rubus laudatus*	G5	S1
Plains Cutleaf Violet	*Viola viarum*	G5	S1
Plains Frostweed	*Crocanthemum bicknellii*	G5	S1S2
Platte River Cinquefoil	*Potentilla plattensis*	G4	S1
Playa Lovegrass	*Eragrostis pilosa* var. *perplexa*	G4TNR	S1
Poison Suckleya	*Suckleya suckleyana*	G5	S1

Common Name	Scientific Name	Grank	Srank
Poverty Oatgrass	*Danthonia spicata*	G5	S1
Poverty Sumpweed	*Iva axillaris* var. *axillaris*	G5TNR	S1S3
Powdery Cloak Fern	*Argyrochosma dealbata*	G4G5	S1
Powell's Saltbush	*Atriplex powellii* var. *powellii*	G4TNR	S1
Prairie Bluebells	*Mertensia lanceolata* var. *lanceolata*	G5T5	S2
Prairie Broomweed	*Amphiachyris dracunculoides*	G4G5	S1S2
Prairie Buttercup	*Ranunculus rhomboideus*	G5	S1
Prairie Fawn-lily	*Erythronium mesochoreum*	G4G5	S2
Prairie Ninebark	*Physocarpus intermedius*	G3G5	S2
Prairie Pinweed	*Lechea stricta*	G4?	S1
Prairie White Aster	*Symphyotrichum falcatum* var. *falcatum*	G5T4T5	S1
Prickly Naiad	*Najas marina*	G5	S1
Prince's-plume	*Stanleya pinnata* var. *pinnata*	G5T4T5	S1
Pull-up Muhly	*Muhlenbergia filiformis*	G5	S1
Purple Cudweed	*Gamochaeta purpurea*	G5	S1
Purple Giant-hyssop	*Agastache scrophulariifolia*	G4	S1
Purple Milkweed	*Asclepias purpurascens*	G5?	S1
Purple Rattlesnake-root	*Prenanthes racemosa* var. *multiflora*	G5T4?	S1
Purple Spikerush	*Eleocharis atropurpurea*	G4G5	S1
Purple-stem Cliff-brake	*Pellaea atropurpurea*	G5	S2
Quaking Aspen	*Populus tremuloides*	G5	S1S3
Ramp	*Allium tricoccum* var. *burdickii*	G5T4T5	S2
Raven-foot Sedge	*Carex crus-corvi*	G5	S1
Red Lovegrass	*Eragrostis secundiflora* var. *capitata*	G5TNR	S1
Red Raspberry	*Rubus strigosus*	G5	S1
Red-seed Plantain	*Plantago rhodosperma*	GNR	S1
Rillscale	*Stutzia dioica*	G4?	S1
River Grass	*Scolochloa festucacea*	G5	S1
Rockpink Fame-flower	*Phemeranthus calycinus*	G5	S1S2
Rocky Mountain Fescue	*Festuca saximontana* var. *saximontana*	G5T5	S1
Rocky Mountain Gayfeather	*Liatris ligulistylis*	G5?	S1
Rocky Mountain Iris	*Iris missouriensis*	G5	S1
Rocky Mountain Knotweed	*Polygonum sawatchense* ssp. *sawatchense*	G4G5TNR	S1S3
Rocky Mountain Maple	*Acer glabrum*	G5	S1?
Rocky Mountain Navarretia	*Navarretia saximontana*	GNR	S1
Rose Heath Daisy	*Chaetopappa ericoides*	G5	S2
Rose Highbush Blackberry	*Rubus rosa*	G5	S1
Rosinweed	*Silphium integrifolium* var. *integrifolium*	G5T5	S1
Ross' Sedge	*Carex rossii*	G5	S2
Rough Buttonweed	*Diodia teres* var. *teres*	G5T5	S1
Rough-fruit Fairybells	*Prosartes trachycarpa*	G5	S1
Rough-pod Copperleaf	*Acalypha ostryifolia*	G5	S1S3
Round-head Prairie-clover	*Dalea multiflora*	G5	S1
Round-leaf Bladder-pod	*Physaria ovalifolia* var. *ovalifolia*	G5?T5?	S1
Round-pod St. John's-wort	*Hypericum sphaerocarpum*	G5	S1
Round-stem False Foxglove	*Agalinis gattingeri*	G4	S1S3
Rydberg's Wild-rye	*Elymus vulpinus*	G1G3Q	S1
Sagebrush Buttercup	*Ranunculus glaberrimus* var. *ellipticus*	G5T5	S1
Saltmarsh Aster	*Symphyotrichum subulatum*	G5	S1S3

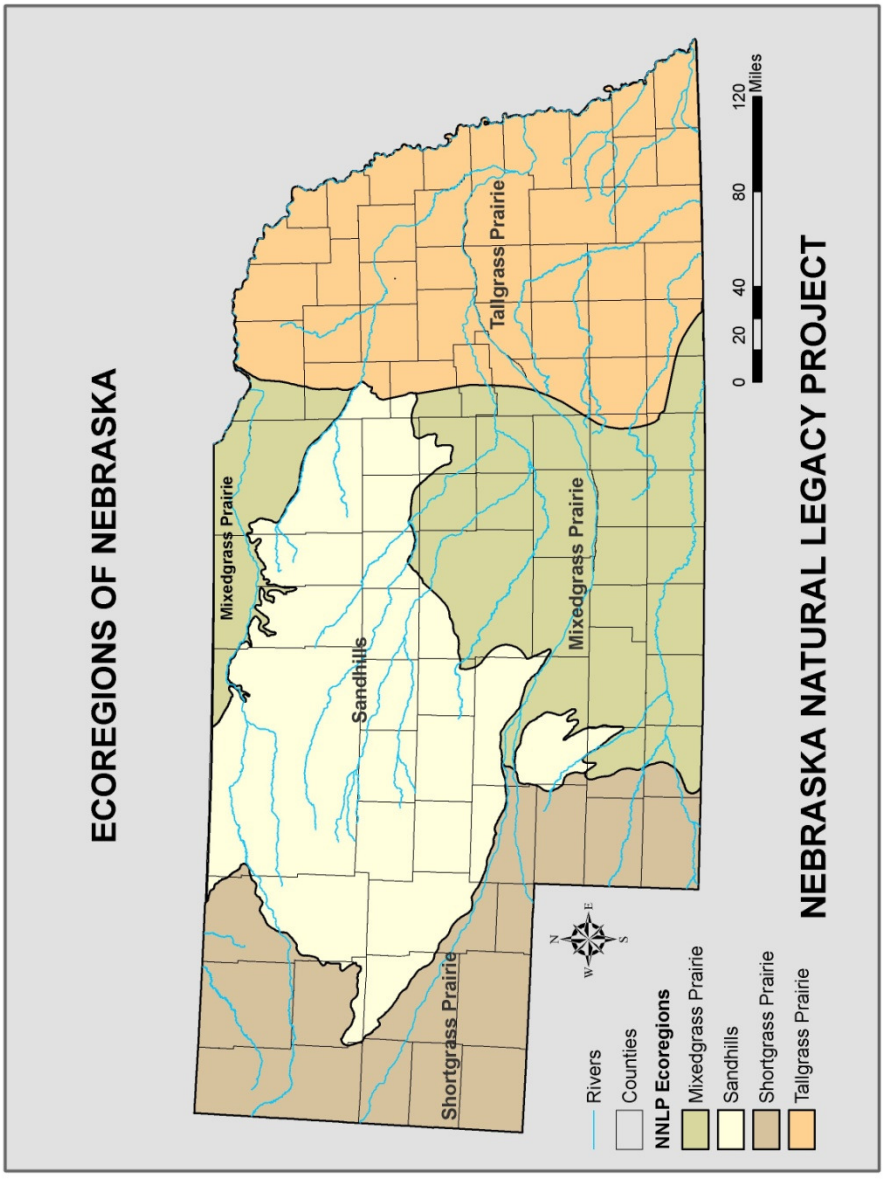
Common Name	Scientific Name	Grank	Srank
Saltmarsh Sand-spurry	*Spergularia salina*	G5	S1
Sandbar Lovegrass	*Eragrostis frankii*	G5	S1
Sandberg's Beggar-ticks	*Bidens connata* var. *pinnata*	G5TNR	S1
Saskatchewan Cinquefoil	*Potentilla effusa* var. *effusa*	G5?TNR	S2?
Scribner's Groundsel	*Senecio scribneri*	G1G3	S1
Sea Milkwort	*Lysimachia maritima*	G5	S1
Seaside Heliotrope	*Heliotropium curassavicum* var. *curassavicum*	G5T5	S1
Seaside Heliotrope	*Heliotropium curassavicum* var. *obovatum*	G5T5	S1
Secund Bladder-Pod	*Physaria arenosa* var. *arenosa*	G5T5	S1
Seep Monkey-Flower	*Mimulus guttatus*	G5	S1
Seneca Snakeroot	*Polygala senega*	G4G5	S1
Sessile-leaf Tick-clover	*Desmodium sessilifolium*	G5	S1
Sharpwing Monkey-flower	*Mimulus alatus*	G5	S1S2
Shining Sumac	*Rhus copallinum* var. *latifolia*	G5T5	S1
Short-pod Draba	*Draba brachycarpa*	G4G5	S1
Short-ray Fleabane	*Erigeron lonchophyllus*	G5	S1
Short-ray Prairie-coneflower	*Ratibida tagetes*	G4G5	S1
Short's Rock Cress	*Boechera dentata*	G5	S2
Short-seed Waterwort	*Elatine brachysperma*	G5	S1
Short-stem Wild-buckwheat	*Eriogonum brevicaule* var. *brevicaule*	G4T4?	S1
Showy Orchid	*Galearis spectabilis*	G5	S1
Showy-wand Goldenrod	*Solidago speciosa* var. *pallida*	G5T4	S1
Silverweed	*Potentilla anserina*	G5	S1
Slender Cotton-grass	*Eriophorum gracile*	G5	S2
Slender Fimbry	*Fimbristylis autumnalis*	G5	S2
Slender Ladies'-tresses	*Spiranthes lacera* var. *gracilis*	G5T4T5	S1
Slender Lip Fern	*Cheilanthes feei*	G5	S2
Slender Yellow Cress	*Rorippa tenerrima*	G5	S1
Slender-leaf Spring-panicum	*Dichanthelium linearifolium*	GNR	S1
Slim-flower Muhly	*Muhlenbergia tenuiflora*	G5	S1
Slim-leaf Scurf-pea	*Pediomelum linearifolium*	G4?	S1
Small Bluets	*Houstonia pusilla*	G5	S1
Small Sundrops	*Oenothera perennis*	G5	S2
Small Venus'-looking-glass	*Triodanis biflora*	G5	S1
Small-flower Bitter Cress	*Cardamine parviflora*	G5	S1
Small-flower Prairie-star	*Lithophragma parviflora*	G5	S1
Small-flower Sandpuffs	*Tripterocalyx micranthus*	G5	S1
Small-flower Wallflower	*Erysimum inconspicuum*	G5	S2
Smith's Hybrid Aspen	*Populus* × *smithii*	GNA	S1
Smooth Cliff-brake	*Pellaea glabella* var. *glabella*	G5T5	S1
Smooth False Foxglove	*Agalinis purpurea*	G5	S1S3
Snowberry	*Symphoricarpos albus* var. *albus*	G5T5	S1?
Soft Rush	*Juncus effusus* var. *solutus*	G5T5	S1
Sooth Four-o'clock	*Mirabilis glabra*	G5	S2
Southern Chervil	*Chaerophyllum tainturieri* var. *tainturieri*	G5T4T5	S1
Southern Wild Senna	*Senna marilandica*	G5	S1S2
Spike Hawthorn	*Crataegus macracantha* var. *occidentalis*	GNRTNR	S1S3
Spikebent	*Agrostis exarata* var. *minor*	G5TNR	S1
Spiked Muhly	*Muhlenbergia glomerata*	G5	S2

Common Name	Scientific Name	Grank	Srank
Spike-fescue	*Leucopoa kingii*	G5	S1?
Spikenard	*Aralia racemosa*	G4G5	S1
Spinulose Wood Fern	*Dryopteris carthusiana*	G5	S2
Spotted Evening-primrose	*Oenothera canescens*	G4G5	S2
Spotted St. John's-wort	*Hypericum punctatum*	G5	S1
Spotted Water-hemlock	*Cicuta maculata* var. *bolanderi*	G5T3T4	S1
Spreading Fleabane	*Erigeron divergens*	G5	S2
Spreading Pygmyleaf	*Loeflingia squarrosa* var. *texana*	G5TNR	S1
Spring Avens	*Geum vernum*	G5	S1
Spring Bitter Cress	*Cardamine bulbosa*	G5	S1S3
Spring Coral-root	*Corallorhiza wisteriana*	G5	S1
Spring Forget-me-not	*Myosotis verna*	G5	S1
Spring Ladies'-tresses	*Spiranthes vernalis*	G5	S1S3
Starved Spring-panicum	*Dichanthelium depauperatum*	G5	S1
Stickleaf	*Mentzelia oligosperma*	G4	S1
Sticky Crane's-bill	*Geranium viscosissimum*	G5	S1
Sticky Gilia	*Aliciella pinnatifida*	G4G5	S1
Straight-leaf Pondweed	*Potamogeton strictifolius*	G5	S1
Streambank Ragwort	*Packera pseudaurea* var. *semicordata*	G5T3T5Q	S1
Striped Coral-Root	*Corallorhiza striata* var. *vreelandii*	G5TNR	S1
Sugarbowls	*Clematis hirsutissima* var. *scottii*	G4T4?	S1
Summer Coral-root	*Corallorhiza maculata* var. *occidentalis*	G5T3T5	S1
Summer Grape	*Vitis aestivalis* var. *aestivalis*	G5T5	S1
Summer Orophaca	*Astragalus hyalinus*	G4	S2
Tall Cotton-grass	*Eriophorum angustifolium* var. *angustifolium*	G5TNR	S2
Taper-tip Rush	*Juncus acuminatus*	G5	S1
Texas Bergia	*Bergia texana*	G5	S1
Texas Dropseed	*Sporobolus texanus*	G5	S1
Texas Sandwort	*Minuartia michauxii* var. *texana*	G5T3T5	S2
Texas Sedge	*Carex texensis*	G5	S1
Texas Toadflax	*Nuttallanthus texanus*	G4G5	S2
Thick-spike Gayfeather	*Liatris pycnostachya* var. *pycnostachya*	G5T5	S1S3
Thread-leaf Pondweed	*Stuckenia filiformis* var. *occidentalis*	G5T5	S1
Three-flower Melic Grass	*Melica nitens*	G5	S1
Three-nerve Fleabane	*Erigeron subtrinervis*	G5	S2
Tine-leaf Milk-vetch	*Astragalus pectinatus*	G5	S1
Tube Penstemon	*Penstemon tubiflorus* var. *tubiflorus*	G5T4T5	S1
Tuberous False Dandelion	*Pyrrhopappus grandiflorus*	G5	S1
Tufted Fleabane	*Erigeron caespitosus*	G5	S2
Twisted Yellow-eyed-grass	*Xyris torta*	G5	S2
Two-leaf Waterweed	*Elodea bifoliata*	G4G5	S1
Vahl's Fimbry	*Fimbristylis vahlii*	G5	S1
Veiny Pepper-grass	*Lepidium oblongum*	G5	S1
Vernal Water-starwort	*Callitriche palustris*	G5	S2
Violet Lespedeza	*Lespedeza violacea*	G5	S1
Virginia Spring-beauty	*Claytonia virginica*	G5	S1
Virginia Wild-rye	*Elymus virginicus* var. *intermedius*	G5TNR	S1S3
Water Dock	*Rumex verticillatus*	G5	S1
Water Horsetail	*Equisetum fluviatile*	G5	S1

Common Name	Scientific Name	Grank	Srank
Water Sedge	*Carex aquatilis* var. *substricta*	G5TNR	S2
Watershield	*Brasenia schreberi*	G5	S2
Water-thread Pondweed	*Potamogeton diversifolius*	G5	S2
Wax-flower Shinleaf	*Pyrola elliptica*	G5	S1
Wedge-leaf Draba	*Draba cuneifolia* var. *cuneifolia*	G5T5	S1
Welsh's Bugseed	*Corispermum welshii*	G2G4	S1
Western Marsh Cudweed	*Gnaphalium palustre*	G5	S1S3
Western Prairie Flax	*Linum lewisii* var. *lewisii*	G5T5	S1
Western Rattlesnake-plantain	*Goodyera oblongifolia*	G5?	S1
Whip Nut-Rush	*Scleria triglomerata*	G5	S1S2
White Arrow-leaf Aster	*Symphyotrichum urophyllum*	G4G5	S1
White Baneberry	*Actaea pachypoda*	G5	S1
White Bear Sedge	*Carex albursina*	G5	S1
White Boltonia	*Boltonia asteroides* var. *latisquama*	G5TNR	S1S3
White Oak	*Quercus alba*	G5	S1
White Water-lily	*Nymphaea odorata* ssp. *tuberosa*	G5T5	S1S3
White Woodland Aster	*Symphyotrichum lateriflorum*	G5	S1
White-scale Sedge	*Carex xerantica*	G5	S2
White-stem Blazing-star	*Mentzelia albicaulis*	G5	S1
White-stem Pondweed	*Potamogeton praelongus*	G5	S1
Whorled Water-milfoil	*Myriophyllum verticillatum*	G5	S1
Wild Geranium	*Geranium maculatum*	G5	S1
Wild Yam	*Dioscorea villosa*	G5	S1
Wild-goose Plum	*Prunus hortulana*	G4?	S1
Wire-lettuce	*Stephanomeria runcinata*	G5	S2
Wood Mint	*Blephilia hirsuta*	G5?	S1
Wool-grass	*Scirpus cyperinus*	G5	S1
Woolly-fruit Sedge	*Carex lasiocarpa* var. *americana*	G5T5	S1
Yellow Lady's-slipper	*Cypripedium parviflorum*	G5	S1
Yellow Marsh-marigold	*Caltha palustris*	G5	S2
Yellow Pond-lily	*Nuphar variegata*	G5	S2
Yellow Stonecrop	*Sedum lanceolatum* var. *lanceolatum*	G5T3T5	S2
Yellow Valley Violet	*Viola vallicola*	G5?	S2
Yellow Vetchling	*Lathyrus ochroleucus*	G4G5	S2
Yellow-fruit Sedge	*Carex brachyglossa*	GNR	S1S3
Zigzag Goldenrod	*Solidago flexicaulis*	G5	S1

Appendix 10: Map of the ecoregions of Nebraska.

Ecoregions are relatively large units of land and water delineated by the biotic and abiotic factors (e.g., climate, topography, geology, vegetation) that regulate the structure and function of the ecosystems within them. There are two main ecoregion maps for the United States, one developed by the U.S. Forest Service (Bailey et al. 1994) and the other developed by the U.S. Environmental Protection Agency (Omernik et al. 1987). For the Nebraska Natural Legacy Project, we delineated ecoregions using primarily Level III ecoregion lines from Ecoregions of Nebraska and Kansas (Chapman et al. 2001), which was a joint project of the USFS and EPA to blend the two systems. However, we used Bailey's Section level line to delineate the western boundary of tall-grass prairie south of the Sandhills since this was a better fit with Kaul and Rolfsmeier's (1993) map of the native vegetation of Nebraska.



Appendix 11: Criteria for changes to the system of Biologically Unique Landscapes

Biologically Unique Landscapes (BULs) were identified in order to increase the efficiency and effectiveness of conservation by focusing efforts in areas with concentrations of at-risk species and high quality natural communities, in a relatively intact landscape. These landscapes offer the best opportunities for conserving the full array of biological diversity in the state. These landscapes were delineated using the best available data at that time. It was recognized that BUL boundaries could be changed or new BULs added as new information became available on the distribution of at-risk species and high quality examples of natural communities.

BULs were designed with the goal of including sites where there is the highest likelihood that the populations and communities will persist over the long term. For individual species, this would include sites with a large population size, good age-class structure and evidence of successful reproduction. For natural communities, this would include sites with a good representation of expected native species, few invasive exotics, and relatively intact ecological processes that maintain these communities (e.g., fire, grazing, flooding). BULs contain high quality examples of at-risk species populations and ecological communities that are nested together and exist within functional landscapes.

Major Additions or Deletions to the BUL System

Adding new BULs or changing the size of existing BULs by more than 10%

Analysis of the distribution and abundance of species and communities within BULs indicates that the original system of BULs does not provide ample opportunity to meet the Natural Legacy conservation goals for all at-risk species and natural communities. Also, in future revisions of the Nebraska Natural Legacy Project, new species and communities will likely be added to the at-risk species and natural communities lists and their distributions may lie outside of existing BULs. In addition, portions of, or entire, BULs may become degraded to the point that they can no longer support the objectives for which they were designated. Thus, changes in the system will be needed.

Additions to the system should complement the existing system and not merely repeat what is already there. They should provide opportunities to meet conservation goals for species and communities that can't be met in the existing system. Proposed additions should strive to include the most intact landscape available and contain multiple occurrences of at-risk species and/or natural communities.

The following criteria were developed by the Natural Legacy Science Team to guide adjustments to the system.

Criteria for additions to the BUL system (expanding existing or adding new BULs):

> Addition must contain documented, high-quality occurrences of at-risk species and/or natural communities and provide opportunities to meet species and/or community goals that can't be met in the existing system of BULs.
>
> > (See below for the current list of species and communities that would qualify for these criteria)

Criteria for deletions from the BUL system (removing portions of, or entire, BULs)**:**

> The area to be removed is degraded to the point that it does not contain high-quality occurrences of at-risk species and/or natural communities and does not provide opportunities to meet species and/or community goals.

Minor Boundary Adjustments

The original BUL boundaries were drawn using the best available information, typically using land-cover maps and including areas that appeared to be relatively intact natural habitats around core areas of documented species and community targets. Given the somewhat coarse scale at which the boundaries were drawn, they no doubt included some areas that are of low conservation value and excluded some adjacent areas that are of high conservation value. To increase the effectiveness of the boundaries, minor adjustments can be made to BUL boundaries. Proposals for minor boundary adjustments are encouraged to include recommendations for deletions, when appropriate, as well as additions. Again, proposed additions to a BUL should strive to include the most intact landscape available and contain multiple occurrences of at-risk species and/or natural communities. Proposals for minor boundary adjustments should meet the following criteria.

Criteria for minor boundary adjustments

> Addition to a BUL must contain documented, high-quality occurrences of at-risk species and/or natural communities.
>
> Area to be removed is degraded to the point that it does not contain high-quality occurrences of at-risk species and/or natural communities and does not provide opportunities to meet species and/or community goals.
>
> The boundary change is minor – moving the boundary a few miles or resulting in no more than 10% increase or decrease in the size of the BUL.

Species and communities that satisfy the major addition criteria

Tier I species for which current data and expert knowledge indicate there was not ample opportunity to meet their conservation goals in the existing system of BULs. Major additions to existing BULs or designating new BULs could be done to conserve these species.

Birds
Buff-breasted Sandpiper
Henslow's Sparrow
McCown's Longspur
Mountain Plover
Short-eared Owl

Fish
Finescale Dace
Northern Redbelly Dace
Topeka Shiner

Insects
Bucholz Black Dash
Iowa Skipper
Ottoe Skipper
Platte River Caddisfly

Mussels
Pimpleback
Pistolgrip
Plain Pocketbook

Plants
Iowa Moonwort
Missouri Sedge
Snow Trillium

Natural communities for which current data and expert knowledge indicate there was not ample opportunity to meet their conservation goals in the existing system of BULs. Additions to existing BULs or designating new BULs could be done to conserve these communities

Eastern Cordgrass Wet Prairie
Eastern Sedge Wet Meadow
Southern Sand/Gravel Mixedgrass Prairie

Appendix 12: Scientific names of non-tier species referred to in the Nebraska Natural Legacy Project

	Common Name	Scientific Name
Amphibians	Blanchard's Cricket Frog	*Acris blanchardi*
	Boreal Chorus Frog	*Pseudacris maculata*
	Bullfrog	*Lithobates catesbeianus*
	Great Plains Toad	*Anaxyrus cognatus*
	Plains Leopard Frog	*Lithobates blairi*
	Plains Spadefoot	*Spea bombifrons*
	Woodhouse's Toad	*Anaxyrus woodhousii*
Birds	American White Pelican	*Pelecanus erythrorhynchos*
	Baird's Sandpiper	*Calidris bairdii*
	Blue-winged Teal	*Anas discors*
	Bobolink	*Dolichonyx oryzivorus*
	Canada Goose	*Branta canadensis*
	Dickcissel	*Spiza americana*
	Field Sparrow	*Spizella pusilla*
	Franklin's Gull	*Larus pipixcan*
	Grasshopper Sparrow	*Ammodramus savannarum*
	Greater White-fronted Goose	*Anser albifrons*
	Greater Yellowlegs	*Tringa melanoleuca*
	Green Heron	*Butorides virescens*
	Horned Lark	*Eremophila alpestris*
	Lark Bunting	*Calamospiza melanocorys*
	Le Conte's Sparrow	*Ammodramus leconteii*
	Lesser Yellowlegs	*Tringa flavipes*
	Mallard	*Anas platyrhynchos*
	Northern Pintail	*Anas acuta*
	Orchard Oriole	*Icterus spurius*
	Rose-breasted Grosbeak	*Pheucticus ludovicianus*
	Ross's Goose	*Chen rossii*
	Snow Goose	*Chen caerulescens*
	Stilt Sandpiper	*Calidris himantopus*
	Upland Sandpiper	*Bartramia longicauda*
	Vesper Sparrow	*Pooecetes gramineus*
	Western Meadowlark	*Sturnella neglecta*
	Western Sandpiper	*Calidris mauri*
	Wilson's Phalarope	*Phalaropus tricolor*
	Wood Duck	*Aix sponsa*
Fish	Bighead Carp	*Hypophthalmichthys nobilis*
	Bluegill	*Lepomis macrochirus*
	Brook Stickleback	*Culaea inconstans*

Fish (cont.)	Brown Trout	*Salmo trutta*
	Channel Catfish	*Ictalurus punctatus*
	Common Carp	*Cyprinus carpio*
	Flathead Chub	*Platygobio gracilis*
	Grass Carp	*Ctenopharyngodon idella*
	Iowa Darter	*Etheostoma exile*
	Johnny Darter	*Etheostoma nigrum*
	Largemouth Bass	*Micropterus salmoides*
	Northern Pike	*Esox lucius*
	Orangethroat Darter	*Etheostoma spectabile*
	Rainbow Trout	*Oncorhynchus mykiss*
	River Carpsucker	*Carpiodes carpio*
	Shortnose Gar	*Lepisosteus platostomus*
	Shovelnose Sturgeon	*Scaphirhynchus platorynchus*
	Silver Carp	*Hypophthalmichthys molitrix*
	Speckled Chub	*Macrhybopsis aestivalis*
	Striped Bass	*Morone saxatilis*
	Walleye	*Sander vitreus*
	White Bass	*Morone chrysops*
	Yellow Perch	*Perca flavescens*
Insects	Emerald Ash Borer	*Agrilus planipennis*
	Mountain Pine Beetle	*Dendroctonus ponderosae*
Mammals	American Badger	*Taxidea taxus*
	American Beaver	*Castor canadensis*
	American Bison	*Bos bison*
	American Black Bear	*Ursus americanus*
	American Mink	*Neovison vison*
	Big Brown Bat	*Eptesicus fuscus*
	Black-tailed Prairie Dog	*Cynomys ludovicianus*
	Bobcat	*Lynx rufus*
	Common Muskrat	*Ondatra zibethicus*
	Coyote	*Canis latrans*
	Eastern Cottontail	*Sylvilagus floridanus*
	Eastern Red Bat	*Lasiurus borealis*
	Franklin's Ground Squirrel	*Spermophilus franklinii*
	Gray Wolf	*Canis lupus*
	Grizzly Bear	*Ursus arctos*
	Least Weasel	*Mustela nivalis*
	Masked Shrew	*Sorex cinereus*
	Meadow Jumping Mouse	*Zapus hudsonius*
	Meadow Vole	*Microtus pennsylvanicus*
	Mule Deer	*Odocoileus hemionus*
	North American Least Shrew	*Cryptotis parva*
	Northern Grasshopper Mouse	*Onychomys leucogaster*

Mammals (cont.)	Ord's Kangaroo Rat	*Dipodomys ordii*
	Plains Pocket Gopher	*Geomys bursarius*
	Prairie Vole	*Microtus ochrogaster*
	Pronghorn	*Antilocapra americana*
	Raccoon	*Procyon lotor*
	Red Fox	*Vulpes vulpes*
	Silver-haired Bat	*Lasionycteris noctivagans*
	Striped Skunk	*Mephitis mephitis*
	Thirteen-lined Ground Squirrel	*Spermophilus tridecemlineatus*
	White-tailed Deer	*Odocoileus virginianus*
Mussels	White Heelsplitter	*Lasmigona complanata*
	Zebra Mussel	*Dreissena polymorpha*
Reptiles	Bullsnake	*Pituophis catenifer*
	Common Garter Snake	*Thamnophis sirtalis*
	Common Snapping Turtle	*Chelydra serpentina*
	Eastern Yellow-bellied Racer	*Coluber constrictor flaviventris*
	False Map Turtle	*Graptemys pseudogeographica*
	Great Plains Skink	*Plestiodon obsoletus*
	Lesser Earless Lizard	*Holbrookia maculata*
	Northern Painted Turtle	*Chrysemys picta*
	Northern Prairie Lizard	*Sceloporus undulatus garmani*
	Northern Prairie Skink	*Eumeces septentrionalis*
	Northern Water Snake	*Nerodia sipedon*
	Ornate Box Turtle	*Terrapene ornate*
	Plains Garter Snake	*Thamnophis radix*
	Prairie Rattlesnake	*Crotalus viridis*
	Six-lined Racerunner	*Aspidoscelis sexlineata*
	Spiny Softshell	*Apalone spiinifera*
	Western Fox Snake	*Mintonius vulpinus*
	Western Hognose Snake	*Heterodon nasicus*
	Wild Turkey	*Meleagris gallopavo*
	Yellow Mud Turtle	*Kinosternon flavescens*
Plants	Alfalfa	*Medicago sativa* ssp. *sativa*
	Alkali Sacaton	*Sporobolus airoides*
	American Elm	*Ulmus Americana*
	Annual Buckwheat	*Eriogonum annuum*
	Arrowhead	*Sagittaria* spp.
	Basswood	*Tilia americana*
	Bedstraw	*Gallium* spp.
	Big Bluestem	*Andropogon gerardii*
	Black Walnut	*Juglans nigra*
	Bladderwort	*Utricularia* spp.
	Bluegrass	*Poa* spp.

Plants (cont.)	Blue Grama	*Bouteloua gracilis*
	Bog Buckbean	*Menyanthes trifoliate*
	Box-elder	*Acer negundo*
	Broad-leaf Cattail	*Typha latifolia*
	Broom Snakeweed	*Gutierrezia sarothrae*
	Buffalo grass	*Bouteloua dactyloides*
	Bur Oak	*Quercus macrocarpa*
	Bur-reed	*Sparganium* spp.
	Bush Morning-glory	*Ipomoea leptophylla*
	Canada Thistle	*Cirsium arvense*
	Canada Wild-rye	*Elymus canadensis*
	Cheatgrass	*Bromus tectorum*
	Chokecherry	*Prunus virginiana*
	Clustered Field Sedge	*Carex praegracilis*
	Common Buckthorn	*Rhamnus cathartica*
	Common Cattail	*Typha latifolia*
	Common Reed	*Phragmites australis* ssp. *americanus*
	Coontail	*Ceratophyllum demersum*
	Coyote Willow	*Salix exigua*
	Crown-vetch	*Securigera varia*
	Cutleaf Ironplant	*Xanthisma spinulosum*
	Deervetch	*Lotus purshianus*
	Desert Goosefoot	*Chenopodium pratericola*
	Dotted Gayfeather	*Liatris punctata*
	Duckweed	*Lemna* spp.
	Dwarf Juniper	*Juniperus communis* var. *depressa*
	Dwarf Prairie Rose	*Rosa arkansana*
	Eastern Red-cedar	*Juniperus virginana*
	Emory's Sedge	*Carex emoryi*
	Entire-leaf Thelypody	*Thelypodium integrifolium*
	Eurasian Phragmites	*Phragmites australis* ssp. *australis*
	Eurasian Water-milfoil	*Myriophyllum spicatum*
	False Indigo-bush	*Amorpha fruticosa*
	Field Horsetail	*Equisetum arvense*
	Flatsedge	*Cyperus* spp.
	Foxtail Barley	*Hordeum jubatum*
	Fragile Fern	*Cystopteris fragilis*
	Garlic Mustard	*Allaria Petiolata*
	Garrison Creeping-foxtail	*Alopecurus arundinaceus*
	Green Ash	*Fraxinus pennsylvanica*
	Green Needle Grass	*Nassella viridula*
	Hackberry	*Celtis occidentalis*
	Hairy Grama	*Bouteloua hirsuta*
	Hard-stem Bulrush	*Schoenoplectus acutus*
	Hickory	*Carya* spp.
	Hood's Phlox	*Phlox hoodii*

Plants (cont.)	Honeysuckle	*Lonicera* spp.
	Hound's-tongue	*Cynoglossum officinale*
	Indian Grass	*Sorghastrum nutans*
	Japanese Brome	*Bromus japonicus*
	Juniper	*Juniperus* spp.
	Kentucky Bluegrass	*Poa pratensis*
	Leadplant	*Amorpha canescens*
	Leafy Spurge	*Euphorbia esula*
	Lemon Scurf-pea	*Psoralidium lanceolatum*
	Little Bluestem	*Schizachyrium scoparium*
	Marsh Muhly	*Muhlenbergia racemosa*
	Milk-vetch	*Astragalus* spp.
	Mountain-mahogany	*Cercocarpus montanus*
	Musk Thistle	*Carduus nutans*
	Narrow-leaf Cattail	*Typha angustifolia*
	Needle-and-thread	*Hesperostipa comata*
	Needlegrass	*Nassella* spp.
	Nodding Smartweed	*Polygonum lapathifolia*
	Old World Bluestem	*Bothriochloa* spp.
	Paper Birch	*Betula papyrifera*
	Peachleaf Willow	*Salix amygdaloides*
	Plains Coreopsis	*Coreopsis tinctoria*
	Plains Cottonwood	*Populus deltoides*
	Plains Gayfeather	*Liatris squarrosa*
	Plains Sunflower	*Helianthus petiolaris*
	Ponderosa Pine	*Pinus ponderosa*
	Poverty-weed	*Monolepis nuttalliana*
	Prairie Blazing-star	*Liatris pycnostachya*
	Prairie-clover	*Dalea* spp.
	Prairie-coneflower	*Ratibida* spp.
	Prairie Cordgrass	*Spartina pectinata*
	Prairie Sandreed	*Calamovilfa longifolia*
	Prickly Pear	*Opuntia* sp.
	Purple Locoweed	*Oxytropis lambertii*
	Purple Loosestrife	*Lythrum salicaria*
	Quackgrass	*Elymus repens*
	Rayless Alkali Aster	*Aster brachyactis*
	Reed Canary Grass	*Phalaris arundinacea*
	Ripgut Sedge	*Carex lacustris*
	River Bulrush	*Bolboschoenus fluviatilis*
	Rough-leaf Dogwood	*Cornus drummondii*
	Rubber Rabbit-brush	*Ericameria nauseosa*
	Russian-olive	*Elaeagnus angustifolia*
	Russian-thistle	*Kali* sp.
	Sagebrush	*Artemisia* spp.
	Saltbush	*Atriplex* spp.

Plants (cont.)	Saltcedar	*Tamarix ramosissima*
	Saltgrass	*Distichlis spicata*
	Saltmarsh Bulrush	*Bolboschoenus maritimus*
	Sandbar Willow	*Salix exigua*
	Sand Bluestem	*Andropogon hallii*
	Sand Cherry	*Prunus pumila*
	Sand Dropseed	*Sporobolus cryptandrus*
	Sand-lily	*Mentzelia nuda*
	Saskatoon Serviceberry	*Amelanchier alnifolia*
	Scarlet Globe-mallow	*Sphaeralcea coccinea*
	Scarlet Gaura	*Gaura coccinea*
	Scouring-rush	*Equisetum* spp.
	Scratchgrass	*Muhlenbergia asperifolia*
	Sericea Lespedeza	*Lespedeza cuneata*
	Showy Goldenrod	*Solidago speciosa*
	Showy Ipomopsis	*Ipomopsis longiflora*
	Siberian Elm	*Ulmus pumila*
	Sideoats Grama	*Bouteloua curtipendula*
	Silver Buffalo-berry	*Shepherdia argentea*
	Silver Orache	*Atriplex* sp.
	Skeletonplant	*Lygodesmia juncea*
	Skunkbush Sumac	*Rhus aromatica*
	Skyblue Aster	*Aster oolentangiensis*
	Slender-flower Scurf-pea	*Pediomelum tenuiflorum*
	Smartweed	*Polygonum* spp.
	Smooth Brome	*Bromus inermis*
	Spearscale	*Atriplex patula*
	Spikerush	*Eleocharis* spp.
	Stemless Tetraneuris	*Tetraneuris acaulis*
	Stiff Sunflower	*Helianthus pauciflorus*
	Sun Sedge	*Carex heliophila*
	Sweet-clover	*Melilotus* spp.
	Switchgrass	*Panicum virgatum*
	Tall Wheatgrass	*Thinopyrum ponticum*
	Thick-spike Wheatgrass	*Elymus lanceolatus*
	Viscid Camphor-daisy	*Rayjacksonia annua*
	Western Sea-blite	*Suaeda calceoliformis*
	Western Wheatgrass	*Pascopyrum smithii* (*Elymus smithii*)
	Western Wild Rose	*Rosa woodsii* var. *woodsii*
	White Sage	*Artemisia ludoviciana*
	Willow	*Salix* spp.
	Wolfberry	*Symphoricarpos occidentalis*
	Woolly Sedge	*Carex pellita*
	Yucca	*Yucca* spp.