Oklahoma Comprehensive Wildlife Conservation Strategy:
A Strategic Conservation Plan for Oklahoma's Rare and Declining Wildlife

Oklahoma Department of Wildlife Conservation

Planning for the Future for Oklahoma's Wildlife

Financial Support for the Development of this Conservation Plan was Provided by: State Wildlife Grants T-2-P-1 and T-62-P

Executive Summary and Statewide Perspective

Keeping Oklahoma's Common Species Common

The Oklahoma Comprehensive Wildlife Conservation Strategy (OCWCS) provides broad, proactive guidance for the conservation of Oklahoma's rare and declining species, and meets the expectations of the congressionally authorized State and Tribal Wildlife Grants Program. The OCWCS is a strategic conservation plan that identifies Oklahoma's species of greatest conservation need, the conservation landscapes (key habitats) that they require, the conservation challenges that they face, potential conservation actions that can be implemented to improve each species population status and the potential partnerships that can deliver proactive conservation - all within a framework that is based on Oklahoma's ecological regions.

The Oklahoma Comprehensive Wildlife Conservation Strategy is integrally connected to the congressional State and Tribal Wildlife Grants program and is a plan focused on proactive wildlife conservation to address the needs of declining species that traditionally have not benefited from a dedicated funding source. Under the North American model for wildlife conservation, wildlife is a public trust resource and states hold the authority and responsibility for managing most fish and wildlife populations. For decades, state fish and wildlife agencies across our nation have worked successfully with the U.S. Fish and Wildlife Service to conserve and strengthen populations of game and sport fish through long-term federal assistance programs with dedicated funding via federal excise taxes on hunting and fishing equipment (federal aid in Wildlife Restoration and federal aid in Sport Fish Restoration). Beginning in the 1970s, Congress established a funding program for the conservation and recovery of species that are federally-listed as threatened and endangered species. Since then, state and federal wildlife agencies have worked in cooperation to improve the condition of these populations and have learned that recovery is often difficult and expensive when working with species that are poorly understood, have specialized ecological needs and have reach dangerously low population sizes. The State and Tribal Wildlife Grants program was born from this realization and endeavors to address the conservation needs of wildlife species before they decline to the point at which they are threatened with extinction.

As a requirement of this new program, Congress directed each state and territory to develop a strategic conservation plan that identifies the species with the greatest need for additional conservation attention and outlines the actions that could be taken for the benefit of these species. The OCWCS is that plan for Oklahoma and is both the fulfillment of a congressional requirement and the guiding document for how Oklahoma uses the state portion of the State and Tribal Wildlife Grants funding that it receives. Beyond these purposes, the broader conservation community can use the OCWCS to articulate and justify the need for increased funding for wildlife and habitat conservation to Congress and the public.

The use of the OCWCS by the broader conservation community makes it a conservation plan for the State of Oklahoma, not just for the Oklahoma Department of Wildlife Conservation (ODWC). Although it provides guidance for the use of State and Tribal Wildlife Grants funding and was developed as a requirement of that program, the conservation issues and recommended actions within the OCWCS are not limited to those for which the ODWC has legal authority or even those activities that can be funded solely through the State and Tribal Wildlife Grants program. Instead, the OCWCS attempts to examine the full range of conservation issues that face rare and declining species in Oklahoma. Implementation of a majority of the actions recommended within the OCWCS will require voluntary cooperation and funding from private landowners, industries, municipalities, regulatory agencies, conservation organizations, research entities and the general public. Because of the OCWCS's comprehensive approach and dependence upon partnerships for implementation, a wide range of conservation stakeholders, organizations and agencies were brought into the process at the early stages of its development. Technical input was sought from over 300 experts and professionals in land management and in fish and wildlife conservation from both within and outside of state government. The public was invited to participate in both the initial development and the revision process through public meetings and interaction via the Internet. Additionally, guidance provided by Congress, the U.S. Fish and Wildlife Service, and the Association of Fish and Wildlife Agencies was used in preparing the organizational structure and content of the OCWCS.

Oklahoma’s Comprehensive Wildlife Conservation Strategy is not a traditional government report or research study. Instead, it is a strategy based upon the best available information and the professional judgment of more than 150 technical experts representing a wide range of perspectives tied to Oklahoma’s ecology, natural history and land management. The results of stakeholder and technical expert participation produced multiple lists of conservation issues that were eventually consolidated into those specific conservation issues addressed in this document.

Based upon the initial stakeholder input, the OCWCS was written in light of several overarching concepts:

1) the organizational focus should be on habitat types because most wildlife populations are limited by habitat quantity and quality;
2) the recommended actions should place greater emphasis on voluntary measures rather than the development of new regulations;
3) all conservation issues and actions should be considered including those that lie beyond the authority of wildlife agencies as well as those actions that are not eligible for funding through the State Wildlife Grants program, and
4) the building of partnerships should be encouraged as a means of implementing conservation actions.

Several re-occurring issues emerged from the input provided by technical experts and stakeholders. Conservation issues that emerged repeatedly across habitat types and regions were placed into categories based on their similarity, which included:

1) there are gaps in existing data that impede effective conservation planning and implementation;
2) land management practices over the past century that have changed the structure of habitats over large areas;
3) wildlife in most habitat types have been affected negatively by the fragmentation and the conversion of native habitats to other land uses;
4) invasive, exotic plants and animals have altered the structure and composition of many habitats and reduced habitat quality;
5) the modification of water flow in streams and rivers brought about by water removal, impoundments and channel modifications has negatively affected many aquatic species, and
6) water quality impairment continues to threatened aquatic species in developed landscapes.

The current edition of Oklahoma's Comprehensive Wildlife Conservation Strategy is not an end point, but is another step in a long process of conservation that seeks to maintain healthy populations of fish and wildlife for present and future generations of Oklahomans. In order for it to be more than another document on a shelf, it needs to be examined, modified and embraced by conservation-minded partners in order to be implemented. The funding base and legal authority to implement many of its recommendations does not exist within wildlife conservation agencies; therefore partnerships are crucial for its implementation. It is our desire that through the on-going communication and coordination among all stakeholders, Oklahoma’s CWCS will remain a vital and adaptive template for future fish and wildlife conservation efforts. Federal and state agencies, municipal planners and regional, national and international conservation partners are encouraged to use the OCWCS as a guide for their own activities and are encouraged to share the results of their efforts with state wildlife agencies and other partners.

Purpose and Introduction

The primary purpose of the Oklahoma Comprehensive Wildlife Conservation Strategy (OCWCS) is to articulate the conservation strategies necessary to conserve our rare and declining wildlife species and in do so maintain Oklahoma's rich biological heritage for present and future generations. The OCWCS is an off-shoot of, and a guiding document for, a relatively new federal conservation assistance program called State and Tribal Wildlife Grants. When Congress created the State and Tribal Wildlife Grants program in 2001, it required each state and territory to develop a comprehensive, strategic conservation plan that would serve as the primary guidance for how each state would use its portion of the program's funding. This document represents the current end-product of both the development of the original version of the OCWCS (completed in July, 2005) and the first subsequent comprehensive review and revision (completed in September, 2015).

Adaptive management principles were applied to the review and revision process used to produce this edition of the OCWCS. The information collected through more than forty State Wildlife Grants-funded projects between 2004 and 2014 was used to update the list of Oklahoma's species of greatest conservation need and to refine, based on that new and/or updated information, the status, population trend and habitat association for each species. Input was sought from technical experts, land managers, government natural resource agencies and the general public to further update the species information as well as to incorporate emerging conservation issues and innovative new conservation approaches. During the course of this revision, each species, species status, habitat type, conservation issue and conservation action was reviewed and modified as needed. Seven of the original species of greatest conservation need were removed from list, while 67 new species were added (two amphibians, three birds, five fish, fifty-one invertebrates, and six mammals). The selection criteria for determining which species qualified as species of greatest conservation need were not modified, but several changes were made to the ranking criteria. As a result, all of the species were re-evaluated and re-ranked.

Under our current adaptive management protocol, the next comprehensive review and revision of the OCWCS will be initiated in 2023 and completed in 2025 in order to maintain a 10-year interval between reviews.

Background

Connection to State and Tribal Wildlife Grants

The OCWCS is a direct outcome of the State and Tribal Wildlife Grants program, which itself is a Congressional response to the Teaming With Wildlife Initiative of the 1990s. The OCWCS is the guiding plan for determining which species and activities are eligible for State and Tribal Wildlife Grants funding in order to maximize the conservation benefits gained from the investment of these dollars. State and Tribal Wildlife Grants is a congressional conservation program that provides cost-share funding to eligible Tribes and state fish and wildlife agencies for the proactive conservation of species that the state recognizes as its species in greatest need of additional conservation attention (also known as "species of greatest conservation need"). A species of greatest conservation need is a rare, uncommon or declining species whose long-term persistence is in doubt or in jeopardy. Most of these species are traditionally classified as "nongame" species but, in Oklahoma and other states, this list includes some sport fish and game species. Species of greatest conservation need can include both vertebrates and invertebrates, but the congressional language prohibits the use of State and Tribal Wildlife Grants funding to address the direct conservation of individual plant species. Therefore, rare and declining plants are not formally recognized as species of greatest conservation need for the purposes of the OCWCS, or this grant program, even though there may be a substantial conservation concern for these species. The limitations regarding plants are based upon the legal classification of plants as private property. While animals are considered a public trust resource in North America, plants are considered to be the property of the landowner upon whose property they are growing and states have limited legal authority for plants. The State and Tribal Wildlife Grants program seeks to stabilize and/or increase the populations of rare and declining species in a proactive manner before these species decline to the point at which they are threatened with endangerment or extinction. The program is funded through an annual congressional appropriation that is a line-item addition to the U.S.

Fish and Wildlife Service's budget. Like other federal grants-to-states programs, it is administered on behalf of Congress through a federal agency and is subject to the same rules and regulations as other federal funds.

National Conservation Funding History

Congress created the State and Tribal Wildlife Grants program in response to a tangible need articulated by the Teaming With Wildlife initiative. The Teaming With Wildlife initiative is based on the need for a dedicated and reliable source of conservation funding for those species, often referred to as nongame species or watchable wildlife, that otherwise would have no such funding. Funding for these species would be earmarked to increase public appreciation and connection with wildlife and to bolster populations of rare and declining species to ensure their survival and continuation of the ecological services and functions that they provide. Teaming With Wildlife's proponents made the case that the costs for maintaining and recovering populations of threatened and endangered species are far greater than conserving common species and that the costs for managing species typically increases as population size decreases. Therefore, investing dollars into the conservation of declining species while they are still relatively common will save money in the long-term and should reduce the number of costly threatened and endangered species listings.

In the United States, wildlife is a public-trust resource. Most wildlife populations are managed by the individual states for the benefit of their respective citizens. The exceptions to this pattern are migratory birds, diadromous fish (those that migrate between fresh and saltwater), and species that are federally-listed as threatened or endangered species; the management authority and responsibility for these species are held by the federal government. For decades, the majority of direct fish and wildlife conservation in Oklahoma, and across the country, has been funded by sportsmen and sportswomen. These funds are generated through two main sources: 1) the sale of state fishing and hunting licenses, and 2) dedicated federal excise tax revenue that is attached to the sale of fishing and hunting equipment and apportioned back to the states through the U.S. Fish and Wildlife Service according to set formulas. This system has been very effective for funding conservation of species that are hunted or sought by anglers. Species including the Wild Turkey, White-tailed Deer, Largemouth Bass and Channel Catfish are probably more abundant today than at any time in recent history. With the passage of the Endangered Species Act in 1973, a funding became available for the conservation of American's rarest and most imperiled species through an annual congressional appropriation.

These important programs have borne the costs for most of our fish and wildlife conservation, because a reliable funding mechanism had not been established to adequately address the remaining species that are not hunted, fished, endangered, nor threatened. These species represent more than 80% of the fish, amphibians, reptiles, birds and mammals in North America, as well as nearly all of the invertebrate species. In the closing years of the 20th Century, visionary leaders in the field of fish and wildlife conservation sought to provide a new source of funding for those species. The largest conservation coalition coalesced to date was created by the Teaming With Wildlife Initiative in the late 1990s. Across the country over 3,000 organizations and businesses lobbied Congress for passage of a national funding system for all species of wildlife with an emphasis on those species that are in decline.

The fruits of this effort were realized in federal fiscal year 2001 with the passage of two funding bills. The Commerce, Justice and State Appropriations Act (FY 2001), Title IX, Public Law 106-553, created the Wildlife Conservation and Restoration Program. Although this act provided only one year's appropriation of funds for fish and wildlife conservation, it identified the elements required to be included in the "Wildlife Conservation Strategy and Plan" that states committed to develop by October 2005. The second act, the Department of the Interior and Related Agencies Appropriations Act of 2002, Public Law 107-63, Title 1, created the "State and Tribal Wildlife Grants Program" that required the states to develop a "Comprehensive Wildlife Conservation Plan" by October 2005 if they wanted to be eligible to receive State and Tribal Wildlife Grants funding. All 50 states, the District of Columbia and the U.S. territories of Puerto Rico, U.S. Virgin Islands, American Samoa and the Commonwealth of the Northern Marianna Islands developed approved comprehensive wildlife conservation plans.

Overview of the OCWCS Requirements

Oklahoma's Comprehensive Wildlife Conservation Strategy meets the requirements of both federal funding acts. It is based on the best available information contributed by more than 150 technical experts representing a wide range of disciplines tied to Oklahoma's ecology, natural history and land management. As the name implies, this is a strategic-level conservation plan rather than a work plan. It identifies issues and potential actions that could be taken across the state, but it meant to serve as general guidance and not as a plan that commit funds and partners to specific actions. Of critical importance, this is a strategic plan that is written for all agencies and organizations in Oklahoma, not just the Oklahoma Department of Wildlife Conservation. Many of the potential actions identified in the plan lie beyond the available funding and legal authority of ODWC. Although the OCWCS was written to provide guidance for the use of State and Tribal Wildlife Grants funding, the recommendations extend beyond that program and include some activities, such as education and law enforcement, which are important conservation tools but are not eligible for funding under the program.

The enabling legislation for the State and Tribal Wildlife Grants program requires that each state and territory develop a "Comprehensive Wildlife Conservation Strategy" that includes the following elements:

1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the Oklahoma Department of Wildlife Conservation deems appropriate, that are indicative of the diversity and health of Oklahoma's wildlife;
2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1);
3. Descriptions of issues 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;
4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions;
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;
6. Descriptions of procedures to review the Comprehensive Wildlife Conservation Strategy at intervals not to exceed 10 years;
7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Comprehensive Wildlife Conservation Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within Oklahoma or administer programs that significantly affect the conservation of identified species and habitats; and
8. Provisions to ensure public participation in the development, revision, and implementation of projects and programs. Congress has affirmed that broad public participation is an essential element of this process.

The OCWCS is the result of a process specifically designed to meet the above required elements. Although the OCWCS is required in order for Oklahoma to participate in the State and Tribal Wildlife Grants program, it has far greater ramifications. The essence of this document is the identification of those species with the greatest need for additional conservation attention and the priority conservation actions that can be taken by individuals, agencies, and organizations in order to conserve Oklahoma's wildlife heritage. The job of conserving and managing all of Oklahoma's fish and wildlife, and the habitats on which they depend, is too large for any one group or agency to achieve alone. Therefore the OCWCS identifies a wide menu of potential actions that can be used by any conservation-minded person or organization for years into the future.

Approach and Methods

Development of the Original Oklahoma Comprehensive Wildlife Conservation Strategy

Public Involvement and Coordination with other Agencies and Tribes:

For the development of the first version of the Oklahoma Comprehensive Wildlife Conservation Strategy (OCWCS), the Oklahoma Department of Wildlife Conservation (ODWC) chose to partner with a contractor (Dynamic Solutions Group, LLC) to create a seven-person Planning Team comprised of three professional wildlife planners from Dynamic Solutions Group and four staff members from the ODWC. The Planning Team began work on the OCWCS in the fall of 2003and completed their document in the summer of 2005. Additionally, the Planning Team met with and coordinated their work plan with Bob Anderson from the U.S. Fish and Wildlife Service's Region 2 Division of Federal Aid. An Advisory Group comprising representatives from 35 public agencies and organizations was convened to review and provide guidance during the development of the OCWCS. The Advisory Groups met in-person in January of 2004, and corresponded with the Planning Team via e-mail throughout the remainder of the project.

The Comprehensive Wildlife Conservation Strategy was developed with an understanding that it was to be Oklahoma's conservation strategy, not just a planning document for the ODWC. Therefore, the priorities identified in the OCWCS were meant to serve as broad guidance and to help focus the efforts of all conservation agencies and partners working in Oklahoma. The Planning Team chose an aggressive approach to public and stakeholder involvement based on the axiom of "early and often." This included offering opportunities for early and continual input through ODWC's website and in an early round of statewide internal and external public meetings in March of 2004. The ODWC publicized these meetings, and all other avenues for public input, through sequential news releases, the *Outdoor Oklahoma* magazine, direct mailings to Advisory Group members (they were asked to convey updates within their own organizations and through their publications), the ODWC's monthly employee newsletter (Wildlife-O-Gram), the ODWC website, the *Outdoor Oklahoma* television show, the *Wild Side* newsletter (reaching approximately 15,000 wildlife enthusiasts), a direct letter to Tribal leaders, and interviews with several radio and local television personalities.

The Planning Team decided not to create an official technical committee, but instead they invited nearly 400 technical experts to provide distribution and abundance information, and land management insights relevant to Oklahoma's species of greatest conservation need. The list of technical experts was developed from a variety of sources. Biology and zoology professors from every university in Oklahoma with experience in the fields of behavior, taxonomy, population management and ecology were contacted. As were biologists working for land and population management entities including the U.S. Fish and Wildlife Service, the U.S. National Forest Service, the Army Corps of Engineers, The Nature Conservancy, The Noble Foundation, Oklahoma State Parks, Oklahoma Biological Survey, Oklahoma Conservation Commission, and the ODWC. A specific effort was made to involve the natural resource and environmental program managers for each of the Native American tribes in Oklahoma.

After several rounds of review and revision, all available technical data regarding species, regions, habitats, population trends and habitat trends were compiled into a 99-page workbook that served as a handout for the "Oklahoma's Wildlife Future Conference" held on the campus of Oklahoma State University on July 13-14, 2004. Attendance was open to the general public and all of the more than 300 technical experts that had been contacted previously were invited. During the first day of the conference/workshop, the participants were divided into break-out groups based upon animal taxonomic groups - amphibians & reptiles, fish, birds, invertebrates and mammals. On the second day, participants were divided into break-out sessions based upon Oklahoma's six major ecological region groups - Shortgrass Prairie, Mixed-grass Prairie, Tallgrass Prairie, Cross Timbers, Ozark Highlands, and the Ouachita Mountains/West Gulf Coastal Plain. Three regional breakout sessions were held during the morning and the other three in the afternoon to allow each participant to provide input for two regions. Over the two days, the 110 conference participants resolved the remaining data discrepancies, but focused primarily on conservation issues, conservation actions, research and survey needs, monitoring mechanisms, and identifying potential partnerships that could be important for conservation implementation. This conference ended the intensive data-gathering phase of Oklahoma's CWCS development.

The writing phase began as soon as the conference adjourned, with the first draft of the Comprehensive Wildlife Conservation Strategy completed in September 2004. The Internet again proved highly useful in the several rounds of review and modifications, leading to a second round of internal (i.e., ODWC) and external (i.e., technical experts, specific interests, and other stakeholders) meetings in March 2005. The final version of the OCWCS was completed in July 2005 and submitted to the U.S. Fish and Wildlife Service in August of 2005.

Identifying and Ranking the Species of Greatest Conservation Need:

In cooperation with the Advisory Group and technical experts, ODWC staff developed a set of six selection criteria that were used to determine which species qualified for designation as an Oklahoma species of greatest conservation need. All vertebrate species and a subset of invertebrate species for which adequate status information existed, were evaluated using these six criteria. The list of selection criteria are shown below and in Appendix D.

1) Species that are listed as federal candidate, threatened or endangered species under the Endangered Species Act.
2) Species that are classified as state species of special concern, threatened, or endangered species (OAC Title 800).
3) Species that have been assigned global ranking scores of G1, G2 or G3 by the network of state Natural Heritage Inventory programs.
4) Species that have been identified as conservation priorities through a national, peer-reviewed status assessment, or assessment of a large taxonomic division. Examples of these include: assessments of freshwater fish, freshwater mussels and crayfish prepared by the American Fisheries Society, and bird conservation plans such as the national Partners In Flight Conservation Plan, the North American Waterfowl Conservation Plan and the U.S. Shorebird Conservation Plan.
5) Reptile, amphibian, fish and mussel species that are subject to commercial harvest in Oklahoma but are not eligible for funding under existing Federal Assistance Programs in order to monitor or periodically assess their status.
6) Species which are regionally endemic regardless of their conservation status.

Once selected, each species of greatest conservation need was then ranked according to five ranking criteria that were scored on a scale of 1 to 3 points each. These results are summarized in Appendix D and the ranking criteria were as follows:

1) the species' Natural Heritage Global score
2) the availability of other federal assistance funding for their management
3) the percentage of the species population or geographic range that lies within Oklahoma
4) the species' trend in population size or geographic range over the past 40 years
5) the availability of existing data to support the inclusion of the species as a species of greatest conservation need

Each species was assigned to one or more of the six ecological regions where a manageable population existed currently or could be restored. Next, each species was assigned to one or more habitat types within the region that represented the species primary habitat (i.e. the habitat type(s) in which management actions could be implemented most effectively.

Identifying priorities:

Conservation funding is not limitless and the total funding available for wildlife conservation has traditionally fallen far short of meeting existing needs. Even the level of funding provided by Congress through the State and Tribal Wildlife Grants program has never equaled the level at which the program was authorized. Because of these limitations, when fiscal and human resources are allocated to the implementation of the OCWCS, resources are available to address only a small percentage of the conservation issues facing species of greatest conservation need. Therefore, where feasible, general priorities were established so that resources could be allocated to first address the higher ranked species, habitats and issues.

All species of greatest conservation need were ranked and placed into three Tiers (priority levels) to identify those species requiring the most immediate attention. This scoring and ranking process is described above and in greater detail in Appendix D.

The six ecological regions were not prioritized because each is important in a unique way to the conservation of Oklahoma's wildlife heritage. However, the Conservation Landscapes (i.e. habitat types) within each region were prioritized using a simple system developed by a team of ODWC biologists and technical experts outside of the agency. Within each region, the Conservation Landscapes were ranked based upon four factors:

1) the uniqueness of each Conservation Landscape to that region,
2) the number of tier I species of greatest conservation need occurring within each Conservation Landscape,
3) the number of tier II species of greatest conservation need occurring within each Conservation Landscape, and
4) the number of tier I and tier II species of greatest conservation need that were unique or endemic to that Conservation Landscape.

Once evaluated, the Conservation Landscapes within each region were grouped into three categories of conservation priority:

1) very high,
2) high, and
3) moderate.

Conservation Landscapes were not ranked further within each of the three categories of conservation priority; therefore, the order in which Conservation Landscapes are listed within each priority category does not imply rank or importance.

The term "conservation issues," as it is used in the OCWCS, is the term used for the "conservation problems" identified by Congress (i.e., required element 3). As conservation issues were identified in each habitat type by the technical experts, they were placed into four to six broad categories with other similar issues (e.g. habitat loss and fragmentation; invasive exotic species, or altered patterns of flow and water quantity). These four to six broad categories were then prioritized based upon the number of species of greatest conservation need that were affected by each issue. The proposed conservation actions that were recommended to address or ameliorate each grouping of conservation issues were linked to and prioritized by default with their associated group of conservation issues. Because of the complexity and inter-relatedness of conservation issues and actions, we did not attempt to prioritize issues and actions within their broad categories. For example, some issues were additive while some conservation actions could be used to address two or more conservation issues simultaneously.

The types of activities that can be funded through the State and Tribal Wildlife Grants program (e.g. research, survey, monitoring, management) should first address the needs identified for the highest priority Conservation Landscapes (i.e., those listed first within each geographic region); and secondly, according to the species of greatest conservation need tier/score designations. Those species of greatest conservation need having a poorly known status and population trend are of particular priority for research and/or survey efforts.

<u>Identifying Conservation Partnerships</u>:

At the end of each regional chapter, potential conservation partners relevant to that region were identified. The challenges associated with conserving and improving the status of rare and declining species is a larger task than can be accomplished by one program or one agency. While the State and Tribal Wildlife Grants program is essential to the conservation of these species, in order to secure the human resources, habitat, and funding needed to address the wide-ranging issues that exist on the landscape, the ODWC must forge partnerships will other programs, agencies, organizations and private landowners.

The range of potential partnerships seems almost limitless. Because more than 95% of the land within Oklahoma is privately owned, individual landowners are important partners for conservation, enhancement and restoration of the habitats needed by species of greatest conservation need. Universities and non-governmental organizations possess much of the expertise and manpower to conduct biological surveys, research the ecological needs and limiting factors for species, and develop effective monitoring programs. Several effective multi-agency and multi-organization partnerships have formed within the past twenty years. Habitat-based avian joint ventures (JVs), including the Central Hardwoods JV, Oaks and Prairies JV, Lower Mississippi Valley JV and Playa Lakes JV, currently encompass the entire state and can assist with landscape-level planning, conservation delivery and resource monitoring. Similarly, the U.S. Fish and Wildlife Service recently established Landscape Conservation Cooperatives based on the same principles but addressing a larger geographic area and a broader range of natural resources.

The non-profit Oklahoma Wildlife and Prairie Heritage Alliance (OWPHA) is a successful melding of conservation, education, and outreach in northwestern Oklahoma. The founding of the Alliance was made possible by the federal Wildlife Conservation and Restoration Program, a pre-cursor to the State and Tribal Wildlife Grants program. The OWPHA encourages conservation of Oklahoma's wildlife and prairie heritage by increasing landowner awareness of existing incentives funding and technical assistance programs. The Alliance helps landowners obtain the resources needed to restore playa wetlands and shortgrass prairie habitat and also has helped develop a road-based, wildlife-viewing trail that is projected to increase region revenue by increasing domestic travel and nature-based tourism in western Oklahoma. The Alliance's outreach and education has been more wide-reaching and successful than anything that a single partner could have achieved alone.

Conducting the First Comprehensive Review and Revision of the Oklahoma Comprehensive Wildlife Conservation Strategy

This comprehensive review and revision of the OCWCS builds on the successes of the original version. Rather than start new and repeat the process from 2004 and 2005, the original version of the OCWCS was used as a template and modifications were incorporated based upon new information and input from technical experts and the public. The ODWC's Wildlife Diversity Program staff led the review and revision process with input from a range of partners as described below. While the formal revision and editing of the OCWCS didn't begin until 2012, the collection of new information began almost as soon as the original version was completed. Additionally, throughout the ten-year interval between the two OCWCS versions, attempts were made to raise awareness of the conservation plan and to incorporate relevant portions of it into the management plans of other natural resource agencies. As an example, the OCWCS was used by the U.S. Fish and Wildlife Service in the development of its Comprehensive Conservation Plans for national wildlife refuges in Oklahoma (e.g. Wichita Mountains Wildlife Refuge, Tishomingo NWR and Ozark Plateau NWR). Likewise, the Department of Defense incorporated aspects of the OCWCS into their Integrated Natural Resource Management Plans (e.g. Tinker AFB, Camp Gruber, and McAlester Army Ammunition Plant). Joint Ventures also incorporated OCWCS information and recommendations into their conservation planning and modeling efforts (e.g. Oaks and Prairies JV Grassland Conservation Plan, Central Hardwoods JV Oak Woodland Restoration Plan, and Lower Mississippi Valley JV Open Pine Woodland Assessment). Information from the OCWCS also was used to develop successful projects for the USDA's CRP-State Acres For Wildlife program and the Healthy Forest Reserve Program. Each time that a conservation partner used the OCWCS, it opened a dialog with the ODWC Wildlife Diversity Program staff through which feedback was obtained regarding the strengths and shortcomings of the OCWCS.

Throughout the review and revision process, the primary focus was placed on communication with and soliciting input from stakeholders and technical experts in the disciplines of biology and natural resource management. The first formal stakeholder meeting was held in January of 2010 when nearly 80 biologists from universities and conservation organizations were invited to provide comments on modifications to the OCWCS and to share their ideas about the activities that should be priorities for the State and Tribal Wildlife Grants program in Oklahoma. Following this meeting, individual meetings were held with our long-term partners to solicit their suggestions for improving the OCWCS. One to three meetings were held with staff representing the following: Oklahoma Biological Survey and Oklahoma Natural Heritage Inventory, Tulsa Field Office of the U.S. Fish and Wildlife Service, The Nature Conservancy, Sutton Avian Research Center, Ouachita National Forest, Oklahoma Conservation Commission and Oklahoma Department of Transportation. In-reach meetings were conducted with other programs within the ODWC including, its private lands, streams, fisheries research, game management, and aquatic nuisance species program, as well as staff at individual wildlife management areas, each of whom provided information specific to their areas of expertise. Additionally, presentations/updates were presented at agency division meetings. Presentations about the OCWCS and its revision were presented at meetings of the Oklahoma Ornithological Society (2012), Ozark Summit (2012), and Oklahoma Clean Lakes and Watershed Association (2014). Via these meetings, we reached stakeholders in the birding community, academia (e.g. USGS, museums and universities) , water management agencies (ODEQ, OWRB, OCC), local water management programs (e.g. municipalities and Native American tribes), and land management agencies (e.g. USFWS, BLM, Oklahoma State Parks, Oklahoma Forestry Division).

With this input in-hand, the Wildlife Diversity Program staff then reviewed every table and every line of text in the strategic plan and incorporated comments throughout. Specifically, the following changes were made:

- the list of species of greatest conservation need was reviewed and 67 new species (primarily invertebrates) were added, while seven species were removed
- modifications were made to the ranking system for species and all species were re-evaluated
- narrative status descriptions were prepared for each species
- habitat description was reviewed and revised as needed; where appropriate, some similar habitat sections were combined to reduce duplication
- a new Large Rivers chapter was created to give greater emphasis on the species that are dependent upon these aquatic systems that cross the boundaries of the traditional terrestrial communities
- habitat types were re-evaluated and their rankings changed as needed
- blocks of conservation issues within each habitat section were prioritized
- the tables of species of greatest conservation need in each habitat section were reviewed to fix errors of omission and to remove those species for whom that habitat type was not one of their primary habitats
- a climate change adaptation section was added
- all conservation issues were re-evaluated and re-written, where necessary, to provide greater clarity
- all of the recommended conservation actions were re-evaluated and re-written to provide specific guidance to the greatest extent possible
- new conservation issues (emerging issues) were incorporated into each chapter

An eleven-member Internal Review Team was created with representatives from three ODWC Divisions (Wildlife, Fisheries and Information & Education) and multiple programs. This team conducted an initial review and edited each chapter before it was released for technical review.

Three hundred and sixteen (316) people were invited to review the first draft of the revised OCWC as technical reviewers. These technical reviewers included zoologists, biologists and ecologists from every university in the state and represented expertise with every vertebrate and invertebrate group that is regularly studied within Oklahoma. Other technical reviewers included biologists with each state and federal land management and water management agency in Oklahoma, biologists with conservation organizations (e.g. The Nature Conservancy and the Noble Foundation), biologists with the habitat Joint Ventures and the Landscape Conservation Cooperatives that operate in Oklahoma, and representatives from the environmental and/or natural resources programs from twenty-two of Oklahoma's Native American tribes. The draft OCWCS was sent to the technical reviewers in three separate segments, each of which was comprised of three to four chapters or appendices. The technical reviewers were provided with Word files for each chapter and appendix so that they could easily edit these files and return them with their comments.

When the technical review was nearly complete, the updated draft of the OCWCS was released for public review. A news release was prepared with a link to a .pdf file of the OCWCS. This was sent to every newspaper, television station and radio station on the ODWC's news release list. Additionally, nearly 70,000 Oklahomans receive ODWC's electronic news releases and they too were sent the news release and a link to a .pdf file of the OCWCS to review. The Wildlife Diversity Program also has a monthly electronic newsletter with over 7,000 subscribers that we consider to be important stakeholders because they have demonstrated a continued interest in nongame wildlife conservation. The news release and draft OCWCS was sent to these stakeholders as well. During the public review period, ODWC continued to solicit and accept comments from the technical reviewers.

Adaptive Management and Monitoring:

Adaptive Management:

Adaptive management has been used by conservation planners and natural resource managers for decades. Adaptive management involves four essential pieces: (1) developing plans, (2) implementing those plans, (3) monitoring the effects of management actions, and (4) adjusting future plans. This approach is being applied to the Oklahoma Comprehensive Wildlife Conservation Strategy in that it is periodically evaluated in its entirety and the information gained between reviews, including the data collected through projects that are funded by the State and Tribal Wildlife Grants program, is used to re-evaluate species, habitats, issues and actions.

Monitoring:

Potential monitoring approaches are identified for conservation actions within each Conservation Landscape. Monitoring is crucial to employing adaptive management approaches and assuring that conservation actions are producing the desired results.

Because of limited funding and the potential costs involved with monitoring every species and conservation action proposed within the OCWCS, monitoring efforts are necessarily somewhat limited. Work with other partners and within existing monitoring programs will continue to the greatest extent possible. Examples of existing monitoring programs include the multi-species bird monitoring approach of the national Breeding Bird Survey, the forest acreage and condition monitoring accomplished through the national Forest Inventory and Analysis program, and the multi-species fish community assessments conducted by the Oklahoma Conservation Commission, Oklahoma Department of Environmental Quality and the Oklahoma Water Resources Board. Monitoring programs and periodic status assessments for representative species of greatest conservation need such as those that have been developed for the Swift Fox, Black-tailed Prairie Dog, Leopard Darter and Arkansas Darter will continue to be supported. Because many of Oklahoma's species of greatest conservation need are rare, secretive and/or difficult to detect through field surveys, the use of habitat monitoring as an indirect approach for monitoring suites of associated species will continue to be explored. For example, it may be feasible to use remote imagery to periodically measure changes in the acreage and distribution of habitats across a region or statewide. Finally, monitoring will be used to determine whether the conservation actions that are funded through the State and Tribal Wildlife Grants program are adequately ameliorating conservation issues. When the level of conservation success is not what was anticipated, monitoring will allow these actions to be altered and developed into new actions that can be implemented – the “adaptive” part of adaptive management.

Strategy Review and Revision:

The Comprehensive Wildlife Conservation Strategy, as with any planning document, requires periodic review and revision (i.e., updating). Over time, new information will become available, implemented actions will resolve issues, and new situations or circumstances will occur that were unforeseen when the Comprehensive Wildlife Conservation Strategy was first developed. As a regular part of the ODWC's operations, information will be accumulated that are relevant to the Comprehensive Wildlife Conservation Strategy's elements for such things as statuses and trends of species of greatest conservation need and changes in the distribution, abundance and condition of conservation landscapes.

Communication and coordination will continue with the conservation partners that were involved in preparation of each version of the Comprehensive Wildlife Conservation Strategy. This will help track progress and identify new or changing circumstances and situations. We anticipate that many of these conservation partners will contribute information that they gain through their normal operations, and this will be incorporated into each subsequent review and revision of the OCWCS.

It most cases, several years of actions may be needed before noticeable conservation progress can be demonstrated. This time lag between the planning and implementation of conservation strategies, and the responses of natural systems will influence Oklahoma’s schedule for review and revision of its CWCS. However, at a seven to ten-year interval, the OCWCS will be thoroughly and completely reviewed and portions of it will be revised as needed. This will include something considerably less than the levels of effort put into the initial Comprehensive Wildlife Conservation Strategy development and its first revision, but it will involve all conservation partners and will continue to address all eight of the required elements. Additionally, as new conservation partners are identified, they will be integrated into the review and revision process.

Climate Change Adaptation

In response to climate change legislation that was passed by the U.S. House of Representatives in 2009, states are required to incorporate climate change adaption strategies into their comprehensive wildlife conservation strategies). There is nearly universal agreement that the Earth's climate is in a constant state of change; most of the disagreements are based on different interpretations of the rate and causes of climate change. This section of the OCWCS discusses climate change and the strategies that will help wildlife, and the habitats on which they depend, adapt to changing conditions. The on-going discussion of climate change is an opportunity to consider long-range conservation planning. Traditionally, wildlife management plans have looked at 10-year, 25-year and occasionally 50-year time periods; however, it is increasingly important to consider planning in temporal scales that are measured in centuries rather than years.

The study of climate change is a relatively young discipline although the intensity of climate research has escalated rapidly during the past twenty years. Model-based climate change predictions are variable, but several widespread themes have emerged. Earth's climate has been in experiencing a warming trend for many decades. As this trend continues, Oklahoma is likely to experience higher daytime high temperatures and higher night-time low temperatures, although the magnitude of this change is unlikely to be as large as that experienced by more northerly states. Rainfall patterns are more difficult to predict, but Oklahoma is likely to experience drier conditions over time and more frequent periods of drought. It is likely that seasonal rainfall patterns may change with increased winter precipitation and decreased summer precipitation. The degree of seasonal precipitation change will be influenced by the position of the Jet Stream; if the Jet Stream shifts northward as predicted, then we will have fewer opportunities for rainfall events. Over time, more winter-time precipitation is likely to fall as rain or ice and less of it will fall as snow. Some species may expand or contract their geographic ranges northward in response to temperature shifts and/or eastward in response to rainfall shifts. These changes are likely to have a disproportionally negative effect on aquatic and forest habitats, but may have beneficial effects on grasslands, shrublands and woodland communities. The magnitude of these changes and the speed at which they may occur are debatable but should become clearer over time. This uncertainty underscores the importance and need for monitoring programs that measure changes in habitat conditions, climate variables (e.g. rainfall, daytime and night-time high temperatures) and the population responses of plants and animals over time. In addition to potential geographic shifts in the distribution of species, biologists are monitoring the potential for temporal shifts in plant and animal activity. For example, warmer spring temperatures and wetter winter conditions may trigger earlier flowering or leaf-out by plants; early emergences by insects, amphibians and reptiles; prolonged growing seasons for some plants; longer activity periods for some insects, and altered spawning times for fish. Because the reproductive timing of many wildlife species is dependent upon seasonal peaks in the availability of key food resources (e.g. insects, seeds, juvenile fish), some species may experience declines if they are not able to adapt to the temporal shifts of their prey or food base.

Climate change adaptation has been defined in the 2000 report of the Intergovernmental Panel on Climate Change as "adjustment in natural systems in response to actual or expected climatic stimuli, or their effects, which moderates harm or exploits beneficial opportunities." The concept of adjusting natural systems to moderate the harmful effects of changing conditions and to exploit the beneficial opportunities is a fundamental principal that applies to all long-term conservation planning. Many of our commonly-implemented, short-term conservation actions can be strategically modified, coordinated, and expanded to address the long-term challenges brought about by changes in climate, human population growth, development pressure or land use practices. In the foreseeable future, increased development pressure brought about by an expanding human population are as likely to affect Oklahoma's species of greatest conservation need as changes in climate.

Facilitating the successful adaptation of natural systems (e.g. animal species, aquatic communities and plant communities) to climate change will require multiple, concurrent strategies. As managers of fish, wildlife and habitat, particular attention must be focused on the actions that improve the resistance, resilience and adaptability of these natural systems in the face of changing environmental conditions. In the context of climate changes, resistance is the ability of a species or community to withstand the negative effects of change. Often, this involves growing or maintaining large population sizes or large tracts of contiguous or connected habitat/plant communities that provide a buffer or cushion against potential losses that may result from change. Resilience is the ability of a population or a community, or an ecological process, to recover or maintain a new stable state after disturbance. Often, this involves actions that increase structural diversity in a system or genetic diversity within a population. Adaptability contains elements of resilience, but also includes the ability of species to change genetically, temporally, spatially or behaviorally in response to environmental change. Adaptability from a community perspective is the ability to change its species composition as well as the inter-related interactions of its species. The following actions can be taken to help species and their habitats adapt to changing climate through a combination of resistance, resilience and adaptability.

- *Expand the size of habitat tracts*: Larger tracts of habitat can support larger populations of plants and animals and can act as refugia. Larger populations are often more robust and better able to resist the negative effects of population isolation, fluctuations in reproductive success due to climate variables and competition from invading species. Larger tracts of habitat typically have a smaller proportion of edge conditions and this buffers them against potential negative influences of climate change and changes in surrounding land-uses. Larger habitat tracts are likely to contain greater microhabitat variability and are thus better able to sustain a wider diversity of native species.
    - Conservation of habitat tracts can be accomplished through fee-title acquisition from willing sellers or through the purchase of conservation easements. Fee-title acquisition provides longer term conservation, but conservation easements are less expensive, can be extended or allowed to lapse as conditions change. Additionally, they serve to keep land in private ownership.

- *Increase habitat connectivity*: Greater connectivity between tracts of habitat increases dispersal of both plant and animal species and connects neighboring populations in a metapopulation fashion. Connectivity reduces the isolation of populations and helps to maintain the genetic diversity that helps populations adapt to change. Habitat connectivity also assists in movement of populations across the landscape and allows them to track changes and shift their range.
    - Connectivity can be accomplished by conserving tracts of similar habitat in close proximity, developing corridors of habitat between larger tracts, or connecting ecologically compatible tracts of habitat (e.g. connecting upland deciduous forest with bands of riparian forest).

- *Maintain natural processes such as fire*: Develop prescribed burning plans that help maintain habitats in their natural condition, reduce excessive fuel loads and make habitats more resistant to catastrophic wild fire that can dramatically alter habitat conditions and community composition.

- *Manage invasive exotic species*: In both aquatic and terrestrial habitats, exotic plant species that have invasive tendencies can make habitats more homogeneous and reduce diversity. A reduction in species diversity can decrease the resilience and adaptability of communities and habitat. Invasive animals (e.g. exotic fish and insects) and exotic pathogens (e.g. fungi and viruses) can compete with, depredate or reduce the longevity and reproductive success of native species. Management of invasive, exotic species has multiple components:
    - Educate landowners and the public about the identification of invasive species and the negative ecological consequences of invasive species establishment.
    - Develop BMPs or regulations to limit the spread of invasive species (e.g. transporting invasive plant seeds on equipment, bait-bucket introductions, and transporting seeds or organisms in soil, hay or fire wood).
    - Use only native plants when conducting revegetation of disturbed sites to resist establishment of invasive plant species.
    - Develop surveillance and monitoring programs for the early detection of invasive species
    - Conduct research into the development of effective control and eradication methods that are ecologically safe.
    - Fund and implement control and eradication programs on a regional basis.

- Conduct follow-up monitoring to measure the success of control and eradication efforts.

- *Maintain habitats in a diversity of structural conditions*: Manage forests to have a diversity of age classes and plant species within stands to increase adaptability. Manage grasslands and shrublands in a mosaic of structural conditions to enhance diversity and adaptability.

- *Monitor populations and habitats*: Develop monitoring programs for rare species and species that are representative of specific communities and habitat conditions in order to document changes in population size or geographic range in response to changes in climate variables. Monitor habitat conditions and community diversity to detect changes in response to climate variables.
    - Where feasible, build on existing monitoring programs such as the USGS Breeding Bird Survey or the USDA Forest Inventory Assessment.

- *Focus on areas with a high degree of topographic relief*: Mountainous areas tend to be more resilient to climate changes because their varied topographic relief can support many microhabitat conditions and an elevational gradient that facilitates the easy movement of plants and animals upward or downward in response to changes in temperature or rainfall. Mountainous areas are often higher in biological diversity than surrounding areas and are more likely to support endemic species. Habitat conservation should include a focus on areas such as the Ouachita, Boston and Wichita mountains, the Arbuckle and Ozark plateaus and Black Mesa.

- *Conserve riparian forests and flood plain habitats*: Aquatic communities are likely to be more negatively affected by changes in climate than many terrestrial communities. Restoring, enhancing, and conserving existing riparian forests and other native flood plain habitats will help to shade streams, protect flood plain wetlands and areas for groundwater recharge from development, maintain natural stream bank stability and provide dispersal and movement corridors for aquatic and terrestrial species. Streams and riparian communities often harbor high plant and animal diversity, but are vulnerable to invasive species.
    - Focus on cold-water aquatic communities: . Cold-water aquatic communities such as those found in the Ozark Highlands are especially vulnerable to change. Measures to conserve cold-water communities include: identifying stream reaches with species of greatest conservation need, high species diversity and high vulnerability to climate change. Restore and conserve riparian forests and limit groundwater withdrawal to maintain cold water in-flows from springs and seeps.

- *Increase in-stream connectivity*: Remove barriers to the in-stream movement of fish and aquatic invertebrates in order to maintain dispersal and seasonal movements. Structures such as box culverts, low-water crossings and dams can block the movement of aquatic species and isolate upstream populations. These barriers can reduce gene flow and population sizes thus decreasing adaptability and resilience at the population and community levels. Barriers can also prevent movement into or out of stream reaches in response to changing conditions of temperature and flow.
    - Where barriers to fish movement cannot be removed (e.g. dams of municipal water supply lakes), research and implement strategies that mimic historic gene flow within and between streams such as the periodic translocation of disease-free individuals, or the construction of fish passage structures such as fish ladders.

- *Develop research partnerships*: Partner with federal agencies, research organizations, the USFWS Landscape Conservation Cooperatives, the USGS Climate Science Centers and other interested parties to:
    - collect climate data in order to gain a more complete understanding of and to more accurately predict the effects of climate change.
    - downscale national climate models to the state or regional level
    - assess the vulnerability of each ecological region and important habitat type to climate changes

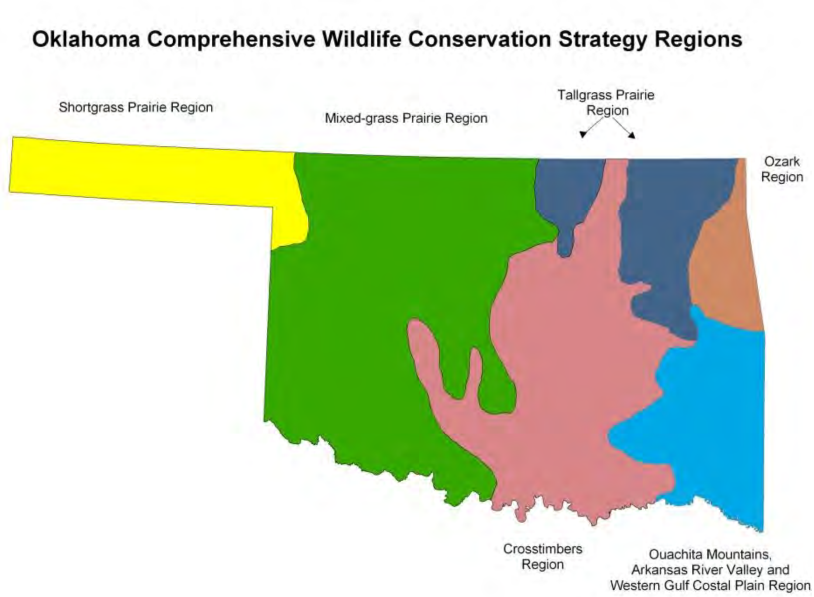
- assess the vulnerability of watersheds that support species of greatest conservation need to climate changes

State Overview and Ecological Framework

Oklahoma is a very diverse state, both geologically and ecologically. It stands on the western edge of the great deciduous forest of the eastern United States, and the Great Plains and Black Mesa on the west, with the flint hills on the north, and the Texas High Plains and Coastal Plain on the south. Because of this ecological and geological diversity, it supports rich plant and animal communities.

These communities have been characterize by two academic models that have been tested for 20 years. Each has its draw-backs and its advantages. They have been used by the U.S. Department of Agriculture Forest Service, U.S. Environmental Protection Agency, The Nature Conservancy, and the National Audubon Society. The ODWC has adapted these to fit its specific needs and their reconciliation of these models was use in the Oklahoma Comprehensive Wildlife Conservation Strategy. The regions used to organize the OCWCS are intended to be compatible with Omernick's Ecoregional framework used by the Environmental Protection Agency and its partners, as well as Bailey's Ecological Region hierarchy used by the U.S. Department of Agriculture and its partners. Both of these are hierarchical classification systems that are based on a combination of climate, soils, and dominant vegetation.

Shortgrass Prairie/High Plains Region: This region is comprised by the Western High Plans and Black Mesa and is essentially the panhandle of Oklahoma. It includes Cimarron, Texas, Beaver, and portions of Harper and Ellis counties.



Mixed-grass Prairie Region: This region is known also as the Central Great Plains or Central Mixed-grass Prairie. In Oklahoma, this region comprises all or portions of Harper, Ellis, Woods, Woodward, Major, Alfalfa, Grant, Kay, Noble, Logan, Garfield, Kingfisher, Canadian, Blaine, Dewey, Custer, Washita, Roger Mills, Beckham, Harmon, Greer, Jackson, Kiowa, Tillman, Caddo, Comanche, Cotton, Stephens, and Jefferson counties.

Crosstimbers Region: This ecological region is generally the central one-third of Oklahoma and is comprised of oak woodlands and prairies. All or portions of the following counties are part of Cross Timbers ecological region: Kay, Noble, Pawnee, Payne, Logan, Lincoln, Oklahoma, Cleveland, McClain, Grady, Caddo, Stephens, Jefferson, Garvin, Murray, Carter, Love, Marshall, Johnston, Pontotoc, Coal, Atoka, Bryan, Choctaw, Pittsburg, McIntosh, Hughes, Seminole, Pottawatomie, Okfuskee, Creek, Okmulgee, Tulsa, and Osage.

Tallgrass Prairie Region: This region is comprised of the Flint Hills and the Osage Plain ecological regions. Its counties are: Osage, Kay, Pawnee, Washington, Nowata, Rogers, Wagoner, Tulsa, Okmulgee, Muskogee, Mayes, Craig, and Ottawa.

Ozark Region: The Ozark region is comprised of the Ozark Highlands and the Boston Mountains ecological regions. The counties that comprise this region are Ottawa, Delaware, Mayes, Cherokee, Adair, and Sequoyah.

Ouachita Mountains/West Gulf Coastal Plain Region: This is diverse and complex region that is comprised by the combining of three similar ecological regions – the Ouachita Mountains, Arkansas Valley and the West Gulf Coastal Plain. Each of these regions is largely dominated by pine communities – Loblolly Pine in the low-elevation West Gulf Coastal Plain and Shortleaf Pine throughout the rest of the region. The counties within this region include Sequoyah, Haskell, Leflore, Latimer, Pittsburg, Atoka, Pushmataha, Choctaw, and McCurtain.

Appendix B entitled, *Maps used in the Development of the Oklahoma Comprehensive Wildlife Conservation Strategy*, include the following:

- CWCS Regions Compared to Duck and Fletcher Game Types
- CWCS Regions Compared to Soil Class
- CWCS Regions Compared to Soils
- Central Mixed-grass Prairie Ecoregion Assessment by The Nature Conservancy
- Ouachita Mountains and Upper West Gulf Coastal Plain Ecoregional Assessment by The Nature Conservancy
- Osage Plains/Flint Hills Prairie Ecoregion Assessment by The Nature Conservancy
- Ozark Ecoregion Assessment by The Nature Conservancy
- Southern Shortgrass Prairie Ecoregional Assessment by The Nature Conservancy
- Central Shortgrass Prairie Ecoregional Assessment by The Nature Conservancy

Table 1. Oklahoma's Species of Greatest Conservation Need Cross-referenced by Region.

Common Name	Group	Cross Timbers	Large Rivers	Mixed-grass Prairie	Ouachita Mountains WGCP	Ozarks	Shortgrass Prairie	Tallgrass Prairie
Crawfish Frog	Amphibian	X			X	X		X
Four-toed Salamander	Amphibian				X			
Grotto Salamander	Amphibian					X		
Hurter's Spadefoot	Amphibian	X			X			
Kiamichi Slimy Salamander	Amphibian				X			
Many-ribbed Salamander	Amphibian				X			
Mole Salamander	Amphibian				X			
Oklahoma Salamander	Amphibian					X		
Ouachita Dusky Salamander	Amphibian				X			
Ozark Salamander	Amphibian					X		
Rich Mountain Salamander	Amphibian				X			
Ringed Salamander	Amphibian				X	X		
Sequoyah Slimy Salamander	Amphibian				X			
Southern Red-backed Salamander	Amphibian				X			
Texas Toad	Amphibian			X				
Three-toed Amphiuma	Amphibian				X			
Western Bird-voiced Treefrog	Amphibian				X			
Western Lesser Siren	Amphibian	X			X			
American Golden Plover	Bird	X	X	X	X	X	X	X
American Woodcock	Bird			X	X	X		X
Bachman's Sparrow	Bird	X			X	X		X
Baird's Sparrow	Bird			X			X	
Bald Eagle	Bird	X	X	X	X	X	X	X
Barn Owl	Bird	X		X	X		X	X
Bell's Vireo	Bird	X	X	X	X	X	X	X
Black Rail	Bird	X	X	X	X		X	
Black-capped Vireo	Bird	X		X				
Blue-winged Warbler	Bird					X		

Common Name	Group	Cross Timbers	Large Rivers	Mixed-grass Prairie	Ouachita Mountains WGCP	Ozarks	Shortgrass Prairie	Tallgrass Prairie
Brown-headed Nuthatch	Bird				X	X		
Buff-breasted Sandpiper	Bird	X	X	X	X			X
Bullock's Oriole	Bird			X			X	
Burrowing Owl	Bird			X			X	
Canvasback	Bird	X	X	X	X	X	X	X
Cassin's Sparrow	Bird			X			X	
Cerulean Warbler	Bird				X	X		
Chestnut-collared Longspur	Bird	X		X			X	
Ferruginous Hawk	Bird			X			X	
Golden Eagle	Bird			X			X	
Golden-fronted Woodpecker	Bird			X				
Greater Prairie Chicken	Bird	X						X
Harris's Sparrow	Bird	X		X	X	X	X	X
Henslow's Sparrow	Bird	X			X	X		X
Hooded Warbler	Bird	X			X	X		
Hudsonian Godwit	Bird	X	X	X	X			X
Interior Least Tern	Bird	X	X	X	X			X
Juniper Titmouse	Bird						X	
Kentucky Warbler	Bird	X			X	X		X
King Rail	Bird	X	X	X	X			X
LeConte's Sparrow	Bird	X		X	X	X	X	X
Lesser Prairie-Chicken	Bird			X			X	
Lesser Scaup	Bird	X	X	X	X	X	X	X
Little Blue Heron	Bird	X	X	X	X	X	X	X
Loggerhead Shrike	Bird	X		X	X	X	X	X
Long-billed Curlew	Bird	X	X	X			X	
Louisiana Waterthrush	Bird	X		X	X	X		X
McCown's Longspur	Bird			X			X	
Mountain Plover	Bird						X	
Nelson's Sharp-tailed Sparrow	Bird	X			X	X		X
Northern Bobwhite	Bird	X		X	X	X	X	X
Northern Pintail	Bird	X	X	X	X	X	X	X
Painted Bunting	Bird	X		X	X	X	X	X

Common Name	Group	Cross Timbers	Large Rivers	Mixed-grass Prairie	Ouachita Mountains WGCP	Ozarks	Shortgrass Prairie	Tallgrass Prairie
Peregrine Falcon	Bird	X	X	X	X		X	X
Pinyon Jay	Bird						X	
Piping Plover	Bird	X	X	X	X			X
Prairie Falcon	Bird	X		X			X	X
Prairie Warbler	Bird				X	X		
Prothonotary Warbler	Bird	X		X	X	X		X
Red-cockaded Woodpecker	Bird				X			
Red-headed Woodpecker	Bird	X		X	X	X	X	X
Rusty Blackbird	Bird	X			X	X		X
Scaled Quail	Bird			X			X	
Short-eared Owl	Bird	X		X		X	X	X
Smith's Longspur	Bird	X		X	X	X		X
Snowy Egret	Bird	X	X	X	X	X		X
Snowy Plover	Bird		X	X				
Solitary Sandpiper	Bird	X	X	X	X	X	X	X
Sprague's Pipit	Bird	X		X	X		X	X
Swainson's Hawk	Bird	X		X			X	X
Swainson's Warbler	Bird				X			
Swallow-tailed Kite	Bird				X			
Trumpeter Swan	Bird	X	X	X	X	X	X	X
Upland Sandpiper	Bird	X	X	X	X	X	X	X
Western Sandpiper	Bird	X	X	X	X		X	X
Whip-poor-will	Bird				X	X		
Whooping Crane	Bird	X	X	X			X	
Willow Flycatcher	Bird				X	X		X
Wilson's Phalarope	Bird	X	X	X	X		X	X
Wood Stork	Bird		X		X			
Wood Thrush	Bird	X			X	X		X
Worm-eating Warbler	Bird				X	X		
Yellow Rail	Bird	X			X	X		X
Alabama Shad	Fish		X		X	X		
Alligator Gar	Fish	X	X		X			
American Eel	Fish		X		X			X
Arkansas Darter	Fish		X	X		X	X	X
Arkansas River Shiner	Fish		X					

Common Name	Group	Cross Timbers	Large Rivers	Mixed-grass Prairie	Ouachita Mountains WGCP	Ozarks	Shortgrass Prairie	Tallgrass Prairie
Black Buffalo	Fish		X		X			X
Blackside Darter	Fish				X	X		
Blackspot Shiner	Fish	X			X			
Blue Sucker	Fish	X	X		X	X		
Bluehead Shiner	Fish				X			
Bluntface Shiner	Fish	X	X			X		X
Brown Bullhead	Fish				X			
Cardinal Shiner	Fish					X		X
Chub Shiner	Fish		X		X			
Creole Darter	Fish							
Crystal Darter	Fish	X			X			
Cypress Minnow	Fish				X			
Flathead Chub	Fish		X					
Goldstripe Darter	Fish				X			
Harlequin Darter	Fish				X			
Ironcolor Shiner	Fish				X			
Kiamichi Shiner	Fish	X			X			X
Least Darter	Fish	X				X		
Leopard Darter	Fish				X			
Longnose Darter	Fish				X	X		
Mooneye	Fish				X			
Mountain Madtom	Fish				X			
Neosho Madtom	Fish		X					
Orangebelly Darter	Fish	X			X			
Ouachita Mountain Shiner	Fish				X			
Ozark Cavefish	Fish					X		
Ozark Minnow	Fish					X		
Paddlefish	Fish	X	X			X		X
Pallid Shiner	Fish	X	X		X			
Peppered Shiner	Fish				X			
Plains Minnow	Fish	X	X	X	X		X	X
Plains Topminnow	Fish					X		
Prairie Speckled Chub	Fish		X	X				
Red River Pupfish	Fish	X	X	X				
Red River Shiner	Fish	X	X	X				
Redfin Darter	Fish				X	X		X

Common Name	Group	Cross Timbers	Large Rivers	Mixed-grass Prairie	Ouachita Mountains WGCP	Ozarks	Shortgrass Prairie	Tallgrass Prairie
Redspot Chub	Fish	X				X		
Redspot Darter	Fish				X			
River Darter	Fish		X			X		
Rocky Shiner	Fish	X			X			
Scaly Sand Darter	Fish		X		X			
Shorthead Redhorse	Fish		X			X		
Shovelnose Sturgeon	Fish		X					X
Silverband Shiner	Fish		X					
Southern Brook Lamprey	Fish					X		
Spotfin Shiner	Fish					X		
Sunburst (Stippled) Darter	Fish					X		
Taillight Shiner	Fish				X			
Wedgespot Shiner	Fish					X		
Western Sand Darter	Fish	X	X		X			
Crosstimbers Coil	Inve - Gastropod		X					
Lidded Oval	Inve - Gastropod				X			
Oklahoma Liptooth Snail	Inve - Gastropod					X		
Ouachita Mantleslug	Inve - Gastropod				X			
Ouachita Slitmouth Snail	Inve - Gastropod				X			
Ozark Mantleslug	Inve - Gastropod					X		
Rich Mountain Slitmouth Snail	Inve - Gastropod				X			
Shadow Gloss Snail	Inve - Gastropod					X		X
Slope Ambersnail	Inve - Gastropod	X						X
Tulsa Whitelip Snail	Inve - Gastropod	X						X
Wax Coil Snail	Inve - Gastropod							X
Wichita Mountains Pillsnail	Inve - Gastropod			X				
Wyandotte Liptooth Snail	Inve - Gastropod	X				X		
Butterfly Mussel	Inve - Bivalve				X			X
Elktoe	Inve - Bivalve					X		
Little Spectaclecase	Inve - Bivalve	X			X			
Louisiana Fatmucket	Inve - Bivalve				X			

Common Name	Group	Cross Timbers	Large Rivers	Mixed-grass Prairie	Ouachita Mountains WGCP	Ozarks	Shortgrass Prairie	Tallgrass Prairie
Monkeyface Mussel	Inve - Bivalve	X	X					X
Neosho Mucket	Inve - Bivalve		X			X		X
Ouachita Creekshell	Inve - Bivalve				X			
Ouachita Kidneyshell	Inve - Bivalve	X			X	X		X
Ouachita Rock Pocketbook	Inve - Bivalve				X			
Ozark Pigtoe	Inve - Bivalve					X		
Plain Pocketbook	Inve - Bivalve	X	X		X	X		X
Purple Lilliput	Inve - Bivalve				X	X		
Pyramid Pigtoe	Inve - Bivalve				X			
Rabbitsfoot	Inve - Bivalve				X	X		X
Scaleshell	Inve - Bivalve				X			
Southern Hickorynut	Inve - Bivalve				X			
Texas Lilliput	Inve - Bivalve				X			
Wartyback Mussel	Inve - Bivalve	X						X
Washboard	Inve - Bivalve	X	X		X			X
Western Fanshell	Inve - Bivalve							X
Winged Mapleleaf	Inve - Bivalve				X			
Cave Harvestman	Inve - Arachnid					X		
Allocapnia jeanae (stonefly)	Inve - Insect							
American Bumble Bee	Inve - Insect	X		X				X
American Burying Beetle	Inve - Insect	X			X	X		X
Apobaetis futilis (mayfly)	Inver - Insect							
Arogos (Iowa) Skipper	Inver - Insect	X		X		X		X
Big Cedar Grasshopper	Inve - Insect				X			
Bleached Skimmer	Inve - Insect						X	
Byssus Skipper	Inve - Insect	X			X	X		X
Cherokee Needlefly	Inve - Insect				X			
Diana Fritillary	Inve - Insect				X	X		
Dotted Skipper	Inve - Insect	X						X
Ghost Tiger Beetle	Inve - Insect			X			X	
Hydroptila protera (microcaddisfly)	Inve - Insect	X						
Linda's Roadside Skipper	Inve - Insect					X		X

Common Name	Group	Cross Timbers	Large Rivers	Mixed-grass Prairie	Ouachita Mountains WGCP	Ozarks	Shortgrass Prairie	Tallgrass Prairie
Little Dubiraphian Riffle Beetle	Inve - Insect	X						
Loamy-ground Tiger Beetle	Inve - Insect							X
Mayatrichia ponta (microcaddisfly)	Inve - Insect	X						
Metrichia nigritta (spring caddisfly)	Inve - Insect	X						
Nixe flowersi (mayfly)	Inve - Insect					X		
Ochrotrichia weddleae (microcaddisfly)	Inve - Insect				X			
Oklahoma Clubtail	Inve - Insect	X			X	X		
Oklahoma Spur-throat Grasshopper	Inve - Insect				X			
Outis Skipper	Inve - Insect			X				
Ozark Clubtail	Inve - Insect				X	X		
Ozark Emerald	Inve - insect				X	X		
Prairie Mole Cricket	Inve - Insect	X		X		X		X
Pseudosinella dubia (cave springtail)	Inve - Insect							
Rattlesnake Master Borer Moth	Inve - Insect	X				X		
Regal Fritillary	Inve - Insect	X						
Shinnery Oak Buck Moth	Inve - Insect			X				
Southern Plains Bumble Bee	Inve - Insect	X		X				
Swift Tiger Beetle	Inve - Insect			X				
Three-tooth Trianodes Caddisfly	Inve - Insect				X			
Toothed Stonefly	Inve - Insect				X			
Tricorythodes curvatus(mayfly)	Inve - Insect					X		
Truncate Stonefly	Inve - Insect				X			
Trigenotyla blacki (cave obligate millipede)	Inve - Diploda					X		
Trigenotyla vaga	Inve - Diploda				X			
Americgoniscus centralis	Inve - Isopod	X			X			

Common Name	Group	Cross Timbers	Large Rivers	Mixed-grass Prairie	Ouachita Mountains WGCP	Ozarks	Shortgrass Prairie	Tallgrass Prairie
Caecidotea ancyla	Inve - Isopod					X		
Caecidotea acuticarpa	Inve - Isopod	X						
Caecidotea antricola	Inve - Isopod					X		
Caecidotea mackini	Inve - Isopod					X		
Caecidotea macropropoda	Inve - Isopod					X		
Caecidotea occulata	Inve - Isopod				X			
Caecidotea simulator	Inve - Isopod					X		
Caecidotea stiladactyla	Inve - Isopod					X		
Miktoniscus oklahomensis	Inve - Isopod	X						
Crangonyx forbesi	Inve - Amphipod					X		
Bowman's Cave Amphipod	Inve - Amphipod					X		
Kansas Well Amphipod	Inve - Amphipod					X		X
Oklahoma Cave Amphipod	Inve - Amphipod	X						
Ozark Cave Amphipod	Inve - Amphipod					X		
Delaware Co. Cave Crayfish	Inve - Crayfish					X		
Faxonella blairi	Inve - Crayfish				X			
Kiamichi Crayfish	Inve - Crayfish				X			
Oklahoma Cave Crayfish	Inve - Crayfish					X		
Orconectes difficilis	Inve - Crayfish	X			X			
Orconectes macurus	Inve - Crayfish					X		
Orconectes meeki	Inve - Crayfish					X		
Orconectes menae	Inve - Crayfish				X			
Orconectes nana	Inve - Crayfish					X		
Procambarus tenuis	Inve - Crayfish				X	X		
Oregon Fairy Shrimp	Inve - Brachipod						X	
Black-tailed Prairie Dog	Mammal		X				X	
Brazilian (Mexican) Free-tailed Bat	Mammal			X			X	
Colorado Chipmunk	Mammal							
Desert Shrew	Mammal			X			X	
Eastern Harvest Mouse	Mammal	X			X			X
Eastern Small-footed Bat	Mammal				X			

Common Name	Group	Cross Timbers	Large Rivers	Mixed-grass Prairie	Ouachita Mountains WGCP	Ozarks	Shortgrass Prairie	Tallgrass Prairie
Eastern Spotted Skunk	Mammal	X		X	X	X		X
Eastern White-throated Woodrat	Mammal						X	
Golden Mouse	Mammal				X			
Gray Bat	Mammal					X		
Hog-nosed Skunk	Mammal						X	
Indiana Bat	Mammal				X	X		
Long-tailed Weasel	Mammal	X		X		X	X	
Marsh Rice Rat	Mammal	X			X			
Meadow Jumping Mouse	Mammal	X						X
Mountain Lion	Mammal			X			X	
Northern Long-eared Bat	Mammal				X	X		X
Northern Rock Mouse	Mammal						X	
Ozark Big-eared Bat	Mammal					X		
Rafinesque's Big-eared Bat	Mammal				X			
Ringtail	Mammal	X		X			X	
Seminole Bat	Mammal				X			
Southeastern Bat	Mammal				X			
Swamp Rabbit	Mammal	X			X	X		X
Swift Fox	Mammal						X	
Texas Kangaroo Rat	Mammal			X				
Tri-colored Bat	Mammal	X		X	X	X		X
Western Big-eared Bat	Mammal			X			X	
White-ankled Mouse	Mammal	X						
Yellow-faced Pocket Gopher	Mammal						X	
Alligator Snapping Turtle	Reptile	X	X		X	X		X
American Alligator	Reptile		X		X			
Common Checkered Whiptail	Reptile						X	
Eastern River Cooter	Reptile	X	X		X	X		X
Gulf Crayfish Snake	Reptile				X			
Lesser Earless Lizard	Reptile			X			X	
Louisiana Milksnake	Reptile				X			

Common Name	Group	Cross Timbers	Large Rivers	Mixed-grass Prairie	Ouachita Mountains WGCP	Ozarks	Shortgrass Prairie	Tallgrass Prairie
Midland Smooth Softshell	Reptile	X	X	X	X			X
Mississippi Map Turtle	Reptile	X	X		X	X		X
Northern Map Turtle	Reptile					X		
Northern Scarletsnake	Reptile	X			X	X		
Ouachita Map Turtle	Reptile	X	X	X	X	X		X
Razor-backed Musk Turtle	Reptile	X			X			
Round-tailed Horned Lizard	Reptile						X	
Spiny Softshell Turtle	Reptile	X	X	X	X	X	X	X
Texas Gartersnake	Reptile	X		X			X	
Texas Horned Lizard	Reptile	X		X			X	X
Texas Long-nosed Snake	Reptile			X			X	
Western Chicken Turtle	Reptile	X			X			
Western Diamond-backed Rattlesnake	Reptile	X		X	X	X		
Western Massasauga	Reptile	X		X			X	X
Western Mudsnake	Reptile				X			

Large Rivers Ecological Region

For the purposes of the Oklahoma Comprehensive Wildlife Conservation Strategy, the Large Rivers Ecological Region consists of the rivers that transcend the traditional terrestrial ecological regions. These rivers typically exceed 150 miles in length, have very large and/or long drainage basins, well developed and wide flood plains, and often have dramatic seasonal variation in their flow rates with peak flows in the spring followed by extremely low flows in the late summer and early fall. Within the Large Rivers Ecological Region are several inter-related aquatic and terrestrial habitats that are treated collectively as one system. All of these habitats are influenced and dependent upon seasonal fluctuations in flow, periodic flooding and scouring. Therefore, many of them are spatially ephemeral and their distribution shifts over time. The aquatic habitat components of the Large River Ecological Region include the main channel, side channels, backwaters, shallow waters along the shoreline and over submerged sandbars, off-channel sloughs and shallow-water wetlands within the river flood plain. Terrestrial habitat components include shorelines, exposed sandbars, mudflats and ephemeral riparian communities along the shifting river banks such as willow thickets and sedge/rush associations. This mosaic of shifting habitats within the large river system supports a diversity of species of conservation interest including the federally endangered Interior Least Tern (*Sterna antillarum*) that requires sandbars for nesting; shorebirds and wading birds that depend upon mudflats and wetlands; Arkansas River Shiners (*Notropis girardi*) that occupy shallow, braided channels, and Alligator Gar (*Atractosteus spatula*) and Paddlefish (*Polyodon spathula*) that occupy deep channels and pools. Because of the dynamic nature of large river channel morphology, these rivers often have a low diversity and abundance of freshwater mussels despite their high diversity of fish. The downstream portion of the Arkansas River differs from the other large rivers in that it has been modified by a series of low dams to create the McClellan-Kerr Navigation Channel. These modifications have resulted in an increase in deep, slow-flowing water habitat and have altered the historic fluctuation in flow rates and the magnitude of flood events that has diminished the abundance and condition of ephemeral habitats such as sandbars. Additionally, the banks along this portion of the river are more stable and support mature riparian forests that are typically absent along the shifting and dynamic river channels upstream.

Oklahoma's large rivers are the Arkansas, Cimarron, North Canadian, Canadian, Washita, Red and Neosho/Grand rivers. The Neosho/Grand, Arkansas, Cimarron, North Canadian and Canadian rivers are all connected and form the Arkansas River system that drains approximately the northern 2/3 of Oklahoma as well as southwestern Missouri, the southern third of Kansas, southeastern Colorado, northeastern New Mexico and the northern half of the Texas panhandle. The Washita and Red rivers, as well as their tributaries, form the Red River system. The Red River system drains approximately the southern 1/3 of Oklahoma as well as a small part of northern Texas. Both the Arkansas River and Red River systems are each western tributaries of the Mississippi River and share many of the same fish and invertebrate species.

The Neosho/Grand River originates as the Neosho River in the tallgrass prairies of eastern Kansas and flows southward to its confluence with the Arkansas River east of Muskogee, Oklahoma. Within 25 miles of entering Oklahoma, the Neosho River joins with the Spring River and becomes the Grand River, hence the label Neosho/Grand River. This river's watershed drains the eastern part of Oklahoma's Tallgrass Prairie Region and the northern half of Oklahoma's Ozark Region in addition to portions of southwesterrn Missouri and southeastern Kansas. The river itself delineates the western boundary of the Ozark Region and the eastern boundary of the Tallgrass Prairie Region. Historically, the Neosho/Grand River was deep and swift-moving, but it has been modified by the construction of three reservoirs, Grand Lake, Hudson Reservoir and Fort Gibson Reservoir, which have inundated most of the river's length in Oklahoma. For the purposes of the OCWCS, we consider this large river's habitat to be comprised of the three impoundments, the remaining river channel that connects these and the seasonally flooded areas along the river and reservoirs.

The Cimarron, North Canadian and Canadian rivers are similar in that each river originates within the Rocky Mountains and flows from west to east through the High Plains and into the Crosstimbers region of Oklahoma. Each river has a long, narrow watershed that encompasses portions of three or more ecological regions (e.g. Shortgrass Prairie, Mixed-grass Prairie and Crosstimbers), and each is a tributary of the Arkansas River. These rivers have broad, sandy floodplains and much of their flow occurs below the surface in alluvial deposits. During the summer months, surface flow often ceases in the western-most (upstream) portions of each river, triggering downstream seasonal movements by many species of fish. Additionally, the upper reaches of the Cimarron and North Canadian rivers in the Oklahoma panhandle have only sporadic surface flow – most of their flow is subsurface. These rivers have varying degrees of shallow, braided channel structure, being particularly prominent in the Cimarron and Canadian rivers in the western half of the state. In all three rivers, the braided structure diminishes toward a single channel structure as these rivers flow east and their volume increases. These rivers share many of the same species of fish including, historically, the Arkansas River Shiner which has been extirpated across a large percentage of its range and now appears to be limited to the Canadian River. Each river has been modified to some extent by reservoir construction. The Cimarron has the fewest reservoirs, with only Keystone Reservoir impounding its confluence with the Arkansas River. The North Canadian River is impounded at Optima Reservoir in the Oklahoma panhandle, Canton Reservoir in west-central Oklahoma, Overholser Reservoir in Oklahoma City and Eufaula Reservoir that impounds its confluence with the Canadian River. The Canadian River is impounded near its headwaters to form Conchas Reservoir and Ute Reservoir in eastern New Mexico. It is impounded again in the Texas panhandle to form Meredith Reservoir. The river is free-flowing through most of Oklahoma until it reaches Eufaula Reservoir, which impounds it a few miles upstream from its confluence with the Arkansas River.

The Arkansas River is Oklahoma's largest river in terms of flow volume. It originates in the Rocky Mountains in southern Colorado and flows through the High Plains of eastern Colorado and western Kansas before entering Oklahoma near Ponca City. Within Oklahoma, the Arkansas River has been modified by the construction of Kaw Reservoir, Keystone Reservoir, the locks and dams of the McClellan-Kerr Navigation Channel and Kerr Reservoir. The Arkansas River receives flow from four large rivers, the Cimarron, North Canadian, Canadian and Neosho/Grand, as well as several small rivers including the Salt Fork, Chikaskia, Deep Fork, Verdigris and Illinois.

The Red River, which delineates the southern boundary for the Mixed-grass Prairie, Crosstimbers and Ouachita Mountains/West Gulf Coastal Plains regions, drains the southern third of Oklahoma. It receives flow from one other larger river, the Washita River, as well as several small rivers including the North Fork, Blue, Boggy and Kiamichi. The Red River system receives flow from several naturally occurring salt deposits and this increased salinity has facilitated the development of a distinctly different fish community that includes four endemic species - the Red River Shiner (*Notropis bairdi*), Red River Pupfish (*Cyprinodon rubrofluviatilis*), Prairie Speckled Chub (*Macrhybopsis australis*) and Chub Shiner (*Notropis potteri*). The Red River originates in the Texas Panhandle and, like the Cimarron and Canadian rivers, the upper reaches of the Red River have a shallow, braided channel morphology that transitions to a single channel as its base flow increases downstream. Additionally, surface flows cease in the upper reaches of the river during drought conditions. The river is impounded at Texoma Reservoir in the middle of its course through Oklahoma, and this lake creates a substantial barrier to the upstream movement of fish.

The Washita River has a long, narrow watershed that extends from the Texas panhandle through the southwestern and south-central portions of Oklahoma in the Mixed-grass Prairie and Crosstimbers regions. It is impounded by Foss Reservoir near its headwaters and by Lake Texoma at its confluence with the Red River. The Washita River is less saline than the Red River into which it flows.

As a general trend, water quality has been improving over the past half century in most of Oklahoma's large rivers, but water quantity has been in decline as a result of water diversions and withdrawals from impoundments on the rivers themselves and their tributaries. This is perhaps most pronounced in the North Canadian and Canadian Rivers where water is withdrawn from reservoirs for municipal use. Some habitat types within the Large River Ecological Region have diminished in abundance and quality as a result of changes in seasonal flow rates and changes in the magnitude of flood events. Those habitats most affected include the relatively disturbance-dependent habitats such as sand bars, mud flats and sloughs.

The species of greatest conservation need that occupy the Large River Ecological Region in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend is based upon an evaluation of the existing statewide or regional data covering the past 50 years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown, I = increasing and Ex = probably extirpated.

Group	Species of Greatest Conservation Need Common Name	Status within the State	Trend in Population Size or Range
Bird	American Golden Plover	common spring and fall migrant using mudflats and shorelines as stop over and feeding habitats across the main body of the state	S
Bird	Bald Eagle	year-round resident in the eastern half of the state and a winter resident in the western half; nests in mature trees along rivers and around reservoirs in eastern Oklahoma	I
Bird	Bell's Vireo	uncommon summer resident; nests in willow thickets in the riparian zone adjacent to the large rivers in central and western Oklahoma	D
Bird	Black Rail	Rare summer resident; is likely to breed in flood plain wetlands along the Cimarron River and other rivers in northwestern Oklahoma	U
Bird	Buff-breasted Sandpiper	Uncommon spring and fall migrant through the central third of Oklahoma; uses mudflats and wetlands as stopover habitats	U
Bird	Canvasback	uncommon winter resident statewide in sloughs and flood plain wetlands	S
Bird	Hudsonian Godwit	uncommon spring migrant through the eastern 3/4 of the state; uses shallow water, side channels & flood plain wetlands as foraging areas	U
Bird	Interior Least Tern	rare summer resident along the Arkansas, Cimarron, Canadian and Red rivers; nests locally in small colonies on islands and sandbars; federally listed as an endangered species	S
Bird	King Rail	rare summer resident that nests very locally in herbaceous wetlands and sloughs along river channels in central and eastern Oklahoma	U
Bird	Lesser Scaup	locally common winter resident in sloughs, reservoirs and flood plain wetlands	D
Bird	Little Blue Heron	locally common summer resident in the eastern 2/3 of the state; nests in colonies with other species of herons and egrets	U
Bird	Northern Pintail	common winter resident statewide; forages in shallow water in side channels and wetlands	D
Bird	Peregrine Falcon	rare spring and fall migrant throughout the state; most commonly seen around wetlands and mudflats where shorebirds, small waterfowl and other birds congregate	I
Bird	Piping Plover	rare spring and fall migrant that uses sandbars and mudflats statewide as feeding areas; federally listed as a threatened species	D
Bird	Snowy Egret	locally common summer resident in the vicinity of their nesting colonies in the main body of the state	U
Bird	Snowy Plover	rare and locally occurring on sand bars and scoured bends on the Cimarron, Canadian and Red rivers in central and western Oklahoma	U
Bird	Solitary Sandpiper	common spring and fall migrant statewide using shorelines and sloughs as feeding areas	S
Bird	Trumpeter Swan	rare winter resident using sloughs and wetlands in the northern half of the state	I

Group	Species of Greatest Conservation Need Common Name	Status within the State	Trend in Population Size or Range
Bird	Upland Sandpiper	common spring and fall migrant throughout the state; uses mudflats and wetlands as stopover habitats	I
Bird	Western Sandpiper	rare spring and fall migrant using mudflats and shorelines in the western 2/3 of the state	U
Bird	Whooping Crane	rare spring and fall migrant in the western half of the state using shallow river channels and sand bars as foraging and roosting areas; federally listed as an endangered species	I
Bird	Wilson's Phalarope	Common spring and fall migrant statewide using shallow water and wetlands as foraging areas	U
Bird	Wood Stork	rare; after the nesting season, birds wander north into southeastern Oklahoma during late summer; forage in sloughs and side channels	I
Fish	Alabama Shad	probably extirpated; historically migrated up the Red and Arkansas rivers in the summer to spawn in tributary streams and rivers	Ex
Fish	Alligator Gar	uncommon resident of the Red River in the eastern half of the state, and a rare resident of the eastern quarter of the Arkansas River	D
Fish	Arkansas Darter	locally common in vegetation along the shoreline of the Cimarron River in Beaver & Harper counties	S
Fish	Arkansas River Shiner	historically occurred in all of the large rivers of the Arkansas River system, but is currently restricted to the Canadian River above Eufaula Lake; federally listed as a threatened species	D
Fish	Black Buffalo	uncommon but widespread in the eastern half of the state in the Grand, Arkansas, Cimarron and Red rivers	U
Fish	Blue Sucker	apparently uncommon but difficult to detect due to its affinity for deeper water; present in the Red, Arkansas and Grand rivers	U
Fish	Bluntface Shiner	uncommon and locally occurring in unimpounded portions of the Neosho/Grand River	D
Fish	Chub Shiner	locally common but restricted to the main stem of the Red River across southern Oklahoma	U
Fish	Flathead Chub	very rare and limited to the headwaters of the Cimarron River near Black Mesa and the Colorado state line	U
Fish	Neosho Madtom	uncommon and federally listed as a threatened species; restricted to the reach of the Neosho River upstream from Grand Lake	S
Fish	Paddlefish	locally common in some river reaches and reservoirs; found in the Grand, Arkansas, Red and Cimarron rivers in the eastern half of the state	S
Fish	Pallid Shiner (Chub)	uncommon and occurring in side channels and backwaters along the lower Arkansas and Red rivers in the eastern third of Oklahoma	U
Fish	Plains Minnow	common in all of the large rivers in the western 3/4 of the state	U
Fish	Prairie Speckled Chub	uncommon and endemic to the Red River system upstream from Lake Texoma	U
Fish	Red River Pupfish	common and widespread; endemic to the Red River but has been introduced and become established in the Canadian and Cimarron rivers	I
Fish	Red River Shiner	Common and widespread; endemic to the Red River but has been accidentally introduced into the Cimarron River; closely related to the federally threatened Arkansas River Shiner	I

Group	Species of Greatest Conservation Need Common Name	Status within the State	Trend in Population Size or Range
Fish	River Darter	uncommon but difficult to document because of its affinity to deeper water; found in the Neosho/Grand River	S
Fish	Scaly Sand Darter	locally common in the lower Red River and its tributaries	U
Fish	Shorthead Redhorse	uncommon and limited to the Grand River in northeastern Oklahoma	U
Fish	Shovelnose Sturgeon	an uncommon, small sturgeon found in the Arkansas and Red rivers in the eastern half of Oklahoma	U
Fish	Western Sand Darter	common along the Red River downstream from Lake Texoma	U
Inve	Black Sandshell	probably extirpated from Oklahoma; weathered shells document its past occupation of the Grand River system	U
Inve	Crosstimbers Coil	documented from river drift only; status unknown	U
Inve	Monkeyface Mussel	locally common in suitable substrate in the Neosho/Grand rivers	U
Inve	Neosho Mucket	occurred historically but now probably extirpated from the Neosho/Grand River; federally listed as an endangered species	D
Inve	Plain Pocketbook	locally common in the Red and Neosho/Grand rivers in eastern Oklahoma	U
Inve	Washboard	uncommon and locally occurring in the Neosho/Grand River	S
Rept	Alligator Snapping Turtle	uncommon and occurs at low densities, but widespread in the Red and Arkansas rivers in eastern Oklahoma; recently re-introduced to the lowest portion of the Washita River	U
Rept	American Alligator	rare in the Red River in the eastern third of Oklahoma	I
Rept	Eastern River Cooter	locally common and widespread in all of the large rivers in the eastern half of the state	U
Rept	Midland Smooth Softshell	common in the Arkansas, Cimarron, Canadian and Red rivers across the state	U
Rept	Mississippi Map Turtle	uncommon; occurs in the Red, Arkansas and Grand/Neosho river in the eastern third of Oklahoma.	U
Rept	Ouachita Map Turtle	uncommon but widespread in all of the rivers in the eastern half of Oklahoma	S
Rept	Spiny Softshell Turtle	common and widespread along all of the large rivers statewide	S

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and the Large River Habitat Type:

1. Data are incomplete regarding the distribution and ecology of Tier I and Tier II species of greatest conservation need that occupy the large rivers in the region. In order to establish effective conservation actions, more complete data are needed to determine the population status and trend for many species.
2. More thorough evaluations are needed to determine the factors that limit population sizes or are responsible for apparent declines.
3. More complete data are needed to determine management practices that may enhance populations of species of greatest conservation need, particularly for some species of fish and freshwater mussels.

4. Few data exist regarding the historic (presettlement) condition of the large rivers in Oklahoma. This information is important for setting conservation goals.
5. We have an incomplete understanding of the flow requirements of the aquatic species of greatest conservation need and their population responses to changes in flow rates.
6. Knowledge of the historic patterns of season flow, the structural condition of in-stream habitats and the complete community composition found both historically and currently in each large river is incomplete.

Conservation Actions:

- Conduct reviews of existing literature, technical reports, and museum records to evaluate the historic distributions, abundances, and habitat needs of all species of greatest conservation need.
- Use historic literature and maps, in conjunction with present-day field studies, to evaluate the presettlement and current conditions (e.g., channel morphology, flow patterns, and water quality) of each of Oklahoma's large river systems.
- Conduct field surveys to assess the current distributions, abundances and habitat affinities of species of greatest conservation need. The taxa in greatest need of survey effort are freshwater mussels and fish.
- Develop and provide long-term funding to maintain databases to store and analyze distributional and ecological data for all species of greatest conservation need. Make these data available to natural resource planners (e.g., wildlife agencies and environmental agencies).
- Conduct ecological studies on Tier I and Tier II species of greatest conservation need to identify factors that limit current population sizes, evaluate factors that may be responsible for suspected population declines, and develop recommendations to enhance populations through improved habitat conditions or increased recruitment.
- Use field surveys, technical expert workshops, and the results of ecological studies to update the Oklahoma Comprehensive Wildlife Conservation Strategy.
- Investigate methods for restoring channel morphology and seasonal flow dynamics to improve habitat conditions for aquatic species of greatest conservation need.
- Identify spawning areas of importance to species of greatest conservation need and develop strategies for their conservation and/or enhancement.
- Develop a monitoring program to track habitat condition/quality and status of species of greatest conservation need

Conservation Issues Related to Historic and Current Activities that Alter Flow Patterns, Channel Morphology and Water Quantity within Large Rivers:

7. Flow patterns have been modified on all of Oklahoma's large rivers as a result of reservoir construction. Reservoirs have been constructed to reduce the magnitude of naturally occurring flood events to protect human developments within river floodplains. Reservoir construction on river main stems and major tributaries alters the historic flooding frequencies and flow patterns. Reservoirs can reduce the magnitude of small floods especially the annual high-flow events that occur each spring and early summer. Reservoirs can reduce flow rates during normal summer low-flow periods by holding back water.
8. The channels of large rivers normally meander through their floodplains and expand into the floodplain during major flood events. In an effort to control flooding and allow human development within river floodplains, river channels have been altered. Levees and dikes have been constructed to prevent the movement of the channel and to confine flood waters, while portions of some rivers have been dredged to make them deeper and narrower.
9. The geomorphologies of large rivers and their tributaries have been altered by the combined effects of channelization, blockage of sediment transport by impoundments, reduction in peak flow rates by impoundments, dredging of sand and gravel from their channels and development of their shorelines.
10. Rivers respond to channelization by attempting to restore nature meanders. In doing so, they erode the channelized banks which causes the deposition of sediment into the river. Fine

sediment from eroding banks can settle into gravel beds and riffles, which impairs their quality as spawning areas for fish and habitat for freshwater mussels.

11. Dams and water diversions have altered the hydrology of the upper reaches of Oklahoma's large rivers and their tributaries. Withdrawal of water from rivers and reservoirs for irrigation has reduced water availability, and these withdrawals often have their greatest negative impact during periods of drought and high temperatures.
12. The pumping of shallow groundwater beneath river flood plains in western Oklahoma can decrease surface flows, especially during the summer months.
13. Dams alter the movement of sand, gravel, and other sediment within rivers by increasing their deposition within reservoirs. Over time, this alters the substrate below dams making these reaches rockier.
14. Species that require shallow water conditions (e.g. Least Terns, some shorebirds and some fish) have been negatively affected by the reduction in sediment transport and sand bar development that is caused by reservoirs.
15. Minimal legal provisions exist to establish and maintain minimum in-stream flows in Oklahoma rivers and streams.
16. The movement of fish within large rivers is often impeded or blocked by dams. These structures fragment and isolate fish populations and increase their risk of extirpation within some river reaches.
17. Reservoirs and impoundments alter in-stream flows by reducing peak flows following rainfall events and reducing base flows during periods of drought.
18. Maintaining minimum in-stream flows to provide habitat for species of greatest conservation need can be controversial because it may require reallocation of water from one user group to another.
19. The proposed desalinization of the Red River system would reduce water quality for the fish adapted to the salinity of that system. Reducing salinity may facilitate a greater human demand for water in the Red River that would further limit the water quantity available to fish and wildlife.
20. Reservoirs, flood control impoundments, and recreational ponds hold storm water runoff and can reduce the volume of surface flows that reach rivers and streams.
21. The ability of flood plains to hold and slowly release storm water has been impaired by the loss of wetlands. This results in "flashier" flows in which water enters the channel quickly to create a pulse of increasing flow that then rapidly decreases.
22. Surface flows are diverted from the large river systems at impoundments on their tributaries and then withdrawn from the system for irrigation and residential use. The increasing human demand for water both in Oklahoma and in neighboring states has spurred discussions of inter-basin transfers and out-of-state sales of water that would further limit the quantity of water available to fish and wildlife.
23. The construction of reservoirs reduces the amount of shallow, moving water and increases the amount of deep, still or slow-moving water immediately upstream of the dam.
24. Recreational use of river channels and river beds by off-road and all terrain vehicles can create local erosion and sedimentation problems. Off-road vehicle use can create a disturbance to local wildlife that may cause their avoidance of habitat that would be otherwise suitable, and in some cases, it may serve as a source of direct mortality for ground-nesting birds such as Least Terns and Snowy Plovers.

Conservation Actions:

- Provide funding for landowners, municipalities and conservation districts to restore the morphology of river channels.
- Support research into the efficacy of alternative bank stabilization and channel restoration techniques that incorporate fluvial geomorphology principles.
- Conduct studies assessing and comparing current and historic flow patterns on large rivers. Where changes in flow patterns are documented, evaluate methods to restore historic patterns such as modifying reservoir management to release water in such a way as to mimic historic flows (e.g. volume and seasonality).

- Work in cooperation with the U.S. Army Corps of Engineers, within the limits of their authorities, to modify the management of reservoir operations to benefit species of greatest conservation need through the release of water in a manner that mimics historic seasonal flow patterns.
- Support the continued use of the Fish and Wildlife Coordination Act to improve communication between the U.S. Fish and Wildlife Service and the U.S. Army Corps of Engineers to address the requirements of species of greatest conservation need.
- Increase the funding for and use of existing cost-share programs to restore riparian habitat and wetlands that stabilize banks, serve as filters of storm water, and as wildlife habitat.
- Inform the public, landowners and industries about the existing laws that regulate efforts to alter river morphology through channelization, dredging, in-stream sand mining and bank armament. Produce information to explain why these regulatory programs are important.
- Purchase conservation easements from private landowners or acquire property in title from willing sellers within the floodplains of rivers and streams and in the headwaters of streams to limit residential and agricultural development. Restore, enhance or create wetlands and riparian vegetation on these acres to stabilize stream banks and filter sediment to limit development within sensitive floodplains and improve habitat conditions for wildlife species of greatest conservation need.
- Develop monitoring programs for fish and wildlife populations, habitat quality, and water quality to assess the effects of habitat restoration and conservation easement programs.
- Research the use of tax incentives or other programs to discourage residential and infrastructure development within river floodplains.
- Evaluate the impact of structures such as reservoir dams that isolate populations of species of greatest conservation need or prevent these species from recolonizing reaches of rivers where they have become extirpated. Develop a program to restore fish passage through impoundments or mitigate the effects of impoundments through the careful translocation of aquatic species.
- Research alternative methods of flood control such as levee removal or wetland restoration within floodplains to reduce the need for flood control impoundments that alter flows and block fish passage.
- Synthesize existing research publications that demonstrate the negative consequences of river channelization, flood plain development, in-stream sand mining and reservoir construction. Ensure that the results of these ecological studies are readily available to the public and to water conservation and regulatory agencies (e.g., U.S. Army Corps of Engineers and Oklahoma Water Resources Board) so that water use decisions can be made using the best available information.
- Cultivate greater coordination and data sharing between the wildlife conservation organizations and the water regulatory agencies.
- Provide adequate resources to the Oklahoma Department of Wildlife Conservation to acquire sufficient information to effectively protect and restore populations of species of greatest conservation need.
- Research the applicability and use of e-SWIM model (Ecologically Sustainable Water Impoundment Management) to Oklahoma’s large rivers.
- Research the impact that reservoirs and hydropower projects have on downstream fish communities and species of greatest conservation need. Where warranted, support mitigation requirements to offset these impacts to fish and wildlife resources.
- Identify important spawning areas for fish and habitats for freshwater mussels so that they can be conserved or enhanced.
- Improve and standardize the water release requirements below dams to improve water quality and to maintain adequate flows for all native aquatic species.
- Implement mitigation and reimbursement for fish losses to entrainment and stranding at reservoirs.
- Conduct studies of the in-channel habitat needs and flow requirements for species of greatest conservation need. Establish minimum in-stream flow standards/requirements that will meet

the needs of these species and conserve populations within the watersheds in which they occur.

- Fund public education efforts directed at increasing the use and acceptance of water conservation techniques.
- Develop monitoring programs for wildlife populations and habitat quality to assess the effects of flow management, habitat restoration, and conservation easement programs.
- Increase the consideration that fisheries, wildlife, and recreation receive on federal reservoirs relative to that of hydropower and flood control.
- Discourage residential and infrastructure development within floodplains that would contribute to efforts to channelize rivers, construct flood control impoundments, or remove wetlands.
- Evaluate the potential to remove structures that block the passage of fish species of greatest conservation need and/or alter the presettlement pattern of water flow and flooding.
- Support congressional reprioritizing of existing federal reservoir projects to increase the importance of fish and wildlife propagation and recreation as beneficial uses.
- Research and publicize the likely consequences of the proposed Red River Chloride Control project on the fish community and the aquatic species of greatest conservation need.
- Conduct research to better understand the effects of recreation (e.g. off-road vehicle use) on the reproduction, recruitment and longevity of species of greatest conservation need, and on the quality of their habitat.
- Develop and promote actions to minimize the impact of recreational activity on species of greatest conservation need and consider mitigation plans to compensate for unavoidable impacts.

Conservation Issues Related to Historic and Current Activities that Alter Water Quality in Ways that Negatively Affect Species of Greatest Conservation Need:
Conservation Issue: Water quality changes as a result of nutrients, sediment, and other pollutants:

25. Nutrients, in excess of pre-settlement levels, are contributed to the large river systems by several sources including concentrated animal operations (e.g., dairies, poultry houses, and their land application fields), septic systems from homes, plant nursery operations, fertilized crop fields and lawns, and municipal discharges.
26. Impairment of water quality in streams and small rivers ultimately affects the water quality of large rivers.
27. Several pesticides mimic growth hormones and endocrine system disruptors. These chemicals have low toxicity to terrestrial vertebrates but if they enter rivers through storm water runoff from agricultural fields and concentrated animal operations, they may affect the reproduction and development of crustaceans, freshwater mussels, fish and amphibians.
28. Septic systems and animal waste application fields that occur on porous soils in or near river floodplains can contribute nutrients and other pollutants to rivers through groundwater connections.
29. Wetlands within river floodplains have been filled or drained to create land for agricultural and residential purposes. This has eliminated or reduced their value as filters of storm water runoff to keep sediment and nutrients out of rivers. These wetlands also serve as important breeding areas for amphibians and feeding areas for waterfowl and shorebirds.
30. Because of periodic flood events, it is difficult for landowners to maintain fencing around rivers to control livestock access. Livestock in river channels and floodplains can increase nutrients in the water, reduce riparian vegetation and increase bank erosion as a result of their movement and grazing.
31. Rivers are the ultimate receptor of herbicides, insecticides, heavy metals, nitrates, fine sediment, salt, and other pollutants that are carried into aquatic systems through storm water runoff.

Conservation Actions:

- Increase the use of Best Management Practices (BMPs) and conservation cost-share programs to control nutrients and sediment in storm water runoff throughout entire watersheds.

- Increase the funding for and use of cost-share programs that help landowners and local governments implement BMPs for the control of pesticides, sediment and nutrients. Similarly, increase the funding for and use of existing cost-share programs to restore riparian habitat and wetlands that serve as filters of storm water and as wildlife habitat along rivers and their tributaries.
- Continue to provide cost-share funding for the construction of fences and alternative sources of water to exclude livestock from rivers and riparian areas. Encourage the protection of riparian areas from grazing using fencing and landowner incentives payments to restore riparian vegetation structure.
- Develop and distribute educational materials to schools and landowners about BMPs to control nutrients and sediment, the interconnection of rivers, wetlands and groundwater, and the importance of riparian vegetation and wetlands as filters of nutrients and sediment.
- Purchase conservation easements from private landowners or acquire property in title from willing sellers in the floodplains of river and streams and in the headwaters of streams. Restore, enhance or create wetlands and riparian vegetation on these acres to stabilize stream banks and filter sediment, nutrients, and other pollutants and to limit development within sensitive floodplains and improve habitat conditions for wildlife species of greatest conservation need.
- Discourage residential development and concentrated animal operations within or near river floodplains in order to reduce the potential for nutrients and pesticides to enter rivers through storm water runoff.
- Develop local stream teams or watershed groups comprised of citizens and/or governmental organizations to address local concerns, monitor water quality, monitor wildlife populations, and provide public outreach and education.
- Acquire conservation easements or fee-title from willing sellers to land at the headwaters of large rivers and their tributaries in order to protect water quality by controlling potential inflows of sediment, nutrients and pollutants.
- Develop and distribute information to landowners regarding the economic and ecological benefits of riparian vegetation, concerns regarding grazing within riparian habitats, and BMPS for maintaining water quality.
- Strengthen concentrated animal operation regulations that limit the volume of animal waste that can be applied on the land.
- Identify limits to chemicals such as phosphorous at the watershed level.
- Support and encourage pollution abatement efforts.
- Encourage the release of water through dams in order to maintain sufficient dissolved oxygen and temperature conditions to protect aquatic species in tail waters.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

32. More than two dozen non-native aquatic and wetland plant species have become established within the Red and Arkansas river systems. Where they occur, they often dominate shallow water or riparian habitats and compete with or crowd out more beneficial native vegetation. These exotic species often provide poorer habitat and food resources for native fish and wildlife than their native plant counterparts. Expansion of these exotic plants in Oklahoma's large rivers will further diminish habitat quality for many species of greatest conservation need.
33. Exotic aquatic animals, including Zebra Mussels, Silver Carp and Bighead Carp, are likely to expand their ranges within the Red and Arkansas river systems and affect native mussel, fish, and aquatic plant populations through resource competition and herbivory.
34. The inter-basin transport and introduction of native aquatic species (e.g., accidental introduction of Red River Pupfish from the Red River to the Canadian River) can create community disruption and competition with species that are native to the receiving river. In some cases, hybridization may occur between similar and related species that would normally be isolated from each other in unconnected water systems. Such intermixing can result in the

loss of genetic integrity or elimination of the native species and replacement by its hybrids or close relative.

35. Expansion of non-native Salt Cedars along the large rivers in western and central Oklahoma has reduced the quality of riparian habitats for many species of greatest conservation need by displacing native vegetation such as cottonwood stands.
36. The loss or reduction in the frequency of periodic fires in the riparian areas along large rivers has facilitated the range expansion or increased the abundance of invasive species such as the native Eastern Redcedar and exotic species such as privets, Autumn Clematis, salt cedars and Russian Olive. These species have altered vegetation density and structure in local areas in a way that has reduced their value to species of greatest conservation need.

Conservation Actions:

- Evaluate the severity and magnitude of the ecological damage done by exotic plant and animal species (e.g., displacement of native plant communities and predation or competition with native animal populations) to identify those exotic species causing the greatest impact to this habitat and species of greatest conservation need.
- Increase the funding for the implementation of Oklahoma's Aquatic Nuisance Species Management Plan.
- Provide the results of studies of exotic species impacts to landowners and conservation agencies/organizations to encourage them to take actions to control their spread.
- Improve coordination between wildlife biologists, conservation agencies, and agricultural organizations so that these groups can share information about the negative effects of using exotic animals and plants, and can place their emphasis on the restoration of native plants and plant communities.
- Develop control or management plans for the exotic species that cause the greatest ecological damage (e.g., herbicide treatment and mechanical removal). And, develop monitoring programs to measure and evaluate the effectiveness of these control measures.
- Develop and implement invasive species management plans for all public conservation lands.
- Increase the funding for cost-share programs to encourage private landowners to control invasive and exotic species.
- Identify preventative control measures for invasive species instead of reactionary ones. For example, identify ways to address invasive species that are newly established or occur at low density before they spread or become more well-established.
- Develop and distribute educational materials for anglers about the ecological problems associated with the introduction of fish from other watersheds through bait bucket releases.

Conservation Issues Associated with Commercial Harvest Practices that Negatively Affect Species of Greatest Conservation Need:

37. Commercial harvest of aquatic turtles, minnows and freshwater mussels may affect the sustainability of species of greatest conservation need that are disturbed or captured incidentally with the target species.
38. Commercial harvest of minnows may facilitate the accidental translocation of fish from one river basin to another where it is not native.
39. Few studies have been conducted to determine the long-term level of commercial harvest that specific species/populations can sustain.

Conservation Actions:

- Study the effects of commercial harvest on the population dynamics of species of greatest conservation need.
- Conduct pilot studies to determine successful management strategies that maintain harvestable populations of mussels, minnows and aquatic turtles.
- Devote more resources into the monitoring and regulation of commercial harvest.
- Develop comprehensive monitoring programs for commercially harvested species and dedicate the revenue generated from commercial harvest toward funding these.

Potential indicators for monitoring the effectiveness of the conservation actions:

- number of river segments with designated in-stream flows or ecological flows that maintain aquatic ecosystem health
- changes in the population sizes and trends of representative species of greatest conservation need
- changes in seasonal flow volumes as measured through U.S. Geological Survey and other gauging stations
- changes in the distribution and abundance of exotic, invasive species
- the condition of large river channels in terms of channel morphology, healthy riparian vegetation and the vegetative structure of the flood plain
- monitoring of river water to measure adherence to state water quality standards
- acres of degraded riparian and flood plain habitat that have been restored or enhanced
- acres under easements or conservation practices within river flood plains
- number of local conservation groups that exist and their effectiveness
- groundwater level in the alluvial aquifers along rivers
- number of landowners participating in conservation practices
- changes in water clarity, nutrients and suspended algae
- number and acres of wetlands within flood plains that are restored or improved
- number and acres of freshwater mussel beds and site with suitable spawning habitat for representative species of greatest conservation need
- stream flow and habitat quality (e.g., measure return of stream flow with range of natural variation)
- length and acres of riparian forests and woodlands with a natural (diverse) structure
- changes in channel structure over time using remote imagery
- number of reservoir management plans that maintain a natural hydro period, protect water quality in their tail waters, and maintain riparian and bottomland forest habitat downstream
- number of river miles degraded or improved over time
- number and structural condition of sand bars
- recovery of federally-listed fish and mussels occurring in large rivers

Potential partnerships to deliver conservation for Oklahoma's Large Rivers:

State Government

- Oklahoma Department of Wildlife Conservation
- Oklahoma Biological Survey
- Oklahoma Conservation Commission
- Oklahoma Corporation Commission
- Oklahoma Department of Mines
- Oklahoma Department of Food, Forestry and Agriculture
- Oklahoma Department of Environmental Quality
- Oklahoma Department of Transportation
- Oklahoma Legislature
- Oklahoma Scenic Rivers Commission
- Oklahoma State University, Cooperative Extension Service and Department of Ecology and Natural Resources Management
- Oklahoma Tourism and Recreation Department, State Parks Division
- Oklahoma Water Resources Board
- State universities and their biology departments
- Sam Noble Oklahoma Museum of Natural History and other state-funded museums

Federal Government

- U.S. Army Corps of Engineers
- U.S. Department of Agriculture, Farm Service Agency
- U.S. Department of Agriculture, Natural Resources Conservation Service
- U.S. Department of the Interior, National Park Service
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- U.S. Fish and Wildlife Service - Gulf Prairies Landscape Conservation Cooperative
- U.S. Fish and Wildlife Service - Tishomingo National Wildlife Refuge
- U.S. Fish and Wildlife Service - Sequoyah National Wildlife Refuge
- U.S. Geological Survey

Local Government

- Municipalities in Oklahoma
- Native American tribal governments
- Oklahoma Conservation Districts and Blue Thumb Chapters

Businesses, Citizens and Citizen Groups

- Canoe Operators Association
- Chambers of Commerce
- Ducks Unlimited
- Farm Bureau
- Farmers Union
- Hunting cooperatives
- Kerr Center for Sustainable Agriculture
- Land Legacy
- Local citizens groups
- Lower Mississippi Valley Joint Venture
- National Wild Turkey Federation
- Oklahoma Anglers United
- Oklahoma Cattlemen's Association
- Oklahoma Forestry Association
- Oklahoma Native Plant Society
- Oklahoma Ornithological Society
- Oklahoma sportsmen's groups
- Private landowners
- Sierra Club
- Southern Oklahoma Water Alliance
- The Nature Conservancy

Shortgrass Prairie Region

In Oklahoma, the Shortgrass Prairie Region encompasses the panhandle and the northwestern corner of the main body of the state (all or part of Cimarron, Texas, Beaver, Harper, and Ellis counties). From the perspective of Omernick and Bailey ecological region systems, the Shortgrass Prairie Region is analogous to the combination of the Western High Plains and the Black Mesa regions.

The best professional judgment of the advisory group and technical experts was used to identify each Conservation Landscape's status and trend. And, even though some issues and actions apply to multiple regions, each regional chapter is designed to stand alone.

Conservation Landscapes listed in general priority order:

- Very High priority Conservation Landscapes:
  - Shortgrass Prairie
  - Pinyon Pine/Juniper Woodlands and Savannahs
- High priority Conservation Landscapes:
  - Herbaceous Wetlands
  - Sand Sagebrush/Bluestem Shrublands
- Moderate priority Conservation Landscapes:
  - Mixed-grass Prairie
  - Sandy-bottom Streams, Springs and Associated Riparian Woodlands

Very High Priority Conservation Landscape: Shortgrass Prairie

Shortgrass prairie habitat is the most abundant habitat type found throughout the Shortgrass Prairie Region. Despite its abundance, more than half of the historic shortgrass prairie has been lost due to its conversion to agricultural fields. Currently, the trend in the acreage of shortgrass prairie appears to be stable and many shortgrass prairies are in good condition. Nearly all of the shortgrass prairie habitat in Oklahoma occurs within this region, where it is widespread and often forms the habitat matrix within which other habitat types occur. Shortgrass prairies are comprised of several herbaceous plant associations including Sideoats Grama (*Bouteloua curtipendula*), Blue Grama (*Bouteloua gracilis*), and Buffalograss (*Buchloe dactyloides*) on well drained soils or rocky slopes, Blue Grama / Hairy Grama (*Bouteloua hirsuta*) on loamy or sandy soils, and Blue Grama/Buffalograss on clay soils. Other grasses and forbs include Scarlet Globemallow (*Sphaeralcea coccinea*), Plains Blackfoot (*Melampodium leucanthum*), Prairie Zinnia (*Zinnia grandiflora*), Muhly Grass (*Muhlenbergia torreyi*), Pricklypear Cactus (*Opuntia humifusa*) and Yucca (*Yucca glauca*). Vine Mesquite (*Panicum obtusum*) and Western Wheatgrass (*Pascopyrum smithii*) grow in more mesic sites such as the margins of playas. Over half a million acres of shortgrass prairie may remain in Oklahoma, but this is less than half of what occurred historically. Much of the original Shortgrass Prairie has been converted to crop production, particularly dryland wheat or irrigated corn, soybeans, or alfalfa. Many crop fields have been enrolled in the Conservation Reserve Program (CRP) during the past 20 years because of the potential for soil loss due to wind erosion. However, most of the Conservation Reserve Program acreage has been planted to exotic grasses such as Yellow (Old World) Bluestem (*Bothriochloa ischaemum*) or mixed-grass prairie species such as Little Bluestem (*Schizachyrium scoparium*) instead of to native shortgrass prairie species.

Recognized vegetation associations within this habitat type include:

- Blue Grama – Broom Snakeweed Grassland
- Blue Grama – Buffalograss Grassland
- Blue Grama – Galleta Grassland
- Blue Grama – Hairy Grama Grassland
- Buffalograss Grassland
- Hairy Grama – Sideoats Grama Grassland
- Sideoats Grama – Blue Grama-Buffalograss Grassland
- Sideoats Grama Grassland
- Western Wheatgrass – Blue Grama Grassland

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past 50 years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Baird's Sparrow	very rare spring and fall migrant; rarely documented in Oklahoma but presumably occupies stands or taller or denser grasses	U
Bird	Barn Owl	uncommon year-round resident in agricultural landscapes where barns and building provide nesting and roosting sites	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Burrowing Owl	uncommon but widespread summer resident and rare winter resident; typically found in association with prairie dog colonies which are used as nesting and roosting sites	S
Bird	Cassin's Sparrow	locally common summer resident in prairies and CRP fields with yucca and sparse woody shrub cover	U
Bird	Chestnut-collared Longspur	uncommon winter resident; found in large tracts of prairie grasses	D
Bird	Ferruginous Hawk	uncommon summer resident in the western half of the region (about 30 nesting pairs) and uncommon but widespread winter resident	S
Bird	Golden Eagle	Widespread winter resident that occurs in low density; a few resident pairs may be present in shortgrass prairies in the western part of the region	S
Bird	Lesser Prairie-Chicken	uncommon and locally occurring in Sideoats Grama-dominated grasslands and in shortgrass prairie in proximity to Sand Sagebrush and CRP	D
Bird	Loggerhead Shrike	occurs locally as a year-round resident in landscapes dominated by prairie and/or agricultural land where scattered trees provide nesting and perching sites	D
Bird	Long-billed Curlew	uncommon summer resident in the western half of the region; typically found in prairie habitats and playa depressions	S
Bird	McCown's Longspur	uncommon winter resident in large tracts of prairie grasses and areas where tracts of prairie are mixed with winter wheat fields	U
Bird	Mountain Plover	rare and locally occurring in areas of level, clay soils in Cimarron and NW Texas counties; often nests in fallow crop fields, grazed prairies and within prairie dog colonies	D
Bird	Prairie Falcon	uncommon winter resident throughout the region; occurs year-round on prairies in the vicinity of nesting sites around Black Mesa	S
Bird	Scaled Quail	common year-round resident in shortgrass prairies with some degree of woody shrub cover or yucca/cacti; found throughout the region	S
Bird	Short-eared Owl	uncommon but widespread winter resident in tracts of prairie with taller or denser grasses	U
Bird	Swainson's Hawk	common summer resident throughout the region; most common in relatively flat landscapes with sparse tree cover	U
Mamm	Black-tailed Prairie Dog	locally occurring at approximately 600 colonies distributed throughout the region	S
Mamm	Desert Shrew	rare and rarely documented; its distribution is poorly known but this species typically inhabits active or abandoned woodrat nests	U
Mamm	Swift Fox	occurs at low-density but is widespread across the region in landscapes dominated by grazed prairie and/or non-irrigated wheat fields	S
Mamm	Yellow-faced Pocket Gopher	Uncommon and limited to shortgrass prairies and sandy prairie/shrublands in the western half of the panhandle; secretive, burrowing species	U
Rept	Lesser Earless Lizard	uncommon and locally occurring in shortgrass prairie tracts, dunes and edges of crop fields	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Rept	Texas Horned Lizard	locally common in large tracts of prairie grasses	Stable in this region but Declining statewide
Rept	Texas Long-nosed Snake	uncommon but widespread; this is a secretive, burrowing species whose range is poorly documented	U
Rept	Western Massasauga	occurs locally in the eastern third of the region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

1. The conversion of Shortgrass Prairies to crop fields has been widespread across the region. Much of the original shortgrass prairie has been lost to conversion in landscapes that are relatively level and where there is direct access to ground water for irrigation. This conversion of shortgrass prairie not only reduces the quantity of habitat available for wildlife, but also reduces the size of and isolates the remaining tracts of habitat. This reduction in size and isolation reduces the quality of the remaining habitat for species that require large tracts of habitat and/or have poor dispersal capabilities.
2. Locally, the use of center-pivot irrigation has facilitated the conversion of additional acres of Shortgrass Prairie habitat. Conversion of shortgrass prairie to irrigated crop fields of winter wheat, corn and soybeans is largely driven by market prices for these crops and the price of fuel that is used to operate the irrigation pumps.
3. Tracts of shortgrass prairie have been fragmented by the construction of roads, overhead utility lines, oil and gas wells, fencing, and wind turbines. Because utility lines, pumps and wind turbines are much taller than the surrounding vegetation, they can alter the behavior of some shortgrass prairie-adapted wildlife in ways that cause them to avoid the habitat surrounding these structures.
4. Through the Conservation Reserve Program (CRP), over a quarter of a million acres of erodible cropland has been converted to perennial grass cover. Most of this acreage occurs in landscapes that were historically dominated by shortgrass prairie, but most of the CRP fields have been planted to taller grasses such as Old World Bluestem and Little Bluestem that have mixed-grass prairie structural characteristic. This has resulted in the continued fragmentation of shortgrass prairie by stands of ungrazed mixed-grass prairie that is less beneficial to shortgrass prairie wildlife.

Conservation Actions:

- Continue to work with the Natural Resources Conservation Service (NRCS) and other land management and technical assistance agencies to modify their guidance/ specifications to reduce undesirable grass species and increase desirable forbs and native grasses.
- Continue to work with NRCS to eliminate the use of Old World Bluestem or Weeping Lovegrass in new CRP fields and replant existing CRP lands to native short grasses such as Blue Grama and Buffalograss.
- Conduct research to facilitate effective methods for converting existing CRP fields to native grasses and forbs that restore shortgrass prairie habitat.
- Encourage the development of perpetual easement programs, leases or fee-title land acquisitions from willing sellers in order to place higher quality tracts of shortgrass prairie under conservation management to proactively conserve population of rare and declining species.

- Encourage expansion of the CRP in the Farm Bill as well as increasing its funding from the subsidy side of the Farm Bill.
- Encourage the use of tax incentives and tax relief to motivate landowners to maintain good quality prairie that meets the needs of shortgrass prairie species of greatest conservation need.
- In cooperation with the agriculture community and other conservation-minded partners, develop demonstration areas that show the grazing practices, native prairie restoration techniques and fire regimes that are beneficial for species of greatest conservation need.
- Conduct field studies to better understand the impacts of wind power development on species of greatest conservation need.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

5. Existing data are incomplete for some species of greatest conservation need with respect to their current distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
6. Knowledge of the historic and current structural condition, distribution and community composition of Shortgrass Prairie Habitat is incomplete.

Conservation Actions:

- Conduct reviews of existing literature, reports, and museum records, and interview technical experts to compile historic and recent distributional and ecological information for all species of greatest conservation need.
- Conduct surveys and research to assess the current distribution, abundance and habitat affinities for the Tier I and Tier II species of greatest conservation need. Use these data to identify the geographic areas and habitat conditions where conservation efforts should be directed to provide the greatest benefit for populations of species of greatest conservation need. Identify and prioritize core areas of habitat and, where needed, corridors to increase habitat connectivity.
- Conduct research to identify the factors that limit the distributions and abundances of species of greatest conservation need and examine the possible causes of any suspected population declines.
- Develop management recommendations to enhance populations of species of greatest conservation need through improved habitat conditions or enhanced juvenile recruitment, and conduct field studies to establish a baseline population condition.
- Develop monitoring programs for high priority species of greatest conservation need to measure their abundance, geographic range and the condition of the habitats on which they depend. Develop and maintain databases to store and analyze these distributional and ecological data.
- Work with the NRCS's Ecological Site Description program to develop realistic and biologically meaningful descriptions for the condition of high quality shortgrass prairie communities. These should serve as the range of target conditions for shortgrass prairie restoration, enhancement and maintenance efforts.
- Develop methods to identify and map the remaining tracts of Shortgrass Prairie habitat, then inventory these tracts to determine their condition and the biological communities that they support. Where appropriate, identify the conservation practices that could enhance the value of these habitat tracts.

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need Conservation:

7. Introduced species such as Old World Bluestem (*Bothriochloa ischaemum*), Prickly Russian Thistle (*Salsola tragus*), White Sweet Clover (*Melilotus alba*) and several species of brome (*Bromus* species) have become widespread throughout this habitat

in this region. These species have displaced more beneficial native vegetation and have altered the structure (increased height) of shortgrass prairie habitats.

Conservation Actions:

- Continue to work with the NRCS, the OSU Cooperative Extension Service and their county offices to modify erosion control and CRP guidance and specifications to eliminate the planting of undesirable, exotic species and increase desirable forbs and grasses.
- Support the NRCS's current policy that prohibits the use of Old World Bluestem and Weeping Lovegrass in new CRP fields.
- Develop financial incentives to eliminate Old World Bluestem and replant existing CRP to native short grasses such as grama grasses and Buffalograss. Conduct field research to determine the most effective methods for eliminating Old World Bluestem to improve the success rate of native prairie establishment on CRP fields.
- Develop and distribute information to landowners on the identification and control of invasive species and recommendations for modifying grazing, plowing and mowing practices to prevent the spread or establishment of exotic invasive species.
- Develop and implement management plans to control or eliminate invasive and exotic plant species on all public conservation lands. Provide cost-share funding or economic incentives to private landowners to encourage them to control invasive species.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

8. Throughout its history, Shortgrass Prairie habitat has been shaped by grazing, but current grazing patterns are very different than the presettlement patterns. Historically, grazing was seasonal and accomplished by nomadic or migrating herds of Bison and American Pronghorn. Most of the current grazing is accomplished by domestic cattle and horse that graze rangeland continuously.
9. The Shortgrass Prairie Region receives scant and variable rainfall, and is prone to extended periods of drought. Frequent and unpredictable droughts increase the complexity and difficulty for landowners to manage livestock grazing. The vegetation response following years of careful management can be set back dramatically by relatively short periods of severe drought and result in overutilization of grasses and forbs.
10. Black-tailed Prairie Dog control and the fragmentation of prairie dog colony complexes has had a detrimental effect on the habitat and food base for several species of greatest conservation need.
11. To date, most of the land that has been enrolled in the Conservation Reserve Program in the Shortgrass Prairie Region has been planted to exotic Old World Bluestem or to native mixed-grass prairie grasses that do not meet the ecological requirements of shortgrass prairie species such as the Mountain Plover and Swift Fox.
12. Exotic invasive species such as Russian Thistle (tumbleweed) and Old World Bluestem have spread into shortgrass prairie habitats from disturbed agricultural fields.

Conservation Actions:

- Provide information to landowners about the economic value of nature-based tourism in an intact and complete shortgrass prairie landscape, and encourage involvement in The Great Plains Trail, a road-based wildlife-viewing trail that provides travelers with recommended destinations for quality wildlife-viewing opportunities.
- Support prairie dog control regulations that allow for small-scale control but minimize the risk of eliminating entire colonies.

- Support research into grazing practices to determine which practices are most sustainable and best balance economic benefits with the maintenance of healthy shortgrass prairie landscapes. Publish and distribute these recommendations to ranchers/landowners.
- Purchase short-term grazing leases to remove livestock or reduce stocking rates on over-utilized rangeland in a manner that still provides income (economic incentives) to landowners.
- Work with a variety of partners in the Shortgrass Prairie Region to encourage the continuation – and possibly expansion – of programs like the Landowner Incentive Program for the conservation of Black-tailed Prairie Dog colonies and other associated species. Increase the payments made per acre to landowners to increase the attractiveness of a LIP-like program and increase enrollments.
- Support legislation that will enable large ranches to remain in single family ownership and be passed down from one generation to the next.
- Encourage land acquisitions and the purchase of conservation easements by non-governmental organizations (e.g. land trusts or The Nature Conservancy) for the conservation of important tracts of shortgrass prairie habitat.
- Support increased funding for the grassland conservation component of the Agricultural Conservation Easements Program which includes the conservation that was accomplished by the former Grassland Reserve Program.
- Encourage and support ranch diversification for lower grazing rates and offset by lease hunting, fishing access, and wildlife viewing opportunities.
- Support, encourage and assist with development or updating of Best Management Practices for agricultural development.
- Identify and prioritize core areas of Black-tailed Prairie Dog colonies to enhance complex development.
- Research the efficacy of methods for controlling exotic invasive species such as Russian Thistle without damaging native forb diversity.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acres enrolled in conservation programs, including the Landowner Incentive Program and the Lesser Prairie Chicken Range Wide Plan
- changes in acreage/coverage of exotic vegetation
- easements secured and acreage enrolled in conservation programs
- numbers of acres of native plant communities restored / Conservation Reserve Program fields converted from Old World Bluestem to native shortgrass prairie
- population sizes, trends and distributions of species of greatest conservation need, prairie dog - associated species, and indicator species (e.g., Mountain Plover, Burrowing Owl, Long-billed Curlew, Swift Fox, Texas Horned Lizard, and Cassin's Sparrow)
- condition and quantity of shortgrass prairie habitat

Very High Priority Conservation Landscape: Pinyon Pine/Juniper Woodlands and Savannahs

In Oklahoma, the Pinyon Pine/Juniper Woodland and Savannah habitat type is unique to the Shortgrass Prairie Region. It is found on rocky soils in the Black Mesa area in the northwestern corner of the Oklahoma panhandle. The dominant woody plants in this woodland community are One-seeded Juniper (*Juniper monosperma*) and Pinyon Pine (*Pinus edulis*). The understory of this woodland is dominated by short grasses including Sideoats Grama, Hairy Grama, Blue Grama, Buffalograss and Silver Bluestem. Other less common woody plants include clump-forming shrubs such as Skunkbrush (*Rhus aromatica*), Mountain Mahogany, Gamble Oak (*Quercus gambelii*), and several cacti including Tree Cholla (*Opuntia immbricata*) and Prickly Pear (*Opuntia sp*.). Ponderosa Pine (*Pinus ponderosa*) occurs in one canyon location within this habitat in Oklahoma. Much of the Pinyon Pine/Juniper Woodland or Savannah habitat is in good to fair condition and the number of acres occupied by this woodland/savannah community has been stable in recent decades.

Recognized vegetation associations within this habitat type included:

Oneseed Juniper – Pinyon Pine/Grama Woodland
Oneseed Juniper/Grama Woodland
Ponderosa Pine/Grama – Little Bluestem Woodland

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past 50 years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Cassin's Sparrow	uncommon summer resident; nests in areas with scattered brush and sparse juniper	D
Bird	Juniper Titmouse	uncommon year-round resident; restricted to mature Pinyon Pine/Juniper woodlands around Black Mesa	U
Bird	Loggerhead Shrike	uncommon year-round resident; in open pine/juniper savannahs	D
Bird	Pinyon Jay	rare year-round resident in woodlands with mature Pinyon Pines	S
Bird	Prairie Falcon	rare year-round resident; a few pairs nest on cliffs in the Black Mesa area	S
Bird	Scaled Quail	common year-round resident in open woodlands and savannahs with a sparse, shrubby understory	S
Mamm	Colorado Chipmunk	rare in rocky canyons and Pinyon Pine/Juniper woodlands around Black Mesa	U
Mamm	Desert Shrew	uncommon in woodlands with a brushy understory; typically found in association with woodrat nests and piles of woody debris.	U
Mamm	Eastern White-throated Woodrat	uncommon resident of brushy canyons and pine/juniper woodlands	U
Mamm	Hog-nosed Skunk	very rare and reported only a few times in the	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
		vicinity of Black Mesa	
Mamm	Mountain Lion	rare and secretive resident in Pinyon Pine / Juniper woodlands; seen more frequently in recent years	I
Mamm	Ringtail	rare and secretive resident of rocky and brushy canyons, cliffs and hillsides	U
Mamm	Western Big-eared Bat	rare and secretive resident; reported from only a few rocky canyons and buttes around Black Mesa	D
Rept	Common Checkered Whiptail	uncommon and locally occurring in sparsely vegetated rocky slopes and canyons	D
Rept	Lesser Earless Lizard	uncommon and locally occurring in sparsely vegetated sandy or rocky sites around Black Mesa	U
Rept	Round-tailed Horned Lizard	very rare and reported only a few times from sparsely vegetated, rocky buttes in juniper savannahs	U
Rept	Texas Horned Lizard	common in open, juniper savannahs and grasslands between buttes and hills	Stable in this region but Declining statewide

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

1. Existing data are incomplete for some species of greatest conservation need with respect to their current distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
2. Our knowledge about the historic and current structural condition, distribution and community composition of Pinyon Pine-Juniper Woodland Habitat is incomplete.

Conservation Actions:

- Conduct reviews of existing literature, reports, and museum records, and interview technical experts to compile historic and recent distributional and ecological information for all species of greatest conservation need.
- Conduct surveys and research to assess the current distribution, abundance and habitat affinities for Tier I and Tier II species of greatest conservation need. Use these data to identify the geographic areas and habitat conditions where conservation efforts should be directed to provide the greatest benefit for SGCN. Identify and prioritize core areas of habitat and, where needed, corridors to increase habitat connectivity.
- Conduct research to identify the factors that limit the distributions and abundances of species of greatest conservation need and examine the possible causes of any suspected population declines.
- Develop management recommendations to enhance populations of species of greatest conservation need through improved habitat conditions or enhanced juvenile recruitment. Conduct field surveys to establish baseline population statuses.
- Develop monitoring programs for high priority species of greatest conservation need to measure their abundance, geographic range and the condition of the habitats on which they depend. Develop and maintain databases to store and analyze these distributional and ecological data.

- Research the historic condition of Pinyon Pine – Juniper Woodland habitat in order to develop realistic and biologically meaningful descriptions for the condition of high quality habitats. These should serve as the range of target conditions for habitat restoration, enhancement and maintenance efforts.
- Develop methods to identify and map the remaining tracts of Pinyon Pine – Juniper Woodland habitat, then inventory these tracts to determine their condition and the biological communities that they support. Where appropriate, identify the conservation practices that could enhance the value of these habitat tracts.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

3. Fire suppression and heavy grazing pressure have facilitated an increase in juniper density and abundance. Juniper abundance often increases without a similar increase in Pinyon Pine or Pinyon Pine may be suppressed by the expansion of junipers.
4. Because this region receives sparse rainfall and is prone to drought conditions, it is difficult to manage grazing pressure because grass growth is extremely variable from year to year. Grazing pressure can become excessive very quickly during periods of drought and this may alter vegetation structure, reduce its density and increase soil erosion.
5. Continuous grazing by cattle periodically results in excessive grazing during drought periods which results in a reduction in the cover provided by grasses, forbs, and deciduous shrubs. Heavy continuous grazing also can facilitate the dispersal and establishment of exotic or invasive species.

Conservation Actions:

- Purchase conservation easements, short-term grazing leases or fee title from willing sellers to conserve especially valuable tracts of pinyon/juniper woodlands.
- Lease grazing rights temporarily to reduce stocking rates or remove cattle from heavily grazed and eroded areas.
- Develop demonstration areas on public lands to show how the management of healthy pinyon/juniper woodland habitat can be compatible with profitable grazing. Consider working with partners across state lines is an insufficient acreage of this habitat exists on public lands in Oklahoma.
- Research the efficacy of a patch/burn grazing system in the Shortgrass Prairie Region. If this is demonstrated to be a beneficial technique for pinyon/juniper woodland management, then develop a technical and financial assistance program to help landowners implement patch/burn grazing.
- Increase funding for the incentive programs that have been developed for landowners to enable restoration of habitat through prescribed burning or deferred grazing.
- Research management techniques that can promote the recruitment of Pinyon Pine in order to sustain or enhance populations of pine-dependent wildlife species.

Potential indicators for monitoring the effectiveness of the conservation actions:

- number of acres acquired and number of acres placed into conservation programs
- number of technical assistance visits provided to private landowners
- increased use of prescribe fire and/or rotational grazing on the landscape
- number of landowners participating in landowner incentive and easement programs
- changes in population sized and trends of species of greatest conservation need
- relative condition and acreage of pinyon/juniper woodland habitat.
- vegetation response to fire and rotational grazing (e.g., grasses and woody plant species diversity, abundance and structural diversity)

High Priority Conservation Landscape: Herbaceous Wetlands

The relative condition of the Herbaceous Wetland habitat in the Shortgrass Prairie Region of Oklahoma is currently poor with a declining trend. The majority of herbaceous wetlands in the Shortgrass Prairie Region occur as playas, which are round, clay-lined depressions that occur on level terrain within shortgrass prairie habitat. They collect surface runoff after heavy rains to form small, temporarily flooded wetlands. Playa wetlands are small (they average about 17 acres in size) and individual basins may be separated from the next nearest playa by two or three miles. Other seasonal wetlands occur in the floodplains of streams and the Beaver and Cimarron rivers. Wetland plant communities are diverse as a result of variations in length of time the soil is saturated. Widespread wetland plants in the Shortgrass Prairie Region include: Common Spikerush (*Elocharis palustris*), Pink Smartweed (*Polygonum pensylvanicum*), Three-square Bulrush (*Schoenplectus pungens*), and Sand Spikerush (*Elocharis montevidensis*). In saline or semi-alkaline wetlands, Inland Saltgrass (*Distichlis spicata*) and Alkali Sacaton (*Sporobolus airoides*) may be the dominant plants. Other common wetland plants include Saltmarsh Aster (*Aster sublatus*), Barnyard Grass (*Echinochloa crus-galli*), Plains Coreopsis (*Coreopsis tinctoria*), and Marshelder (*Iva sp*.).

Though herbaceous wetlands are widespread in the region, they comprise less than two percent of the total acreage. Many wetlands are in poor condition as a result of sedimentation that occurs when exposed soil from surrounding crop fields is carried by storm water runoff and deposited in wetland depressions. Additionally, many playas and other seasonal wetlands have been plowed and converted to agricultural uses.

Recognized vegetation associations within this habitat type include:

- Broadleaf Cattail Marsh
- Common Spikerush – Hairy Waterclover Marsh
- Inland Saltgrass – Alkali Sacaton Temporarily Flooded Grassland
- Inland Saltgrass – Three-square Bulrush Temporarily Flooded Grassland
- Pennsylvania Smartweed – Curlytop Smartweed Wetland
- Prairie Cordgrass Marsh
- Three-square Bulrush Marsh
- Water Smartweed Wetland

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that are found in the Herbaceous Wetlands habitat type in substantial numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend is based upon an evaluation of the existing statewide or regional data over the past 50 years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	American Golden Plover	uncommon spring and fall migrant through the eastern half of the region	U
Bird	Bald Eagle	very rare winter resident; often associated with flood plain wetlands and wetland complexes with large concentrations of waterfowl	I
Bird	Barn Owl	uncommon year-round resident; hunts in wetlands but is dependent upon barns and buildings for nesting and roosting sites	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Black Rail	rare spring and fall migrant; may nest in wet years in wetlands along the Cimarron and Beaver rivers	U
Bird	Canvasback	uncommon spring and fall migrant; occupies larger, vegetated wetlands	S
Bird	LeConte's Sparrow	uncommon spring and fall migrant; occupies tall grassy vegetation at the margins of wetlands	U
Bird	Lesser Scaup	uncommon winter resident; occupies large wetland basins	D
Bird	Little Blue Heron	rare summer resident in the eastern third of the region	U
Bird	Long-billed Curlew	uncommon migrant region-wide & uncommon summer resident in the western half of the region; nests in grasslands often near playas	S
Bird	Northern Pintail	common winter resident throughout the region	U
Bird	Peregrine Falcon	rare but widespread spring and fall migrant; typically found in basins with large concentrations of shorebirds	S
Bird	Short-eared Owl	uncommon winter resident that roosts and hunts in tall grassy vegetation around the margins of wetlands	U
Bird	Solitary Sandpiper	uncommon spring and fall migrant	S
Bird	Trumpeter Swan	rare winter resident in the eastern half of the region	I
Bird	Upland Sandpiper	common spring and fall migrant; uncommon summer resident that breeds in grasslands around wetland basins	I
Bird	Western Sandpiper	uncommon spring and fall migrant throughout the region	D
Bird	Whooping Crane	very rare spring and fall migrant through the eastern third of the region	I
Bird	Wilson's Phalarope	common and widespread spring and fall migrant across the region	U
Inve	Bleached Skimmer	rare and locally occurring in the western half of the region; distribution is poorly documented	U
Inve	Oregon Fairy Shrimp	uncommon and locally occurring in seasonal wetlands; distribution is poorly documented	U
Rept	Spiny Softshell Turtle	uncommon and locally occurring in wetlands in stream and river flood plains	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality or Result in Habitat Loss through Wetland Conversion:

1. Draining and filling of wetlands for cropland development has permanently eliminated some herbaceous wetlands.
2. Heavy cattle grazing and fire suppression can cause conditions favorable for the invasion of flood plain wetlands by Salt Cedar and other woody plants.
3. Some playa basins have been dredged to create deep pits for the storage of water. This eliminates the shallow wetland habitat that normally dominates these basins.
4. Because wetland basins in the Shortgrass Prairie Region are typically seasonally wet and ephemeral, some landowners and lessees do not recognize them as wetlands nor understand their ecological value and value for groundwater recharge.

Conservation Actions:

- Encourage landowners to enroll wetlands in the Agricultural Conservation Easements Program (ACEP) that includes the continuation of the conservation that was accomplished by the former Wetland Reserve Program.
- Continue to distribute information about ecological value of playas and wetlands, as well as their importance for groundwater recharge. The Playa Lakes Joint Venture has helpful written, web-based and radio resources.
- Acquire conservation easements or fee-title from willing sellers to place biologically valuable (e.g. those that support SGCN) wetlands into conservation ownership.
- Recognize landowners and businesses that practice good land, water and wildlife stewardship through recognition and certification programs.
- Develop financial or tax incentives to cover the cost of maintenance and conservation of herbaceous wetlands. Provide cost-sharing to encourage wetland owners to control invasive plant species.
- Continue to provide cost-share funding to construct fencing around playas and wetlands to control cattle access.
- Provide cost-share funding or financial incentives to offset the costs of establishing vegetated buffers around wetlands and playa basins in agricultural fields.
- Conduct field studies to evaluate the severity and magnitude of the ecological damage done by invasive, exotic plants to species of greatest conservation need and the habitats on which they depend. Develop and implement control or management plans for those invasive species that cause the greatest impact.
- Implement a regional eradication and control program for Salt Cedars to remove them from flood plain wetlands.

Conservation Issues Related to Activities that Alter Flow and Inundation Patterns as well as Water Quantity:

5. Some irrigation practices can lower the water table and disrupt the normal hydrological cycle of wetlands.
6. Roads, berms and terraces sometimes divert water away from wetland basins and reduce the magnitude or duration of seasonal inundation.
7. Plowing and planting crops in and around playa basins causes sedimentation problems that impair a basin's ability to collect and retain surface water. These practices can alter the playa vegetation community from one that is dominated by perennial plants to one that is dominated by annuals.
8. Some farming practices fail to provide buffer vegetation around wetlands to control sediment in storm water runoff. These basins become repositories for sediment which eventual fills in the wetland and eliminates their potential for periodic or seasonal flooding.

Conservation Actions:

- Work with the agricultural community to improve irrigation technology and implement best practices to conserve water. Provide cost-share funding to upgrade irrigation systems to conserve water.
- Promote the use of Farm Bill programs that fund the creation of vegetative buffers around wetlands.
- Encourage landowners to enroll playas and wetlands in the Agricultural Conservation Easements Program (ACEP) that includes the continuation of the conservation that was accomplished by the former Wetland Reserve Program.
- Develop demonstration areas to show landowners the practices that can reduce soil erosion and halt the movement of sediment into wetland basins.
- Remove berms and terraces that block the movement of surface water into wetland basins and affect their seasonal hydrology.
- Repair semi-impervious substrates under wetlands that have been breached or broken and reduce the wetland's ability to hold water.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

9. Existing data are incomplete for some species of greatest conservation need with respect to their current distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
10. Our knowledge of the historic and current structural condition, distribution and community composition of Herbaceous Wetland Habitats within the Shortgrass Prairie Region is incomplete.

Conservation Actions:

- Conduct reviews of the existing literature, reports, and museum records, and interview technical experts to compile historic and recent distributional and ecological information for all species of greatest conservation need.
- Conduct surveys and research to assess the current distributions, abundances and habitat affinities for Tier I and Tier II species of greatest conservation need. Use these data to identify the geographic areas and habitat conditions where conservation efforts should be directed to provide the greatest benefit for populations of SGCN. Identify and prioritize core areas of habitat and, where needed, corridors to increase habitat connectivity.
- Conduct research to identify the factors that limit the distributions and abundances of species of greatest conservation need and examine the possible causes of any suspected population declines.
- Develop management recommendations to enhance populations of species of greatest conservation need through improved habitat conditions or enhanced juvenile recruitment. Conduct field surveys to establish baseline population statuses.
- Develop monitoring programs for selected species of greatest conservation need to measure their abundances, geographic ranges and the conditions of the habitats on which they depend. Develop and maintain databases to store and analyze these distributional and ecological data.
- Work with the NRCS's Ecological Site Description program to develop realistic and biologically meaningful descriptions for the condition of high quality herbaceous wetland communities. These should serve as the range of target conditions for wetland/playa restoration, enhancement and maintenance efforts.
- Inventory the mapped herbaceous wetlands as identified in the Playa Lake Joint Venture spatial data layer of county-based probable playas to determine their condition and the biological communities that they support. Where appropriate, identify the conservation practices that could enhance the value of these habitat tracts for SGCN.
- Make the results of all ecological studies available to agencies and organizations who can use them to inform local and regional planning efforts including future revisions of the Oklahoma Comprehensive Wildlife Conservation Strategy.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality:

11. Pesticides, sediment, endocrine disruptors and elevated concentrations of nutrients can be carried into wetlands through storm water runoff from agricultural areas. Because many wetland basins are closed or nearly closed systems, these substances can accumulate in wetlands and impair their water quality.
12. The removal of buffer vegetation around wetlands increases their exposure to pollutants that may be carried in storm water runoff and results in a decline in habitat quality. Pesticides and hormones can cause acute or chronic health and reproductive problems for invertebrates, fish and amphibians that live in wetlands.

Conservation Actions:

- Use conservation easements or land acquisition to place biologically important wetlands and surrounding buffers into conservation management or ownership in order to limit urban and agricultural development in the immediate watershed of wetlands (e.g. cultivation, land application of animal waste, concentrated animal operations and irrigation-dependent crop production).
- Establish set-back distances around wetlands for "soil farming" of oil & gas drilling waste, the land-application of animal waste or the use of pesticides in order to reduce the potential for excessive nutrients, hormones, pesticides, hydrocarbons, salts and solvents from entering wetlands via storm water runoff.
- Continue to provide financial and technical assistance to landowners to develop or maintain vegetated buffers around wetlands to protect water quality.
- Encourage the fencing of wetlands to control grazing in and around them and to allow the development of vegetative buffers.

Potential indicators for monitoring the effectiveness of the conservation actions:

- number of acres or number of wetlands enrolled in the ACEP (includes former Wetlands Reserve Program)
- acreage of wetlands that are fenced or burned
- change in the acreage that is annually irrigated
- change in acreages occupied by Salt Cedars in flood plain wetlands
- acres either acquired or placed under conservation easements
- amount of funding devoted to the implementation and monitoring of cost-share programs
- number and effectiveness of educational materials and their distribution.
- GIS evaluation of the distribution and dispersion of wetlands
- aerial surveys that track the number of wetlands with vegetative buffers
- number of wetlands restored to seasonal inundation and perennial vegetation
- changes in both the shallow water table and deep aquifers in the region
- population sizes and trends for representative species of greatest conservation need

High Priority Conservation Landscape: Sand Sagebrush/Bluestem Shrublands

Sand Sagebrush (*Artemisia filifolia*) shrublands are found in scattered locations across most of the Shortgrass Prairie Region, but are most common in the eastern third of the region and restricted to sites with deep sandy soils and stabilized dunes, primarily in the vicinity of the Beaver/North Canadian and Cimarron rivers. Sand sagebrush is typically associated with Sand Dropseed (*Sporobolus cryptandrus*) and Little Bluestem (*Schizachyrium scoparium*). In these plant communities, Sand Sagebrush may comprise five to 40 percent of the canopy cover depending upon factors such as grazing pressure which tends to decrease grass coverage and increase sagebrush, or fire frequency which tends to decrease sagebrush and increase the coverage by grasses. Other grasses and forbs found in this community include Sand Bluestem (*Andropogon hallii*), Sideoats Grama (*Bouteloua curtipendula*), Prairie Sandreed (*Calamovilfa longifolia*), Sand Lovegrass (*Eragrostis trichodes*), Sand Paspalum (*Paspalum stramineum*), Prairie Sunflower (*Helianthus petiolaris*), Mentzelia (*Mentzelia sp.*), Hairy Goldenaster (*Chrysopsis villosa*), Halfshrub Sundrops (*Calylophus serrulatus*), Annual Buckwheat (*Eriogonum anuum*), Indian Blanket (*Gaillardia pulchellum*), Western Spiderwort (*Tradescantia occidentalis*) and Yucca (*Yucca glauca*). The Shortgrass Prairie Region encompasses approximately half of the sand sagebrush shrublands that occur in Oklahoma. Most of the sand sagebrush/bluestem shrubland habitat is currently in fair to good condition (its condition is similar to its historic community structure) and the acreage occupied by this habitat has been stable for the past decade.

In the stabilized dune systems with the greatest magnitude of dune height, shrublands dominated by Skunkbrush (*Rhus aromatic*) and smaller numbers of Sand Plum (*Prunus angustifolia*) occur on the lower slopes and in swales. This specialized shrub community occurs locally in the eastern portion of the region in the stabilized dunes closely associated with the north banks of the Beaver and Cimarron rivers. Other woody plants that occur in small numbers include Sand Sagebrush (*Artemesia filifolia*), and Netleaf Hackberry (*Celtis reticulata*). Common grasses and forbs include Little Bluestem (*Schizachyrium scoparium*), Indian Blanket (*Gaillardia pulchellum*), Sideoats Grama (*Bouteloua curtipendula*) and Switchgrass (*Panicum virgatum*). The historic and current acreages for the skunkbrush shrub community type have not been measured, but they are unlikely to exceed more than 50,000 acres.

Recognized vegetation associations within this habitat type include:

Sand Sagebrush/Sand Dropseed – Little Bluestem Shrubland
Sand Plum/Little Bluestem Shrubland
Skunkbrush (Aromatic Sumac) Shrubland

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that are found in the Sand Sagebrush Shrubland habitat type in substantial numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past 50 years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Barn Owl	uncommon but widespread year-round resident in the vicinity of barns and buildings that provide nesting and roosting sites	U
Bird	Bell's Vireo	rare summer resident; nests locally in taller sand dune systems that support sand plum and skunkbrush thickets - particularly near	D

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
		riparian habitats	
Bird	Burrowing Owl	uncommon summer resident and rare winter resident; occurs locally in the vicinity of prairie dog colonies, which provide nesting and roosting habitat	S
Bird	Cassin's Sparrow	common summer resident; nests in open Sand Sagebrush habitats with abundant herbaceous vegetation.	U
Bird	Ferruginous Hawk	uncommon but widespread winter resident throughout the region	S
Bird	Harris's Sparrow	uncommon winter resident; occurs locally in taller sand dune systems that support sand plum and skunkbrush thickets - particularly near riparian habitats	U
Bird	Lesser Prairie-Chicken	uncommon year-round resident; widespread in open Sand Sagebrush habitats with abundant herbaceous vegetation	D
Bird	Loggerhead Shrike	uncommon year-round resident; occurs throughout the region in open sagebrush habitat where scattered trees provide nesting and perching sites	D
Bird	Northern Bobwhite	common year-round resident in a wide range of Sand Sagebrush habitats in the eastern half of the region	D
Bird	Painted Bunting	rare summer resident; nests locally in taller sand dune systems that support deciduous thickets of riparian-like vegetation	U
Bird	Red-headed Woodpecker	locally common summer resident; nests in mature cottonwoods in swales within the taller sand dune systems	D
Bird	Scaled Quail	uncommon year-round resident in low, sparse rolling sand sagebrush shrublands in the western half of the region	S
Bird	Swainson's Hawk	uncommon summer resident that occurs in the transition between sand sagebrush shrublands and the surrounding prairies	U
Inve	Ghost Tiger Beetle	locally occurring in stabilized dune habitats; range is incompletely documented	U
Mamm	Black-tailed Prairie Dog	locally common in colonies that occupy well-drained swales between dunes.	S
Rept	Lesser Earless Lizard	uncommon and locally occurring in areas of sparse vegetation on the crests of dunes, and on eroding or actively moving dunes	U
Rept	Texas Horned Lizard	common throughout this region in the sagebrush shrubland habitat type	Stable in this region but Declining statewide
Rept	Texas Long-nosed Snake	uncommon, nocturnal and secretive; this is a burrowing species that is uncommonly encountered; therefore its range has been incompletely documented	U
Rept	Western Massasauga	rare and locally occurring in the eastern third of the region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

1. Excessive grazing can reduce the quality and structure of sagebrush shrublands by reducing native grass cover, in particular bluestem cover, and facilitating the expansion of sagebrush. Less grass cover reduces the competition for water and space that sagebrush would normally face and reduces the fuel load for fires that might setback sagebrush. Because the entire Shortgrass Prairie Region receives irregular and scant rainfall, all habitat types within the region are prone to unpredictable droughts that create additional challenges for ranchers who have to quickly adjust stocking rates to compensate for decreased forage production.
2. Continuous grazing or the frequent rotation of grazing livestock may result in the loss of forb species that are especially palatable and favored by cattle. It also may reduce the abundance of standing dead herbaceous cover in the winter and spring, which reduces habitat quality for some wintering birds and nesting habitat quality for early-spring breeding birds.
3. Aerial spraying of broadleaf herbicides to reduce sand sagebrush density has a negative effect on diversity and the abundance of native forbs, which in turn reduces habitat quality and food availability for insects, birds, reptiles and small mammals.
4. Fire suppression has created conditions that encourage the encroachment of Eastern Redcedar into the sand sagebrush shrubland habitat. Excessive numbers of redcedars negatively affect some bird species by providing cover for their predators and by shading or crowding out native sagebrush, forbs and grasses. Fire suppression also can facilitate a local over-abundance of Sand Sagebrush.
5. Land conversion and prairie dog control efforts have resulted in the loss of large prairie dog complexes (i.e., those in excess of 1,000 acres) that are important to the long-term sustainability of Black-tailed Prairie Dogs themselves as well as associated species including Burrowing Owl and Ferruginous Hawk.

Conservation Actions:

- Encourage nature tourism, lease hunting and lease fishing as a supplemental economic benefit to landowners so that they can manage for improved sagebrush shrubland habitat by reducing grazing pressure during times of drought.
- Develop and distribute technical assistance information to landowners on economic benefits of adjustments to stocking rates, prescribed fire, patch-burn grazing techniques, conservation cost-share programs and invasive species management.
- Identify and prioritize core areas of Black-tailed Prairie Dog colonies to enhance complex development. Maintain or possibly expand programs like the Landowner Incentive Program for the conservation of Black-tailed Prairie Dogs and other species, focusing on restoration and enhancement.
- Acquire fee-title from willing sellers or conservation easements in order to place high quality examples of sand sagebrush habitat into conservation management (e.g., by conservation agencies or non-governmental organizations such as The Nature Conservancy) for the conservation of species of greatest conservation need.
- Increase funding for the Conservation Reserve and the Agricultural Conservation Easement programs of the Farm Bill, and increase the eligibility of sand sagebrush shrubland habitat in the enrollments of the ACEP.
- Develop or update existing Best Management Practices (BMPs) for grazing and fire management to enhance the diversity and quality of sand sagebrush shrublands.
- Develop demonstrations areas that showcase the compatibility between sustainable ranching and sand sagebrush shrubland habitat management. Recognize the efforts of landowners who are good habitat and wildlife stewards.
- Encourage and promote alternative grazing practices that use patch burning and mineral blocks to control the movement of cattle rather than relying entirely on fencing.

- Facilitate the use of prescribed burning as a tool to control Eastern Redcedar in the eastern portion of the region, by providing technical assistance to landowners and by providing logistical and financial assistance to prescribed burning associations.
- Continue the cost-share program for the clipping/cutting of Eastern Redcedar. Promote enrollment of industries and landowners in the Lesser Prairie-Chicken Range Wide Plan which provides a higher cost share ratio for redcedar control.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

6. Existing data are incomplete for species of greatest conservation need with respect to their distributions, ecological needs, and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
7. Baseline knowledge about the historic and current distribution and structural condition of the Sand Sagebrush shrubland habitat type is incomplete.

Conservation Actions:

- Conduct reviews of existing literature, reports, and museum records, and interview technical experts to compile historic and recent distributional and ecological information for all species of greatest conservation need.
- Conduct surveys and research to assess the current distribution, abundance and habitat affinities for Tier I and Tier II species of greatest conservation need. Use these data to identify the geographic areas and habitat conditions where conservation efforts should be directed to provide the greatest benefit for these species. Identify and prioritize core areas of habitat and, where needed, corridors to increase habitat connectivity.
- Conduct research to identify the factors that limit the distributions and abundances of species of greatest conservation need and examine possible causes of suspected population declines.
- Develop management recommendations to enhance populations of SGCN through improved habitat conditions or enhanced juvenile recruitment, and conduct field studies to establish baseline population data/information.
- Develop monitoring programs for representative species of greatest conservation need to measure their abundance, geographic range and the condition of their habitat. Develop and maintain databases to store and analyze these distributional and ecological data.
- Work with the NRCS's Ecological Site Description program to develop a realistic and biologically meaningful set of descriptions for how high quality Sand Sagebrush / Little Bluestem communities should look. These should serve as the range of target conditions for Sand Sagebrush shrubland restoration, enhancement and maintenance efforts.
- Develop methods to identify and map the distribution of the remaining habitat tracts, then inventory these to determine their condition and the biological community that they support. Where appropriate, identify the conservation practices that could enhance the habitat value of these tracts for species of greatest conservation need.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

8. Most of the fragmentation of sand sagebrush shrublands has been the result of small-scale activities such as roads, pipelines, oil/gas drilling locations, electric transmission lines and wind energy developments. Larger-scale conversions have taken place to develop crop fields, but these are primarily in locations where access to supplemental irrigation water is available through deep wells and/or confined livestock rearing operations.

9. Fences play a role in the fragmentation of sagebrush habitats because they provide locations where Eastern Redcedars can become established. Additionally, they can create a collision hazard for ground-nesting birds (e.g. Lesser Prairie-Chicken) and travel corridors for larger predators.
10. Landscape-scale fragmentation has occurred in recent years due to the construction of wind turbines. If new interstate transmission lines are constructed, the region will see further expansion of utility-scale wind energy developments and continued habitat fragmentation. Additionally, wind turbines and transmission lines may cause direct bird and bat mortalities due to collisions, and may trigger avoidance behavior from species such as the Lesser Prairie-Chicken.

Conservation Actions:

- Identify/prioritize core areas of habitat and corridors to connect them. Purchase conservation easements or fee-title from willing sellers to conserve biologically important tracts and place them under conservation management or ownership.
- Provide cost-share funding or financial incentives to remove unneeded or abandoned fences in areas where they would produce obstacles for Lesser Prairie-Chickens or facilitate the expansion of Eastern Redcedar.
- Support increasing the funding available for the Farm Bill's Agricultural Conservation Easements Program (ACEP) and CRP.
- Update fire-related BMPs to encourage increased use of prescribed burning to control the abundance of Eastern Redcedar.
- Subsidize burn schools, training and equipment for prescribed burning associations and contractors to make the use of prescribed fire more affordable for landowners.
- Support ranching and encourage grazing practices that conserve sand sagebrush habitat in a manner that is consistent with its historic condition.
- Promote enrollment in the Lesser Prairie Chicken Range Wide Plan by industry and private landowners.

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

11. Much of the Conservation Reserve Program within or adjacent to this habitat type has been planted to exotic invasive species such as Old World Bluestem.
12. The quality and quantity of this habitat has been decreased by invasive species - particularly the native Eastern Redcedar, the exotic Old World Bluestem and Russian Thistle. Loss of the historic fire regime across the region has allowed for the expansion of Eastern Redcedar into many tracts of Sand Sagebrush shrubland.

Conservation Actions:

- Encourage the use of rotational prescribed burning to maintain Sand Sagebrush shrubland habitat and control the abundance of invasive junipers and locusts.
- Develop and implement an Invasive Species Management Plan on all public conservation lands to address the control of exotic and/or invasive species. Use these areas as demonstration sites to encourage neighboring landowners to implement invasive species controls.
- Provide cost-share funding or economic incentives to landowners to encourage them to implement invasive species control methods.
- Provide financial and logistical support to the existing prescribed burning associations or commercial burn teams to make the use of prescribed fire more accessible to landowners.
- Encourage and support actions to manage native Brown-headed Cowbird populations in areas where they would affect avian species of greatest conservation need (e.g. near riparian habitats and sand plum/skunkbush shrublands).

- Where feasible, remove exotic grasses from CRP fields and replant with native grasses and forbs. Include native shrubs as part of the planting mix in new and re-enrolling CRP contracts.
- Continue to provide cost-share funding for the clipping/cutting of Eastern Redcedar.
- Develop new or update existing BMPs for controlling invasive species.

Potential indicators for monitoring the effectiveness of the conservation actions:
- acres of native plant communities restored
- changes in acreage/coverage of exotic vegetation
- numbers of acres burned/treated
- numbers of acres enrolled in conservation programs, including the Landowner Incentive Program and Lesser Prairie Chicken RWP
- population sizes and trends for species of greatest conservation need and key indicator species
- relative condition and acres of sagebrush shrubland habitat

<u>Moderate Priority Conservation Landscape: Mixed-grass Prairie</u>

This is a relatively common habitat type found in the eastern third of the Shortgrass Prairie Region. In the western portion of the region, mixed-grass prairies are most often found in rich soils and bottomlands. Mixed-grass Prairies in this region are dominated by Little Bluestem (*Schizachyrium scoparium*), Sideoats Grama (*Bouteloua curtipendula*) and Blue Grama (*Bouteloua gracilis*). Silver Bluestem (*Bothriochloa saccharoides*) and Prairie Threeawn (*Aristida oligantha*) occur in disturbed sites. Other common grasses and forbs include Sneezeweed (*Helenium amarum*), Heath Aster (*Aster ericoides*), Roundleaf Bladderpod (*Lesquerella ovalifolia*), and Foxtail Barley (*Hordeum jubatum*). This habitat type seems more common today than it was historically in the region because of the large acreage of former cropland that has been enrolled into the Conservation Reserve Program and planted to bluestem grasses. These fields resemble mixed-grass prairies in structure, but most of these fields are dominated by exotic grasses such as Old World Bluestem (*Bothriochloa ischaemum*) and many have been planted in areas that were historically vegetated by shortgrass prairies.

Recognized vegetation associations within this habitat type include:

- Little Bluestem – Blue Grama Grassland
- Little Bluestem – Sideoats Grama – Blue Grama Grassland
- Silver Bluestem Grassland
- Vine Mesquite – Buffalograss Grassland

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past 50 years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Baird's Sparrow	very rare spring and fall migrant; rarely documented in Oklahoma but presumably occupies stands of taller or denser grasses	U
Bird	Barn Owl	uncommon year-round resident in prairies and agricultural landscapes where barns and buildings provide nesting and roosting sites	U
Bird	Burrowing Owl	uncommon but widespread summer resident and rare winter resident; typically found in association with prairie dog colonies, which provide nesting and roosting sites	S
Bird	Cassin's Sparrow	locally common summer resident; nest in prairies and CRP fields with yucca and sparse woody shrub cover	U
Bird	Chestnut-collared Longspur	uncommon winter resident in grazed prairie with sufficient standing grass cover	U
Bird	Ferruginous Hawk	uncommon year-round resident in the western half of the region; uncommon but widespread winter resident throughout the region	S
Bird	Harris's Sparrow	uncommon winter resident in mixed-grass prairies that contain some shrub cover or thickets	U
Bird	LeConte's Sparrow	uncommon spring and fall migrant that occupies mixed-grass prairies with tall standing vegetation	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Lesser Prairie-Chicken	uncommon year-round resident; widespread in open grassland habitats with abundant herbaceous vegetation	D
Bird	Loggerhead Shrike	uncommon but widespread year-round resident; occupies grazed mixed-grass prairies that contain scattered trees for nesting and perching	D
Bird	Long-billed Curlew	Common spring and fall migrant; a few pairs nest in the western half of the region	S
Bird	McCown's Longspur	uncommon winter resident; usually found in small flocks; occupies grazed prairies as well as winter wheat fields	U
Bird	Northern Bobwhite	common year-round resident in mixed-grass prairies that have some shrub cover	D
Bird	Prairie Falcon	uncommon but widespread in the region, primarily as a winter resident	S
Bird	Short-eared Owl	common winter resident and rare summer resident; occupies ungrazed or lightly grazed mixed-grass prairie and CRP fields that have abundant standing cover	U
Bird	Sprague's Pipit	uncommon spring and fall migrant through the eastern half of the region; occupies a wide range of prairie conditions including heavily grazed sites	U
Bird	Swainson's Hawk	common summer resident throughout the region; occurs in open, level prairies with isolated or scattered trees to provide nesting sites	U
Bird	Upland Sandpiper	common spring and fall migrant; rare summer resident that may nest during wet years in mixed-grass prairie tracts with abundant standing cover	S
Mamm	Black-tailed Prairie Dog	locally common in colonies; approximately 600 colonies are found throughout this region	S
Mamm	Swift Fox	occurs at low density but is widespread across the region; occurs in landscapes with a mosaic of shortgrass and mixed-grass prairie habitats	S
Rept	Texas Horned Lizard	Locally common in large tracts of native grassland and in landscapes dominated by native, warm-season grasses	Stable in this region but Declining statewide
Rept	Texas Long-nosed Snake	uncommon, nocturnal and secretive; this is a burrowing species that is uncommonly encountered; therefore its range has been incompletely documented	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversions:

1. Conversion of native prairie to crop fields has reduced the acreage of mixed-grass prairie in the region by more than 50%. As prairies have been converted to agricultural fields, the remaining tracts of prairie have declined in quality because of reduced sized and increased isolation from each other. Decreased size and increased isolation of habitat tracts disproportionally affects species of greatest conservation need that require large acreages of habitat for their home ranges or territories (e.g. Lesser Prairie Chicken), or that have limited dispersal and long-distance movement abilities (e.g. Texas Horned Lizard).

2. Energy exploration and development, including wind power development, fragments prairie habitats through the construction of access roads, pipelines, electric transmission lines, wind turbines and drilling pads. This type of fragmentation reduces the quality of the habitat for species of greatest conservation need by creating obstacles for the movement of wildlife across the landscape and triggering avoidance behavior in some species.

Conservation Actions:

- Assess the current distribution of large tracts of mixed-grass prairie and known populations of species of greatest conservation need in order to identify those areas that have the greatest conservation value. Acquire fee-title from willing seller or conservation easements in order to place some of the most important tracts of mixed-grass prairie into conservation ownership or management.
- Encourage or cost share the development of demonstration areas that show and describe grazing and fire regimes in the region that benefit species of greatest conservation need.
- Develop and update Best Management Practices (BMPs) for grazing management, erosion control, and herbicide application.
- Provide cost-share funding to encourage landowners to convert cropland to native mixed-grass prairie grasses and forbs.
- Increase the funding for the Agricultural Conservation Easement Program (includes the former Grassland Reserve Program) and place greater emphasis on mixed-grass prairies.
- Increase the funding available to cost-share with landowners to implement practices that maintain or improve existing mixed-grass prairie habitat.
- Support the continuation of the Conservation Reserve Program (CRP) policies that require re-enrolling contracts to be planted to at least 51% native grasses and forbs, and research planting and management techniques that will help native grasses compete with established Old World Bluestem. Advocate for requiring that new CRP contracts be planted to 100% native species.
- Encourage the removal of unneeded or abandoned fences.
- Encourage and promote alternative grazing practices that use patch burning and mineral blocks to control the movement of cattle rather than using fencing.
- Cooperate with appropriate entities (e.g., energy companies, federal and state agencies, and individual landowners) to site energy developments in a way that will minimize fragmentation of native habitats and have less impact on species of greatest conservation need.
- Require on-site or off-site mitigation for unavoidable energy development impacts on native prairie habitats.

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

3. Introduced and/or invasive species, particularly the native Eastern Redcedar and the exotic Old World Bluestem and Russian Thistle, have established themselves widely in mixed-grass prairies in the region and have altered habitat structure.
4. Many of the CRP enrollments in the region have been planted to exotic grasses, primarily Old World Bluestem, which has facilitated their expansion.

Conservation Actions:

- Provide financial and technical assistance to landowners who are willing to convert crop fields, expired CRP fields and pastureland back to native mixed-grass prairie vegetation.
- Require that new CRP enrollments use only native grasses and forbs that are appropriate for their soil type and location.

- Develop and implement an Invasive Species Management Plan on all public conservation lands to address the control of exotic and/or invasive species. Use these areas as demonstration sites to encourage neighboring landowners to implement invasive species controls.
- Provide cost-share funding or economic incentives to landowners to encourage them to implement invasive species control methods.
- Provide financial and logistical support to the existing prescribed burning associations and to commercial burn teams to make the use of prescribed fire more accessible to landowners.
- Support prescribed burning as a means for controlling the abundance of Eastern Redcedar in mixed-grass prairie habitats.
- Develop of tax incentives for landowners who maintain high quality native prairie.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

5. Heavy and/or continuous grazing has reduced the species and structural diversity of mixed-grass prairies. This reduction has lowered the availability of food and cover for wildlife.
6. The construction of fences to intensively manage livestock grazing has created collision obstacles for prairie-dependent species such as Lesser Prairie Chickens. Fences also create travel corridors across prairies that are used by generalist predators such as Coyotes and Red-tailed Hawks, and they are often colonized by Eastern Redcedars.
7. Land use changes and control measures have reduced the number and sizes of Black-tailed Prairie Dog colonies and have isolated many of the remaining colonies.
8. Broadleaf herbicide treatments have reduced the abundance of native forbs, and thus reduce the food resources available for insects, birds, reptiles and small mammals.

Conservation Actions:

- Encourage and support economic incentives and programs like the former Landowner Incentives Program that provide payments to landowners who maintain or restore Black-tailed Prairie Dog colonies.
- Encourage and support ranch diversification to allow for lower stocking rates that would be economically off-set by income from lease hunting, fishing access, and nature tourism/wildlife viewing.
- Provide technical assistance to landowners to encourage grazing practices that minimize fencing and increase the structural diversity of rangelands.
- Encourage private land acquisition and conservation easements (e.g., by land trusts and non-governmental organizations such as The Nature Conservancy) to maintain high quality examples of mixed-grass prairie habitat.
- Encourage and facilitate burn schools for fire cooperatives and contractors.
- Develop and distribute informational materials to increase landowner awareness and use of grazing BMPs and Farm Bill conservation programs.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

9. Existing data are incomplete for some species of greatest conservation need with respect to their current distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
10. Incomplete information exists regarding the historic and current structural condition, distribution and community composition of mixed-grass prairies within the Shortgrass Prairie Region.

Conservation Actions:

- Review existing literature, reports and museum records, and interview technical experts to compile historic and recent distributional and ecological information for all species of greatest conservation need.
- Conduct surveys and research to assess the current distribution, abundance and habitat needs of the Tier I and Tier II species of greatest conservation need. Use these data to identify the geographic areas and habitat conditions where conservation efforts should be directed to provide the greatest benefit for these species.
- Identify and prioritize core areas of habitat and, where needed, corridors to increase habitat connectivity.
- Conduct research to identify the factors that limit the distributions and abundances of species of greatest conservation need and examine possible causes of any suspected population declines.
- Develop management recommendations to enhance populations through improved habitat conditions or enhanced juvenile recruitment.
- Develop monitoring programs for representative species of greatest conservation need to measure their abundance, geographic range and the condition of their habitats. Develop and maintain a database to store and analyze these distributional and ecological data.
- Evaluate the NRCS's Ecological Site Descriptions for the range of mixed-grass prairie communities. Use these and other literature, to develop a series of realistic and biologically meaningful descriptions for how high quality mixed-grass prairie habitats should look. These should serve as the range of target conditions for habitat restoration, enhancement and maintenance efforts.
- Develop methods to identify and map the distribution of the remaining mixed-grass prairie tracts, then inventory these to determine their condition and the biological communities that they support. Where appropriate, identify the conservation practices that could enhance the habitat value of these tracts.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acres of complete mixed-grass prairie communities restored
- acres of habitat occupied or impacted by wind energy and oil/gas development
- acres under easements or enrolled in conservation programs
- number of Black-tailed Prairie Dog colonies and Lesser Prairie-Chicken leks enrolled in conservation programs and throughout the landscape
- change in acreage that is affected by invasive exotic vegetation.
- index of habitat fragmentation and isolation of prairie tracts
- population sizes and trends for species of greatest conservation need and key indicator species
- change in condition and quantity of mixed-grass prairies

Moderate Priority Conservation Landscape: Sandy-bottom Streams, Springs and Associated Riparian Woodlands

Only a small number of perennial and intermittent streams are found in this relatively arid Shortgrass Prairie Region. Most streams have a sandy or silty substrate except for a few locations in the Black Mesa area where streams may have rocky or gravel substrates. Many streams are not perennial and water may cease to flow above ground during the driest periods in the summer. Many stream channels are lined with semi-aquatic vegetation such as Cattails (*Typha angustifolia*), Three-square Bulrush (*Schoenoplectus pungens*) and Spikerushes (*Eleocharis sp*.). The riparian areas along these streams are often open woodlands dominated by Eastern Cottonwood (*Populus deltoides*), Sandbar Willow (*Salix exigua*), Peachleaf Willow (*Salix amygdaloides*), and Sand Plum (*Prunus angustifolia*). Herbaceous plants include Switchgrass (*Panicum virgatum*), Sweetscent (*Pluchea odorata*), and Germander (*Teucrium canadense*).

Recognized vegetation associations in this habitat type include:

Eastern Cottonwood – Black Willow Woodland
Eastern Cottonwood – Sandbar Willow Woodland
Sandbar Willow/Switchgrass Shrubland

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

Springs and seeps are rare in this region, and most of these are found in the Black Mesa area or along stream channels. The ground surrounding springs and seeps is often vegetated with herbaceous wetland plants such as Three-square Bulrush, Spikerushes and cattails. From the perspective of species of greatest conservation need, the most biologically significant springs occur in the Cimarron River watershed, where springs support populations of the Arkansas Darter (*Etheostoma cragini*), which is a candidate for potential federal listing under the Endangered Species Act.

The species of greatest conservation need that occupy the streams, springs and riparian woodlands of the Shortgrass Prairie Region in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend estimate is based upon an evaluation of the existing statewide or regional data during the past 50 years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Bell's Vireo	rare summer resident in the eastern half of the region; nests in willow and plum thickets in riparian woodlands	D
Bird	Bullock's Oriole	locally common summer resident throughout the region; nests in open, riparian woodlands dominated by Plains Cottonwood and American Elm	U
Bird	Little Blue Heron	rare summer resident in the eastern third of the region	U
Bird	Northern Bobwhite	common year-round resident that is found in open, shrubby riparian habitats in the eastern half of the region	D
Bird	Painted Bunting	rare summer resident; nests locally in riparian thickets in the eastern third of the region	U
Bird	Red-headed Woodpecker	locally common summer resident in open riparian woodlands dominated by cottonwoods	D

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Solitary Sandpiper	uncommon spring and fall migrant along streams throughout the region	S
Fish	Arkansas Darter	locally common in springs and seeps on tributaries of the Cimarron River in the eastern half of the region	U
Fish	Plains Minnow	uncommon in tributaries of the Beaver and Cimarron rivers throughout the region	D
Mamm	Long-tailed Weasel	rare and secretive; its range is poorly known but is likely to occur in riparian areas throughout the region	U
Mamm	Mountain Lion	rare and occurs at low density throughout the region; most records are from the western third of the region	I
Mamm	Western Big-eared Bat	rare resident species that forages in riparian habitats in the area surrounding Black Mesa	U
Rept	Spiny Softshell Turtle	locally common species that occurs in perennial stream and pools throughout the region	U
Rept	Texas Gartersnake	rare resident of riparian areas in the eastern quarter of the region; its range is poorly known and may intergrade with Red-sided Gartersnake	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Activities that Alter Flow Patterns and Water Quantity:

1. Irrigation practices that involve groundwater pumping from shallow aquifers have the potential to lower the water table and reduce the quantity of water available to feed springs and streams.
2. Dams and water diversions have been constructed on many streams and intermittent tributaries. These have the potential to reduce the volume of water that flows into stream channels and can diminish flow during periods of drought.
3. Impoundments in the headwaters of streams have reduced inflows into streams following storm events.

Conservation Actions:

- Encourage the adoption of minimum stream flow requirements for streams that support biologically important populations of aquatic species of greatest conservation need.
- Delineate the recharge areas for biologically important springs and seeps in order to protect water quantity. Use conservation easements or fee-title acquisition to place springs and their recharge areas under conservation management to maintain ground water to sustain surface flows at springs.
- Provide cost-share funding to encourage the development of alternative water sources (e.g. wind mills or solar pumps with stock tanks) to prevent livestock from watering directly from streams.
- Where feasible, remove dams that block or impede the movement of fish and other aquatic species of greatest conservation need within and between streams.
- Discourage the pumping of water from shallow aquifers underlying streams and springs that support aquatic species of greatest conservation need.
- Purchase water rights from willing sellers around springs and seeps that maintain/support populations of aquatic species of greatest conservation need.
- Construct seasonal wetlands within the flood plains for streams to store flood flows and storm water runoff for slow release into the water table or directly into the stream to sustain surface flows and ground water.

- Develop and distribute informational materials to landowners concerning water conservation practices.
- Provide cost-share funding to landowners to purchase more efficient irrigation equipment as a means of conserving ground water to sustain springs and streams.

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

4. Cottonwood regeneration has been reduced or eliminated in some stream reaches due to lowering of the water table and encroachment of Salt Cedars into riparian areas.
5. Widespread encroachment exotic Salt Cedars has occurred in riparian woodlands throughout the region. Salt Cedars increase soil salinity and compete with native woody vegetation.
6. Exotic and/or invasive plant species such Ravenna Grass, Giant Reed, Salt Cedar, Johnson Grass, Russian Olive and several species of Brome have become established locally in riparian habitats. These plants displace more beneficial native vegetation, compete with native plants for water and have unnaturally altered the structure and density of riparian areas.

Conservation Actions:

- Conduct field studies to determine the factors responsible for the decreased level of Eastern Cottonwood regeneration in riparian areas.
- Conduct studies to determine the negative effects of the more common exotic species and develop control or eradication programs for those species that cause the greatest damage to the habitats required by species of greatest conservation need.
- Develop and distribute technical assistance materials to landowners and others concerning mechanisms for eradicating or managing invasive species.
- Develop and implement invasive and exotic species management plans on all public conservation lands in the region. Provide financial incentives to private landowners to encourage them to participate in invasive species management programs.
- Coordinate with the NRCS and local conservation districts to disseminate information to private landowners, leases and land management companies to discourage or stop the introduction of exotic and invasive plants.
- Modify erosion control recommendations to eliminate the planting of exotic species.
- Conduct field studies to determine the most efficient and effective methods of controlling Salt Cedar. Support the continued study of the efficacy of Salt Cedar leaf beetles for the biological control of Salt Cedar.
- Facilitate the establishment of demonstration plots showing successful techniques for the removal of Salt Cedar, Russian Olive and other riparian invasive species.
- Develop and distribute education materials to anglers and landowners about the ecological problems associated with the introduction of fish from other watersheds (e.g. through bait bucket releases).

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

7. Heavy grazing within riparian areas during the growing season reduces the abundance and diversity of native understory vegetation and hinders cottonwood regeneration.
8. Springs and stream channels have been modified by the construction of concrete and earthen dams to create ponds for watering cattle or storing water for irrigation. These modifications alter the habitat and create barriers for the passage of fish.
9. Riparian habitats have been converted to agricultural land uses such as Bermuda-grass pasture and crop fields because of their rich, level soils. This directly eliminates riparian habitat and has indirect consequences for streams such as decreased shading, decrease bank stability and increased sedimentation of in-stream habitats.

Conservation Actions:

- Develop and distribute informational materials to landowners and others concerning ways to successfully manage or enhance this wildlife value of riparian habitats.
- Encourage the use of erosion control cost-share programs and incentives programs, such as the stream buffer program provided by the Natural Resources Conservation Service, to conserve and enhance riparian habitat along streams and around springs.
- Develop programs to provide tax relief for landowners who engage in practices that protect and enhance native riparian plant communities.
- Provide cost-share funding to landowners for the fencing of riparian corridors to control access by cattle during the summer months, and to develop alternative sources of shading for livestock to reduce their impact to riparian habitat.
- Provide cost-share funding to encourage the development of alternative water sources (e.g. wind mills/solar pumps with stock tanks) as a replacement to livestock ponds that are constructed across streams or to prevent livestock from watering directly from streams.
- Assess existing stream and riparian habitat and the distributions of species of greatest conservation need in order to identify those stream reaches that have the greatest value to the conservation of uncommon or declining species. Acquire conservation easements or fee-title from willing sellers on these stream and riparian habitats that have high conservation value in order to place them into conservation ownership or conservation management to benefit SGCN.
- Develop cost-share programs and landowner incentive programs that fund and encourage the protection and restoration of riparian vegetation, water quality, springs and in-stream habitat.
- Provide cost-share funding to restore native vegetation around springs and to remove modifications such as small impoundments. Encourage the construction of bridges and water crossing that do not impede the movement of fish SGCN.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality:

10. Wastes from concentrated animal farming operations/hog farms are typically applied to crop fields through irrigation lines. In local situations where application fields are close to streams, the application of liquid waste increases the potential for excessive nutrients (e.g. nitrogen from ammonia) to enter waterways in storm water runoff. Ammonia can directly kill fish and other aquatic life, while nutrients can contribute to algal blooms and dissolved oxygen fluctuations that may cause fish-kills.
11. The uncontrolled access of livestock to stream channels and riparian areas can result in increased amounts of nutrients in the water. Additionally, the activity of livestock may damage the riparian vegetation that stabilizes stream banks and thus contribute to bank erosion and sedimentation.
12. Hormones and pesticides that function as growth inhibitors or endocrine system disruptors may enter streams through storm water runoff and discharges associated with crop fields and poultry, hog and cattle feeding operations. These chemicals can disrupt the development and/or reproduction of non-target organisms such as crayfish, fish and amphibians.

Conservation Actions:

- Develop and distribute informational materials to landowners and others concerning ways to minimize or eliminate the harmful effects of pesticides, hormones and fertilizers in streams.
- Amend the regulations for concentrated animal feeding operations to limits the amount of waste, especially phosphorus, which can be applied on the land in proximity to streams and wetlands.

- Provide cost-share funding to landowners for the fencing of riparian corridors to control access by cattle during the summer months, and to develop alternative sources of shading for livestock to reduce their impact to riparian habitat.
- Construct seasonal wetlands within flood plains to capture and filter storm water runoff and slowly release it into the water table or directly into the stream to sustain surface flows and ground water.
- Encourage the use of erosion control cost-share programs and incentives programs, such as the stream buffer program provided by the Natural Resources Conservation Service, to enhance riparian habitat along streams and around springs to filter sediment, nutrients and chemicals from agricultural storm water runoff.
- Encourage the development of set-back distances from streams for the application of fertilizer, pesticides and animal wastes to protect water quality.
- Encourage and support restoring vegetation around springs and removing human modifications such as small impoundments.
- Encourage fencing springs and the headwaters of streams to control access by livestock and retain buffer vegetation to filter storm water runoff.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

13. Data are incomplete for some species of greatest conservation need with respect to their current distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
14. Incomplete information exists regarding the historic and current structural condition, seasonal flow dynamics and community composition of streams and riparian habitats in the Shortgrass Prairie Region.
15. Data are incomplete with respect to the locations and conditions of springs and seeps, largely because these are small habitat types embedded within larger landscapes of prairies and shrublands or are scattered along stream channels

Conservation Actions:

- Conduct reviews of existing literature, reports and museum records, and interview technical experts to compile historic and recent distributional and ecological information for all species of greatest conservation need.
- Conduct research to identify the factors that limit the distribution and abundance of Tier I and Tier II species of greatest conservation need. Develop management recommendations to enhance their populations through improved habitat conditions or increased juvenile recruitment.
- Conduct field surveys to assess the current distribution and habitat needs of Tier I and Tier II species of greatest conservation need, and use these data to identify the streams and watersheds where conservation efforts should be directed to provide the greatest benefit for these species.
- Research the historic condition of stream and riparian habitats in the Shortgrass Prairie Region in order to develop a series of realistic and biologically meaningful descriptions for the structure and condition of high quality habitat. These should serve as the range of target conditions for habitat restoration, enhancement and maintenance efforts.
- Develop population monitoring programs for selected stream and riparian species of greatest conservation need and monitor the quality/condition of their habitats.
- Develop and provide long-term funding to create and maintain a springs/streams data base to track location, land ownership, and biological data for species of greatest conservation need.
- Work with individual landowners to gain permission to conduct biological inventories of springs and streams.

Potential indicators for monitoring the effectiveness of the conservation actions:

- number of protected springs and stream reaches
- relative condition of riparian woodlands (e.g. species diversity)
- stream and spring flow
- changes in water quality parameters
- acres of degraded and restored stream and riparian habitat
- number of acres under easements or conservation practices
- groundwater levels and surface flow rates
- landowners participating in conservation practices
- population sizes and trends for species of greatest conservation need and key indicator species

Potential partnerships to deliver conservation in the Shortgrass Prairie Region:

State Government

- Conservation Districts
- Oklahoma Dept. of Wildlife Conservation
- Oklahoma Commissioners of Land Office
- Oklahoma Conservation Commission
- Oklahoma Department of Environmental Quality
- Oklahoma Energy Resources Board
- Oklahoma Legislature
- Oklahoma Renewable Energy Council
- Oklahoma State University, Cooperative Extension Service
- Oklahoma State University, Department of Natural Resources, Ecology and Management
- Oklahoma Tourism and Recreation Department
- Oklahoma Water Resources Board
- Other state universities and departments
- University of Oklahoma, Oklahoma Natural Heritage Inventory
- Association of Fish and Wildlife Agencies
- Western Association of Fish and Wildlife Agencies

Federal Government

- Federal Regulation and Oversight of Energy
- U.S. Army Corps of Engineers
- U.S. Bureau of Reclamation
- U.S. Department of Agriculture, Farm Service Agency
- U.S. Department of Agriculture, Forest Service
- U.S. Department of Agriculture, Forest Service, Rita Blanca National Grasslands
- U.S. Department of Agriculture, Natural Resources Conservation Service
- U.S. Department of Agriculture, Resource Conservation and Development Councils
- U.S. Fish and Wildlife Service
- U.S. Fish and Wildlife Service Great Plains Landscape Conservation Cooperative
- U.S. Geological Survey

Local Government

- Municipalities
- Tribal governments

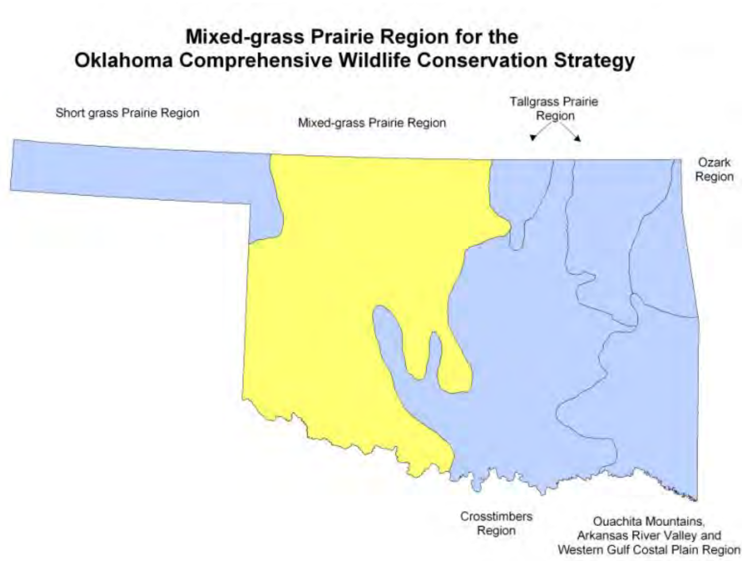
Businesses, Citizens and Citizen Groups

- Black-tailed Prairie Dog Conservation Team
- Chambers of Commerce
- Ducks Unlimited
- Electric Utility Cooperatives
- Farm Bureau
- Farm organizations and individual farmers
- Farmers Union
- Local citizens groups
- National and Oklahoma Wind Power Initiative
- National Wild Turkey Federation and local Oklahoma chapters
- North American Grouse Partnership
- Oklahoma Cattlemen’s Association
- Oklahoma Wildlife and Prairie Heritage Alliance
- Sportsmen groups

- Playa Lakes Joint Venture
- Private landowners, farmers and ranchers
- Producer Cooperatives
- Quail Forever and local Oklahoma chapters
- Rocky Mountain Bird Observatory
- Sutton Avian Research Center
- Swift Fox Conservation Team
- The Nature Conservancy
- Wind Energy Developers

Mixed-grass Prairie Region

The Mixed-grass Prairie Region is ecologically known as the Central Great Plains or the Mixed-grass Prairie. This large region includes all or parts of the counties of Harper, Ellis, Woods, Woodward, Major, Alfalfa, Grant, Kay, Noble, Logan, Garfield, Kingfisher, Canadian, Blaine, Dewey, Custer, Washita, Roger Mills, Beckham, Harmon, Greer, Jackson, Kiowa, Tillman, Caddo, Comanche, Cotton, Stephens, and Jefferson.



The best professional judgment of the advisory group and technical experts was used to identify each Conservation Landscape's status and trend. And, even though some issues and actions apply to multiple Regions, each Region chapter is designed to stand-alone.

Conservation Landscapes listed in general priority order
- Very High priority Conservation Landscapes:
  - Mixed-grass Prairie
  - Shinnery Oak Shrubland
  - Sand Sagebrush/Bluestem Shrubland
  - Gypsum Canyon lands and Gypsum Caves
- High priority Conservation Landscapes:
  - Tallgrass Prairie
  - Herbaceous Wetland
  - Small Rivers
  - Blackjack Oak/Post Oak Woodlands and Shrublands
- Moderate priority Conservation Landscapes:
  - Streams, Springs and Associated Riparian Forests
  - Mesquite Savannas or Shrublands
  - Juniper Savannas or Woodlands

Very High Priority Conservation Landscape: Mixed-grass Prairie

Historically, this was the most widespread and common habitat type found in the Mixed-grass Prairie Region. Mixed-grass prairies have a diverse species composition, however most plant communities are dominated by Little Bluestem (*Schizachyrium scoparium*) and Sideoats Grama (*Bouteloua curtipendula*). Mixed-grass prairies typically include Little Bluestem, Indiangrass (*Sorghastrum nutans*), Blue Grama (*Bouteloua gracilis*), Big Bluestem (*Andropogon gerardii*), and Switchgrass (*Panicum virgatum*). Silver Bluestem (*Bothriochloa saccharoides*) and Prairie Threeawn (*Aristida oligantha*) often occur on disturbed sites. Other common grasses and forbs include Sneezeweed (*Helenium amarum*), Prairie Sunflower (*Helianthus petiolaris*), Heath Aster (*Aster ericoides*), Roundleaf Bladderpod (*Lesquerella ovalifolia*), Western Ragweed (*Ambrosia psilostachya*), Texas Croton (*Croton texensis*), Purple Coneflower (*Echinacea angustifolia*), Leadplant (*Amorpha canescens*), Panic Grass (*Dichanthelium oligosanthes*), and Foxtail Barley (*Hordeum jubatum*). Much of the historic mixed-grass prairie in the region has been converted to other land uses, especially crop land and introduced pasture. Nearly 4 million acres of mixed-grass prairie is thought to remain but this is less than 40 percent of the historic acreage. Mixed-grass prairies have been altered by several factors including fire suppression and heavy year-round grazing which have facilitated the invasion of prairies by introduced grasses and forbs, and the expansion of the native Eastern Redcedar (*Juniperus virginiana*).

Recognized plant associations within this habitat type include:

- Little Bluestem – Big Bluestem - Switchgrass Grassland
- Silver Bluestem Grassland
- Vine Mesquite – Buffalograss Grassland
- Little Bluestem – Sideoats Grama – Blue Grama Grassland
- Little Bluestem – Blue Grama Grassland

(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference.)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Texas Toad	locally common in the vicinity of seasonally flooded breeding ponds in the southwestern quarter of the region	S
Bird	American Golden Plover	uncommon spring/fall migrant that may stop over at sites with short vegetation due to burning or grazing	U
Bird	Baird's Sparrow	very rare spring/fall migrant; recorded only a few times in relatively tall vegetation	U
Bird	Barn Owl	uncommon and occurs locally in areas with suitable nesting and roosting structures	U
Bird	Bell's Vireo	uncommon and locally-occurring summer resident; nests in sand plum thickets within mixed-grass prairie	D
Bird	Buff-breasted Sandpiper	rare spring/fall migrant that may stop over at sites with short vegetation due to burning or grazing	D

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Burrowing Owl	uncommon summer resident that nests locally in association with prairie dog colonies	U
Bird	Cassin's Sparrow	uncommon summer resident; nests in sites with sparse, low shrubs or yucca	U
Bird	Chestnut-collared Longspur	uncommon winter resident; found in large tracts of prairie	U
Bird	Ferruginous Hawk	rare winter resident; occurs in low density throughout region	S
Bird	Harris's Sparrow	winter resident throughout the region; occurs on prairies with some shrub cover	U
Bird	LeConte's Sparrow	uncommon migrant; small numbers winter in southern half of region in prairies with tall standing vegetation	U
Bird	Lesser Prairie Chicken	uncommon year-round resident; occurs locally in the northwestern corner of region	D
Bird	Loggerhead Shrike	widespread year-round resident throughout the region, but occurs at low density; breeds where scattered trees provide nesting sites	D
Bird	Long-billed Curlew	uncommon spring/fall migrant throughout the region	S
Bird	McCown's Longspur	uncommon winter resident; found in grazed prairies and agricultural fields in west half of the region	U
Bird	Northern Bobwhite	locally common year-round resident in prairie sites with some shrub cover	D
Bird	Prairie Falcon	rare winter resident; found in low density throughout region	S
Bird	Short-eared Owl	uncommon winter resident that is found in prairies with relatively tall or dense vegetation	U
Bird	Smith's Longspur	uncommon winter resident in the eastern half of the region; often associated with wire grass that occurs in disturbed sites	U
Bird	Sprague's Pipit	uncommon spring/fall migrant across the entire region; solitary or found in small flocks in grazed or disturbed sites	U
Bird	Swainson's Hawk	widespread summer resident that occurs at low density throughout the region	U
Bird	Upland Sandpiper	common spring/fall migrant throughout the region; small numbers nest in prairies in the northern tier of counties in some years	S
Inve	Prairie Mole Cricket	range is incompletely known; appears to occur in some intact prairie sites along the eastern edge of the region	D
Inve	Southern Plains Bumblebee	uncommon but widespread throughout the region	U
Mamm	Black-tailed Prairie Dog	occurs locally at approximately 50 colony sites scattered across the region but primarily in the western half	S
Rept	Texas Horned Lizard	locally common but occurs in scattered populations across the region	D
Rept	Texas Long-nosed Snake	uncommon and secretive burrowing species whose range is poorly documented; appears to occur in scattered sites in the western half of the region	U
Rept	Western Massasauga	widespread but occurs locally in scattered sites in the western 2/3 of the region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion Issue:

1. In areas where the topography is relatively level and the soils are fertile, the conversion of native mixed-grass prairies to cropland (primarily winter wheat, soybeans and cotton) and domestic pasture grasses (primarily Bermuda grass and Old World bluestem cultivars) has occurred at a large-scale. In some areas, conversion has occurred at a scale that is sufficient to alter entire landscapes. Large-scale habitat conversion has resulted in the loss of a substantial acreage of mixed-grass prairie and it has isolated the remaining prairie tracts from one another. Species of greatest conservation need that require large acreages of contiguous habitat (e.g. Lesser Prairie Chicken) or have poor dispersal abilities (e.g. Texas Horned Lizard) are disproportionately affected in a negative way.
2. The fragmentation and isolation of mixed-grass prairie tracts reduces their quality and value to species of greatest conservation need. Fragmentation can be caused by urban/suburban development around existing towns, the expansion of infrastructure and right-of-ways for public roads, utility lines, and pipelines, and energy exploration and development which requires the construction of access roads and drilling pads.
3. Fragmentation can be facilitated by changes in landownership. Inheritance laws that make it economically difficult to pass large tracts of land intact to succeeding generations, directly encourage heirs to divide/sell ranches to entities that may use these for non-grazing purposes. Landowners also have split surface and mineral ownership, which has resulted in conflicts and the limited ability of surface owners to negotiate the locations of drilling pads and access roads.

Conservation Actions:

- Encourage landowners to take advantage of Farm Bill provisions, including those providing economic incentives for practices favorable to species of greatest conservation need.
- Support necessary changes in the inheritance legislation to enable large ranches to remain in single family ownership.
- Encourage fee title habitat acquisition and the acquisition of conservation easements by private entities (e.g., land trusts and organizations such as The Nature Conservancy (TNC)).
- Consider land acquisition and conservation easements to protect some of the more important tracts of this habitat. Identify and prioritize core areas of habitat and potential connecting corridors to get the greatest ecological benefit for the dollars spent.
- Restore crop and pastureland to native mixed-grass prairie habitat, especially in areas where they will expand on an existing tract of prairie and/or serve to connect two or more fragmented parcels of prairie.
- Encourage changing the existing Conservation Reserve Program (CRP) guidance to be more favorable to mixed-grass prairie habitat by requiring that CRP lands be planted to 100 % native grasses and forbs instead of Old World Bluestem (*Bothriochloa ischaemum*) and Weeping Lovegrass (*Eragrostis curvula*).
- Increase funding for the CRP and Agricultural Conservation Easement Program components of the Farm Bill.
- Start an initiative in all Farm Bill programs to recommend native vegetation as a first priority over exotic species.

Conservation Issues Related to Incomplete Data Concerning Species of Greatest Conservation Need and their Relationships with Mixed-grass Prairie Habitat:

4. Data are incomplete for some species of greatest conservation need with respect to distributions, ecological needs and population trends. These deficiencies serve as impediments to the development and implementation of effective conservation strategies.
5. Baseline knowledge about the historic and current distribution, structural condition and community composition of mixed-grass prairies is incomplete.

Conservation Actions:

- Conduct ecological studies on Tier I and Tier II species of greatest conservation need to identify factors that limit population sizes, evaluate factors that may be responsible for population declines, and develop recommendations to enhance populations through improving habitat conditions
- Conduct research to identify the factors that limit the distribution and abundance of Tier I and Tier II species of greatest conservation need and develop management recommendations to enhance populations through improved habitat conditions.
- Conduct reviews of existing literature, reports and museum records, and interview technical experts to compile historic and recent distributional and ecological information for species of greatest conservation need in order to use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest benefit for species of greatest conservation need.
- Examine the recently developed Natural Resource Conservation Service Ecological Site Descriptions and existing literature regarding the historic condition of mixed-grass prairie habitat in order to develop a realistic and biologically meaningful description for how high quality habitat should look. This description should serve as the range of target conditions for habitat restoration and enhancement efforts.
- Develop methods to identify and map the distribution of the remaining habitat tracts, then inventory these tracts to determine their condition. Identify the conservation practices that could enhance the value of these habitat tracts to species of greatest conservation need.
- Develop monitoring programs for the populations of representative species of greatest conservation need and for measuring the abundance and condition of their habitat.
- Develop and provide long-term funding to maintain databases to store and analyze distributional and ecological data for species of greatest conservation need.
- Publish and make the results of all ecological studies available to land managers and conservation agencies so that these can be incorporated into site-specific, species-specific and regional conservation plans including future revisions of the Oklahoma Comprehensive Wildlife Conservation Strategy.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality

6. Heavy grazing and/or continuous grazing have reduced the plant species diversity and the structural diversity of mixed-grass prairies. This reduction in diversity has reduced the quality of the remaining prairie tracts.
7. The historic (natural) fire regime has been disrupted or eliminated across most of the remaining mixed-grass prairie tracts. Historically, these would have burned at approximately a three to six year interval, but widespread fire suppression has greatly extended that time period. The loss of regular burning has fostered an increase in the density and dominance of Eastern Redcedars on many prairies.
8. The construction of fences to intensively manage livestock grazing has created collision obstacles for prairie-dependent species such as Lesser Prairie Chickens that are susceptible because of their behavior. Fences also create travel corridors across prairies that are used by generalist predators such as Coyotes and Red-tailed Hawks, and fence rows are often colonized by invasive Eastern Redcedars.

9. Land use changes have reduced the number and sizes of Black-tailed Prairie Dog colonies.

Conservation Actions:

- Encourage landowners to take advantage of Farm Bill programs such as the Lesser Prairie Chicken Initiative and the Environmental Quality Improvement Program that provide economic incentives for practices such as native grass planting and prescribed burning that are favorable to species of greatest conservation need.
- Acquire fee title or conservation easements to protect some of the most important tracts of mixed-grass prairie habitat.
- Promote and encourage grazing practices having the fewest negative impacts on habitat quality such as patch-burning systems that reduce the need for interior fencing and promote the structural diversity of herbaceous vegetation.
- Coordinate with stakeholders and energy developers on site selection to minimize habitat alteration and disturbance as a result of construction. Encourage voluntary off-sets or mitigation for habitat disturbances that can't be avoided.
- Support the development of a statewide mitigation plan for wind energy development and guidelines for the siting of wind energy developments in areas where they will have the smallest impact to species of greatest conservation need.
- Encourage and support economic diversification on native grazing lands through activities such as fee access for hunting, fishing, and ecotourism.
- Provide landowner incentives for retaining Black-tailed Prairie Dog colonies and for following grazing practices that maintain them and the associated habitat.
- Develop and distribute technical assistance informational to landowners and others that cover practices that are beneficial to species of greatest conservation need such as rotational grazing ecology, prescribed burning and the control of exotic, invasive species.
- Continue to fund programs like the Landowner Incentive Program for the conservation of Black-tailed Prairie Dogs and other species of greatest conservation need.
- Encourage the development or updating of Best Management Practices (BMPs) for practices that conserve native mixed-grass prairie and make it suitable for species of greatest conservation need (e.g. retain native grasses and forbs, manage grazing to promote diversity and structural heterogeneity.

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

10. Woody vegetation encroachment, primarily by Eastern Redcedar, Siberian Elm and Black Locust, alters the height profile of prairies and reduces their quality with respect to some grassland-dependent birds and mammals. Woody vegetation also shades and displaces grasses and forbs; therefore it acts as a form of habitat conversion on a small-scale.
11. Widespread fire suppression has removed the naturally occurring control mechanism for invasive woody species.
12. Invasive grasses such Old World Bluestem and several Asian species of *Bromus* have invaded prairies and rangeland that are over-utilized during times of periodic drought or are chronically over-grazed.
13. Johnson grass (*Sorghum halepense*), Sericea Lespedeza (*Lespedeza cuneata*) and White Sweet Clover (*Melilotus albus*) have become established on many sites that were historically disturbed such as roadsides and abandoned crop fields.

Conservation Actions:

- Support the use of prescribed burning through technical assistance and the financial support of burning associations.

- Encourage the use of patch burn management to manage cattle rather than extensive interior fencing
- Develop and implement Integrated Pest Management Plans for all public lands in the region to control exotic and/or invasive species. Use these areas as demonstration sites to show the results of invasive species management techniques and to encourage private landowners to implement similar plans.
- Provide cost-share funding to help landowners control exotic and/or invasive species that alter habitat conditions for species of greatest conservation need.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acres enrolled in conservation programs
- acres of native plant communities restored
- numbers, size and distribution of Black-tailed Prairie Dog colonies
- number and distribution of active Lesser Prairie Chicken leks
- changes in population sizes and trends of species of greatest conservation need
- relative condition and quantity of habitat
- response of species to management practices such as prescribed burning, fence removal, and rotational grazing

Very High Priority Conservation Landscape: Shinnery Oak Shrubland

The Shinnery Oak Shrubland habitat is unique to this Region of the state and occurs locally on sandy soils and stabilized dunes in portions of Harmon, Beckham, Roger Mills, Ellis, Dewey, and Woodward counties. Duck and Fletcher (1944) estimated that nearly 750,000 acres of Shinnery Oak shrublands historically occurred in Oklahoma. Dering and Pettit (1972) estimated that more than 100,000 acres of this had been converted to other cover types; primarily crop fields and introduced pastures. Shinnery Oak shrublands are a climax plant community in which shrubs and grasses are co-dominant. Harvard Oak (*Quercus harvardii*), also known as Shinnery Oak, is the dominant shrub, though Sand Sagebrush (*Artemesia filifolia*), Sand Plum (*Prunus angustifolia*), and Netleaf Hackberry (*Celtis reticulata*) are also common. Dominant grasses are Sand Dropseed (*Sporobolus cryptandrus*) and Little Bluestem (*Schizachyrium scoparium*). Sand Bluestem (*Andropogon hallii*), Switchgrass (*Panicum virgatum*), Sideoats Grama (*Bouteloua curtipendula*), and Sand Lovegrass (*Eragrostis trichodes*) are also common. Harvard (i.e., Shinnery) Oak is a low shrub usually less than two meters tall that develops a massive system of underground stems and a deep root system. A single Harvard Oak may have over 100 above ground stems, each appearing to be a single small shrub and spreading three to 16 meters in diameter (Mueller 1951). Harvard Oak hybridizes with other oak species. Much of the Shinnery Oak shrublands in Oklahoma contain scattered groves or mottes of oaks up to 5 meters tall that are hybrids between Harvard Oak and Post Oak (*Quercus stellata*) (Muller 1951, Correll and Johnston 1970). Like pure Harvard Oak, these hybrids develop large underground stem and root systems. Typically, a motte of hybrid oaks is comprised of a single individual with several dozen large stems.

Recognized plant associations within this habitat type include:
Shinnery Oak/Sand Dropseed – Little Bluestem Shrubland
(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference.)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Bell's Vireo	uncommon summer resident throughout the region; nests in areas with taller mottes of oaks and sand plum thickets	D
Bird	Cassin's Sparrow	locally common summer resident throughout the region; nests in areas with short-stature & sparse shinnery oak	U
Bird	Harris's Sparrow	uncommon winter resident throughout the region; occurs in areas with dense, tall shinnery oak mottes	U
Bird	LeConte's Sparrow	uncommon winter resident throughout the region; found in tracts with tall standing grass and sparse shrubs	U
Bird	Lesser Prairie Chicken	uncommon and locally occurring year-round resident rein the northern half of the region; nests in areas with sparse, low-stature oaks	D
Bird	Loggerhead Shrike	uncommon year-round resident throughout the region; nests in sites with abundant herbaceous vegetation and taller mottes	D

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Northern Bobwhite	common year-round resident through the region	D
Bird	Painted Bunting	common summer resident; nests in tracts with tall, dense shinnery mottes	S
Bird	Swainson's Hawk	summer resident that nests throughout the region but occurs at low population density	U
Inver	Arogos Skipper	uncommon, found in the northern half of the region	U
Inver	Outis Skipper	uncommon, range is poorly delineated in the region	U
Inver	Shinnery Oak Buck Moth	common and widespread, but endemic to this plant community	U
Mamm	Desert Shrew	rare and secretive species sometimes found in association with woodrat nets; its distribution is poorly known	U
Mamm	Mountain Lion	rare and secretive species; apparently widespread but occurs at a very low population density	I
Rept	Texas Gartersnake	rare species with a poorly delineated range; appears to occur in the northern half of region	U
Rept	Texas Horned Lizard	locally common and widespread in this habitat type throughout the region	U
Rept	Texas Long-nosed Snake	uncommon, secretive burrowing species; appears to occur in this habitat throughout the region	U
Rept	Western Massasauga	uncommon but widespread in this habitat type	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversions:

1. Approximately half of the historic acreage of Shinnery Oak-dominated habitat in Oklahoma has been cleared, plowed and converted to agricultural uses. Most of this conversion has been for grain production – primarily winter wheat. In recent decades, some of this acreage has been planted to Bermuda grass pasture or enrolled in the Conservation Reserve Program (CRP) and planted to exotic perennial grasses such as Weeping Lovegrass and Yellow Bluestem.
2. Shinnery Oak does not re-establish itself easily on disturbed soils. For example, twenty years after fields have been planted to grass through the CRP, adjacent stands of Shinnery Oak have not expanded into these fields. Because of its low colonization potential and slow expansion, it is not clear when or if shinnery oak shrublands will become established in sites where they formerly occurred.
3. Herbicide application has been used to eliminate stands of Shinnery Oaks to convert shrublands into rangeland. Shinnery Oak is slow to recover from herbicide treatments and the speed of habitat reestablishment is uncertain.
4. As tracts of Shinnery Oak shrublands are converted to agricultural fields and pastureland, the remaining stands become increasingly fragmented and isolated from one another. Isolation, reduced connectivity and reduction in size all contribute to a reduced quality of habitat for area-sensitive species including many species of greatest conservation need.
5. Infrastructure and energy development activities, including oil and gas drilling pads, right-of-way clearing for utility lines and pipelines, road construction and wind energy (turbine) construction, have resulted in small-scale fragmentation of this habitat.
6. Shinnery Oak shrublands are not currently conserved or restored through the existing Agricultural Conservation Easement Program or the CRP.

Conservation Actions:

- Fund research into feasible methods for propagating Shinnery Oak and reestablishing it on disturbed sites such as CRP fields and retired pastureland to restore shrubland habitat.
- Encourage road right-of-way management that conserves and maintains stands of Shinnery Oaks. Site access roads in such a way as to minimize disturbance to stands of oaks and fragmentation of oak shrublands.
- Assess the current distribution and condition of Shinnery Oak shrublands and purchase conservation easements, grazing leases and fee title to conserve some of the most important tracts of remaining habitat.
- Cooperate with the NRCS and USDA to increase the priority or consideration placed on the conservation of Shinnery Oak shrublands through programs such as the Agricultural Conservation Easement Program (includes the former Grassland Reserve Program) and the Lesser Prairie Chicken Initiative. Work with the NRCS technical committees to promote the incorporation of shrubs such as Shinnery Oak, and the expansion of forb diversity into CRP fields to benefit pollinators.
- Cooperate with oil, gas and wind energy developers to minimize surface damages to shrublands through recommended practices, conservation off-sets and habitat banking. Encourage the development of a statewide mitigation plan for wind power development.
- Encourage ranching diversification that proves sufficient income through hunting leases and ecotourism to encourage landowner to maintain or enhance Shinnery Oak shrublands on their property.
- If a Shinnery Oak propagation method is feasible, develop a cost-share program that encourages landowners to re-establish Shinnery Oak mottes on retired crop and pastureland.

Conservation Issues Related to Incomplete Data Concerning Species of Greatest Conservation Need and their Relationships to Shinnery Oak Shrubland Habitat:

7. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies are an impediment to the development and implementation of effective conservation strategies.
8. Baseline knowledge about the historic and current distribution, structural condition and community composition of shinnery oak shrublands is incomplete.

Conservation Actions:

- Conduct ecological studies on Tier I and Tier II species of greatest conservation need to identify factors that limit population sizes, evaluate factors that may be responsible for population declines, and develop recommendations to enhance populations through improving habitat conditions.
- Conduct research to identify the factors that limit the distribution and abundance of Tier I and Tier II species of greatest conservation need and develop management recommendations to enhance populations through improved habitat conditions.
- Conduct reviews of existing literature, reports and museum records, and interview technical experts to compile historic and recent distributional and ecological information for species of greatest conservation need in order to use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest benefit for SGCN.
- Evaluate the recently developed NRCS Ecological Site Description for Shinnery Oak shrublands and existing literature regarding historic habitat conditions in order to develop a realistic and biologically meaningful description for how high quality habitat should look. This description should serve as the range of target conditions for habitat restoration and enhancement efforts.

- Develop methods to identify and map the distribution of the remaining habitat tracts, and then inventory these tracts to determine their condition. Identify the conservation practices that could enhance the value of these habitat tracts to SGCN.
- Develop population and habitat monitoring programs for representative species of greatest conservation need.
- Develop and provide long-term funding to maintain databases to store and analyze distributional and ecological data for species of greatest conservation need.
- Publish and make the results of all ecological studies available to land managers and conservation agencies so that they can be incorporated into site-specific, species-specific and regional conservation plans.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

9. Heavy, often continuous grazing sometimes reduces the quantity and quality of this habitat by removing herbaceous cover that would naturally compete with small oaks for space. Heavy grazing can remove substantial herbaceous vegetation which reduces the effectiveness of prescribed fire for providing a natural control for shinnery density.
10. The historic (natural) fire regime across most of the Shinnery Oak shrubland landscape has been disrupted or eliminated. This has fostered an increase in the density and dominance of Eastern Redcedars in many Shinnery Oak stands. In many sites, the reduction in fire frequency has increased the fuel load and made tracts of shrublands more vulnerable to habitat altering wildfire.
11. Landowners often use herbicide treatments to control Shinnery Oaks rather than prescribed fire which is less damaging to the persistence of this shrubland community.
12. Advisors to landowners sometimes lack complete technical information about the fragility of Shinnery Oak, the ecological value of shrubland habitats and the land management techniques for balancing the desire for increased herbaceous vegetation for grazing with need to conserve the habitat.

Conservation Actions:

- Fund the research needed to develop grazing recommendations such as timing and stocking rates of livestock, to maintain a balanced landscape of herbaceous vegetation and shinnery oak shrub cover. Develop demonstration sites on private or public lands to show land managers the results of varying grazing and land management practices.
- Fund research on the fire ecology of Shinnery Oak shrublands and use these data to develop prescribed burning recommendations that will maintain the habitat while controlling invasive species and providing herbaceous vegetation for ranching. Research the effects of prescribed burning on species of greatest conservation need such as the Texas Horned Lizard and the Lesser Prairie Chicken in order to develop burning recommendations (e.g. seasonal timing, tract size and frequency) that minimize negative impacts and maximize carrying capacity.
- Where needed, develop a deferred grazing program that pays landowners to reduce stocking rates or temporarily defer grazing on tracts whose condition has declined because of prolonged heavy grazing.
- Develop and distribute the most comprehensive management information and recommended practices to landowners, lessees and others concerning grazing management, fire management and energy development for the conservation of shrublands such as the USDA's Ecology and Management of Sand Shinnery Communities.
- Provide comprehensive technical assistance to landowners who are interested in restoring periodic fire to the landscape. Provide logistical and financial support to the existing prescribed burning associations.

- Research the applicability of patch-burn techniques to Shinnery Oak shrubland landscapes as a means of managing cattle to promote vegetation diversity and minimize the need for interior fencing.
- Increase awareness of the liability insurance that is available to private landowners that protect landowners that conduct prescribed burns properly.
- Increase the awareness of the erosion risks that occur when Shinnery Oak is removed from stabilized sand dunes.

Conservation Issues Related to the Expansion and Increase of Invasive Plants and Animals that are Detrimental to Species of Greatest Conservation Need:

13. Fire suppression has altered the structure of Shinnery Oak shrublands by allowing the expansion of invasive tree species such as Eastern Redcedar, Black Locust and Siberian Elm. As a result of fire suppression, junipers and trees from windrows have invaded many tracts of Shinnery Oak shrubland.
14. Continuous grazing and habitat fragmentation have created landscape conditions that favor increases in Brown-headed Cowbirds, thereby impacting populations of some native songbirds including vireos, buntings and orioles.

Conservation Actions:

- Encourage the use of regular prescribed burning to maintain shrubland habitat and control the abundance of invasive junipers, elms and locusts.
- Develop and implement an Integrated Pest Management Plan on each tract of public land to address the control of exotic or invasive species. Use these areas as demonstration sites to encourage neighboring landowners to implement invasive species controls.
- Provide cost-share funding or economic incentives to landowners to encourage them to implement invasive species control methods.
- Provide financial and logistical support to the existing prescribed burning associations or commercial burn teams to make the use of prescribed fire more accessible to landowners.
- Encourage and support actions to manage Brown-headed Cowbird populations.
- Provide cost-share funding to remove invasive species (especially Black Locust) from shelterbelts and windbreaks where they have the potential to invade shrublands.
- Where feasible, remove exotic grasses from CRP fields and replant with native grasses and forbs. Include native shrubs as part of the planting mix in new and re-enrolling CRP contracts.

Potential indicators for monitoring the effectiveness of the conservation actions:

- numbers of acres of Shinnery Oak habitat and their distribution across the region
- population sizes and trends of species of greatest conservation need
- number of acres or tracts of land that are placed into conservation programs or under conservation ownership
- relative condition of Shinnery Oak shrublands (e.g. herbaceous species diversity, motte height and size diversity)
- number of landowners participating in conservation programs
- average tract size of Shinnery Oak shrublands
- change in acreage of habitat that is affected by invasive woody species
- acres of native plant communities restored

Very High Priority Conservation Landscape: Sand Sagebrush/Bluestem Shrubland

Sand Sagebrush shrublands are found locally in the northwestern portion of the Mixed-grass Prairie Region and occur on deep sandy soils and stabilized dunes in the vicinity of the Cimarron, North Canadian, and Canadian Rivers. Many tracts of Sand Sagebrush/Bluestem shrubland habitat are in fair to good condition in the Mixed-grass Prairie Region and the abundance of this habitat appears to have a stable trend. This region encompasses approximately half of the Sand Sagebrush (*Artemisia filifolia*) shrublands that occur in Oklahoma (the remaining habitat occurs in the Shortgrass Prairie Region). Sand Sagebrush is typically found growing in association with Sand Dropseed (*Sporobolus cryptandrus*) and Little Bluestem (*Schizachyrium scoparium*). In these plant communities, Sand Sagebrush may comprise 5 to 40 percent of the canopy cover depending upon factors such as grazing pressure which tends to decrease grass coverage and increase sagebrush, or fire frequency which tends to decrease sagebrush and increase the coverage by grasses. Other grasses and forbs found in this community include Sand Bluestem (*Andropogon hallii*), Sideoats Grama (*Bouteloua curtipendula*), Giant Sandreed (*Calamovilfa gigantea*), Sand Lovegrass (*Eragrostis trichodes*), Prairie Sunflower (*Helianthus petiolaris*), Mentzelia (*Mentzelia sp*.), Hairy Goldenaster (*Heterotheca villosa*), Halfshrub Sundrops (*Calylophus serrulatus*), Annual Buckwheat (*Eriogonum annuum*), Indian Blanket (*Gaillardia pulchella*), Western Spiderwort (*Tradescantia occidentalis*), and Yucca (*Yucca glauca*). Skunkbush (*Rhus aromatica*) thickets dominate some of the taller, lower-elevation dunes near river floodplains.

Recognized plant associations within this habitat type include:

- Sand Sagebrush/Sand Dropseed – Little Bluestem Shrubland
- Skunkbrush (Aromatic Sumac) Shrubland
- Sand Bluestem/Giant Sandreed Grassland

(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference.)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Barn Owl	uncommon year-round resident, but present where there are suitable nesting sites	U
Bird	Bell's Vireo	uncommon summer resident; nests in sites with sand plums or denser vegetation near water	D
Bird	Burrowing Owl	uncommon summer resident that nests in association with prairie dog colonies	U
Bird	Cassin's Sparrow	common summer resident, nests where this habitat occurs in the region	U
Bird	Ferruginous Hawk	widespread but uncommon winter resident across region	S
Bird	Harris's Sparrow	uncommon winter resident; found in areas with skunkbrush and sand plum thickets	U
Bird	Lesser Prairie Chicken	uncommon year-round resident in northwest corner of region	D
Bird	Loggerhead Shrike	widespread but uncommon year-round resident throughout the region	D

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Northern Bobwhite	common year-round resident where this habitat occurs	D
Bird	Swainson's Hawk	widespread but uncommon throughout the region	U
Inve	Ghost Tiger Beetle	locally common but with scattered populations in sandhills and sand dunes	U
Mamm	Black-tailed Prairie Dog	a few dozen colonies occur locally within this habitat type	S
Mamm	Desert Shrew	rare, distribution poorly known; usually found in association with woodrat nests	U
Rept	Lesser Earless Lizard	rare and locally occurring at sites where disturbance maintains sparse vegetation	D
Rept	Texas Gartersnake	rare and its distribution is poorly known; typically found close to water	U
Rept	Texas Horned Lizard	locally common and widespread in this habitat type	D
Rept	Texas Long-nosed Snake	secretive burrowing species that appears to be uncommon; distribution poorly known.	U
Rept	Western Massasauga	locally common; often found in sites close to water	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

1. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
2. Baseline knowledge about the historic and current distribution, structural condition and community composition of sand sagebrush/bluestem shrublands is incomplete.

Conservation Actions:

- Conduct reviews of existing literature, reports and museum records, and interview technical experts to compile historic and recent distributional and ecological information for SGCN.
- Conduct research to identify the factors that limit the distribution and abundance of priority SGCN and develop management recommendations to enhance populations through improved habitat conditions.
- Conduct surveys to assess the current distribution and habitat affinities for priority SGCN and use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest benefit for SGCN.
- Examine the NRCS Ecological Site Description for Sand Sagebrush shrublands as well as other existing literature in order to develop a realistic and biologically meaningful description for how high quality habitat should look. This should serve as the range of target conditions for habitat restoration and enhancement efforts.
- Develop methods to identify and map the distribution of the remaining habitat tracts, and then inventory these tracts to determine their condition. Identify the conservation practices that could enhance the value of these habitat tracts to SGCN.
- Develop monitoring programs for selected SGCN populations and for measuring habitat abundance and condition.
- Conduct research into the population responses of species of greatest conservation need to practices such as prescribed burning and grazing rotations in order to develop

effective land management recommendations to maintain these species (e.g. stocking rates, burning frequency, grazing rotation frequency).

- Develop and provide long-term funding to maintain databases to store and analyze distributional and ecological data for species of greatest conservation need.
- Publish and make the results of all ecological studies available to land managers and conservation agencies so that they can be incorporated into site-specific, species-specific and regional conservation plans.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

3. Fire suppression has created conditions that encourage the encroachment of Eastern Redcedar into the sand sagebrush shrubland habitat. Excessive numbers of redcedars negatively affect some bird species by providing cover for predators and by shading or crowding out native sagebrush and grasses.
4. In some areas aerial application of broadleaf herbicides is used to remove sagebrush and encourage grasses. This type of spraying not only reduces natural shrub cover but negatively affects the abundance of native forbs that provide important food and cover for wildlife. The overall effect of this kind of herbicide use is a reduction in the quality of the habitat for most species of greatest conservation need.
5. Excessive grazing can reduce the quality of this habitat by reducing native grass cover and facilitating the expansion of sagebrush. Reduced grass cover reduces the competition for water and space that sagebrush would normally face and reduces the fuel load for fires that might setback sagebrush.
6. Continuous grazing or frequent rotational grazing can result in the loss of some forb species that are especially palatable and favored by cattle. It also can reduce the abundance of standing dead herbaceous cover in the winter and spring which reduces habitat quality for some wintering birds and nesting habitat quality for some early-season breeding birds.
7. The use of fencing to control the movement of cattle can have indirect consequences on some species of greatest conservation need such as Lesser Prairie Chicken that may be vulnerable to collisions with fences.
8. Sagebrush shrublands contain a substantial percentage of the remaining Black-tailed Prairie Dog colonies in Oklahoma and are important to their conservation. These colonies are restricted to sites between dunes and at the interface between dunes and prairies where the soils are comprised of silt or clay. Land conversion and prairie dog control efforts have resulted in the loss of large prairie dog complexes (i.e., those in excess of 1,000 acres) that are important to the long-term sustainability of Black-tailed Prairie Dogs themselves as well as associated species including Burrowing Owl and Ferruginous Hawk.

Conservation Actions:

- Provide technical assistance and cost-share funding to implement grazing practices that use patch burn technology, in conjunction with shifting mineral blocks, to manage the movement and grazing of livestock in a manner that maintains the natural diversity of rangeland species and vegetative structural conditions, while at the same time allowing for the removal of interior fencing
- Support ranching and encourage grazing practices that conserve sand sagebrush habitat in a manner that is consistent with its historic condition.
- Use land acquisition and conservation easements to conserve the most important tracts of sand sagebrush shrubland habitat in the Mixed-grass Prairie Region. Develop demonstration areas on public lands or conservation easements to show how ranching activities can be conducted with the maximum benefit to native species of greatest conservation need.

- Develop new or update existing BMPs for grazing practices that best maintain sagebrush shrublands in a condition that is suitable for representative species of greatest conservation need.
- Encourage the use of prescribed fire as an alternative to herbicide application for controlling the abundance of sand sagebrush on sites where historic or current grazing practices and fire suppression have resulted in an over abundance of sagebrush and/or redcedar.
- Provide technical assistance and cost-share assistance to encourage landowners to use periodic prescribed burning, probably on a rotation of 7 to 10 years, to control redcedar and other invasive species.
- Provide financial and logistical support to the existing prescribed burn cooperatives in the Region.
- Provide landowner incentives for following agricultural practices that maintain Black-tailed Prairie Dog colonies and continue the use of a program like the Landowner Incentive Program that provides incentive payments to landowners to conservation or expand Black-tailed Prairie Dog colonies and populations of other associated species of greatest conservation need.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

9. Sand sagebrush shrublands often occur at a landscape level in relatively long and narrow bands in stabilized sand dune formations associated with stream and river channels. These bands are fragmented by roads, overhead utility lines, fences, and energy development (e.g. oil and gas drilling pads, wind turbines and access roads).
10. Fragmentation of the habitat is indirectly facilitated by current inheritance laws that make it cost-prohibitive to pass large ranchlands intact to future generations. Families have to subdivide ranches which increase the potential for the land to be used for purposes that do not favor the retention of sand sagebrush shrublands and their associated species of greatest conservation need.
11. Large-scale conversion of sagebrush shrublands is infrequent but some habitat has been converted to irrigated crop fields (primarily winter wheat and alfalfa).
12. The NRCS Agricultural Conservation Easement Program (formerly Grassland Reserve Program) does not currently target Sand Sagebrush shrublands in their contracting process and this habitat type is not typically considered in the development of revegetation plans for CRP contracts.

Conservation Actions:

- Use land acquisition and conservation easements to conserve the most important tracts of sand sagebrush shrubland habitat in the Mixed-grass Prairie Region. Prior to acquisitions, identify and prioritize core areas of habitat and connecting corridors in order to get the greatest benefit for the money expended.
- Encourage and support changes in inheritance legislation to make it easier to pass large intact tracts of land/habitat to succeeding generations.
- Support ranching and encourage grazing practices that conserve sand sagebrush habitat in manner that is consistent with its historic condition.
- Include shrublands, such as sand sagebrush shrublands, as land cover types that are eligible for inclusion in the Agricultural Conservation Easement Program and Lesser Prairie Chicken Initiative. Increase the funding available to landowners through these programs to allow for the inclusion of shrubland habitats.
- Provide cost-share funding or financial incentives (e.g. tax breaks) to encourage the replanting of cropland, abandoned cropland and improved (e.g., Bermuda grass) pastures to sand sagebrush/bluestem habitat using native grasses, forbs and shrubs.
- Modify the CRP to encourage eligible fields on appropriate soils to be planted to native sagebrush, skunkbrush, sand plums, grasses and forbs instead of Old World bluestem and weeping lovegrass.

- Support the continuation of the guidelines for the CRP contracts that require the incorporation of at least 51% native shrubs, grasses and forbs into current contracts upon their renewal and encourage new contracts in appropriate locations to be replanted to sand sagebrush and native grasses.
- Cooperate with energy developers to site wind turbines, drilling pads and access roads in areas where they will have the least negative effect on existing sand sagebrush shrublands. Encourage financial off-sets or habitat mitigation for impacts to sand sagebrush that cannot be avoided.
- Encourage the development and implementation of a statewide mitigation plan for wind energy development.

Potential indicators for monitoring the effectiveness of the conservation actions:

- changes in population sizes and trends of species of greatest conservation need
- acres enrolled in conservation programs
- acres of native plant communities restored
- GIS/remote sensing data that display the number of habitat acres and their distribution
- numbers, size and distribution of Black-tailed Prairie Dog colonies
- number, size and distribution of active Lesser Prairie Chicken leks
- relative condition of existing sand sagebrush habitat
- response of species to management practices such as prescribed burning, fence removal, and rotational grazing

Very High Priority Conservation Landscape: Gypsum Canyonlands and Gypsum Caves

Rugged gypsum canyon lands and cave systems occur in three discreet portions of the Mixed - grass Prairie Region. The largest expanse of this habitat occurs over the Blaine Gypsum formation in the north central portion of the Region extending through portions of Blaine, Major, Woods, and Woodward counties. Other gypsum region occurs in southwestern Oklahoma in portions of Harmon, Greer and Beckham counties. The third area is comprised of small, scattered pockets of gypsum in eastern Washita County and southern Caddo County.

Unlike many of the other habitats within the Region, gypsum canyon lands are largely intact because their rough topography and dry, rocky, infertile soils are not conducive to agricultural development. Only a small portion of the gypsum canyon lands have been converted to other land uses (primarily gypsum quarries) but the structure of the vegetation community has been affect by redcedar encroachment and erosion. The gypsum canyon lands and caves habitat type occurs on hilly, dissected uplands where layers of brick-red shales, sandstones, and interbedded grayish gypsum are exposed at or near the earth's surface. The thin, dry, calcareous soils overlying these rock layers support a unique community of low stature, drought-tolerant prairie grasses and forbs including Little Bluestem (*Schizachyrium scoparium*), Hairy Grama (*Bouteloua hirsuta*), Dotted Blazingstar (*Liatris punctata*), Gordon's Bladderpod,(*Lesquerella gordonii*),and Thrift-leaf Hymenoxys (*Tetraneuris scaposa*). Years of erosion have carved out canyons, buttes, and mesas while groundwater movement has dissolved gypsum to create numerous caves. These caves harbor the northern most colonies of the Brazilian Free-tailed Bat (*Tadarida brasiliensis*).

Recognized plant associations within this habitat type include:

Little Bluestem - Yellow Indian Paintbrush - Gordon's Bladderpod Grassland

(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference.)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Barn Owl	uncommon year-round resident; nests locally in caves and rocky outcrops	S
Bird	Black-capped Vireo	very rare summer resident; small nesting population exists in the canyons of northern Blaine County	D
Bird	Cassin's Sparrow	uncommon summer resident; nests in prairie tracts with sparse, low shrub cover or yucca	S
Bird	Loggerhead Shrike	widespread year-round resident that occurs at low densities	D
Bird	Scaled Quail	rare and locally-occurring year-round resident in gypsum canyons in southwestern part of the region	S
Bird	Swainson's Hawk	widespread summer resident that occurs in low densities at the interface between canyons and prairies; primarily in the northern 1/3 of region	D
Inve	Swift Tiger Beetle	appears to be locally common in gypsum canyons; range poorly delineated	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Mamm	Brazilian (Mexican) Free-tailed Bat	locally common summer resident around specific cave locations; four or five large maternity colonies occur in gypsum caves	S
Mamm	Desert Shrew	rare and its range is poorly delineated; may occur in brushy sites and often in association with woodrat nets	U
Mamm	Mountain Lion	widespread but rare and occurs at very low densities throughout this habitat and region	I
Mamm	Ringtail	rare and secretive; occurs in brushy canyons throughout the region but more frequently in the southern 1/3	U
Mamm	Western Big-eared Bat	uncommon species that is characteristic of gypsum caves and found in all cave formations within the region.	U
Rept	Common Lesser Earless Lizard	rare and locally occurring in sites with sparse vegetation.	U
Rept	Texas Horned Lizard	common but locally occurring in gypsum canyon lands throughout the region	D
Rept	Western Diamond-backed Rattlesnake	locally common in gypsum canyons throughout the region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

1. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies create impediments to the development and implementation of effective conservation strategies.

Conservation Actions:

- Conduct reviews of existing literature, reports and museum records, and interview technical experts to compile historic and recent distributional and ecological information for all species of greatest conservation need.
- Conduct research to identify the factors that limit the abundance of Tier I and Tier II species of greatest conservation need and develop management recommendations to enhance their populations through improved habitat conditions or recruitment.
- Conduct surveys to assess the current distribution and habitat needs for Tier I and Tier II species of greatest conservation need and use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest benefit for these species.
- Develop methods to identify and map the distribution of gypsum caves with an emphasis on caves that support species of greatest conservation need, and maintain the confidentiality of these locations to protect rare species as well as private landowners from unwanted visitation. Identify the conservation practices that could be used to enhance the value of these caves and their surrounding habitat.
- Develop population and habitat monitoring programs for representative species of greatest conservation need.
- Develop and provide long-term funding to maintain databases to store and analyze distributional and ecological data for species of greatest conservation need.
- Publish and make the results of all ecological studies available to land managers and conservation agencies so that they can be incorporated into site-specific, species-specific and regional conservation plans including future updates to the OCWCS.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

2. Fire suppression has resulted in a tremendous expansion of Eastern Redcedars and to a lesser extent Redberry Junipers. Junipers now dominate some portions of the gypsum canyon lands. Mature junipers are difficult to control or remove because they often grow on slopes that are difficult to access and their removal can disturb highly erodible soils.
3. Heavy and continuous grazing has contributed to increased rates of soil erosion in some parts of this steeply sloping habitat type. The thin, drought-prone soils found in gypsum canyon lands often limit the growth and abundance of grasses and forbs; therefore stocking rates on gypsum soils must be substantially lower than those on more fertile and moisture retentive soils.
4. Gypsum mining has converted local tracts of this habitat to quarries that are unusable by some wildlife. The heavy machinery and explosives used in gypsum mining can threaten the stability of gypsum caves in the areas around the mining activity.
5. Some gypsum canyon landscapes are attractive to wind energy developers because of their high position relative to the surrounding landscapes. Because of their poor soil fertility and rough topography, some landowners are more willing to allow wind energy development on their property because they have fewer alternatives to make a living off of the land (e.g. via agriculture). Wind energy development may reduce the suitability of gypsum canyon lands to some wildlife because of the height of the structures and fragmentation of the habitat by access roads and the infrastructure required to maintain wind turbines.

Conservation Actions:

- Provide cost-share funding for the hand-cutting and burning of Eastern Redcedars. Hand-cutting is often required because the sites on which many redcedars are growing are difficult to access and erosion prone.
- Encourage and facilitate prescribed burning through technical assistance, financial support of burning associations and cost-share programs.
- Provide financial and logistical support for the existing prescribed burning cooperatives in the region.
- Provide payments to landowners to defer grazing in some areas to help re-establish native vegetation. Develop revegetation recommendations that are specific to gypsum soils and promote the re-establishment of native plants that are adapted to dry calcareous soils. Provide cost-share funding if needed to encourage replanting of eroded sites with native grasses and forbs.
- Develop grazing recommendations and provide technical assistance to landowners for managing grazing in a manner that will not facilitate further erosion of highly erodible gypsum soils.
- Provide grants or cost-share funding to landowners with biologically important caves on their property to implement management practices to maintain or enhance populations of species of greatest conservation need.
- Acquire fee title or conservation easements to acres containing and surrounding biologically important caves to protect these sites from human disturbance, cedar encroachment and potentially harmful mineral development (e.g. quarrying). Prior to this, determine the most important caves and tracts of habitat that have native vegetation communities that are in good condition.
- Expand the Grassland Reserve Program GRP) or develop a similar easement program that will pay landowners to maintain gypsum canyons and grasslands and enhance their quality.
- Conduct field studies to clarify the potential impacts of wind power development on sensitive species of greatest conservation need.

- Participate in the development of a statewide mitigation plan for wind power development. Coordinate with local governments, landowners and wind energy developers on site selection for wind energy developments to minimize their impact on species of greatest conservation need. Require off-sets or mitigation for habitat and wildlife impacts that cannot be avoided.

Potential indicators for monitoring the effectiveness of the conservation actions:

- numbers of acres and their distribution in conservation programs or ownership
- changes in population sizes and trends in abundance of species of greatest conservation need
- relative condition and quantity of habitat
- number of protected caves
- continued use of caves by colonies of Mexican Free-tailed Bats and other bat species

High Priority Conservation Landscape: Tallgrass Prairie

The tallgrass prairie community is found locally along the eastern edge of the Mixed-grass Prairie Region in its transition zones with the Crosstimbers and Tallgrass Prairie regions. Tallgrass prairie communities also occur locally in the central and western portions of the region on relatively mesic slopes, on stabilized dunes, and in floodplains. Within the Mixed-grass Prairie Region, tallgrass prairies are dominated by Big Bluestem (*Andropogon gerardii*), Switchgrass (*Panicum virgatum*), and Little Bluestem (*Schizachyrium scoparium*). The structure of this herbaceous community is maintained by the occurrence of periodic fires that suppress the growth of woody plant species and favor grasses and some forbs. Other common grasses and forbs include Prairie Dropseed (*Sporobolus hetrolepis*), Sideoats Grama (*Bouteloua curtipendula*), Compass Plant (*Silphium laciniatum*), Lead Plant (*Amorpha canescens*), Wild Alfalfa/Scurf Pea (*Psoralidium tenuiflorum*), Illinois Bundleflower (*Desmanthus illinoensis*), Blazing Star (*Liatris sp.*), Goldenrod (*Solidago sp.*), Indian Paintbrush (*Castilleja coccinea*), and Maximillian Sunflower (*Helianthus maximilliani*).

Historically, tallgrass prairies were much more abundant and widespread, especially in the eastern portion of this region. Tallgrass prairie habitat remains primarily on sites that are too steeply sloped, sandy, or rocky to be suitable for crop production or conversion to Bermudagrass pasture. The extent and distribution of tallgrass prairies is poorly known, but the existing tracts appear to be scattered and small relative to pre-settlement conditions. Where tallgrass prairie habitat remains, continuous grazing, fire suppression, and the encroachment of invasive plants have changed this plant community's composition and structure by increasing Juniper cover, increasing the abundance of exotic plants, and decreasing the abundance of native perennial forbs.

Interspersed within tallgrass prairies are small tracts of shrub-dominated habitats that occur in sites that are subject to infrequent burning or occur in transition areas with riparian habitats or oak woodlands. These small shrublands are typically dominated by Sand Plum (*Prunus angustifolia*) and/or Smooth Sumac (*Rhus glabra*) and Oklahoma Plum (*Prunus gracilis*).

Recognized vegetation associations (Hoagland 2000) include:

- Big Bluestem – Switchgrass Grassland
- Big Bluestem – Little Bluestem - Indian Grass Grassland
- Sand Bluestem – Giant Sandreed Grassland
- Little Bluestem – Big Bluestem Grassland
- Sand Plum/Little Bluestem Shrubland
- Smooth Sumac Shrubland

(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference.)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	American Golden Plover	uncommon spring/fall migrant that may use seasonally flooded, burned or grazed prairies as stop-over foraging habitat	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Bell's Vireo	uncommon summer resident that nests locally in sites where sand plum thickets and dense shrub cover occur	D
Bird	Buff-breasted Sandpiper	rare spring/fall migrant that may use seasonally flooded, burned or grazed prairies as stop-over foraging habitat	D
Bird	Harris's Sparrow	common winter resident in tracts with tall herbaceous vegetation and shrub thickets	U
Bird	LeConte's Sparrow	uncommon and secretive winter resident throughout the region; occurs in prairie tracts with tall or dense standing vegetation	U
Bird	Loggerhead Shrike	uncommon year-round resident throughout the region; occurs locally and in low densities	D
Bird	Northern Bobwhite	uncommon and locally-occurring year-round resident in areas with shrub cover	D
Bird	Prairie Falcon	rare winter resident; widespread but occurs at very low population density	I
Bird	Short-eared Owl	uncommon winter resident that occurs locally at sites with tall, dense herbaceous vegetation	U
Bird	Smith's Longspur	uncommon winter resident in the eastern quarter of the region in disturbed prairie sites	U
Bird	Sprague's Pipit	uncommon and secretive spring/fall migrant throughout the region	U
Bird	Swainson's Hawk	uncommon summer resident that occurs at low densities in landscapes with sparse tree cover	U
Bird	Upland Sandpiper	common spring/fall migrant throughout the region; small numbers nest in the northern quarter of the region	D
Inve	Prairie Mole Cricket	uncommon and locally occurring in intact tallgrass prairie in the eastern 1/3 of the region; their range is poorly delineated	D
Inve	Southern Plains Bumble Bee	uncommon but widespread in grasslands across the region	U
Rept	Texas Horned Lizard	uncommon and locally occurring in tracts of native prairie habitat	D

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion Issue:

1. Historically, many tracts of tallgrass prairie habitat within the Mixed-grass Prairie Region occurred in flood plains and other areas with high soil fertility and moisture retention. Much of this acreage has been converted to agricultural uses such as crop production, alfalfa and Bermuda grass pasture. These conversions have resulted in the direct loss of habitat and the fragmentation of the remaining tracts of tallgrass prairie, which has negative consequences for prairie-dependent species of greatest conservation.
2. The conversion of tallgrass prairies to monocultures of introduced pasture grasses has dramatically reduced the value of the habitat for resident wildlife and wintering birds. Introduced grass pastures typically produce less seed and lack the diversity in fine-scale vegetation structure that is found in native prairies.

Conservation Actions:

- Encourage the conversion of pastures containing introduced species to diverse stands of native tallgrass prairie grasses and forbs through cost-share programs and incentives payments.
- Support the diversification of tallgrass prairie restoration efforts by funding the production of native forb seed sources.
- Develop tallgrass prairie restoration technical guidance and establish demonstration areas where landowners can see the results of successful restoration techniques.
- Pursue fee title land acquisition from willing sellers to place biologically important tracts of prairie under conservation ownership.
- Acquire grazing leases or conservation easements for protecting the most important tracts of tallgrass prairie remaining in this region.
- Study the economics and profitability of grazing cattle on prairie rangelands containing a diverse community of native forbs and grasses versus grazing cattle on introduced pasture grasses. If the economics of this grazing system favor the restoration of prairies, then promote this and provide technical and financial assistance to landowners to help cover restoration costs.
- Encourage and support ranch diversification to allow for lower stocking rates (grazing pressure) by offsetting the economic loss with additional revenue from lease hunting, fishing access, and ecotourism.
- Increase funding for the Agricultural Conservation Easement Program (includes the former Grassland Reserve Program) and increase the priority placed on tallgrass prairie habitat.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

3. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies are impediments to the development and implementation of effective conservation strategies.
4. Baseline knowledge about the historic and current distribution, structural condition and community composition of tallgrass prairie habitat is incomplete.

Conservation Actions:

- Conduct surveys of existing literature, reports, and museum records to evaluate historic distributions, abundances, and habitat affinities of species of greatest conservation need, and examine possible causes of suspected population declines.
- Conduct field studies to establish baseline conditions for the current distributions, abundances, and habitat affinities of species of greatest conservation need.
- Develop and provide long-term funding to maintain databases to store and analyze distributional and ecological data for species of greatest conservation need.
- Conduct ecological studies on Tier I and Tier II species of greatest conservation need to identify factors that limit population sizes, evaluate factors that may be responsible for population declines, and develop recommendations to enhance populations through improving habitat conditions.
- Develop methods to accurately identify and map the distribution and condition of tallgrass prairie tracts and establish a baseline condition of abundance for future monitoring efforts.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

5. Continuous grazing at moderate to high stocking rates reduces the quality of tallgrass prairie for some species of greatest conservation need because it reduces plant diversity (the most palatable species become eliminated by the selective grazing

behavior of livestock) and the structural diversity of the vegetation declines as it is consumed in a relatively uniform pattern across a pasture.

6. Where herbicide treatments are used to control broadleaved forbs, the quality of the habitat can decline as a result of lowered plant diversity, lower seed and lower insect production. This often affects prairie-dependent species and species of greatest conservation need disproportionately.
7. Energy exploration and development can locally reduce habitat quantity and quality as a result of habitat fragmentation by access roads, wind turbines, drilling pads, pipelines and utility lines.

Conservation Actions:

- Develop and distribute technical guidance and recommended practices for grazing management and the use of prescribed fire to maintain or enhance tallgrass prairie habitat at a quality that benefits species of greatest conservation need.
- Work with landowners, developers and local zoning boards/committees to help site wind, oil and gas developments in such a way as to avoid impacts to biologically sensitive tallgrass prairie stands. Develop recommended practices for the placement and construction of drilling pads, turbine supports and access roads to avoid sensitive habitats, minimize erosion and minimize soil disturbance that might facilitate the spread of invasive plants.
- Support the continuation of the Conservation Reserve Program guidance that requires that contract renewals incorporate native grasses and forbs into the existing plantings, typically through the over-seeding of native plants into CRP fields that are planted to exotic grasses. Maintain the requirement that new CRP contracts be planted to native grasses and forbs, and encourage the planting of multiple species of forbs in CRP fields that are dominated by one or a few native grasses.

Conservation Issues Related to Invasive and/or Exotic Plants and Animals that are Detrimental to Species of Greatest Conservation Need:

8. Exotic invasive species such as Johnson grass and Sericea Lespedeza have become widely established in tallgrass prairies and have displaced more beneficial native vegetation and lowered diversity.
9. The encroachment by woody species such as Eastern Redcedar has reduced the quantity of this habitat for prairie-dependent species of greatest conservation need.
10. Historic fire frequencies have been lost or altered across the region and this fire suppression or reduction has resulted in conditions that are favorable for encroachment by undesirable invasive plants.

Conservation Actions:

- Develop and distribute technical assistance information to landowners and others concerning grazing management, prescribed fire usage, and the control of invasive species.
- Continue cost-share programs that encourage landowners to cut and remove junipers from tracts of native prairie and restorable grasslands.
- Provide cost-share funding, grants or economic incentives to landowners who are willing to convert retired cropland or pastures to diverse tallgrass prairie communities with multiple species of native grasses and forbs.
- Provide financial and logistical assistance to maintain and expand the existing fire management associations and fire management contractors in the region to increase the accessibility and use of prescribed fire by landowners who wish to maintain or improve tallgrass prairie habitat.
- Provide cost-share funding to encourage restoration of native tallgrass prairie habitat from converted Bermuda grass pastures.

Potential indicators for monitoring the effectiveness of the conservation actions:

- changes in population sizes and trends of species of greatest conservation need
- relative condition and quantity (acres) of habitat
- number of acres placed under conservation ownership or in conservation programs
- avian point counts with greater diversity and abundance of tallgrass prairie-dependent birds

High Priority Conservation Landscape: Herbaceous Wetland

During the past century, a dramatic reduction has occurred in the number of wetlands and wetland acres in the Mixed-grass Prairie Region. Herbaceous wetlands in the Mixed-grass Prairie Region are most often small (i.e., less than 10 acres in size). They may occur as sloughs and cutoff channels from streams and rivers, as seasonally flooded depressions within floodplains, or isolated from streams and rivers as swales and depressions in prairies and between stabilized sand dunes.

Notable wetlands and wetland complexes in the region include Hackberry Flat WMA and the Cimarron Terrace wetland complex. Hackberry Flat is a recently restored wetland within an agriculturally-dominated landscape in southern Tillman County. This naturally-occurring wetland developed in what is likely to be an ancient meteor impact crater. The Cimarron Terrace wetland complex consists of dozens of seasonally-flooded depressional wetlands within an ancient dune field on the north and northeast side of the Cimarron River extending from Dover (Kingfisher County) to Ames (Major County).

Periodic fires during dry periods prevent woody plant species from dominating herbaceous wetlands. The plant community composition of herbaceous wetlands is variable depending upon soils and the frequency of soil moisture saturation. Common herbaceous wetland plant communities include Pink Smartweed (*Polygonum pensylvanicum*), Barnyard Grass (*Echinochloa crusgalli*), Three-square Bulrush (*Schoenoplectus americanus*), Softstem Bulrush (*Schoenoplectus tabernaemontani*), and Common Spike Rush (*Eleocharis tenuis*).

Recognized plant associations in this habitat type include:

- Common Reed Semi-permanently Flooded Marsh
- Three-square Bulrush Semi-permanently Flooded Marsh
- Softstem Bulrush - Common Spike Rush Semi-permanently Flooded Marsh
- Broadleaf Cattail Semi-permanently Flooded Marsh
- Pennsylvania Smartweed – Curlytop Smartweed Semi-permanently Flooded Wetland
- Broadleaf Arrowhead – Longbar Arrowhead Semi-permanently Flooded Wetland
- Inland Saltgrass – Alkali Sacaton Temporarily Flooded Grassland
- Inland Saltgrass – Three-square Bulrush Temporarily Flooded Grassland
- Common Spikerush – Hairy Waterclover Temporarily Flooded Marsh
- Prairie Cordgrass Temporarily Flooded Marsh

(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference.)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based on an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Texas Toad	locally common in the vicinity of seasonal breeding ponds and wetlands in the southern quarter of the region	S
Bird	American Golden Plover	common spring and fall migrant through the region.	U
Bird	Black Rail	very rare spring/fall migrant; potentially breeds in wetlands on Salt Plains NWR and flood plain wetlands in large river systems	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Buff-breasted Sandpiper	rare spring/fall migrant in the eastern half of the region	D
Bird	Canvasback	uncommon but widespread winter resident	S
Bird	Hudsonian Godwit	uncommon spring migrant	U
Bird	King Rail	rare summer resident that nests locally and sporadically at larger wetland sites during wet periods	U
Bird	LeConte's Sparrow	uncommon migrant and winter resident around margins of wetlands with tall vegetation	U
Bird	Lesser Scaup	common migrant and uncommon winter resident in wetlands on the margins of impoundments	D
Bird	Little Blue Heron	uncommon summer resident; nests locally in vicinity of a few nesting colonies	U
Bird	Long-billed Curlew	uncommon spring/fall migrant throughout the region	S
Bird	Northern Pintail	common winter resident throughout the region	D
Bird	Peregrine Falcon	rare spring/fall migrant throughout the region; usually found at larger wetlands	I
Bird	Piping Plover	rare spring/fall migrant; recorded at only a few larger wetlands near reservoirs	D
Bird	Solitary Sandpiper	uncommon spring/fall migrant throughout the region	U
Bird	Trumpeter Swan	rare winter resident; usually found in larger wetlands or ones associated with impoundments	I
Bird	Upland Sandpiper	common spring/fall migrant throughout; small numbers nest in the northern tier or counties	S
Bird	Western Sandpiper	rare spring/fall migrant throughout the region	U
Bird	Whooping Crane	very rare spring/fall migrant; total population approx 300 birds	I
Bird	Wilson's Phalarope	common spring/fall migrant throughout the region	U
Rept	Midland Smooth Softshell	uncommon and locally occurring in wetlands associated with flood plains	U
Rept	Spiny Softshell Turtle	locally common; usually found in wetlands associated with flood plains	U
Rept	Texas Gartersnake	rare; found in northwestern part of the region; some taxonomic questions about species validity	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Habitat Loss and Modification as a Result of Habitat Conversion and Land Management Practices:

1. Wetlands have been and continue to be drained or filled to provide land for residential or agricultural development.
2. Irrigation practices that lower shallow water tables may affect the hydrology of those wetlands that are sustained through seeps, springs and other groundwater inputs.
3. Fire suppression and the disturbance of wetlands through continuous grazing or periodic cultivation create conditions that make herbaceous wetlands more vulnerable to invading species, woody species encroachment or introduced species (e.g. broadleaf cattail, salt cedar).

4. Some herbaceous wetlands have been modified into ponds through dredging and dike construction. These practices alter the structure and function of wetlands in ways that reduce their value to species that depend upon shallow water or mud flats.
5. The cultivation of the land surrounding wetlands can create conditions that result in the modification and reduction of wetlands through siltation.
6. Many people do not understand the laws that conserve wetlands and the ecological and water quality benefits of wetlands.
7. The farming of wetlands has converted their plant communities from ones that were dominated by perennials to ones that are dominated by annuals.
8. Inadequate incentives exist within the Wetland Reserve Program (WRP) to encourage landowners to enroll their wetlands.

Conservation Actions:

- Continue to provide technical assistance and financial incentives for landowners to manage wetlands and control exotic or invasive vegetation.
- Use fee title acquisition and conservation easements to conserve and enhance some of the most biologically valuable herbaceous wetlands in the Mixed-grass Prairie Region.
- Encourage legislation that would provide tax breaks for wetlands conservation.
- Encourage fencing of wetlands to control grazing and allow the development of vegetative buffers.
- Encourage legislation to designate groundwater pumping for wetlands as a beneficial use of groundwater.
- Improve the incentives for the WRP and the Conservation Reserve Enhancement Program to increase enrollments.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality:

9. Some farming practices can lead to siltation of herbaceous wetlands.
10. Pesticides, sediment, endocrine disruptors and elevated concentrations of nutrients in storm water runoff from urban and agricultural areas can accumulate in wetlands and impair their water quality.
11. The removal of buffer vegetation around wetlands increases exposure to pollutants that may be carried in storm water runoff results in a decline in habitat quality.

Conservation Actions:

- Encourage improvements in the technology of irrigation that reduce the pressure on groundwater resources and thus protect wetlands that are sustained by groundwater inputs.
- Use conservation easements or land acquisition to place biologically important wetlands and surrounding buffers into conservation management or ownership in order to limit urban and agricultural development in the immediate watershed of wetlands (e.g. cultivation, land application of animal waste, concentrated animal operations and irrigation-dependent crop production).
- Establish set-back distances around wetlands for soil farming of oil & gas drilling waste, the land-application of animal waste or the use of pesticides in order to reduce the potential for excessive nutrients, hormones, pesticides, hydrocarbons, salts and solvents from entering wetlands through storm water runoff.
- Continue to provide financial and technical assistance to landowners to develop or maintain vegetated buffers around wetlands to protect water quality.
- Encourage the fencing of wetlands to control grazing in and around them and to allow the development of vegetative buffers.
- Develop Conservation Reserve Enhancement Program projects around biologically important wetland complexes and encourage enrollments in these programs.
- Improve small landowner access to and use of cost-share programs for wetland habitat improvements and water quality improvements.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

12. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
13. Baseline information about the historic and current distribution, structural condition and community composition of herbaceous wetlands is incomplete and the small size of many wetlands makes them difficult to identify within larger landscapes.
14. Information regarding the distributions and ecological needs of wetland wildlife species (e.g., which wildlife species occupy which wetland types) is incomplete.

Conservation Actions:

- Conduct reviews of existing literature, reports and museum records, and interview technical experts to compile historic and recent distributional and ecological information for all species of greatest conservation need.
- Conduct research to identify the factors that limit the distribution and abundance of Tier I and Tier II species of greatest conservation need and develop management recommendations to enhance their populations through improved habitat conditions or recruitment.
- Conduct field surveys to assess the current distribution and microhabitat needs for Tier I and Tier II species of greatest conservation need and use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest benefits for these species.
- Research the historic conditions of the different herbaceous wetland communities in this region in order to develop a series of realistic and biologically meaningful descriptions for how high quality wetlands should look. These should serve as the range of target conditions for habitat restoration, enhancement and maintenance efforts.
- Locate and map the locations of the remaining wetlands in the region, then inventory these sites to determine their condition and the biological communities that they support. Identify the conservation practices that could enhance the value of these habitat tracts to species of greatest conservation need.
- Develop population and habitat monitoring programs for representative species of greatest conservation need, and develop a database of wetlands and associated ecological data for species of greatest conservation need.
- Develop and distribute information for landowners and conservation planner regarding the ecology of herbaceous wetlands within the region.

Potential indicators for monitoring the effectiveness of the conservation actions:

- number of acres of wetland habitat in conservation programs
- number of acres and number of individual wetlands restored or enhanced
- population sizes and trends for species of greatest conservation need
- number of acres of wetlands in good condition

High Priority Conservation Landscape: Small Rivers

The small rivers within the Mixed-grass Prairie Region are the Salt Fork of the Arkansas, the Chickaskia, and North Fork of the Red. Habitat conditions within most small rivers are currently poor as a result of multiple factors. These rivers have been altered by historic channelization projects that have increased channel incision and increased sediment loads as a result of soil erosion within their watersheds. Additionally, their hydrologies have been altered through the loss of flood plain wetlands and the construction of impoundments on tributaries.

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Bald Eagle	uncommon winter resident along all of the small rivers in the region	I
Bird	Canvasback	uncommon winter resident throughout the region	S
Bird	Little Blue Heron	locally common summer resident in the vicinity of nesting colonies	U
Bird	Northern Pintail	uncommon winter resident throughout region	D
Bird	Peregrine Falcon	rare spring and fall migrant throughout the region	I
Bird	Prothonotary Warbler	rare summer resident that nests in forested reaches of the Salt Fork and Washita rivers	U
Bird	Snowy Plover	locally-occurring summer resident; a total of 200 to 300 pairs nest at three salt flats in the region.	U
Bird	Solitary Sandpiper	uncommon spring/fall migrant throughout the region	U
Bird	Trumpeter Swan	uncommon winter resident found mainly in the northern half of the region	I
Bird	Whooping Crane	very rare spring/fall migrant; total population approx 300 birds	I
Fish	Plains Minnow	widespread but declining in all of the streams and rivers in the region	D
Fish	Prairie Speckled Chub	uncommon in the North Fork of the Red River	U
Fish	Red River Pupfish	common in the North Fork of the Red River	I
Fish	Red River Shiner	common in the North Fork of the Red River	U
Rept	Midland Smooth Softshell	uncommon; found in the Arkansas River tributaries	U
Rept	Ouachita Map Turtle	uncommon in the Washita, Salt Fork and Chickaskia rivers	U
Rept	Spiny Softshell Turtle	common in all of the small rivers in the region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

1. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
2. Information regarding the historic structure and community composition of small rivers in incomplete.

Conservation Actions:

- Develop a monitoring program to track habitat condition/quality and status of species of greatest conservation need.
- Conduct surveys of existing literature, reports, and museum records to evaluate historic distributions, abundances, and habitat affinities of species of greatest conservation need, and to examine possible causes of suspected population declines.
- Conduct field studies to establish baseline conditions for the current distributions, abundances, and habitat affinities of species of greatest conservation need.
- Develop and provide long-term funding to maintain databases to store and analyze distributional and ecological data for species of greatest conservation need.
- Conduct ecological studies on priority species of greatest conservation need to identify factors that limit population sizes, evaluate factors that may be responsible for population declines, and develop recommendations to enhance populations by improving habitat conditions.

Conservation Issues Related to Activities that Alter Flow Patterns and Water Quantity:

3. Channelization and reservoir construction on the main stems of the small rivers work in concert with each other to alter channel morphology and hydrology. Reservoir construction reduces flows during periods of drought and the magnitude of seasonal and periodic flooding events. Reservoir construction facilitates the channelization of rivers which create a more incised channel that becomes disconnected from its riparian zone and flood plain.
4. Channelization of the tributaries of small rivers results in incised channels and the loss of natural flood storage in the form of flood plain wetlands and stream meanders. The loss of flood storage creates small rivers that have flashier flow conditions (e.g. water volume rises and falls more quickly during and following rainfall events).
5. Groundwater withdrawal from the shallow aquifers and alluvium below small rivers can lower the water table and reduce groundwater contributions to the river's base flow. Reduced base flow increases the risk that portions of the river's surface flow will cease during drought conditions.
6. Dams on tributaries and surface water diversions cause reductions in both base flows and peak flows that shape and maintain in-stream habitats and channel structure.
7. If implemented, the currently dormant proposal to divert water from some of the Red River's tributaries in order to reduce the naturally occurring salinity in that system would reduce the quantity of the base flow for the North Fork of the Red River and would likely result in periods of time without surface flows.
8. Existing water laws and permitting processes may allow for excessive water withdrawals during periods of low flow. The need for water for irrigation, municipal use and oil/gas production contribute to the reduction of water quantity and alter flow patterns.

Conservation Actions:

- Fund research to determine the ecological flows required to maintain species of greatest conservation need within the small rivers of this region. Incorporate ecological flow needs into the permitting process for water withdrawals.
- Work with municipalities and federal agencies to improve water quality and flows below reservoirs and restore flows to patterns that more closely reflect historic conditions.
- Fund projects that restore river channel morphology.
- Encourage congressional reprioritizing of the U.S. Army Corps of Engineers projects to include fish, wildlife, and recreation as designated purposes where these are lacking.
- Support legislation to establish minimum in-stream flow provisions on small rivers that support populations of aquatic species of greatest conservation need.
- Provide financial and technical support to landowners, conservation districts and municipalities who are willing to restore or create and maintain riparian buffer zones on small rivers as well as their stream tributaries and headwaters.
- Distribute the results of ecological studies that demonstrate the negative ecological and economic consequences of the proposed Red River chloride control project with a goal of formally de-authorizing it.
- Develop and distribute information to landowners and others concerning the value of water, grazing management, crop selection, fire management, energy development, and natural systems.
- Encourage the replacement of stock ponds with alternative water sources.
- Increase funding for and landowner acceptance of Farm Bill conservation practices that protect riparian areas from grazing, haying or cropping.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality:

9. Excessive grazing in the riparian zone, especially during the summer months, reduces the abundance of herbaceous cover, reduces bank stability, and contributes to bank erosion.
10. Some agricultural practices (e.g. land application of animal wastes; inadequate control of runoff from fertilized fields and concentrations of livestock) that are conducted close to streams and rivers can contribute excessive amounts of nutrients through storm water runoff that can lead to algal blooms and/or high fluctuations in dissolved oxygen concentrations.
11. Clearing of riparian vegetation along small rivers can increase the magnitude of erosion and contribute to sedimentation of in-stream habitats.
12. Water quality in small rivers is sometimes reduced by discharges of herbicides, nitrates, endocrine disruptors, and oil field pollution chemicals that may cause acute (fish kills) or chronic (lower survival or reproductive success) impacts on aquatic populations.

Conservation Actions:

- Provide technical assistance and funding to encourage landowners and municipalities to create, restore and maintain riparian buffer zones along rivers, streams and headwater tributaries.
- Develop new or update existing Best Management Practices for the control of erosion, the application of animal waste and fertilizers and the control of storm water runoff to reduce the amounts of sediment, nutrients and chemicals entering rivers.
- Provide cost-share funding to develop vegetated buffer strips and other storm water control measures around crop fields and feed lots to reduce inputs of nutrients, hormones and pesticides into aquatic systems.
- Support existing point-source and non-point-source pollution abatement efforts.

- Provide cost-share funding to landowners to develop alternate water sources and fencing in order to keep livestock out of riparian areas.
- Acquire fee title from willing sellers or conservation easements on land within the flood plains of rivers to limit development in these areas and allow for the restoration or creation of wetlands to store and filter water during flood events.
- Support an increase in funding for the conservation programs of the Farm Bill and provide better cost-share ratios or other incentives to increase the use of these programs by landowners.

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

13. Conditions such as fire suppression and continuous grazing in the flood plains of rivers have made these areas more suitable for invasive species such as the exotic Salt Cedar, Ravenna Grass and Giant Reed.
14. The unintentional introduction of fish from other river systems (probably through the release of bait fish) threatens native fish populations (e.g., introduction of Red River Pupfish from the Red River to the tributaries of the Arkansas River).

Conservation Actions:

- Financially support programs that help control invasive species and educate the public about the negative consequences of exotic species and the inter-basin movement of fish and aquatic invertebrates (e.g. bait bucket introductions).
- Conduct field surveys to determine the spatial extent of Salt Cedar, Ravenna Grass and Giant Reed along rivers and flood plains across the region.
- Evaluate the actual and potential impacts of invasive species on species of conservation need, and develop control or eradication programs for those that are likely to create substantial conflicts with native wildlife.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acres of riparian habitat restored
- miles of river channel restored
- changes in population sizes and trends for species of greatest conservation need
- relative condition and quantity of in-stream and riparian habitat
- changes in seasonal groundwater levels and rates of surface flow
- water quality parameters such as phosphorus, salt, sediment

High Priority Conservation Landscape: Blackjack Oak/Post Oak Woodlands and Shrublands

Blackjack Oak/Post Oak woodlands and shrublands occur locally in the Wichita Mountains and on bands of sandy soils and stabilized dunes north of the Canadian, North Canadian, and Cimarron rivers in the eastern half of the region. This community often occurs as a structural mosaic with landscape that is dominated by stands of open oak woodlands and patches of thick oak scrub and thickets that interspersed with patches of tallgrass prairie. The structure of this landscape is maintained by periodic fires and drought. The dominant tree in this community is the Blackjack Oak (*Quercus marilandica*) along with smaller numbers of Post Oaks (*Quercus stellata*) and Eastern Redcedars (*Juniperus virginiana*). Other common woody plants include Chittamwood (*Sideroxylon lanuginosa*), Eastern Redbud (*Cercis canadensis*), Roughleaf Dogwood (*Cornus drummondii*), Oklahoma Plum (*Prunus gracilis*), and Winged Sumac (*Rhus copallina*). In a few sheltered sites within the Wichita Mountains, small stands of Sugar Maples (*Acer saccharum*), Shumard Oaks (*Quercus shumardii*), and Little Walnuts (*Juglans microcarpa*) can be found growing in association with Post and Blackjack Oaks. Dominant grasses include common tallgrass prairie species - Little Bluestem *(Schizachyrium scoparium*), Switchgrass (Panicum virgatum), and Big Bluestem (*Andropogon gerardii*). Where this community occurs on exposed, rocky slopes in the Wichita Mountains, it has a structure that is dominated by low, oak thickets that support the last remaining nesting population of the endangered Black-capped Vireo. In the extreme western end of the Wichita Mountains in the vicinity of Quartz Mountain, the scrubby oak community includes the only naturally occurring populations of Texas Live Oak (*Quercus fusiformis*).

Most Post Oak/Blackjack woodland and shrubland complexes are in relatively poor condition and have declined in abundance over the past century as a result of conversion to agricultural uses. Decades of fire suppression have altered the structure of this community throughout the region by facilitating an increase in the abundance of and dominance of Eastern Redcedars (*Juniperus virginiana*), and in some areas fire suppression also has fostered an increased height and density of oaks.

Recognized vegetation associations within this habitat type include:

- Post Oak – Eastern Redcedar Woodland
- Blackjack Oak/Little Bluestem Woodland
- Post Oak – Blackjack Oak/Little Bluestem Woodland
- Texas Live Oak – Post Oak/Little Bluestem Woodland
- Sand Plum/Little Bluestem Shrubland
- Smooth Sumac Shrubland

(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference.)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Bell's Vireo	uncommon summer resident; local nesting populations occur in shrublands that contain sand plum thickets	D

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Black-capped Vireo	rare and locally-occurring summer resident; a nesting population occurs in the Wichita Mountains, but other populations historically occurred in Dewey and Blaine counties.	D
Bird	Harris's Sparrow	common winter resident wherever oak woodlands persist in the region	U
Bird	Northern Bobwhite	locally common year-round resident in sites that support open oak shrubland	D
Bird	Painted Bunting	common summer resident that nests in oak-dominated habitats throughout the region	S
Bird	Red-headed Woodpecker	uncommon and locally-occurring year-round resident in oak woodlands throughout the region	U
Inve	American Bumble Bee	uncommon but widespread in woodland habitats	D
Inve	Arogos Skipper	uncommon and locally occurring in open oak woodlands with an abundance of native tallgrass vegetation	U
Inve	Wichita Mountains Pillsnail	locally common in oak woodlands on rocky slopes in the Wichita Mountains	U
Mamm	Eastern Spotted Skunk	rare and secretive; occurs in wooded, rocky canyons and hills in the Wichita Mountains	U
Mamm	Long-tailed Weasel	rare and secretive species potentially found throughout the region	U
Mamm	Ringtail	secretive and locally occurring in rocky oak shrublands in the Wichita Mountains	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

1. Much of the historic oak woodland and shrubland habitat that occurred on sandy soils north of the Canadian, North Canadian and Cimarron rivers has been cleared and converted to introduced pasture grasses, primarily Bermuda grass, or has been converted to crop fields.
2. Herbicide treatment of oak woodlands has been used as a tool to kill woody cover and convert these acres to pastureland.
3. As tracts of oak woodlands and oak shrublands have been converted to other land uses, the remaining stands become increasingly fragmented and isolated from one another. Isolation, loss of connectivity and reduction in size all contribute to a reduced quality of habitat for area-sensitive species, many of which are species of greatest conservation need.
4. The construction of roads, homes and right-of-way corridors for utility lines and pipelines has fragmented oak woodlands and reduced their quantity for area-sensitive species.

Conservation Actions:

- Assess the structure and biological composition of the remaining Blackjack and Post oak-dominated communities to determine which are in the best condition, have the greatest restoration potential and support biologically important species of greatest conservation need such as the Black-capped Vireo. Conserve the most biologically important tracts through the acquisition of tee title or conservation easements from willing sellers.
- Develop a landowner incentives program or easement program to pay landowners to maintain oak woodlands and shrublands and to help landowners restore stands or improve upon the quality of existing stands.

- Provide grants or cost-share funding to pay landowners to restore oak woodlands or shrublands on retired crop fields and pasture land. Restoration efforts should be focused on tracts that can help to expand or connect the remaining tracks of woodland habitat.
- Monitor and evaluate the success of oak woodland restoration techniques to determine the most cost-effective and successful methods. Use restoration sites on public lands as demonstration areas.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

5. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
6. Our knowledge about the historic and current distribution, structural condition and community composition of Post Oak/Blackjack Oak savannas and shrublands is incomplete.

Conservation Actions:

- Conduct reviews of existing literature, reports and museum records, and interview technical experts to compile historic and recent distributional and ecological information for all species of greatest conservation need.
- Conduct research to identify the factors that limit the distribution and abundance of Tier I and Tier II species of greatest conservation need and develop management recommendations to enhance their populations through improved habitat conditions or juvenile recruitment.
- Conduct surveys to assess the current distribution and habitat needs of Tier I and Tier II species of greatest conservation need and use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest benefit for these species.
- Research the historic range of conditions and the natural range of structural variation in the Post Oak/Blackjack Oak savanna and shrubland complex in order to develop a series of realistic and biologically meaningful descriptions for how the range of high quality habitats should look. These should serve as the range of target conditions for habitat restoration, enhancement and maintenance efforts.
- Develop methods to identify and map the distribution of the remaining habitat tracts, then inventory these tracts to determine their condition and biological communities. Identify the conservation practices that could enhance the value of these habitat tracts for species of greatest conservation need.
- Develop population and habitat monitoring programs for representative species of greatest conservation need.
- Conduct research into the population responses of species of greatest conservation need to practices such as prescribed burning, invasive species management and grazing rotations in order to develop effective land management recommendations to maintain these species (e.g. stocking rates, burning frequency, grazing rotation frequency).
- Develop and provide long-term funding to maintain databases to store and analyze distributional and ecological data for species of greatest conservation need.
- Publish and make the results of all ecological studies available to land managers and conservation agencies so that they can be incorporated into site-specific, species-specific and regional conservation plans including future updates to the OCWCS.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

7. Natural fire regimes in most oak woodlands and shrublands have been disrupted or eliminated. This has fostered an increase in the density and dominance of Eastern Redcedars in many oak stands. It also has resulted in oak stands that are taller and/or denser than the historic condition.
8. Historic cutting of oak woodlands for fuel, followed by decades of fire suppression has resulted in the regrowth of unnaturally dense, even-age stands of oaks and junipers. Because of their dense canopy, these stands often have poor understory development.
9. Prescribed fire is difficult to use as a land management tool because of limited technical assistance, few trained/experienced landowners, and landowner liability. Additionally, the fuel load and abundance of junipers within many oak tracts makes these logistically difficult to burn without negatively affecting the existing oaks. Burning may be further complicated in hills and canyons by rough topography.
10. Burning in this habitat near homes and developments causes smoke conflicts and concerns about fire getting out of control. People in developed areas are frequently unwilling to deal with the fire and smoke associated with prescribed burning.
11. Our knowledge about the effects of prescribed fire on reptile, amphibian and invertebrate populations is incomplete. These burns are often conducted when weather conditions are relatively cool and moist, which may not accurately reflect the ambient conditions that existed during historic, naturally-occurring fires.
12. Oil and gas exploration and development results in increased numbers of roads, increased erosion potential around well sites and roads, increased potential for oil or saltwater spills, and other factors that may reduce habitat quality.

Conservation Actions:

- Conduct studies of the responses of wildlife populations to various land management practices such as thinning, deferred grazing, and prescribed late winter burning.
- Provide increased technical assistance to landowners who are interested and willing to restore periodic fire. Provide logistical and financial support to maintain or expand the existing prescribed burning associations in the region. Develop and distribute technical assistance information to landowners regarding recommended procedures for conducting prescribed burns and fire/grazing rotations.
- Support the continuation of the burn laws and policies that have reduced landowner liability and have helped to foster the increased use of fire as a management tool.
- Facilitate the continuation of professional burn crews that make prescribed burning more accessible and affordable to landowners.
- Develop cost-share assistance or provide financial incentives to landowners who are willing to enhance or to restore habitat structure through thinning, burning or grazing management.
- Cooperate with representatives of the oil and gas industry and agricultural community to develop new or revise existing recommended practices for erosion control that use native plant species, and more ecologically sensible drilling pad and access road site selection.

Conservation Issues Associated with Invasive and/or Exotic Plants and Animals that are Detrimental to Species of Greatest Conservation Need:

13. There has been widespread invasion of exotic plants (e.g., Sericea lespedeza, and Japanese brome) in the understory, and invasive trees (e.g. Black Locust, Eastern Redcedar and Siberian Elm) in the canopy. In some areas the spread of invasive plants has been facilitated by heavy grazing that reduces the cover of native plants and fire suppression.

Conservation Actions:

- Conduct studies of the responses of both invasive species populations and native plant and wildlife populations to various land management practices such as deferred grazing, prescribed late-winter burning and selective herbicide treatment. These studies should identify those practices that will most effectively control invasive species while having minimal or nominal effects on native species of concern.
- Develop and implement control or eradication strategies for invasive species. Provide cost-share assistance to landowners to encourage their participation in invasive species control efforts.
- Facilitate the development of burning associations or professional burning crews to help landowners restore periodic fire to the landscape to control invasive species such as Eastern Redcedar.
- Develop and implement management plans for exotic and invasive species on all public conservation lands in the region.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acres placed into conservation ownership or programs (e.g., easements secured and acreage conserved)
- changes in population sizes and trends for species of greatest conservation need
- acres burned/treated to restore historic community structure and composition
- acres of native plant communities restored
- acreage of land being improved by the implementation of technical assistance recommendations
- animal populations and vegetation response to management practices
- changes in acreage/coverage of exotic vegetation
- number of landowners participating in landowner incentive programs
- vegetative response to prescribed burning (e.g., grasses and woody plants)

Moderate Priority Conservation Landscape: Sandy-bottomed Streams, Springs and Associated Riparian Woodlands

Most streams in the Mixed-grass Prairie Region have sandy or silty substrates, although locally in rocky landscapes such as the Wichita Mountains, streams may flow over areas of hard clay. Very little information exists regarding the historic conditions of these prairie streams but prior to settlement, many streams appear to have been slightly entrenched with well developed floodplains, moderate degrees of channel sinuosity (i.e., meanders), and moderate width-to-depth ratios. Narrow riparian woodlands and shrublands historically grew along the banks of most streams. These communities were comprised of a diversity of tree species including American Elm (*Ulmus americana*), Sugarberry (*Celtis laevigata*), Western Soapberry (*Sapindus drummondii*), Eastern Cottonwood (*Populus deltoides*), Black Willow (*Salix nigra*), Roughleaf Dogwood (*Cornus drummondii*), and Buttonbush (*Cephalanthus occidentalis*). Over the past century, many streams in the region have been altered by human activity such as the removal of riparian vegetation and the straightening of the stream channels to remove meanders. These efforts to reduce the amount of acreage occupied by streams and associated floodplains have resulted in many streams cutting deep, incised channels that separate them from their former riparian zone. This often leads to a reduction in the water table adjacent to the stream, which places additional stress on riparian vegetation.

Included in this habitat classification are springs, seeps and headwater tributaries. Springs are relatively rare in this region and occur primarily in association with gypsum canyon lands and rocky landscapes. Seeps are typically found in association with stabilized dunes and broad stream floodplains.

Recognized plant associations within this habitat type include:

- Eastern cottonwood – American elm – sugarberry temporarily flooded forest
- American/red elm – sugarberry/hackberry – green ash temporarily flooded forest
- American/red elm – chinquapin oak temporarily flooded forest
- Eastern cottonwood – sandbar willow temporarily flooded woodland
- Eastern cottonwood – black willow temporarily flooded woodland
- Black willow temporarily flooded woodland
- Sandbar willow/Switchgrass temporarily flooded shrubland
- Buttonbush semi-permanently flooded shrubland

(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference.)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	American Woodcock	rare winter resident and uncommon spring / fall migrant in the eastern 1/3 of the region	U
Bird	Bell's Vireo	uncommon summer resident; nests in riparian willow thickets	D
Bird	Bullock's Oriole	uncommon summer resident; nests in riparian woodlands in the western half of the region	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Golden-fronted Woodpecker	rare and locally occurring year-round resident in the southwestern corner of the region	U
Bird	Little Blue Heron	occurs locally during the summer months throughout the region	U
Bird	Louisiana Waterthrush	uncommon and found only in streams in the Wichita Mountains and Caddo canyons	S
Bird	Painted Bunting	common summer resident; in the western half of this region, it often nests in brushy, riparian habitats	S
Bird	Prothonotary Warbler	rare summer resident that nests in riparian forests in the eastern edge of the region	U
Bird	Red-headed Woodpecker	uncommon but widespread summer resident in the northern 2/3 of the region; rare winter resident	D
Bird	Snowy Egret	common summer resident; occurs locally in the vicinity of a few nesting colony sites scattered across the region	S
Fish	Arkansas Darter	occurs in springs, seeps and headwater streams in the Cimarron River watershed; known from Traders and West Anderson creeks	S
Fish	Plains Minnow	Widespread, but declining, in all of the perennial streams in the region	D
Fish	Red River Pupfish	locally common in saline streams throughout the region	I
Inve	American Bumble Bee	uncommon but widespread in riparian habitats	D
Mamm	Mountain Lion	widespread and rare; occurs in low density throughout region	I
Mamm	Western Big-eared Bat	forage in riparian woodlands along streams near gypsum formations that contain roosting caves	U
Rept	Midland Smooth Softshell	uncommon and locally occurring in larger streams.	U
Rept	Ouachita Map Turtle	uncommon and restricted to a few streams in the eastern 1/3 of the region and Cache Creek	U
Rept	Spiny Softshell Turtle	locally common and widespread throughout region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Current and Historic Land Uses that Negatively Affect Water Quality:

1. Heavy grazing, especially during the growing season, can reduce the abundance of herbaceous and understory riparian vegetation that can result in an increase in erosion and a decrease in stream bank stability.
2. Landowners and livestock operators sometimes modify springs by adding concrete structures to facilitate cattle watering. Cattle loafing and drinking in springs can increase turbidity, reduce aquatic vegetation and increase nutrients that favor increased algal growth.
3. Heavy cattle grazing and use of chemical fertilizers around springs can elevate nutrient levels and increase algae.
4. Riparian habitats have been converted to agricultural land uses such as Bermuda grass pasture and crop fields because of their rich soils. This directly eliminates riparian habitat and has indirect consequences for streams such as decreased shading, decreased bank stability and increased sedimentation of in-stream habitats.
5. Pesticides, including those that act as growth inhibitors or endocrine system disruptors can enter streams through storm water runoff from agricultural fields and

livestock pens. These pollutants can alter the growth, reproduction and/or survival of non-target fish, amphibians and aquatic invertebrates in the streams.

Conservation Actions:

- Acquire fee title, conservation easements, or leases to conserve the most important stream reaches and springs in the Mixed-grass Prairie Region, especially those that support Arkansas Darter populations.
- Develop cost-share programs and landowner incentive programs that fund and encourage the protection and restoration of riparian vegetation, water quality, springs and in-stream habitat.
- Provide cost-share funding to facilitate the restoration of native vegetation around springs and to remove modifications such as small impoundments.
- Provide cost-share funding to land owners to develop water wells and alternative sources of watering livestock and to fence springs and riparian areas to control access by livestock.
- Conduct field studies to delineate recharge areas of springs necessary to protect water quality and flows.
- Work collaboratively with public agencies and landowners to establish set back distances between streams and sources of nutrients and pesticides such as confined animal feeding operations, animal waste application areas and crop fields that require high nutrient or chemical inputs.
- Increase funding for the conservation programs of the Farm Bill with an emphasis placed on programs that restore or maintain riparian buffers or create filter strips and buffers around ditches, crop fields and livestock pens to control nutrients, pesticides and sediment.
- Restore wetlands within the flood plains of streams to filter and store storm water runoff. Simultaneously reduce agricultural and residential development in flood plains and riparian areas.
- Fund the construction of fencing around springs to control access by livestock and to help re-establish native riparian vegetation.

Conservation Issues Related to Activities that Alter Flow Patterns and Water Quantity:

6. Channelization of streams has caused stream channel incision. This incision can lower the water table immediately adjacent to streams and disconnects stream channels from their flood plains and riparian vegetation. Isolation of stream channels from riparian zones diminishes riparian habitat quality and acreage and reduces the abundance of wetlands within the streams' flood plains.
7. Water that is pumped from streams, especially during drought and low-flow periods, diminishes stream flow and alters riparian hydrology.
8. Groundwater withdrawals from shallow alluvial deposits can reduce the flow from springs and reduce the base flow in streams.
9. Low-water stream crossings and some types of culverts alter the natural pattern of stream flow and sediment transport within streams. These can alter channel morphology and serve as barriers to the upstream movement of fish.
10. Dams constructed on streams permanently inundate segments of streams, create barriers to the movement of fish that isolate upstream and downstream populations, and can alter the fish community composition by favoring fish that area adapted to ponded habitats. Dams can alter the pattern of flow in streams by reducing the frequency and magnitude of high-flow events.
11. The construction of ponds and impoundments on stream tributaries and ephemeral drainages may be reducing the inflow that sustains streams.

Conservation Actions:

- Encourage and facilitate the reconnection of riparian woodlands with their streams by restoring channels and managing for the natural flow pattern.

- Encourage management of water withdrawals to lessen their impact on spring flows and stream flows.
- Work collaboratively with landowners to remove the impoundments on streams that block the movement of fish species of greatest conservation need.
- Establish ecologically acceptable ecological flow rates on streams that support species of greatest conservation need to ensure the continued persistence of these populations.
- Provide cost-share funding, grants or financial incentives to encourage landowners to restore riparian habitat, stream channels and flood plain wetlands.
- Replace low-water crossing and culverts that block the passage of fish species of conservation need with redesigned structures.

Conservation Issues Related to Incomplete Data Concerning Species of Greatest Conservation Need and their Relationships to Streams and Riparian Habitats:

12. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies are an impediment to the development and implementation of effective conservation strategies.
13. Our knowledge about the historic and current structural condition and community composition of streams and springs is incomplete.

Conservation Actions:

- Conduct ecological studies on Tier I and Tier II species of greatest conservation need to identify factors that limit population sizes, evaluate factors that may be responsible for population declines, and develop recommendations to enhance populations through improving habitat conditions or recruitment.
- Conduct research to identify the factors that limit the distribution and abundance of Tier I and Tier II species of greatest conservation need and develop management recommendations to enhance populations by improving habitat conditions.
- Conduct reviews of existing literature, reports and museum records, and interview technical experts to compile historic and recent distributional and ecological information for species of greatest conservation need in order to use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest benefits for these species.
- Research the historic condition of streams and riparian woodlands in this region in order to develop a series of realistic and biologically meaningful descriptions for how high quality examples of these habitats should look. These descriptions should serve as the range of target conditions for habitat restoration and enhancement efforts.
- Develop methods to identify and map springs and seeps, then inventory these sites to determine their condition and the biological communities that they support. Identify the conservation practices that could enhance the value of these sites to species of greatest conservation need.
- Develop population and habitat monitoring programs for representative species of greatest conservation need, and develop a database of springs to store distributional and ecological data for these species.
- Publish and make the results of all ecological studies available to land managers and conservation agencies so that they can be incorporated into site-specific, species-specific and regional conservation plans including future updates to the Oklahoma Comprehensive Wildlife Conservation Strategy.

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

14. Fire suppression and continuous grazing have created conditions in riparian areas that make them vulnerable to invasive species such as Salt Cedar, Eastern Redcedar, and Chinese Privet that alter vegetation structure and composition.

15. Some invasive or over-abundant wildlife species such as Feral Hogs and Brown-headed Cowbirds have become more abundant in riparian zones. Feral Hogs trample riparian vegetation and wallow in stream banks thus increasing erosion, depredate native reptiles and amphibians, and compete for food with birds and mammals. Cowbirds lay their eggs in the nests of migratory songbirds that are poorly adapted to raise cowbird chicks along with their own chicks.

Conservation Actions:

- Develop and fund burn cooperatives to implement periodic prescribed burns in riparian areas to control aggressive redcedar encroachment.
- Implement cowbird control programs to off-set their impact on migratory songbirds.
- Develop and distribute information to landowners about the biology, impact and control measures for exotic invasive species.
- Develop and implement invasive and exotic species management plans for all public lands and use these areas as demonstration sites to show the effectiveness of invasive species control to encourage private landowners to implement similar plans for exotic and/or invasive species.
- Cooperate with other stakeholders to implement programs that control the spread of exotic species such as Salt Cedar.

Potential indicators for monitoring the effectiveness of the conservation actions:

- population response of species of greatest conservation need to management actions such as riparian fencing and prescribed burning
- changes in populations and trends for species of greatest conservation need
- relative condition and quantity of riparian habitat
- number and acreage of easements obtained
- populations of spring/stream organisms
- number and miles of protected springs and stream reaches
- number of fish passage barriers that have been removed or modified
- changes in stream and spring flow
- changes in water quality parameters such as phosphorus and sediment

Moderate Priority Conservation Landscape: Mesquite Savanna or Shrublands

This community is sometimes treated as a variation of the mixed-grass prairie community with the addition of a Honey Mesquite (*Prosopsis glandulosa*) overstory. The Mesquite savanna and shrubland community occurs widely in roughly the southern third of the Mixed-grass Prairie Region, particularly on sites with clay soils. The historic abundance of Mesquite within this community is poorly unknown and heavily debated. Despite the range of opinions regarding the historic abundance of Mesquite, most biologists agree that Mesquite is more prevalent today than it was prior to European settlement. Additionally, Mesquite is typically viewed as a native species with invasive tendencies whose abundance was historically controlled by periodic prairie fires. The combined effects of widespread fire suppression and heavy grazing over the past century have contributed to recent increases in the amount of Mesquite cover.

Common grasses and forbs within this community include Blue Grama (*Bouteloua gracilis*), Buffalo Grass (*Bouteloua dactyloides*), Sideoats Grama (*Bouteloua curtipendula*), Little Bluestem (*Schizachyrium scoparium*), Vine Mesquite (*Panicum obtusum*), and Pricklypear Cactus (*Opuntia sp.*), Soapweed Yucca (*Yucca glauca*), and Sneezeweed (*Helenium amarum*).

Recognized vegetation associations include:
Honey Mesquite – Blue Grama – Buffalo Grass Shrubland
Honey Mesquite – Lotebush Shrubland
(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference.)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Texas Toad	locally common in the vicinity of seasonal breeding ponds in the southern quarter of the region	S
Bird	Barn Owl	uncommon year-round resident throughout the region; occurs locally where suitable nesting sites are available	U
Bird	Burrowing Owl	uncommon summer resident; nests locally at and around prairie dog colony sites	S
Bird	Cassin's Sparrow	uncommon summer resident throughout the region; nests in areas with sparse shrub and mesquite cover	U
Bird	Harris's Sparrow	uncommon winter resident in mesquite tracts with tall grass and deciduous shrub cover	U
Bird	Loggerhead Shrike	common year-round resident; more commonly found in tracts of habitat with an open canopy and mature trees	D
Bird	Northern Bobwhite	common year-round resident; found where there is adequate grass and shrub cover	D
Bird	Painted Bunting	uncommon summer resident; nests in sites with dense shrub and mesquite cover	S

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Mamm	Black-tailed Prairie Dog	occurs locally at a few dozen colony sites scattered primarily in the southern part of the region	S
Mamm	Desert Shrew	rare and secretive; most known populations are found in the southwestern quarter of the region in association with woodrat nests	U
Mamm	Ringtail	rare and secretive; occurs in rocky sites in southwestern Oklahoma	U
Mamm	Texas Kangaroo Rat	very rare and possibly extirpated; historically occurred in parts of Comanche and Cotton counties	U
Rept	Lesser Earless Lizard	uncommon and locally occurring in sites with sparse vegetation	U
Rept	Texas Horned Lizard	locally common but found primarily in larger tracts of habitat in the western half of the region	D
Rept	Texas Long-nosed Snake	uncommon and secretive snake that is known to occur in scattered sites across the western half of the region	U
Rept	Western Diamond-backed Rattlesnake	locally common where mesquite savannas occur on rocky soils	U
Rept	Western Massasauga	uncommon but widespread in mesquite habitat in the western half of the region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

1. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
2. Our knowledge about the historic and current distribution, structural condition and community composition of mesquite savannas and shrublands is incomplete. Uncertainty exists regarding their historic abundance and structure.

Conservation Actions:

- Conduct reviews of existing literature, reports and museum records, and interview technical experts to compile historic and recent distributional and ecological information for all species of greatest conservation need.
- Conduct research to identify the factors that limit the distribution and abundance of Tier I and Tier II species of greatest conservation need and develop management recommendations to enhance their populations through improved habitat conditions.
- Conduct surveys to assess the current distribution and habitat affinities for priority species of greatest conservation need and use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest benefit.
- Research the historic condition of this habitat in order to develop a realistic and biologically meaningful description for how high quality habitat should look. This should serve as the target condition for habitat enhancement and maintenance efforts.
- Map the distribution of this habitat and inventory representative tracts to determine their condition and the biological communities that they support. Identify the conservation practices that could enhance the value of these habitat tracts for species of greatest conservation need.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

3. Many biologists and land managers believe that mesquite shrublands are more common today than they were historically due to encroachment of mesquite into areas that were historically mixed-grass prairie as a result of heavy grazing and fire suppression. However, much of the historic mesquite savanna habitat that occurred on fertile soils has been converted to crop fields.

Conservation Actions:

- Use conservation easements and fee title land acquisition to conserve some of the most important tracts of mesquite savanna in the region. Tracts that support Tier I and Tier II species of greatest conservation need such as the Texas Horned Lizard, Black-tailed Prairie Dog and Burrowing Owl are the most biologically important.
- Encourage the replanting of retired cropland and Bermuda grass pastures to mixed-grass prairie grasses and forbs with a sparse mesquite component.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

4. Mesquite shrublands have increased at the expense of mesquite savannas. As a result of heavy grazing and decades of fire suppression, dense stands of relatively young mesquites have grown in areas that were historically more open. Because mesquite-dominated habitats occupy drought-prone parts of the region, overutilization of the grassy component of the habitat can occur quickly during periodic droughts. Overutilization of grass removes vegetation that would otherwise shade and compete with young mesquite trees. This, coupled with regional fire suppression, has favored the establishment of mesquite trees and prickly pear cacti at densities that are higher than they occurred historically.
5. Some biological components of this habitat, such as Black-tailed Prairie Dog colonies, have been reduced or nearly eliminated.

Conservation Actions:

- Research the most effective techniques (e.g. prescribed burning, selective herbicide treatment or a combination of both) for reducing mesquite abundance without reducing the abundance and diversity of beneficial forbs and other broadleaved plants.
- Provide technical assistance and financial assistance to landowners to implement mesquite savanna restoration in areas that currently function as mesquite shrublands.
- Provide financial incentives for landowners who conserve Black-tailed Prairie Dog colonies.
- Promote rotational grazing practices which conserve mesquite savanna habitat. Develop recommended practices and technical assistance guidance to help landowners with grazing management.
- Research the applicability of patch-burn techniques as an effective means of grazing management in mesquite-dominated habitats. If a patch-burn grazing system maintains mesquite savanna habitat in good condition, then promote its use.
- Fund financial incentives programs like the Landowner Incentive Program for the conservation of Black-tailed Prairie Dog colonies and other associated species of greatest conservation need.
- Support ranch diversification in order to lower stocking rates and grazing pressure by offsetting the lost revenue with lease hunting and ecotourism revenue.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acres enrolled in conservation programs
- acres of native plant communities restored
- numbers, size and distribution of Black-tailed Prairie Dog colonies

- changes in population sizes and trends of species of greatest conservation need
- relative condition and quantity of habitat
- response of species to management practices such as burning and grazing

Moderate Priority Conservation Landscape: Juniper Savanna or Woodlands

Two types of juniper woodlands occur in the Mixed-grassed Prairie Region of Oklahoma – one dominated by Eastern Redcedar (*Juniperus virginiana*) and the other dominated by Redberry Juniper (*Juniperus pinchotii*). Historically, woodlands of Eastern Redcedar (*Juniperus virginiana*) would have been largely confined to canyons and steep hillsides where rocks and bare ground would have limited the extent and frequency of naturally-occurring fires. Eastern Redcedar woodlands are now common and distributed throughout the region. Eastern Redcedar is a native juniper that has shown a dramatic increase in abundance across the region over the past half century, most likely as a result of fire suppression or a combination of year-round grazing pressure coupled with fire suppression. As a result of its increasing abundance, many acres of mixed-grass prairie and tallgrass prairie habitats have developed into juniper savannas or woodlands. The increase in juniper abundance also has affected the structure of other habitat types, including Sand Sagebrush shrublands and Post Oak/Blackjack Oak shrublands.

Much less common and more restricted in range are Redberry Juniper (aka Pinchot Juniper) woodlands, which occur in the southwestern part of the region. These woodlands occur on rugged, dissected hills and canyons in portions of Beckham, Greer, Harmon, and Jackson counties. It is likely that Redberry Juniper also has increased in abundance as a result of fire suppression, but Redberry Juniper woodlands do not appear to have spread beyond their historic range and remain localized in canyons and "badlands" on thin soils derived from gypsum and/or shale.

Recognized plant associations within this habitat type include:

Pinchot Juniper/Grama (Sideoats, Hairy) Woodland
Eastern Redcedar/Little Bluestem Woodland
Little Bluestem/Eastern Redcedar Prairie

(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference.)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Barn Owl	uncommon year-round resident that is found where abandoned buildings & cliffs provide nesting sites	U
Bird	Harris's Sparrow	common winter resident throughout the region	U
Bird	Northern Bobwhite	common year-round resident throughout the region	D
Bird	Painted Bunting	common summer resident that nests throughout the region; more common in the southern half	S
Mamm	Desert Shrew	rare and secretive; most known populations are found in the southwestern quarter of the region in association with woodrat nests	U
Mamm	Ringtail	rare and secretive; potentially occurs in rocky sites dominated by Redberry Juniper	U
Rept	Western Diamond-backed Rattlesnake	locally common in rocky, rugged areas that support Redberry Juniper woodlands	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

1. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
2. Baseline knowledge about the historic and current distribution, structural condition and community composition of Juniper-dominated woodlands is incomplete.

Conservation Actions:

- Conduct reviews of existing literature, reports and museum records, and interview technical experts to compile historic and recent distributional and ecological information for all species of greatest conservation need.
- Conduct research to identify the factors that limit the distribution and abundance of Tier I and Tier II species of greatest conservation need and develop management recommendations to enhance populations through improved habitat conditions.
- Conduct surveys to assess the current distribution and habitat affinities for Tier I and Tier II species of greatest conservation need and use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest benefit.
- Research the historic condition of this habitat in order to develop a realistic and biologically meaningful description for how high quality habitat should look. This should serve as the target condition for habitat enhancement and maintenance efforts.
- Develop methods to identify and map the distribution of the remaining habitat tracts, then inventory these tracts to determine their condition. Identify the conservation practices that could enhance the value of these habitat tracts to SGCN.
- Develop population monitoring programs for representative species of greatest conservation need.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

3. Juniper woodlands often occur in drought-prone regions and on thin, drought-prone soils. Periodic drought coupled with continuous grazing can easily result in over-utilization of herbaceous vegetation by livestock. Over utilization decreases the abundance of vegetation that would compete with junipers and enhances juniper abundance.
4. Fire suppression has increased juniper survival, which has resulted in unnaturally high densities of junipers in many tracts. Tracts of Eastern Redcedar woodland are more extensive and dense than historically and have encroached into other habitats such as prairies and deciduous shrublands. Tracts of Redberry Juniper woodland often contain juniper abundances that are greater than those that would have been found historically, but these woodlands generally remain confined to canyons and "badlands" in a few southwestern counties.

Conservation Actions:

- Develop and distribute technical guidance publications for landowners and lessees covering land management practices such as sustainable grazing and fire ecology to reduce over-grazing and limit juniper abundance.
- Encourage the appropriate use of prescribed fire in this habitat.
- Encourage and support the formation and maintenance of local prescribed burning associations or cooperatives.
- Provide funding for deferred grazing programs to enhance the abundance and diversity of herbaceous vegetation.

- Cooperate with energy companies to minimize surface damages from oil, gas, pipeline and wind energy developments on thin and erosion-prone soils in order to retain or enhance herbaceous vegetation and limit the expansion of junipers.
- Encourage and support programs that improve grazing management and restore native grass cover in this habitat.

Potential indicators for monitoring the effectiveness of the conservation actions:

- number and distribution of habitat acres calculated using GIS & remote sensing
- changes in population sizes and trends of species of greatest conservation need
- changes in acreage dominated by juniper savannas and woodlands
- changed in density of junipers or proportion of juniper-dominated habitat that is in an open savanna condition as opposed to a dense juniper woodland condition

Potential partnerships to deliver conservation for Mixed-grass Prairie Region:

State Government

- Conservation Districts
- Oklahoma Biological Survey
- Oklahoma Commissioners of Land
- Oklahoma Corporation Commission
- Oklahoma Department of Agriculture and Forestry Service
- Oklahoma Department of Environmental Quality
- Oklahoma Energy Resources Board
- Oklahoma Legislature
- Oklahoma Renewable Energy Council
- Oklahoma State University, Cooperative Extension Service
- Oklahoma State University, Department of Natural Resources Management and Ecology
- Oklahoma Water Resources Board
- Other state universities and departments
- Texas Parks and Wildlife Department

Federal Government

- Federal Regulation and Oversight of Energy
- U.S. Army Corps of Engineers
- U.S. Bureau of Reclamation
- U.S. Department of Agriculture, Farm Service Agency
- U.S. Department of Agriculture, Forest Service
- U.S. Department of Agriculture, Natural Resources Conservation Service
- U.S. Department of Agriculture, Resource Conservation and Development Councils
- U.S. Department of Defense
- U.S. Department of the Interior, Bureau of Land Management
- U.S. Department of Agriculture, Forest Service, Black Kettle National Grasslands
- U.S. Fish and Wildlife Service
- U.S. Fish and Wildlife Service Great Plains Landscape Conservation Cooperative
- U.S. Geological Survey

Local Government

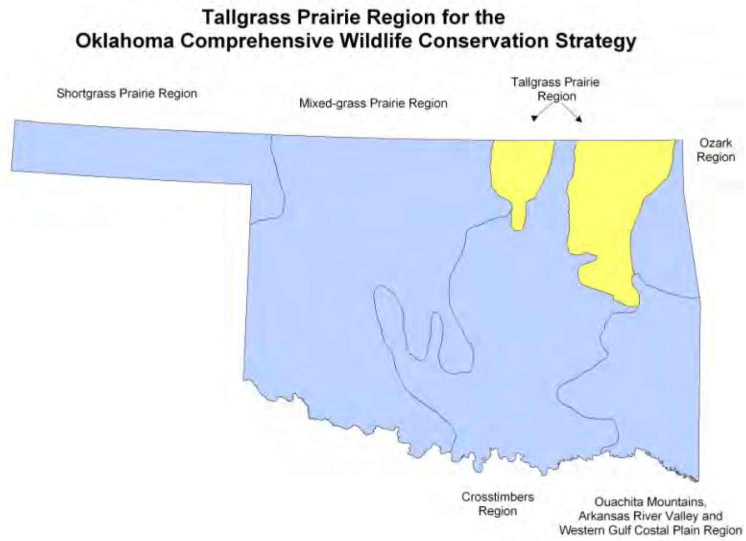
- Municipalities
- County Commissioners
- Tribal governments

Businesses, Non-profit Organizations and Citizen Groups

- Audubon Oklahoma
- Chambers of Commerce
- Ducks Unlimited and local Oklahoma chapters
- Electric Utilities
- Farm Bureau
- Farm organizations
- Farmers Union
- National and Oklahoma Wind Power Initiative
- National Rivers Society
- National Wild Turkey Federation and local Oklahoma chapters
- North American Grouse Partnership
- Northwest Range Fire Management Association
- Off-road vehicle clubs/associations/dealers
- Oklahoma Anglers United

- Oklahoma Cattlemen's Association
- Oklahoma Independent Oil Producers Association
- Oklahoma Native Plant Society
- Oklahoma Section of the Society for Range Management
- Oklahoma Wildlife and Prairie Heritage Alliance
- Playa Lakes Joint Venture
- Private landowners, farmers and ranchers
- Producer Cooperatives
- Quail Forever and local Oklahoma chapters
- Tallgrass Prairie Alliance
- Texas Prairie Rivers, Inc.
- The Nature Conservancy
- The Wildlife Society
- Urban development groups
- Western Governors Association
- Wind energy development groups

Tallgrass Prairie Region



The Tallgrass Prairie Region is comprised of two distinct sections known as the Flint Hills and the Osage Plains. The Flint Hills section is characterized by shallow, rocky soil derived from limestone. It extends from eastern Kansas southward into portions of Osage, Washington, Kay and Pawnee counties. Because of its rocky soil conditions, most of the Flint Hills continues to be covered by native plant communities. The Osage Plains Section is characterized by deep, fertile clay soils and because of this a large percentage of it has been converted to cropland and pastureland. The Osage Plains extends from western Missouri and eastern Kansas into portions of Washington, Nowata, Rogers, Wagoner, Tulsa, Okmulgee, Muskogee, Mayes, Craig, and Ottawa counties.

Nationally, the Tallgrass Prairie Region spans portions of 14 states and nearly 150 million acres. However, large, unbroken tracts of tallgrass prairie are rare and the largest now exist in the Flint Hills of Oklahoma and Kansas. To the east, tallgrass prairie habitats merge into oak savannahs and deciduous forests, and to the west they merge into mixed-grass prairies. Early settlers described grass reaching as high as a horse's back, and extending over vast areas like a sea of endless grass. Today tallgrass prairies may cover only two or three percent of its former range. Frequent fires once maintained the tallgrass prairie ecosystem, but after European settlement, fires were actively suppressed and trees invaded areas that once supported only prairie. These settlers also converted the rich prairie soil to a working landscape of crop fields, pastures and settlements. This is one of the greatest alterations of any ecosystem type in North America.

While the Tallgrass Prairie Region may never again sustain huge herds of free roaming bison and the historic grazing and fire patterns may no longer function on the same massive scale, large tracts of prairie still function as ecological units for many native species.

Conservation Landscapes listed in general priority order

- Very High priority Conservation Landscapes:
  - Tallgrass Prairie
  - Small River
- High priority Conservation Landscapes:
  - Bottomland Hardwood Forest
  - Herbaceous Wetland
- Moderate priority Conservation Landscapes:
  - Post Oak and Black Jack Savannah and Woodland
  - Springs, Streams and Associated Riparian Forests

Very High Priority Conservation Landscape: Tallgrass Prairie

Tallgrass prairies are herbaceous plant communities dominated by four common, tall grass species: Big Bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), Switchgrass (*Panicum virgatum*) and Little Bluestem (*Schizachyrium scoparium*). The structure of this habitat type is maintained by the occurrence of natural fires that limit the growth of woody plant species and favor grasses and some forbs. All four of the dominant grass species are present in most tallgrass prairie sites; however Big Bluestem and Indiangrass tend to be most prevalent in mesic sites, while Big Bluestem and Little Bluestem are most common on drier sites. In mesic loamy soils such as those found in floodplains and bottomlands, Switchgrass, Indiangrass and Big Bluestem are often the dominant grasses. Other widespread or common grasses include Prairie Dropseed (*Sporobolus hetrolepis*), Sideoats Grama (*Bouteloua curtipendula*), and Eastern Gamagrass (*Tripsacum dactyloides*). Common forbs include Rosinweed (*Silphium integrifolium*), Compass Plant (*Silphium laciniatum*), Lead Plant (*Amorpha canescens*), Wild Alfalfa/Scurf Pea (*Psoralea tenuifolia*), Illinois Bundleflower (*Desmanthus illinoensis*), Blazing Star (*Liatris sp.*), Goldenrod (*Solidago sp.*), Roundhead Lespedeza (*Lespedeza capitata*), Indian Paintbrush (*Castilleja coccinea*) and Maximillian Sunflower (*Helianthus maximilliani*). Prairie Cordgrass (*Spartina pectinata*) is often the dominant grass in wet prairie sites which we discuss as a wetland type covered in the herbaceous wetland habitat type.

The tallgrass prairie is the most abundant and widespread habitat type in the Tallgrass Prairie Region. Tallgrass prairie habitat remains widespread in the Flint Hills section of the region where the shallow rocky soils are unsuitable for conversion to crop agriculture and ranching is the most common land use. The Flint Hills Section of Oklahoma and Kansas is one of the largest remaining concentrations of tallgrass prairie habitat in the country. In contrast, much of the native prairie in the Osage Plains Section has been converted to crop production or to Tall Fescue (*Festuca sp.*) pasture. The extent of remnant prairies in this section is unknown, but most tracts of native prairie appear to be scattered and relatively small. Where prairie habitat remains, decades of continuous grazing, altered fire frequency and encroachment of native and non-native plants have changed the plant community composition and structure - often through an increase in exotic grasses and forbs, a decrease in the abundance of highly palatable native forbs and in some areas an increase in woody plant cover.

The current patterns of fire are very different in the Flint Hills and Osage Plains sections of the region. Historically, fires probably occurred at two to five year intervals and occurred primarily in the late summer, fall and winter. In the present time in the Flint Hills, prescribed fires are set annually in the spring over large areas of prairie rangeland in order to stimulate a flush of new herbaceous vegetation for livestock. In contrast, fire suppression has characterized much of the Osage Plains for decades. The combination of continuous grazing and fire suppression has increased woody plant cover, especially along fence rows and right-of-ways.

Recognized plant associations within this habitat type include:

- Big Bluestem – Switchgrass Grassland
- Big Bluestem – Little Bluestem – Indiangrass Grassland
- Switchgrass – Eastern Gamagrass Grassland
- Little Bluestem – Indiangrass Grassland
- Little Bluestem – Big Bluestem Grassland

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that occupy the tallgrass prairie habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Crawfish Frog	uncommon and locally occurring around breeding ponds in prairie landscapes in the eastern half of the region	U
Bird	American Golden Plover	common spring and fall migrant throughout the region; uses recently burned or hayed prairies as well as wet meadows and wetlands	U
Bird	Barn Owl	uncommon year-round resident; found locally in agricultural landscapes where suitable buildings provide roosting and nesting sites	U
Bird	Bell's Vireo	uncommon summer resident; found in plum and other deciduous thickets within prairies	D
Bird	Buff-breasted Sandpiper	rare spring and fall migrant throughout the region; uses recently burned or hayed prairies as well as wet meadows and wetlands	D
Bird	Greater Prairie Chicken	uncommon and locally occurring in large tallgrass prairie landscapes; most of the population occurs in the counties along the Kansas state line	D
Bird	Harris's Sparrow	common winter resident; found in areas of woody thickets within prairies	U
Bird	Henslow's Sparrow	rare summer resident; small numbers nest in scattered tracts of tallgrass prairie where tall standing dead vegetation exists in the spring	U
Bird	LeConte's Sparrow	common spring and fall migrant; uncommon winter resident; occurs in tracts of tallgrass prairie with relatively tall standing vegetation	U
Bird	Loggerhead Shrike	uncommon year-round resident; occurs in prairie landscapes where sparse trees provide nesting and perching sites	D
Bird	Northern Bobwhite	common year-round resident in prairies with scattered brush and thickets that provide cover	D
Bird	Prairie Falcon	rare winter resident; a few birds winter in the region on open prairies	U
Bird	Short-eared Owl	common winter resident in large tracts of grassland with dense standing vegetation; rare nesting species in the Flint Hills	U
Bird	Smith's Longspur	uncommon winter resident; occurs in grazed prairies and early succession grasslands	U
Bird	Sprague's Pipit	uncommon spring and fall migrant; occurs in heavily grazed or disturbed prairies	U
Bird	Swainson's Hawk	rare summer resident; a few pairs appear to nest in the southern edge of the region near the Arkansas River	U
Bird	Upland Sandpiper	common spring and fall migrant throughout the region; common nesting species in grasslands in the northern half of the region	I
Inve	American Burying Beetle	uncommon but widespread in the Flint Hills section; rare and locally occurring in the prairies of the Osage Plains; federally listed as an endangered species	U
Inve	Arogos (Iowa) Skipper	locally common in native tallgrass prairie and open oak woodlands region wide	U
Inve	Byssus Skipper	rare and locally occurring in ungrazed or lightly grazed prairie; dependent upon Eastern Gama	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
		Grass as a larval host plant	
Inve	Dotted Skipper	rare and locally-occurring in prairies in the Flint Hills	U
Inve	Loamy-ground Tiger Beetle	common but locally-occurring in tallgrass prairies; distribution incompletely documented	U
Inve	Prairie Mole Cricket	uncommon and locally-occurring in large tracts of native tallgrass prairie across the region	D
Inve	Regal Fritillary	rare; found in the northern half of the region	U
Inve	Shadow Gloss Snail	uncommon and locally-occurring; distribution has been incompletely documented	U
Inve	Wax Coil Snail	locally common in the Flint Hills sections; some questionable identifications exist	U
Mamm	Eastern Harvest Mouse	rare and locally occurring; to date, populations have been documented at a few sites in tallgrass prairie and open oak woodland habitats	U
Rept	Texas Horned Lizard	rare and locally occurring at a few sites in the Flint Hills section of the region	D
Rept	Western Massasauga	uncommon; found in prairies along the Kansas state line	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

1. Tallgrass prairies, especially in the Osage Plains, typically occur on deep, relatively level and fertile soils. These soil conditions are attractive to agricultural land uses such as row crop production, pastureland and hay fields. As a result, a large percentage of the historic tallgrass prairie has been converted to crop fields and exotic pasture grasses such as Tall Fescue. This creates a direct loss of habitat through conversion, and also a fragmentation of habitat because the remaining tracts of tallgrass prairie are smaller and disconnected from one another. The conversion of native tallgrass prairies to non-native pasture grasses such as Bermudagrass and Tall Fescue is a less obvious form of habitat change and fragmentation, but these pastures have greatly reduced species diversity and may help in the dispersal and spreading of exotic invasive plant species.
2. The conversion of prairies to pastureland is viewed as a means to demonstrate that landowners are actively engaged in farming and eligible for some federal agricultural assistance programs. This creates an incentive to convert prairies to exotic grasses.
3. Prairies are fragmented by actions such as oil and gas production, roads, wind farms, shelterbelts, utility line right-of-ways, and urban sprawl.
4. Fences increase habitat fragmentation. Wildlife disperses tree and shrub seeds along fences, which creates corridors along which woody vegetation can encroach upon prairies.

Conservation Actions:

- Conduct research into the most effective methods for restoring tallgrass prairies on acres that have been converted to crop fields or exotic pasture grasses such as Tall Fescue and Bermudagrass.
- Establish sources for native forb and grass seed so that prairie restorations can incorporate a diversity of plants that are adapted to regional climate conditions.
- Promote and increase the funding for existing cost-share programs for the restoration of native tallgrass prairie and the enhancement of species diversity on degraded grasslands.

- Establish a conservation easement program that targets the protection of large, intact tallgrass prairie landscapes such as those that can still be found in parts of Kay, Osage, Nowata, and Craig counties.
- Acquire fee title to tallgrass prairie tracts that are essential for maintaining populations of Tier I and Tier II species of greatest conservation need.
- Modify agricultural loan and cost-share programs that encourage, directly or indirectly, the conversion of native prairie to crop production or non-native pasture.
- Develop a program that provides reduced property tax rates for private landowners who manage their property for tallgrass prairie and sensitive wildlife species.
- Develop regional landowner organization that facilitates partnerships between ranchers and conservationists to address issues that threaten both the ranching culture and the natural resource heritage on privately owned landscapes.
- Provide information on species of greatest conservation need and important landscapes to local city and county planners to encourage ecological sustainability across the region.
- Encourage the placement of wind farms outside of intact native prairie landscapes by modifying tax credits and other incentives.
- Modify or eliminate cost-share programs that encourage the construction of excessive fencing or the planting of shelterbelts that could fragment prairies.
- Use new urban development (i.e., sustainable development) techniques that minimize impacts such as cluster development that integrate and protect open space.
- Encourage and support the development of partnerships modeled after the Tallgrass Legacy Alliance of the Kansas Flint Hills.
- Create farm/ranch tax credits for maintaining or restoring native tallgrass prairie communities.
- Continue to fund research that evaluates the economic and nutritional advantages of managing native grasses and forbs in ranching operations instead of exotic pasture grasses. Evaluate the costs and benefits of retaining or restoring native prairie.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

5. Herbicide applications designed to control broad-leaved weeds are reducing the broad spectrum of forbs native to the tallgrass prairie community including species that are not traditionally considered to be weeds. The resulting tracts are dominated by a few species of native grasses and are less diverse and less valuable as wildlife habitat.
6. Aerial spraying of broadleaf herbicides is widely practiced to control some weedy species and exotic species within prairies. However, many landowners are not able to distinguish between forbs that are beneficial (e.g. highly palatable) from those that are not. As a result, herbicide applications are not as strategic or as discriminating as they could be and the abundance of beneficial forbs has declined on some properties.
7. The historic fire regime has been lost across most of the Tallgrass Prairie Region. Tallgrass prairie communities are shaped primarily by periodic growing-season and winter fires that occurred at intervals of two to five years. Currently, in the Flint Hills portion of the region, fire is used almost annually as a method for controlling forbs and encouraging a flush of new grass each growing season. This is a much more frequent fire interval and affects forb diversity as well as the cover available for wintering birds and early spring nesters. In the Osage Plains, fire suppression has greatly reduced the frequency of fires and has encouraged an increase in woody plants in the remaining prairies unless they are hayed.
8. The pre-settlement grazing regime has been altered across the region. Historically, grazing was accomplished by nomadic herds of American Bison. These herds were on the landscape primarily in the winter and spring and often selectively grazed areas that had been burned in the preceding year. Currently, grazing occurs year-round by cattle and horse. This level of continuous grazing has altered the plant community

composition (decreased the abundance of highly palatable forbs) and plant structural diversity. These changes alter the food resources and cover available for wildlife.

Conservation Actions:

- Conduct research into grazing systems that will more closely mimic the historic grazing patterns and retain plant diversity on the remaining prairies. Provide cost-share funding for the development of demonstration sites that showcase the results of these grazing systems and their economic and ecological benefits to wildlife and ranchers.
- Develop fire-grazing management programs that promote landscape heterogeneity (i.e., habitat diversity) such as patch-burning, rather than the currently used practices that promoted landscape homogeneity (e.g., uniformity or evenness of use and thus low natural diversity).
- Eliminate cost-sharing programs that encourage the planting of exotic vegetation, the construction of excessive fencing or the non-selective use of herbicides that lower plant diversity.
- Develop and distribute information to landowners about native plant identification and the benefits/value of native plants to ranching operations. For example, reprint the range plant identification guides that help landowners recognize and differentiate between less desirable weedy plants and more beneficial plants.
- Promote and encourage landowners to attend the pesticide (primarily herbicide) spraying education programs that are available through the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State University Extension Service. Educate landowners about the negative consequences of herbicides and that potential benefits to grazing operations are rarely achieved.
- Increase the funding available for prairie easements under the Farm Bill's Agricultural Conservation Easements Program.
- Identify and remove federal and state funding assistance from projects that cause prairie fragmentation.
- Support ranch diversification that will allow ranchers to lower stocking rates/grazing pressure and offset that loss of income with new sources of income from lease hunting, fishing access, and nature-based tourism.
- Conduct research to evaluate the economic and nutritional benefits vs. losses of using herbicides in the management of grasslands (e.g. the economic and nutritional effects of retaining native forb diversity in rangelands).
- Encourage more selective use of herbicide by rights-of-way managers through education.
- Where needed in the Osage Plains, support the development of prescribed burning or fire management associations through technical, equipment and financial assistance.
- Encourage private for-profit fire management contractors to increase the capacity for burning in landscapes where fire is lacking.
- Develop rancher-conservationist partnerships in Osage/Kay and Nowata/Craig counties to restore viable populations of the Greater Prairie Chicken.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

9. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
10. Our knowledge of both the historic and current distributions, structural conditions and community compositions of tallgrass prairies is incomplete. This includes our understanding of where the remaining tracts of tallgrass prairie occur across the landscape.

Conservation Actions:

- Fund research that identifies and remedies the factors that limit the distributions and population sizes of Tier I and Tier II species of greatest conservation need.
- Use remote imagery to identify landscapes that are dominated by grassland and prairie habitats. Conduct extensive ground surveys to identify and map the locations of all existing prairies. Combine the landscape level analysis with the site-specific locations of tallgrass prairies to identify conservation opportunities areas for prairie management, enhancement and restoration efforts in order to gain the greatest benefit for tallgrass prairie species of greatest conservation need.
- Create a long-term habitat monitoring program based upon photographic documentation of habitat structure and condition. Take photographs from specific points to create a database of pictures that document habitat change or fluctuations over time. Where feasible, locate existing historic photographs and their exact location and use those sites as the continuing long-term photo sites for habitat monitoring.
- Conduct reviews of existing literature, reports and museum records, and interview technical experts to compile historic and recent distributional and ecological information for all species of greatest conservation need.
- Conduct surveys to assess the current distribution and ecological needs of Tier I and Tier II species of greatest conservation need. Use these data to inform the selection of geographic areas where conservation efforts should be directed to provide the greatest benefit for these species.
- Work with the NRCS's Ecological Site Description program to research the historic condition of tallgrass prairie habitats in the Flint Hills and Osage Plains in order to develop realistic and biologically meaningful descriptions for how high quality tallgrass prairie communities should look. These should serve as the range of target conditions for habitat restoration and enhancement efforts.
- Develop population and habitat monitoring programs centered on representative Tier I and Tier II species of greatest conservation need.
- Develop and provide long-term funding to maintain a database to store and analyze distributional and ecological data for species of greatest conservation need.
- Publish and make the results of all ecological studies available to land managers and conservation agencies so that they can be incorporated into site-specific, species-specific and regional conservation plans including future updates to the OCWCS.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

11. Invasive and exotic plant species (e.g. Johnsongrass, Sericea Lespedeza) change the structure of the plant community; displace native plants that are more valuable to wildlife as sources of food and cover, and lower overall plant diversity within prairies.
12. In the absence of fire, invasive woody species displace and shade native prairie grasses and forbs. These invasive plants may be native (e.g. Eastern Redcedar, Shining Sumac or Winged Elm), or they may be non-native (e.g. Autumn Olive, Chinese Privet), but their presence reduces habitat quality for grassland-dependent species such as Henslow's Sparrow, Upland Sandpiper and Greater Prairie Chicken.

Conservation Actions:

- Develop educational materials about the negative consequences of invasive species and the control measures that are available.
- Evaluate the ecological damage done by invasive species and implement preventative control measures, as opposed to reactionary efforts, that target invasive species before they become established or widespread.

- Conduct management pilot studies to determine successful management and eradication strategies for exotic and invasive species. Develop alternatives to aerial spraying as a control measure for exotic plants.
- Remove federal funding from research that develops strains or hybrids of exotic plants that may become invasive (e.g. Bermudagrass and turf from other countries).
- Develop and promote certified hay programs that encourage exotic-free hay. Change the way that hay is graded to discourage the unintentional dispersal of seeds from exotic grasses and undesirable weeds through hay.
- Require right-of-way re-vegetation with native species following the construction of roads, pipelines, etc. to discourage the spread of exotic plants.
- Support Congressional or regulatory action to reclassify Sericea Lespedeza as a noxious species in the Southern Tallgrass Prairie Region of the United States (e.g., Oklahoma, Kansas, Nebraska, Missouri, and Arkansas) where it is the greatest invasive and/exotic threat to native rangelands. Fund research into potential control methods for Sericea Lespedeza which the U.S. Department of Agriculture cannot fully fund because of Sericea's status as a USDA crop species.
- Develop and fund invasive species management plans on all public conservation lands that support tallgrass prairie habitat.

Potential indicators for monitoring the effectiveness of the conservation actions:

- annual change (decrease) in the number of prairie acres burned in the Flint Hills
- annual change (increase) in the number of prairie acres burned in the Osage Plains
- change in the acreage of tallgrass prairie habitat that is subjected to aerial spraying
- animal population and vegetation responses to management practices
- changes in acreage affected by exotic, invasive vegetation
- number of acres of native plant communities restored or enhanced
- number of acres conserved through fee-title purchase or conservation easements
- number of landowners and total acreage engaged in conservation programs
- changes in plant diversity within tracts of prairie habitat

Very High Priority Conservation Landscape: Small River

Two small rivers occur within the Tallgrass Prairie Region - the Caney and Verdigris rivers. Both rivers originate within the Tallgrass Prairie Region in Kansas and flow into Oklahoma. The Caney River flows through the Flint Hills section and a small portion of the Crosstimbers Region before its confluence with the Verdigris River in the western edge of the Osage Plains Section. The Verdigris River originates in the Flint Hills of Kansas and flows through the Osage Plains Section where it is joined by the Caney River and then continues to flow into the Arkansas River. Both the Caney and the Verdigris rivers are low-gradient, meandering rivers whose floodplains were largely forested historically. The flood regimes and flow patterns of both rivers have been modified by the construction of reservoirs on each main stem (e.g. Hulah and Oologah reservoirs) as well as reservoirs on one or more of their major tributaries. The lowest portion of the Verdigris River has been further modified by the construction of a navigation channel which has resulted in the construction of a series of locks and low dams and the dredging/deepening of the river's channel. For purposes of the Oklahoma Comprehensive Wildlife Conservation Strategy, the Neosho River has been incorporated into the Large River chapter.

The species of greatest conservation need that occupy the small rivers of the Tallgrass Prairie Region in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown, I = increasing, X = extirpated.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Bald Eagle	uncommon winter resident and rare year-round resident; occurs along rivers and reservoirs throughout the region	I
Bird	Canvasback	uncommon winter resident in wetlands and rivers throughout the region	S
Bird	Lesser Scaup	uncommon winter resident on ponds, lakes and small rivers region-wide	D
Bird	Little Blue Heron	uncommon summer resident that occurs in the vicinity of nesting colonies near rivers and reservoirs	U
Bird	Louisiana Waterthrush	rare summer resident; nests locally along forested banks of streams and rivers region-wide	S
Bird	Northern Pintail	Common winter resident on marshes, ponds and rivers throughout the region	D
Bird	Peregrine Falcon	rare spring and fall migrant; occurs around rivers and wetlands with concentrations of birds	I
Bird	Solitary Sandpiper	common spring and fall migrant	S
Bird	Trumpeter Swan	rare winter resident; small numbers spend the winter on wetlands & ponds across the region	I
Fish	Black Buffalo	rare and limited to the lower Verdigris River	U
Fish	Bluntface Shiner	uncommon and locally occurring in the Verdigris River	U
Fish	Paddlefish	rare and recently re-established in the upper Verdigris River from fish released in Oologah Reservoir	U
Fish	Plains Minnow	uncommon; found in both the Caney and Verdigris rivers	D

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Fish	Redfin Darter	locally common in clear, low-gradient reaches of the Caney and Verdigris rivers	U
Fish	Shovelnose Sturgeon	rare and limited to the lower reaches of the Verdigris River	U
Inve	Black Sandshell	occurred in the Caney and Verdigris rivers in pre-settlement times based on the presence of subfossil shells	X
Inve	Butterfly Mussel	very rare and possibly extirpated from the Verdigris River; documented by weathered shells	D
Inve	Monkeyface Mussel	common but restricted to the Verdigris River; weathered shells indicate historic occurrence in the Caney river	S
Inve	Neosho Mucket	probably extirpated from the Caney and Verdigris rivers; but occurred in pre-settlement times based upon the presence of subfossil shells; listed as a federally endangered species	X
Inve	Ouachita Kidneyshell	rare or extirpated; documented from the Verdigris River by weathered & subfossil shells	U
Inve	Plain Pocketbook	common in both the Caney and Verdigris rivers	S
Inve	Rabbitsfoot	uncommon and restricted to the lower Verdigris River below Oologah Reservoir; federally-listed as a threatened species	D
Inve	Wartyback Mussel	uncommon and restricted to the Caney River and lower Verdigris River below Oologah Reservoir	S
Inve	Washboard	rare but found in both the Caney and Verdigris rivers	U
Inve	Western Fanshell	rare and limited to a short reach of the Verdigris River near the Kansas state line; historically widespread in the Verdigris River	D
Rept	Alligator Snapping Turtle	rare; small population occurs in the lower Verdigris River; reintroduction program is underway in the Caney River	U
Rept	Eastern River Cooter	uncommon but widespread in small rivers and streams throughout the region	U
Rept	Midland Smooth Softshell	rare and limited to the southern and western edges of the region including the lower Verdigris River	D
Rept	Mississippi Map Turtle	uncommon, found in slow-moving, vegetated waters in the Caney and Verdigris watersheds	U
Rept	Ouachita Map Turtle	common in small rivers and streams across the region	U
Rept	Spiny Softshell Turtle	uncommon but widespread in small rivers and streams throughout the region	D

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Activities that Alter Flow Patterns and Water Quantity:

1. Water diversions and withdraws - especially water regime changes (e.g., patterns of flow, lack of channel maintenance flow, sedimentation and erosion) - often have detrimental effects on species of greatest conservation need.
2. Reservoir construction and management has altered the flows of both the Caney and Verdigris rivers. Typically, the presence of reservoirs reduces the magnitude of annual flood events and decreases the base flow during drought periods.
3. Reservoirs block the downstream movement of gravel and sand such that the substrate below reservoirs often becomes coarser over time. Additionally, the

channel below reservoirs may become more incised over time which disconnects the river channel from its riparian vegetation.

4. Reservoirs block the upstream movement of fish and can isolate upstream populations of fish and mussels from those populations that are downstream. This can have a negative effect on the persistence and effective population sizes of species of greatest conservation need.
5. The reduction in the frequency and magnitude of flood events that follows reservoir construction encourages development in the flood plains of rivers and the clearing of riparian vegetation and wetlands. The reduction in riparian vegetation negatively affects river bank stability, while the loss of wetlands in floodplains reduces the ability of the flood plain to store and filter storm water and eliminates habitat that is needed by amphibians for reproduction and by shorebirds, waterfowl and wading birds for foraging and nesting.
6. In-stream and stream-side sand or gravel mining operations alter the structure of the river channel and in-stream habitats. This alteration of the channel's structure further contributes to bank instability.
7. The construction of reservoirs inundates reaches of small rivers and converts relatively shallow moving water habitat into deep, slow-moving or still water habitats.

Conservation Actions:

- Acquire conservation easements or fee-title to land along the banks of and in the flood plains of small rivers and their tributary streams to maintain or restore riparian vegetation and wetlands. These acquisitions will help maintain bank stability and water quality within the rivers and will limit residential and agricultural development within their flood plains.
- Modify reservoir management to release water in a pattern that recreates historic seasonal flow conditions. Allow for periodic high-flow events that are similar to historic flood events and ensure a minimum ecological flow in the channel during periods of drought.
- Conduct management-oriented research and pilot studies to determine the pattern and rate of flow needed to meet the ecological needs of the aquatic communities in each small river, and the most successful water release strategies for effectively restoring historic flow conditions and riparian zone vegetation and flood plain wetlands below reservoirs.
- Research effective methods for mitigating the reduction in fish passage that is created by reservoirs. This could include periodic translocation of fish and mussels to maintain gene flow or the construction of fish passages through or around dams.
- Provide the results of ecological studies to water use planners and encourage their incorporation into water management plans and permitting processes.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

8. Exotic plant species such as Japanese Honeysuckle, Johnsongrass and Chinese Privet have become established in riparian areas where they displace native plants and may alter habitat conditions for wildlife species of greatest conservation need.
9. Some agencies, organizations, and businesses promote exotic plants for erosion control, livestock forage, beautification programs, and wildlife habitat that are actually invasive.
10. Invasive-exotic aquatic plants and animals reduce the diversity and stability of aquatic and riparian communities.

Conservation Actions:

- Improve coordination between wildlife biologists, conservation agencies, and agricultural organizations so that these groups can share information about the negative effects of using exotic plant materials.
- Increase the funding available to implement the Oklahoma Aquatic Nuisance Species management plan.
- Evaluate the severity and magnitude of the ecological damage done by exotic plant and animal species (e.g., displacement of native vegetation/plant communities, predation on native animal populations, or hybridization with native species) to identify those exotic species causing the greatest impact to this habitat and species of greatest conservation need.
- Develop control or management plans for the exotic species that cause the greatest ecological damage (e.g., herbicide treatment and mechanical removal) and develop monitoring programs to measure and evaluate the effectiveness of these control measures.
- Develop cost-share, or incentives programs for private landowners to encourage them to control invasive and exotic species.
- Develop and implement management plans for exotic, invasive species on all public conservation areas.
- Educate anglers about the ecological problems associated with bait bucket introductions and the inter-basin transfer of fish.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality:

11. Endocrine system disruptors (e.g. hormones and hormone-mimicking pesticides) related to agricultural runoff and municipal wastewater discharges pose threats to the reproduction and recruitment of fish, crustacean, mussel and amphibian species of greatest conservation need.
12. Addition of nutrients from fertilizers and livestock waste in storm water runoff degrades water quality.
13. Poor headwaters protection as a result of the clearing of riparian vegetation allows sediments and chemicals to enter aquatic systems and impacts water quality.
14. The removal of riparian vegetation is detrimental to some species of greatest conservation need because it reduces structure/cover along the river banks and it reduces the shading of the water that can alter water temperature.

Conservation Actions:

- Develop local watershed-based citizen's groups or river teams to address local concerns and to monitor water quality and wildlife populations.
- Acquire conservation easements or fee-title to land along the banks of and in the flood plains of small rivers and their tributary streams to maintain or restore riparian vegetation and wetlands. These acquisitions will help maintain bank stability and water quality within the rivers and will limit residential and agricultural development within their flood plains.
- Work collaboratively with landowners to protect riparian areas from grazing (e.g. through the construction of fences).
- Increase funding for the Agricultural Conservation Easement Program and increase the emphasis placed on enrolling acreage and restoring habitat in flood plains.
- Continue to educate landowners and the public about the importance of riparian habitat and the existing Best Management Practices (BMPs) for the control of nutrients, sediment and pesticides for the protection of water quality.
- Manage phosphorous at the watershed scale and support limits to land application rates, especially in course soils and near streams and rivers.
- Work collaboratively with public water managers to enforce water quality standards below reservoir and to ensure that the ecological flow necessary for aquatic species is available.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

15. The available ecological data for many fish and mussel species of greatest conservation need is incomplete, which makes it difficult to accurately assess their habitat needs or to determine the best practices that would maintain or enhance populations.
16. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
17. Our knowledge of the historic pattern of seasonal flow is incomplete for many small rivers.

Conservation Actions:

- Conduct research on species of greatest conservation need to establish a current baseline condition for population size and distribution that could be used for future monitoring efforts.
- Conduct reviews of existing literature, reports and museum records, and interview technical experts to compile historic and recent distributional and ecological information for all species of greatest conservation need.
- Conduct research to identify the factors that limit the distribution and abundance of Tier I and Tier II species of greatest conservation need and develop management recommendations to enhance their populations through improved habitat conditions or recruitment.
- Conduct surveys to assess the current distribution and habitat needs of Tier I and Tier II species of greatest conservation need and use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest benefit for these species.
- Research the historic condition of the Verdigris and Caney rivers in order to develop a realistic and biologically meaningful target condition for habitat restoration and enhancement efforts.
- Develop methods to identify and map the distribution of riffles, gravel beds and other in-stream habitats that are important for freshwater mussel and fish populations. Identify the conservation practices that could enhance the value of these sites or expand them for the benefit of species of greatest conservation need.
- Develop and provide long-term funding to maintain databases to store and analyze distributional and ecological data for species of greatest conservation need.
- Publish and make the results of all ecological studies available to land managers and conservation agencies so that they can be incorporated into site-specific, species-specific and regional conservation plans including future updates to the OCWCS.

Potential indicators for monitoring the effectiveness of the conservation actions:

- number of new local conservation groups and their effectiveness
- miles of degraded and restored river miles of habitat
- number of acres acquired or placed under conservation easements
- number of acres on which conservation practices are implemented
- number of landowners participating in conservation practices
- population trends of fish and wildlife species of greatest conservation need
- changes in the seasonal volume of river flow over multiple years
- adherence to state water quality standards (e.g. dissolved oxygen below reservoirs and nutrient parameters)

High Priority Conservation Landscape: Bottomland Hardwood Forest

Bottomland hardwood forests are found locally in the floodplains of the Caney, Verdigris, Neosho/Grand and Arkansas rivers as well as their larger tributary streams. Bottomland forests in the Tallgrass Prairie Region are seasonally flooded and dominated by Pin Oak (*Quercus palustris*), Pecan (*Carya illinoiensis*), Bur Oak (*Quercus macrocarpa*), Shumard Oak (*Q. shumardii*), Bitternut Hickory (*Carya cordiformis*) and Sugarberry (*Celtis laevigata*). Common understory shrubs include Deciduous Holly (*Ilex decidua*) and Roughleaf Dogwood (*Cornus drumondii*). The loss of bottomland forest acreage in the region has not been assessed, but a reduction has occurred as the result of clearing these forests for agricultural uses (e.g., crop fields, pecan orchards, and fescue pastureland), inundation by reservoir construction and the alteration of the natural hydrology and flooding frequencies in river and stream floodplains.

Recognized vegetation associations within this habitat type include:

Bur Oak – Shumard Oak – Bitternut Hickory Temporarily Flooded Forest
Pin Oak – Pecan/Deciduous Holly Temporarily Flooded Forest
Pecan – Sugarberry Temporarily Flooded Forest

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that occupy bottomland hardwood forests in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status with the Region	Trend in Population Size or Range
Amph	Crawfish Frog	uncommon and locally occurring around breeding ponds in flood plains and in prairie landscapes in the eastern half of the region	U
Bird	American Woodcock	uncommon winter resident in bottomlands and forests throughout the region; small numbers remain into the spring to nest	U
Bird	Bald Eagle	uncommon winter resident and rare year-round resident; occurs along rivers and reservoirs throughout the region; nests in riparian and bottomland hardwood forests along rivers	I
Bird	Kentucky Warbler	uncommon summer resident; nests in bottomland hardwood forests with abundant understory shrubs	U
Bird	Little Blue Heron	uncommon summer resident; occurs in the vicinity of nesting colonies near rivers and reservoirs	U
Bird	Louisiana Waterthrush	rare summer resident; nests locally along forested banks of streams and rivers region-wide	S
Bird	Prothonotary Warbler	uncommon summer resident; nests in bottomland hardwood forests and riparian forests along streams and rivers region-wide	U
Bird	Red-headed Woodpecker	rare and locally-occurring during the summer, but uncommon and widespread during the winter in bottomland forests and oak woodlands	D
Bird	Rusty Blackbird	uncommon winter resident in bottomland forests and forested wetlands throughout the region	D
Bird	Wood Thrush	rare and locally-occurring summer resident; small numbers nest in large bottomland forest tracts	D

Group	Species of Greatest Conservation Need Common or Scientific Name	Status with the Region	Trend in Population Size or Range
Mamm	Eastern Spotted Skunk	rare and locally occurring in bottomland forests along the eastern edge of the region	U
Mamm	Northern Long-eared Bat	not documented, but small numbers are likely to occur in large tracts of bottomland forest in the eastern half of the region; federally listed as a threatened species	U
Mamm	Swamp Rabbit	uncommon and locally occurring in forested bottomlands along streams and rivers in the southern and eastern edges of the region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

1. Historic conversion of bottomland forest to pasture and cropland has resulted in the direct loss of a substantial proportion of this habitat and has contributed to the fragmentation and isolation of the remaining forest tracts.
2. Forest tracts have been fragmented by historic and on-going construction of roads, homes, utility line right-of-ways, natural gas wells, and pipelines.
3. Many of the temporary wetlands and vernal pools that once occurred within the bottomland hardwood forest habitat type have been lost due to the draining of wetlands, the reduction in the frequency and magnitude of the flooding events that maintained their hydrology and the filling of wetlands by direct human action or indirectly by increased siltation. These sites serve as breeding areas for amphibians and foraging areas for waterfowl, shorebirds and herons.

Conservation Actions:

- Promote landowner incentives to encourage the retention of riparian hardwood trees.
- Develop a Conservation Reserve-type program specifically for the restoration and conservation of bottomland hardwood forests.
- Place a greater emphasis on the preservation of bottomland hardwoods in the Agricultural Conservation Easements Program, and increase funding for this Farm Bill program by redirecting funding from the subsidy side of the Farm Bill.
- Place existing bottomland hardwood forests into conservation ownership through land acquisition or conservation easement by natural resource management agencies or private conservation organizations.
- Restore crop fields and pastures in floodplains back to bottomland hardwood forest habitat using native tree and shrub species that were produced within the region.
- Explore economic alternatives to clearing and grazing bottomland hardwoods (e.g., support the development of hunting leases and nature-based tourism as a supplemental revenue source for landowners).
- Work closely with bottomland hardwood forest landowners who purchased their property for its recreational value and are not dependent upon it as a source of income. Provide technical assistance and cost-share funding to these landowners to encourage them to conserve or enhance their bottomland forest acres for wildlife.
- Acquire fee title ownership or conservation easements on existing bottomland hardwood forest habitat or crop fields and pastures that can be preserved or restored to bottomland hardwood forest habitat.
- Use private landowner assistance programs such as the U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program to provide cost-share funding to private landowners to restore hydrology through the construction of small dams and dikes to seasonally flood bottomlands.

- Encourage the protection of private forest land through conservation easement programs.
- Construct vernal pools or similar small wetlands within bottomland forest sites.

Conservation Issues Related to Habitat Loss and Modification as a Result of Altered Patterns of Seasonal Flooding:

4. The construction of reservoirs permanently inundates bottomland hardwood forests, resulting in a direct loss of acreage and alteration of the hydrology of the bottomland hardwood habitat downstream of the reservoir by reducing the amount of the natural flood frequency and pattern.
5. Altered flooding regimes occur as a result of the construction of impoundments and/ or the channelization of streams. In many watersheds there is a dramatic disconnection between the riparian forests/bottomland forests and their streams due to the channelization and incision of streams. This can lead to a lowering of the shallow water table and a reduction in periodic flooding and soil saturation in the bottomland forest zone.
6. Many of the present-day bottomland hardwood forest tracts exist as even-age, dense forests. In the early 1900s, many bottomland hardwood forest stands were clear cut and the regrowth forests that developed tended to be dense, even-aged stands with poor structural diversity, dense mid-stories and sparse understory vegetation.

Conservation Actions:

- Modify reservoir management to allow periodic flooding of bottomland hardwood tracts in the reaches below dams.
- Remove cost-share programs that encourage the construction of lakes on the main stems of perennial streams.
- Develop incentives for the restoration of stream channel meanders and bottomland forest habitat.
- Assess the distribution of existing and restorable bottomland hardwood forests in order to develop focal areas for conservation funding. Acquire conservation easements or fee-title from willing sellers to place existing forests under conservation ownership. Restore bottomland hardwood forests on public land or land under conservation easements.
- Use mitigation funds to acquire existing bottomland hardwood forests and to protect these from future development (e.g., urban development, agricultural development, and future reservoir construction).
- Work with the U.S. Army Corps of Engineers to restore bottom hardwood forest on lands that are under their management authority.
- Provide ecological studies and their implications to land and water use planners and encourage them to incorporate the information into management plans.
- Use private landowner assistance programs such as the U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program to provide cost-share funding to private landowners to restore hydrology and restore stream channel structure to reconnect streams with their riparian zones and flood plain forests.
- Research alternative flood control methods used in different places in the country (e.g., flood other areas, restore or plant new bottomlands inside existing levees, and create wetland mitigation sites/ banks) for applicability to Oklahoma needs.
- Monitor the response of wildlife populations to alternative flood control and bottomland restoration practices.
- Thin and selectively remove trees to increase structural diversity within forest stands and increase understory vegetation.
- Reconnect bottomland hardwoods with the river/stream system along which they developed to restore the natural meanders of streams and historic flooding patterns (e.g., manage for the natural hydro period - many streams have incised channels and do not overflow into bottomland hardwoods regularly).

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

7. Invasive, non-native plants including Japanese honeysuckle, Autumn Olive, Chinese Privet, Kudzu, Nepalese Browntop Grass and Autumn Clematis have become established within bottomland hardwood forest habitat and now compete with and displace native species that are generally more beneficial to wildlife as sources of food and cover.
8. Where Feral Hogs have become established in bottomlands and riparian forests, they damage vernal pools and understory vegetation, thereby negatively affecting amphibian and avian species of greatest conservation need.

Conservation Actions:

- Monitor invasive species in the bottomland hardwoods. Evaluate the severity and magnitude of the ecological damage done by exotic plant and animal species (e.g., displacement of native vegetation, or hybridization with native species) to identify those exotic species causing the greatest impact to species of greatest conservation need.
- Develop control or management plans (e.g., prescribed burning programs, herbicide treatment, and mechanical removal) for the exotic species that cause the greatest ecological damage and develop monitoring programs to measure and evaluate the effectiveness of these control measures.
- Develop educational materials about the ecological damage done by invasive and exotic vegetation and introduced plant diseases.
- Develop and implement invasive species management plans on all public conservation lands in the region. Develop cost-share or incentives programs for private landowners to encourage them to control invasive and exotic species (e.g., privet and honeysuckle).

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

9. Data are incomplete for species of greatest conservation need (particularly those whose populations are low or unknown and for those whose status and trends of are declining or unknown) thus making it difficult to identify management issues and establish effective corrective strategies.
10. Knowledge of bottomland hardwood forest habitat and its associated wildlife species is incomplete.

Conservation Actions:

- Use aerial photos and extensive ground surveys to locate and map the remaining tracts of bottomland hardwood forest across the region.
- Conduct biological inventories of the remaining tracts, or a representative subsample, to determine their species composition and the distribution of species of greatest conservation need that are associated with or dependent upon bottomland hardwood forests. Use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest benefit for these species.
- Conduct research to identify the factors that limit the distribution and abundance of Tier I and Tier II species of greatest conservation need and develop management recommendations to enhance their populations through improved habitat conditions or recruitment.
- Research the historic condition of this habitat in order to develop a realistic and biologically meaningful description for how high quality bottomland hardwood forest habitat should look. This should serve as the target condition for habitat restoration and enhancement efforts.

- Develop population and habitat monitoring programs for representative species of greatest conservation need.
- Publish and make the results of all ecological studies available to land managers and conservation agencies so that they can be incorporated into site-specific, species-specific and regional conservation plans including future updates to the OCWCS.
- Develop a monitoring program to track habitat condition, quality and the status of the species of greatest conservation need.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acres of bottomland forest restored
- acres of bottomland forest placed under conservation ownership or management
- forest stand health as measured by species composition and structural diversity
- natural stream discharge/flow regimes established
- number of landowners/acres involved in conservation programs
- number or percentage of acres acquired or placed into conservation programs (e.g., incentives programs)
- number of landowners educated about watershed concepts, riparian habitat, and Best Management Practices
- changes in the population sizes and trends of representative species of greatest conservation need that serve as indicators of bottomland hardwood forest quality
- number of modified reservoir management plans to allow periodic flooding and natural hydro periods
- connectivity between bottomland forests and their streams
- number of days per year and in the growing season during which the soil is saturated
- percent of available habitat in conservation programs, measuring net gain or loss of habitat

High Priority Conservation Landscape: Herbaceous Wetland

Herbaceous wetlands are uncommon and their distribution and biological characteristics are poorly known in the Tallgrass Prairie Region. These wetlands are often small, seasonally flooded depressions and swales within prairies, or occur in the floodplains of rivers and large streams. While they occur sporadically within the larger tallgrass prairie habitat type, they are more frequent in the broad floodplains of rivers. The conditions that maintain herbaceous wetlands are poorly understood but appear to involve the complex interaction of fire and fluctuating water levels. Herbaceous wetlands are also found in association with meandering prairie streams at locations where beaver activity has impounded small reaches of stream and created permanently flooded marsh habitats. Wet meadows and temporarily flooded prairie sites, such as those dominated by Prairie Cordgrass (*Spartina pectinata*) are included in the herbaceous wetland habitat type because of their soils and vegetation.

Recognized plant associations within this habitat type include:

- Ravenfoot Sedge Seasonally Flooded Marsh
- Common Rush Seasonally Flooded Marsh
- Softstem Bulrush - Common Spike Rush Semi-permanently Flooded Marsh
- Narrowleaf Cattail – Southern Cattail Semi-permanently Flooded Marsh
- Broadleaf Cattail Semi-permanently Flooded Marsh
- Pennsylvania Smartweed – Curlytop Smartweed Semi-permanently Flooded Wetland
- Broadleaf Arrowhead – Longbar Arrowhead Semi-permanently Flooded Wetland
- Prairie Cordgrass Temporarily Flooded Marsh

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that occupy the herbaceous wetlands habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Crawfish Frog	uncommon and locally occurring around breeding ponds in prairie landscapes in the eastern half of the region	U
Bird	American Golden Plover	common spring and fall migrant throughout the region; forages in shallow wetlands, mudflats and recently burned or mowed grasslands	S
Bird	American Woodcock	uncommon winter resident in bottomlands and forests throughout the region; small numbers remain into the spring to nest	U
Bird	Buff-breasted Sandpiper	uncommon spring and fall migrant that uses shallow wetlands, mudflats and recently burned or mowed grasslands as foraging sites	D
Bird	Canvasback	uncommon winter resident in wetlands and ponds with submerged aquatic vegetation	S
Bird	Hudsonian Godwit	rare spring migrant across the region	U
Bird	Interior Least Tern	rare summer resident; may forage in wetlands near the Arkansas River channel where this species nests in scattered colonies; federally listed as an endangered species	S

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	King Rail	rare summer resident; small numbers are likely to nest in herbaceous vegetation in wetlands along the Arkansas and lower Verdigris rivers	U
Bird	LeConte's Sparrow	common migrant and winter resident; occupies tallgrass prairies and herbaceous wetlands with tall standing vegetation in the winter	U
Bird	Lesser Scaup	uncommon winter resident on ponds, lakes and small rivers region-wide	D
Bird	Little Blue Heron	uncommon summer resident that occurs in the vicinity of nesting colonies near rivers and reservoirs	U
Bird	Nelson's Sharp-tailed Sparrow	rare fall migrant; has been documented only a few times in wet prairies/seasonal wetlands	U
Bird	Northern Pintail	common winter resident on marshes, ponds and rivers throughout the region	D
Bird	Peregrine Falcon	rare spring and fall migrant; occurs around rivers and wetlands with concentrations of birds	I
Bird	Piping Plover	rare spring and fall migrant stopping over on shallow wetlands, mudflats and open shorelines; federally listed as a threatened species	D
Bird	Solitary Sandpiper	common spring and fall migrant	S
Bird	Trumpeter Swan	rare winter resident; small numbers spend the winter on wetlands & ponds across the region	I
Bird	Upland Sandpiper	common spring and fall migrant throughout the region; uncommon summer resident that nests in prairies in the northern half of the region	I
Bird	Western Sandpiper	rare spring and fall migrant; typically in wetlands near the Arkansas and Verdigris rivers	U
Bird	Willow Flycatcher	uncommon spring and fall migrant; a small number of birds nest in wetlands with shrub thickets and scattered trees in the Osage Plains	U
Bird	Wilson's Phalarope	common spring and fall migrant in shallow herbaceous wetlands and ponds region-wide	S
Bird	Yellow Rail	rare spring and fall migrant through the region	U
Mamm	Swamp Rabbit	uncommon and locally occurring in forested bottomlands along streams and rivers in the southern and eastern edges of the region	U
Rept	Mississippi Map Turtle	uncommon; found in wetlands in close proximity to streams and rivers region wide	U
Rept	Ouachita Map Turtle	common in wetlands in close proximity to streams and rivers throughout the region	U
Rept	Spiny Softshell Turtle	uncommon and limited to wetlands adjacent to streams and rivers region wide	D

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversions:

1. Wetlands are drained or filled to convert these lands to residential, agricultural or industrial uses.
2. Water may be pumped from wetlands for irrigation which may lower the water table in some areas and alter the time during which the soil is saturated.
3. Some wetlands are dredged or deepened to create ponds to hold more water for irrigation, to store water for cattle or to create ponds for fishing. These actions result in a loss of shallow water habitat and may result in the introduction of predatory fish.

4. Woody plants such as willows encroach on and dominate herbaceous wetlands because of fire suppression and/or past overgrazing.
5. Heavy grazing of wetlands by cattle removes plant cover for wildlife, reduces the abundance of some wetland plants and can lower overall plant diversity.
6. Seasonal wetlands are plowed and cropped which reduces perennial vegetation and alters the plant community composition and structure toward one that is dominated by annuals.

Conservation Actions:

- Continue to provide cost-share funding or grants to landowners to restore farmed wetlands and to enroll them in conservation easements.
- Provide information to landowners and the public regarding the ecological values of wetlands, especially seasonal wetlands.
- Use land acquisition and conservation easement programs to place high quality and biologically valuable herbaceous wetlands under conservation ownership or stewardship.
- Fund management-oriented research to determine effective wetland management protocols that will enhance or maintain habitat value for species of greatest conservation need. Provide cost-share funding to private landowners to cover the costs of maintaining wetlands in the desired condition.
- Improve the economic incentives for landowners to enroll wetlands in the Farm Bill's Agricultural Conservation Easement Program's Wetland Reserve Easements (this contains the function of the former Wetland Reserve Program).
- Develop tax breaks and other financial incentives for landowners that maintain wetlands.
- Connect the owners of degraded or impaired wetlands with entities that are seeking wetland mitigation credits and have the funding to enhance or restore these sites.
- Use fire or mechanical cutting to remove woody vegetation that has encroached upon herbaceous wetlands.
- Provide cost-share funding or grants for the development of vegetated buffer zones and the construction of fencing around wetlands to filter storm water runoff and to control the access that livestock have to wetlands.
- Monitor the response of vegetation and wildlife to wetland management practices (e.g. prescribed fire or water level manipulation) and wetland restoration efforts.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

7. Our knowledge of the distribution and condition of herbaceous wetlands is incomplete, particularly for wetlands that are not located within the flood plains of rivers and streams. In part, this is due to the small size of wetlands that makes them difficult to locate within larger habitat types such as prairies and woodlands.
8. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
9. Our understanding of wetland ecology and the needs of wetland-dependent wildlife is incomplete. This information is necessary for determining the effectiveness of management practices for enhancing or maintaining wildlife populations.

Conservation Actions:

- Conduct a region-wide survey for wetlands that builds on the earlier work of the USFWS's National Wetland Inventory project and places emphasis on seasonal, herbaceous wetlands. Map all wetland locations and conduct biological inventories of a representative sample of wetlands to determine plant community composition and the distributions and abundances of species of greatest conservation need.

- Develop a database of wetland locations and conditions that can be shared with biologists, natural resource managers and local planners.
- Conduct studies to determine the ecological needs of wetland wildlife species (e.g., types of plant communities and the timing and duration of flooding needed for each wildlife species).
- Produce and distribute educational information for landowners and state and federal conservation agency staff regarding the ecology of herbaceous wetlands by region and wetland type.
- Develop descriptions of quality wetland habitats to serve as the target conditions for wetland restoration and enhancement efforts.
- Use surveys, workshops and data acquisition to update the Comprehensive Wildlife Conservation Strategy.
- Update the National Wetlands Inventory data and enumerate losses and gains of wetlands.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality:

10. Where feedlots, dairies, hog farms, and chicken houses are located near wetlands, the risk exists for excessive nutrients from these operations to travel in storm water runoff and collects in wetlands basins and closed depressions. Increased nutrient inputs due to crop/pasture fertilizers and land application of animal waste result in increased algal and bacteria growth in wetlands that may reduce water quality and dissolved oxygen.
11. Many wetlands lack buffer vegetation around them to control the movement of sediment, pesticides and nutrients into the wetlands through storm water runoff from pastures, crop fields and residential areas.
12. Endocrine system disrupters from animal hormones, pesticides and agricultural chemicals enter wetlands in storm water runoff. This affects the survival, growth and reproduction of fish, amphibians and invertebrates.
13. Grazing of wetlands by cattle increases nutrient inputs and alters the structure and diversity of wetland vegetation.

Conservation Actions:

- Promote the use of and increase the funding for the Farm Bill conservation programs that are designed to improve water quality and protect wetlands (e.g., conservation easements, the planting of vegetated buffer strips and filter strips, and the construction of fences around wetlands to control access by livestock).
- Continue to fund the restoration of native vegetation around wetlands to serve as filters for the removal of sediment and nutrients in storm water runoff.
- Develop certification programs to recognize conservationists and land stewards of wetlands.
- Review existing Best Management Practices for controlling nutrients and sediment around wetlands and update if needed.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

14. Invasive and exotic plant species that become established in wetlands will compete with and/or displace native vegetation. When exotic plant species dominate wetlands, they reduce overall plant diversity and structural diversity, which reduces the wetlands' value as wildlife habitat because exotic plant species often provide poorer food resources for wildlife.
15. Some agencies, organizations, and businesses promote exotic plants for erosion control, livestock forage, beautification programs, and wildlife habitat that are actually invasive.

16. When wetlands that are normally shallow and/or seasonal are deepened to hold water for longer periods of time, the wetland vegetation community can shift from one that is dominated by sedges, rushes and arrowheads to one that is dominated by cattails.
17. Exotic wetland plants such as Barnyard Grass, Brazilian Waterweed, Eurasian Watermilfoil and Curly Dock have become established in wetlands across this region where they displace and dominate native plants.

Conservation Actions:

- Develop management plans to control exotic plants and reduce their abundances and distributions.
- Improve coordination between wildlife biologists, conservation agencies, and agricultural organizations so that these groups can share information about the negative effects of using exotic plant materials.
- Increase the funding available to implement the Oklahoma Aquatic Nuisance Species management plan.
- Evaluate the severity and magnitude of the ecological damage done by exotic plant and animal species (e.g., displacement of native vegetation/plant communities, predation on native animal populations, or hybridization with native species) to identify those exotic species causing the greatest impact to this habitat and species of greatest conservation need.
- Remove exotic wetland plants and restore native plant communities using management/eradication strategies that have been researched and demonstrated to be effective and environmentally safe.
- Monitor response of native wetland vegetation and wildlife populations to the control practices that are implemented for invasive, exotic species.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acres in conservation programs
- acres of vegetated buffer strips that have been planted
- changes in the number of wetlands, total acres of wetlands and average size of wetlands
- number of wetland conservation easements
- number of wetlands and wetland acres that are placed under conservation ownership
- number of wetlands that are fenced
- number of wetlands negatively affected by exotic invasive vegetation
- number of farmed or drained wetlands that are restored
- population trends of wetland-dependent species of greatest conservation need

Moderate Priority Conservation Landscape: Post Oak and Blackjack Oak Savannah and Woodland

Oak woodlands occur locally within the Osage Plains Section on sandy soils and sandstone ridges, and in the Flint Hills Section at the transition between the Tallgrass Prairie and Crosstimbers regions. This habitat type is a diverse mosaic of oak savannahs, oak woodlands and oak/hickory forests that varies geographically depending upon soil conditions, slope aspect and fire history. The dominant tree species are Post Oak (*Quercus stellata*) and Blackjack Oak (*Quercus marilandica*), comprising more than 80 percent of the canopy cover. Other common trees include Black Hickory (*Carya texana*), Bitternut Hickory (*Carya cordiformis*), Black Oak (*Quercus velutina*), and Chinkapin Oak (*Quercus muehlenbergii*) on more mesic sites. Eastern Redcedar (*Juniperus virginiana*) is locally common in parts of the region within oak woodland communities and it has increased in abundance during the past century as a result of the reduction in periodic fires. Prominent understory trees include Chittamwood (*Bumelia lanuginosa*), Eastern Redbud (*Cercis canadensis*), Roughleaf Dogwood (*Cornus drummondii*), Mexican Plum (*Prunus mexicana*), and Winged Sumac (*Rhus copallina*). On sites with well-drained soils and/or higher fire frequencies, this habitat type has a more woodland or savannah-like structure than occurs on the more mesic and less frequently burned forested sites. These woodlands typically have a grassy understory dominated by Little Bluestem (*Schizachyrium scoparium*) with lesser amounts of Indiangrass (*Sorghastrum nutans*, Big Bluestem (*Andropogon gerardii*) and Small Panicgrass (*Panicum oligosanthes*).

Recognized vegetation associations in this habitat type include:

Chinquapin Oak – Shumard Oak Forest
Post Oak – Blackjack Oak – Black Hickory Forest
Post Oak – Shumard Oak – Bitternut Hickory Forest
Post Oak – Winged Elm Forest

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that occupy oak woodlands, savannahs and forests in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	American Woodcock	uncommon winter resident in bottomlands and forests throughout the region; small numbers remain into the spring to nest	U
Bird	Bachman's Sparrow	rare and locally-occurring summer resident; small numbers nest in open oak woodlands	D
Bird	Greater Prairie Chicken	year-round resident in tallgrass prairies; may occupy open oak woodlands during the winter	D
Bird	Harris's Sparrow	common winter resident in open oak woodlands and savannahs	U
Bird	Kentucky Warbler	uncommon summer resident; nests in tracts of oak forest with abundant woody understory vegetation	U
Bird	Loggerhead Shrike	uncommon year-round resident; occupies open oak savannahs and prairie/woodland edges	D

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Northern Bobwhite	common year-round resident; occupies oak woodlands and savannahs with a mix of herbaceous vegetation and shrub cover	D
Bird	Painted Bunting	uncommon summer resident; nests in oak woodlands and woodland/prairie edges	S
Bird	Red-headed Woodpecker	uncommon and locally occurring year-round resident in open oak savannahs/woodlands	D
Inve	American Bumble Bee	common and widespread in oak woodlands and forest edges	D
Inve	American Burying Beetle	uncommon and locally occurring in open oak woodlands and savannahs in the Flint Hills and southern Osage Plains; federally endangered	U
Inve	Arogos (Iowa) Skipper	uncommon and locally occurring in oak savannahs and prairie edges region-wide	U
Inve	Byssus Skipper	rare and locally occurring in open woodlands, savannahs and prairies; depends upon Eastern Gama Grass as its caterpillar host plant	U
Inve	Dotted Skipper	rare and locally-occurring in prairies and open oak woodlands in the Flint Hills	U
Inve	Slope Ambersnail	Uncommon and locally occurring in rocky oak woodlands and forests; range poorly known	U
Inve	Tulsa Whitelip Snail	Uncommon and locally-occurring in oak woodlands in the southern half of the region	U
Mamm	Eastern Harvest Mouse	rare and locally occurring; to date, populations have been documented at a few sites in tallgrass prairie and open oak woodland habitats	U
Rept	Texas Horned Lizard	rare and locally occurring in prairies and oak savannahs in the Flint Hills section	D

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

1. The historic fire regime has been lost or altered across most of the region. In the Flint Hills, many areas burn more frequently than they did in the past because prescribed fires are set almost annually to reduce forbs and to encourage a flush of new grass growth each spring. In the Osage Plains, fire has become much less frequent as a result of fire suppression and the conversion of a large portion of the landscape to pastureland and crop fields. Where fire frequency has increased, woody plant abundance and canopy cover have decreased. In areas where fires are now less frequent, tracts of woodlands and savannahs have become more dense and canopy cover has increased. In local areas, Eastern Redcedar has become more abundant in the mid-story of oak woodlands as a result of fire suppression. Woodlands and forests with denser mid-stories often have a diminished abundance of understory vegetation.
2. Many oak woodland and forest communities occur on land that is used for grazing. Historically, grazing was accomplished by nomadic herds of American Bison or by resident American Elk. In the present day, most grazing is done by cattle and horses which are confined by fences and graze tracts of land continuously. Because of supplemental winter feeding, domestic livestock can be stocked at a greater density in woodlands today than the densities at which native grazers occurred historically.

Conservation Actions:

- Study the responses of wildlife populations to land management prescriptions such as thinning, deferred grazing, and prescribed late winter burning that can be used to restore or maintain oak woodlands and savannahs.
- Restore oak woodlands and savannahs on public lands and on lands under conservation easements.
- Develop a technical and financial assistance program that focuses on landowners who have purchased acreages that are suitable for managing oak woodland and savannah habitats for their recreational value. These landowners are less dependent upon their property as a source of income and can manage native plant communities that have poor agricultural compatibility.
- Develop a program to assist landowners with proper fire management in portions of the region where an increased use of prescribed fire is needed. Provide financial, training and logistical assistance to emerging prescribed burning associations.
- Provide farmers and ranchers with information and assistance to implement Best Management Practices for grazing their land in ways that mimic historic grazing patterns such as patch burning. Patch-burn grazing uses small-scale prescribed fire and mineral blocks to influence where livestock graze within larger tracts of rangeland. This type of grazing system increases the diversity in vegetation structure which is beneficial to many avian species of greatest conservation need.
- Develop Best Management Practices or recommendations for the siting and construction of oil and gas drilling pads, access roads and pipelines so that these can be integrated into the landscape in a manner that minimizes fragmentation and habitat conversion.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

3. Invasive and exotic species such as Sericea Lespedeza, Johnsongrass, Old World Bluestem and Tall Fescue compete with and displace native plants which are more beneficial to most species of wildlife. These invasive species can lower overall plant diversity and the diversity of food resources available to wildlife.
4. Some government agencies continue to recommend exotic and invasive species for uses such as erosion control, livestock forage, and shelterbelts.
5. Feral animals (e.g., cats and hogs) harm species of greatest conservation need and their habitat.

Conservation Action:

- Develop a state plan for exotic and invasive species control, eradication, and prevention.
- Improve coordination between wildlife biologists, conservation agencies, and agricultural organizations so that these groups can share information about the negative effects of using exotic plant materials.
- Evaluate the severity and magnitude of the ecological damage done by exotic plant and animal species (e.g., displacement of native vegetation/plant communities, predation on native animal populations, or hybridization with native species) to identify those exotic species causing the greatest impact to this habitat and species of greatest conservation need.
- Conduct research into the control and eradication methods that are most effective and ecologically safe. Implement these methods and monitor their success and the response of non-target species.
- Recommend appropriate spraying methods to right-of-way managers and landowners that will target the control of exotic and invasive species without negatively effecting beneficial native species. Encourage right-of-way managers to use only native plant species in their revegetation efforts following construction projects so that they don't establish or facilitate the spread of exotic species.

- Develop and share techniques to limit or reduce the impacts of feral animals on species of greatest conservation need.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversions:

6. Many tracts of oak woodland and savannahs have been cleared and converted to pastureland that is planted to exotic grasses including Tall Fescue and Bermudagrass which provide poor habitat conditions for most species of greatest conservation need. Other tracts have been cleared or dramatically thinned to increase the acreage of rangeland available for livestock grazing.
7. Oak woodlands, savannahs and forests have been fragmented by urbanization, small-scale conversions that create rangeland or pastureland, road construction, and utility and pipeline right-of-ways.
8. Large-scale, aerial applications of broadleaf herbicides have been used to reduce or eliminate native tree cover to maximize grass cover for grazing.
9. Oil and gas industry may affect species of greatest conservation need by increased number of roads, increased erosion around well sites, soil compaction, disturbance, noise and an increased potential for oil or saltwater spills.

Conservation Actions:

- Enroll tracts of oak woodlands and forests in conservation easements to prevent development and conversion.
- Research alternative methods for the restoration of oak woodlands on acres that have been cleared for rangeland, pastureland or cropland in order to identify those that are most successful and cost-effective.
- Identify the landscapes that are most suitable for oak woodland restoration or management, and then rank those that have the greatest benefit for species of greatest conservation need so that restoration, enhancement and protection efforts to can be focused there.
- Promote existing cost-share or grant programs for private landowners that encourage the restoration or maintenance of oak woodland and forest habitat.
- Acquire fee title to large tracts of oak woodland acres that are exceptionally valuable to conservation of species of greatest conservation need. Acquire representative tracts of old-growth oak woodlands.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

10. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
11. Data are incomplete regarding the historic and current distribution, structural condition and community composition of oak woodlands in this region.

Conservation Actions:

- Use historic records, soil survey maps and aerial photographs to estimate the historic distribution of oak woodland communities across the region as well as the likely canopy structure (savannah, woodland or forest) at specific sites.
- Conduct reviews of existing literature, reports and museum records to determine the historic and recent distributions and ecological needs for all species of greatest conservation need.
- Conduct research to identify the factors that limit the distribution and abundance of Tier I and Tier II species of greatest conservation need and develop management recommendations to enhance their populations through improved habitat conditions or recruitment.

- Research the historic structural condition of oak woodlands across different conditions of soil type, slope and aspect. Use this analysis to develop realistic and site-specific target conditions for habitat restoration and enhancement efforts.
- Conduct biological inventories of the remaining tracts of oak-dominated communities and identify the conservation practices that could enhance their value.
- Develop population and habitat monitoring programs for representative species of greatest conservation need. Develop and provide long-term funding to maintain databases to store and analyze distributional and ecological data for species of greatest conservation need.

Potential indicators for monitoring the effectiveness of the conservation actions:

- number of acres burned
- number of acres of native plant communities restored
- number of technical assistance visits provided and the number of acres on which recommendations were implemented
- change in the population sizes and trends of species of greatest conservation need
- changes in acreage covered or impacted by exotic vegetation
- number of fire crews that are trained and working
- number of acres acquired or placed under conservation easements
- number of landowners participating in conservation programs and the number of acres improved by these practices
- response by specific plant species or by overall vegetation structure to different management protocols such as prescribed burning or grazing rotations

Moderate Priority Conservation Landscape: Springs and Streams with their Associated Riparian Forests

Little information exists regarding the historic condition of streams in the Tallgrass Prairie Region, but at one time many of these streams appear to have had well developed floodplains, channels that were only slightly entrenched, moderate to high degrees of channel sinuosity (i.e. the number of meanders, bends, or curves), and relatively high width to depth ratios. In their present condition, many streams appear to have been altered by human activities including the removal of riparian vegetation and increased sedimentation as a result of soil erosion and deposition into streams. In some watersheds, streams have been altered by historic channelization projects to remove stream meanders. Where channelization efforts have taken place to reduce the area occupied by the stream's channel and floodplain, these streams frequently cut incised channels that separate the stream from its riparian vegetation.

Within the Flint Hills Section of the Tallgrass Prairie Region, many streams have gravel substrates or mixed gravel/silt substrates. Nearly all of the streams within the Osage Plains Section of the region have predominantly sandy or silty substrates. Riparian forests of fast-growing trees grow along the banks of most streams in the region. These forests are comprised of diverse, forest associations including American Elm (*Ulmus americana*), Sugarberry (*Celtis laevigata*), Green Ash (*Fraxinus pennsylvanica*), Eastern Cottonwood (*Populus deltoides*), Black Willow (*Salix nigra*), Sycamore (*Platanus occidentalis*) and Boxelder (*Acer negundo*). Understory vegetation is dominated by shrubs such as Buttonbush (*Cephalanthus occidentalis*), Deciduous Holly (*Ilex decidua*), Green Hawthorn (*Crataegus viridis*), Roughleaf Dogwood (*Cornus drummondii*) and perennial forbs. Along headwater and small streams, the riparian forests are often narrow bands, but these forest tracts become wider as stream size and/or flood plain width increase.

Springs and seeps are rare and typically occur in conjunction with streams and flood plains. There are few concentrations of springs within this region and few species that are dependent upon this habitat type. Little is known about the historic and current conditions springs in the Tallgrass Prairie Region

Recognized riparian plant associations found within this habitat type include:

- Silver Maple – Boxelder Temporarily Flooded Forest
- River Birch – Sycamore Temporarily Flooded Forest
- Sycamore – Boxelder Temporarily Flooded Forest
- Eastern Cottonwood – American Elm – Sugarberry Temporarily Flooded Forest
- American/Red Elm – Sugarberry/Hackberry – Green Ash Temporarily Flooded Forest
- American/Red Elm – Chinquapin Oak Temporarily Flooded Forest
- Green Hawthorn – Cockspur Hawthorn – Downy Hawthorn Temporarily Flooded Shrubland
- Buttonbush Semi-permanently Flooded Shrubland
- Swamp Privet - Buttonbush Semi-permanently Flooded Shrubland
- Giant Cane Temporarily Flooded Shrubland

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that occupy springs, streams and riparian forests in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	American Woodcock	uncommon winter resident in bottomlands and forests throughout the region; small numbers remain into the spring to nest	U
Bird	Bell's Vireo	uncommon summer resident; nests in low willow and deciduous shrub thickets in riparian areas and in plum thickets in prairie landscapes	D
Bird	Little Blue Heron	uncommon summer resident; occurs locally in the vicinity of a few nesting colonies	U
Bird	Louisiana Waterthrush	uncommon summer resident; nests along forested, perennial stream region wide	S
Bird	Northern Pintail	common winter resident on marshes, ponds and open streams throughout the region	D
Bird	Prothonotary Warbler	uncommon summer resident; nests in bottomland hardwood forests and riparian forests along streams and rivers region-wide	U
Bird	Snowy Egret	uncommon summer resident; occurs locally in the vicinity of a few nesting colonies	U
Bird	Solitary Sandpiper	common spring and fall migrant throughout the region	S
Bird	Trumpeter Swan	rare winter resident on wetlands, ponds and larger streams	I
Fish	Arkansas Darter	uncommon and locally-occurring in vegetated seeps and springs in a few tributary streams to the Neosho/Grand River	U
Fish	Bluntface Shiner	uncommon and locally occurring throughout the region in large, clear streams, typically with gravel or sand substrate	U
Fish	Cardinal Shiner	uncommon and locally occurring in a few tributary streams to the Neosho/Grand River	S
Fish	Kiamichi Shiner	uncommon in a few gravel-bottom streams in the Flint Hills Section; the origin of these isolated population is unknown	U
Fish	Plains Minnow	uncommon but widespread in soft-bottom streams throughout the region	D
Fish	Redfin Darter	locally common in low-gradient, clear streams region-wide	U
Inve	American Bumble Bee	common and widespread in oak woodlands and forest edges	D
Inve	Kansas Well Amphipod	uncommon and locally occurring in seeps and spring-fed wetlands across the Osage Plains section	U
Inve	Linda's Roadside Skipper	rare species with a poorly-known distribution; likely to occur in riparian forests in the southeastern edge of the region	U
Mamm	Meadow Jumping Mouse	rare and possibly extirpated from the region; known only from one location in riparian thickets in the Bird Creek watershed	U
Mamm	Northern Long-eared Bat	not documented in the region but may be a rare resident or migrant in riparian and bottomland forests in the eastern half of the region; federally listed as a threatened species	S
Mamm	Swamp Rabbit	uncommon and locally occurring in forested bottomlands along streams and rivers in the southern and eastern edges of the region	U
Rept	Alligator Snapping Turtle	rare; small population occurs in tributaries of the lower Verdigris River; reintroduction underway in the upper Caney River watershed	D

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Rept	Eastern River Cooter	uncommon but widespread in small rivers and large streams throughout the region	U
Rept	Midland Smooth Softshell	rare and limited to stream tributaries of the Arkansas River along the southern and western edges of the region	D
Rept	Mississippi Map Turtle	uncommon, found in slow-moving, vegetated waters throughout the Osage Plains and in the Caney River watershed	U
Rept	Ouachita Map Turtle	common and widespread in small rivers and streams throughout the region	U
Rept	Spiny Softshell Turtle	uncommon but widespread in small rivers and streams throughout the region	D

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Habitat Loss Resulting from Land Management Practices:

1. The abundance and diversity of understory vegetation has declined in riparian areas as a result of livestock grazing, especially during the growing season.
2. Riparian forests have been cleared and converted to crop fields, or introduced pastures of exotic grasses such as Tall Fescue and Bermudagrass.
3. Fragmentation of riparian forests is caused by roads, houses, pastures and utility right-of-ways.
4. Clearing of riparian vegetation reduces stream bank stability which subsequently increases erosion and alters the width/depth ratios of streams.
5. Streams and riparian habitats are fragile and easily disturbed or modified.
6. The loss of riparian vegetation increases erosion and sedimentation.
7. Lack of headwaters protection causes more sediment, nutrients, pesticides and other pollutants to enter streams.
8. Livestock grazing along stream banks increases bank erosion and increases the sediment load in the stream.
9. Livestock grazing causes a loss of stream shading as a result of reduced riparian vegetation, increasing water temperatures and negatively affecting the aquatic community.
10. Increased sediment in the stream can fill or alter riffles and gravel beds which serve as spawning areas for fish and habitats for freshwater mussels.

Conservation Actions:

- Promote existing cost-share programs that provide funding for the installation of fences around streams and riparian forests to control/limit access by livestock.
- Purchase easements to protect or enhance existing riparian vegetation, and to restore riparian forests.
- Work collaboratively with landowners to encourage the planting/construction of alternative shading for livestock to reduce their use of riparian areas.
- Provide landowner incentives or cost-share programs to protect or restore riparian forests, stream banks and in-stream habitat.
- Acquire fee title purchase of stream and riparian habitat to place this into conservation ownership to conserve or enhance existing habitat.
- Acquire fee title, from willing sellers, to the headwaters of streams to control the introduction of sediment, nutrients and chemical pollutants.
- Develop new or promote existing Best Management Practices for the grazing of cattle in or adjacent to riparian zones.
- Increase the availability of aquatic resource educational information in the public schools.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality:

11. Concentrated animal operations (e.g., dairies, poultry houses) and their waste application fields, homes with septic systems, and fertilized crop fields each have the potential to contribute nutrients to streams via storm water runoff where they are placed in or near flood plains and headwater drainages. Increased nutrient levels in streams increases the abundance of algae, which can overgrow existing aquatic vascular plants, submerged rocks and other in-stream structures that provide fish habitat. Excessive algae also affects water quality by increasing the magnitude of the daily fluctuation of dissolved oxygen in the water (increases daytime and decreases nighttime oxygen concentrations).
12. Additional nutrients enter streams at locations where livestock have uncontrolled access and loaf or drink directly from streams and grazing in riparian areas.
13. Some pesticides act as endocrine system disrupters and these may enter aquatic systems through storm water runoff from agricultural fields and concentrated animal operations disrupting the reproduction and development of freshwater mussels, amphibians, and fish.
14. Municipal and industrial discharges can contribute to pollutant loads, especially nutrients, in rivers.
15. In areas where wetlands within and adjacent to stream channels and floodplains have been filled or drained for agricultural and residential purposes, the natural storage and filtering of storm water runoff has been impaired and increased amounts of sediment and nutrients may reach the streams. Additionally, these wetlands provide important breeding areas for amphibians and feeding areas for waterfowl and wading birds.
16. In the northeastern corner of the Tallgrass Prairie Region, the water quality and in-stream habitat of some streams have been affected by pollution from the tri-state mining area. These include excessive amounts of lead, zinc and iron in the water, increased water acidity and precipitated particulates.

Conservation Actions:

- Work collaboratively with landowners to reduce nutrient inputs (i.e., point and non-point sources) through the implementation of Best Management Practices and Farm Bill environmental quality cost-share programs, and through the restoration of wetlands in flood plains and intermittent headwater tributaries.
- Promote existing cost-share programs for ranchers that provide funding to construct alternative water sources for livestock (e.g. solar pumps with stock tanks) in order to keep these animals out of streams.
- Increase public awareness of importance of riparian habitats and wetlands, the Best Management Practices that exist for controlling nutrients, sediment and pollutants.
- Improve awareness of the existing conservation programs that provide funding to landowners for the control of non point-source pollutants such as nutrients, pesticides and sediment.
- Purchase conservation easements or acquire land to maintain or restore natural riparian vegetation along streams and reduce or limit agricultural and suburban development in and adjacent to riparian areas and streams.
- Work with landowners and public agencies to establish set back distances between streams and confined animal feeding operations, waste lagoons and land application areas. Setback distances could vary depending upon a stream's potential to support populations of species of greatest conservation need.
- Promote existing cost-share funding opportunities for landowners and local governments to construct fencing along streams and riparian areas to control/limit their access by livestock and to restore riparian forests.
- Develop local watershed-based citizen groups or stream teams to address local concerns through education and to monitor water quality and wildlife populations.

- Promote awareness of the existing Farm Bill incentives and cost-share programs that are designed to improve water quality through the implementation of Best Management Practices and establishment of streamside buffer zones.
- Support remediation of the tri-state mining district and containment of the heavy metal pollutants on-site to prevent them from entering streams.

Conservation Issues Related to Geomorphic Alteration and Instability of Stream Channels, Altered Patterns of Flow and Decreasing Water Quantity:

17. Dams and some types of culverts can become barriers to the movement of fish during low-flow conditions.
18. Bridges, dams and diversion structures alter the natural flow patterns and other processes of streams, especially the frequency and magnitude of natural flooding events.
19. Sedimentation, discharge, erosion, and channel straightening affect in-stream flow, community structure and the sustainability of species of greatest conservation need.
20. Water is being pumped from streams for irrigation.
21. Groundwater is being pumped from shallow aquifers for municipal and agricultural purposes, lowering water tables and reducing the flow volume of springs and seeps that feed streams.
22. There has been a widespread loss of connection between streams and their riparian vegetation in the Osage Plains due to historic channelization projects that have caused stream channels to become incised. Incised streams commonly have a reduced abundance of riparian vegetation and wetlands within their floodplains.
23. In-stream gravel mining reduces bank stability upstream and downstream of the mining area, increasing bank erosion, and altering the width to depth ratio of the stream by making it wider and shallower.
24. In-stream gravel mining can remove or reduce riffles, gravel beds and other stream structures that are important habitat for aquatic wildlife.

Conservation Actions:

- Work collaboratively with landowners to remove ponds and impoundments which are obsolete but have been shown to block the movement of fish species of conservation need.
- Work collaboratively with landowners to remove or rehabilitate culverts and road crossing with new structures that do not create barriers to fish.
- Work collaboratively with landowners to replace ponds that have been constructed on streams with alternative water sources.
- Work collaboratively with public managers to establish minimum in-stream flow levels on all biologically important streams (e.g., those streams that support populations of species of greatest conservation need, or diverse aquatic communities).
- Work collaboratively with public managers to manage water withdrawals to have the least impact on aquatic biota.
- Work collaboratively with public managers to manage the proposals to sell water outside of the state, or the transfer of water between basins within Oklahoma.
- Provide results and implications of ecological studies to the water use planners and permit administrators so that they can make more informed decisions that will better protect Oklahoma's aquatic natural resources.
- Support the development of a state water management plan with sound biological data that demonstrates the ecological impact of water sales, water withdrawals and inter-basin transfers of water.
- Provide cost-share funding or grants to restore the natural meander patterns and profile to stream channels and establish natural vegetation on stream banks for stability.

- Restore or construct seasonal wetlands/vernal pools within the riparian zones or floodplains of streams.
- Reconnect stream and riparian vegetation through the restoration of stream channels.
- Work collaboratively with public managers to develop regulations to eliminate the detrimental effects of gravel mining from within streams on species of greatest conservation need.
- Conduct management pilot studies to determine successful stream protection and management strategies.
- Work with local communities and counties to reduce stream channel impacts including in-stream gravel mining, placement of rip-rap on stream banks at bridge crossings, and recreational use of streams by off-road vehicles.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

25. Exotic plant species such as Chinese Privet, Kudzu, Autumn Clematis, Johnsongrass, Nepalese Browntop and Japanese Honeysuckle have become established and are becoming more abundant in riparian forests. These species compete with or displace native plants, thereby reducing plant diversity and altering the structure of the habitat that can be used by wildlife.
26. Feral hogs that forage in streams and along stream banks damage riparian vegetation and reduce bank stability.
27. Some native plants and animals have become more abundant in riparian forests as a result of fire suppression and changes in grazing patterns. Although they are native, they have altered plant and animal communities in ways that have negatively affected some species of greatest conservation need. Eastern Redcedar has increased in abundance and increased canopy closure and reduced the abundance of understory vegetation in some riparian areas. Brown-headed Cowbirds have become more abundant in riparian areas due to the presence of cattle during the summer months. Brown-headed Cowbirds are brood parasites that lay their eggs in the nests of avian species such as the Kentucky Warbler and Prothonotary Warbler, thus reducing the reproductive success of their host species.

Conservation Actions:

- Develop management plans to control the abundance and distribution of exotic species and invasive species.
- Conduct management pilot studies to determine the most successful management strategies for invasive and exotic species.
- Conduct studies to quantify the impact of exotic species on riparian forest communities (i.e., both plants and animals), or on aquatic animal communities.
- Increase educational efforts and public awareness of the ecological and economic impacts of exotic plant and animal populations.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

28. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
29. Limited historic data exist from which to evaluate the condition of springs, streams and riparian forests prior to large scale human alteration of these habitats.
30. The biological resources within riparian forests, streams and springs are difficult to monitor because most of the habitat occurs on private land and is distributed in small tracts across many individual landowners.

31. While the locations and distributions of streams are well-known, our knowledge of the distributions of springs and seeps is incomplete due to the difficulty in locating these small sites.
32. There is incomplete information from which land managers can predict the affect of habitat changes on populations of species of greatest conservation need.

Conservation Actions:

- Conduct ecological research on species of greatest conservation need to determine what factors limit their population size and distribution.
- Conduct research on species of greatest conservation need to establish a broader base of knowledge regarding their population sizes, densities, distributions and habitat relationships.
- Conduct biological inventories of springs and streams to increase the knowledge of the amphibian, fish, crayfish and mussel populations in streams and the biological communities associated with specific watersheds.
- Conduct field surveys to locate and map springs and to create a database of springs to track their condition, ownership and biological data.
- Conduct literature reviews and focused studies to establish what spring, stream and riparian habitats looked like historically to establish a set of target conditions for future stream and riparian restoration efforts.
- Develop relational databases to monitor the populations of species of greatest conservation need and the conditions of springs, streams and riparian habitats.
- Use surveys, workshops and data acquisition to update the Comprehensive Wildlife Conservation Strategy.
- Develop local watershed-based stream teams to address local conservation concerns through education and to monitor water quality and wildlife populations.

Potential indicators for monitoring the effectiveness of the conservation actions:

- number of acres of stream and riparian habitat that are acquired or placed under conservation easements
- acres of riparian forest having a diverse native species composition and possessing well developed understory, mid-story and canopy vegetation
- change in the number of active in-stream and streamside gravel and sand mining operations
- number of landowners participating in conservation program and implementing BMPs
- number of acres of enhanced or restored riparian forest
- number of mussel beds identified and protected
- changes in riffle to pool ratio of streams
- number of local citizen groups or stream teams monitoring streams
- number of springs restored and placed under conservation easements or conservation ownership
- changes in the number of miles of degraded streams
- changes in the population sizes and trends of species of greatest conservation need
- change in the population sizes or trends of representative spring/stream-dependent organisms
- changes in stream and spring base flow
- changes in water quality parameters

Potential partnerships to deliver conservation within the Tallgrass Prairie Region:

State Government
- Arkansas-Oklahoma Arkansas River Compact Commission
- Grand River Dam Authority
- Kansas State University – Monarch Monitoring Program
- Wildlife, forestry and water regulating agencies in Kansas
- Oklahoma Corporation Commission
- Oklahoma Department of Wildlife Conservation
- Oklahoma Department of Agriculture, Food and Forestry
- Oklahoma Department of Environmental Quality
- Oklahoma Legislature
- Oklahoma Conservation Commission
- Oklahoma State University – Cooperative Extension Service
- Oklahoma State University – Department of Ecology and Natural Resources Management
- Oklahoma Tourism and Recreation Department
- Oklahoma Water Resources Board
- Other state universities and departments
- University of Oklahoma – Oklahoma Biological Survey
- University of Oklahoma – Oklahoma Natural Heritage Inventory
- University of Oklahoma – Sam Noble Oklahoma Museum of Natural History

Federal Government
- U.S. Army Corps of Engineers
- U.S. Bureau of Reclamation
- U.S. Congress
- U.S. Department of Agriculture – Animal and Plant Health Inspection Service
- U.S. Department of Agriculture – Farm Services Agency
- U.S. Department of Agriculture – Natural Resources Conservation Service
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- U.S. Geological Survey

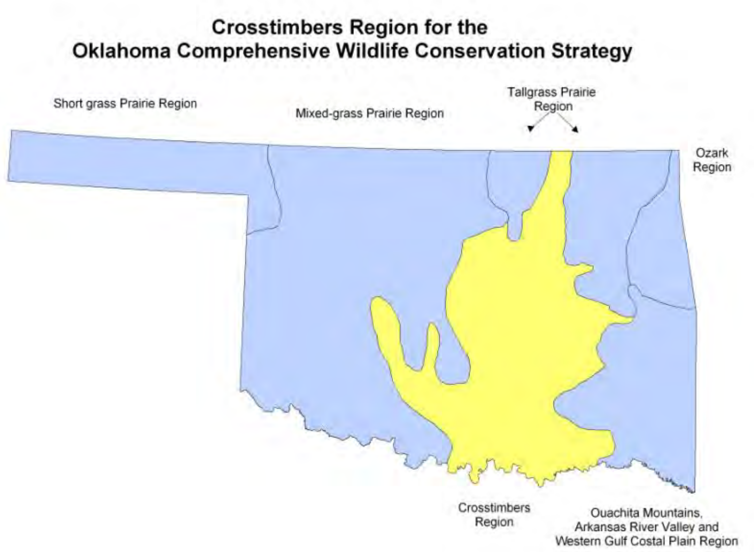
Local Government
- Municipalities in Oklahoma, Arkansas, Missouri
- Municipalities wanting to buy water
- Tribal governments

Businesses, Citizens and Citizen Groups
- Chambers of Commerce
- Ducks Unlimited and local Oklahoma chapters
- Farm Bureau
- Farmers Union
- Land Legacy
- Local citizens groups
- National Wild Turkey Federation and local Oklahoma chapters
- Oklahoma Anglers United
- Oklahoma Cattlemen's Association
- Oklahoma Forestry Association
- Oklahoma Native Plant Society
- Oklahoma Ornithological Society
- Oklahoma Section of the Society for Range Management

- Other sportsmen's groups
- Private landowners, farmers and ranchers
- Producer Cooperatives
- Quail Unlimited and local Oklahoma chapters
- The Izaak Walton League of America
- The National Audubon Society and Tulsa Audubon Society
- The Nature Conservancy
- The Wildlife Society
- Urban development groups
- Vernal Pool Society

Crosstimbers Region

The Crosstimbers Region represents the central one-third of Oklahoma with oak and prairie savanna. The following counties are part of the Crosstimbers Ecoregion: Kay, Noble, Pawnee, Payne, Logan, Lincoln, Oklahoma, Cleveland, McClain, Grady, Caddo, Stephens, Jefferson, Garvin, Murray, Carter, Love, Marshall, Johnston, Pontotoc, Coal, Atoka, Bryan, Choctaw, Pittsburg, McIntosh, Hughes, Seminole, Pottawatomie, Okfuskee, Creek, Okmulgee, Tulsa, and Osage.



The Crosstimbers Region is a complex mosaic of upland deciduous forest, savanna, and prairie communities that highlight the broad ecotone between the eastern forests and the grasslands of the Great Plains. The Crosstimbers woodlands are dominated by Post Oak (*Quercus stellata*) and Blackjack Oak (*Q. marilandica*). It extends from central Texas, across east-central Oklahoma, and into southeastern Kansas. The presettlement Crosstimbers may have covered nearly 20 million acres and consisted largely of low-stature oaks that were not suited for lumber production.

According to Duck and Fletcher (1945)[1], the Crosstimbers represent the largest single ecosystem type in the state of Oklahoma. East-central Oklahoma, north central Texas, and southeastern Kansas contain some of the most extensive tracts of ancient woodland in the eastern United States. Most of these remnant woodlands are found in fragmented tracts from 40 to 2,800 acres in size along cliffs and rocky uplands. But, several areas have been identified where ancient Crosstimbers are still present over thousands of contiguous acres and dominate the landscape. These ancient oak-dominated woodlands provide natural habitat in an increasingly human-dominated landscape and are becoming increasingly fragmented, but the remnants provide vital habitat for Neotropical migrant birds and other native flora and fauna.

Ecologically distinct lines usually do not exist between regions. The Crosstimbers Region, the Tallgrass Prairie Region and the Mixed-grass Prairie Region are adjacent, and there are areas of overlap between each. Patches of tallgrass prairie and mixed-grass prairie habitats are embedded within oak woodlands and patches of oak woodlands and oak shrublands are embedded within and intergrade into tallgrass prairie and mixed-grass prairie habitats.

[1] Duck, L. G. and J. B. Fletcher. 1945. A survey of the game and furbearing animals of Oklahoma. Div. Wildl. Restor. and Res., Oklahoma Game and Fish Comm., Pitman-Robertson Ser. No. 2, State Bull. No. 3. Oklahoma City.

The best professional judgment of the advisory group and technical experts was used to identify each Conservation Landscape's status and trend. And, even though some issues and actions apply to multiple regions, each regional chapter is designed to stand-alone.

Conservation Landscapes listed in general priority order:

- Very High priority Conservation Landscapes:
  - Small River
  - Oak and Hickory Bottomland Hardwood Forest
- High priority Conservation Landscapes:
  - Post Oak/Blackjack Oak/Hickory Woodland and Forest
  - Tallgrass Prairie
  - Small Gravel (hard)-bottom Streams and Associated Riparian Forest
  - Limestone Cave
  - Springs
- Moderate priority Conservation Landscapes:
  - Herbaceous Wetlands
  - Sandstone Canyonlands and Post Oak and Blackjack Oak Shrubland
  - Small Sandy (soft)-bottom Streams and Associated Riparian Forest
  - Mixed-grass Prairie

Very High Priority Conservation Landscape: Small Rivers

The Small River habitat type within the Crosstimbers Region includes all or a portion of three tributaries to the Red River (the Blue, Clear Boggy, and Muddy Boggy rivers) and three tributaries within the Arkansas River system (the Little, Deep Fork and Caney rivers). The water quality and flow conditions, as well as the aquatic species compositions, of these small rivers are variable and some species are restricted to specific rivers or those rivers within only the Red River or Arkansas River systems. These rivers differ from the Large River habitat by having more moderate seasonal flow fluctuations and by having a shorter length that minimally transcends terrestrial ecoregion boundaries. Each of these is a relatively low-gradient river that meanders through a broad, predominately forested floodplain. The current condition of Small River habitat is poorly understood. Water quality is generally stable or improving, but bank stability and the condition of riparian vegetation are often poor and are declining in many reaches. Because of sedimentation, in-stream habitat conditions are likely to be on the decline. Flow rates are generally greater during the winter and spring months and lower during the summer and fall; however the seasonal variation is less than that which is seen on large rivers.

The Blue and Clear Boggy rivers originate within the rocky Arbuckle Uplift. The upper portions of these two rivers are clear and swiftly flowing over gravel or cobble substrate. The lower portions of these rivers are more similar to the Muddy Boggy, Little, Caney and Deep Fork rivers, which are slow-moving rivers with silty to sandy substrates that meander across relatively broad floodplains. The Blue River supports an important population of the Seaside Alder (*Alnus maritima*), which is a small riparian tree that occurs in only two other isolated populations in Georgia and around the Chesapeake Bay.

The species of greatest conservation need found in the Small River habitat types are listed in the following table along with a narrative description of each species' status and population trend. Current literature and the best professional judgment of technical experts were used to determine each species' status within the region and its population trend based on statewide or regional data over the past fifty years. A species was included within this habitat section if a manageable population was known to or likely to exist within the region and if this habitat type was one in which conservation efforts would be most effective (e.g. this was a habitat type of primary occurrence for the species). Other species of greatest conservation need may occur within this habitat type, but actions to further their conservation would be more effective elsewhere. Species are sorted alphabetically within groups of amphibians (Amph), birds, fish, invertebrates (Inve), mammals (Mamm), and reptiles (Rept) for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common Name	Status within the Region	Trend in Population Size or Range
Bird	Bald Eagle	small resident breeding population; common and widespread wintering population	I
Bird	Canvasback	uncommon winter resident throughout the region	U
Bird	Little Blue Heron	widespread and locally common summer resident in the vicinity of its scattered nesting colonies	U
Bird	Northern Pintail	common winter resident throughout the region	D
Bird	Prothonotary Warbler	uncommon summer resident; nests in riparian forests along all of the small rivers in the region	D
Bird	Solitary Sandpiper	uncommon spring/fall migrant found through the region	U
Bird	Trumpeter Swan	rare winter resident throughout the region	I
Fish	Alligator Gar	occurs in low densities within the lower portions of the Blue and Boggy rivers	D
Fish	Blackspot Shiner	rare; recently documented in the Muddy Boggy River	U

Group	Species of Greatest Conservation Need Common Name	Status within the Region	Trend in Population Size or Range
Fish	Least Darter	uncommon and limited to the Blue River and tributaries	U
Fish	Blue Sucker	rare; appears to be limited to the Red River tributaries	U
Fish	Bluntface Shiner	uncommon and limited to the Caney River	U
Fish	Crystal Darter	very rare; existence in region is uncertain but may occur in Boggy River system	U
Fish	Kiamichi Shiner	rare; existence in region is uncertain but may occur in Boggy and Caney rivers	D
Fish	Paddlefish	rare; occurs in the lower Blue and Boggy rivers	S
Fish	Pallid Shiner (Chub)	uncommon and limited to the Boggy River	U
Fish	Plains Minnow	locally common and widespread in the region	D
Fish	Red River Shiner	common in the lower portions of the Blue and Boggy rivers	I
Fish	Redspot Chub	uncommon and limited as an isolated population in the Blue River	S
Fish	Rocky Shiner	locally common but limited to the Blue and Boggy rivers	U
Fish	Western Sand Darter	uncommon and limited to the lower portions of the Red River tributaries	U
Inve	Little Dubiraphian Riffle Beetle	rare and occurs locally within the Blue River watershed	U
Inve	Little Spectaclecase	uncommon and limited to the Red River tributaries	S
Inve	Monkeyface Mussel	rare; limited to the Caney River unless extirpated	S
Inve	*Orconectes difficilis*	locally common in the Clear and Muddy Boggy rivers	U
Inve	Ouachita Kidneyshell	rare and limited to the Blue and Boggy rivers	D
Inve	Plain Pocketbook	uncommon and locally occurring, but found throughout the region	D
Inve	Wartyback Mussel	uncommon and locally occurring; limited to the Boggy and Caney rivers	S
Inve	Washboard	uncommon and locally occurring; limited to the Boggy and Caney rivers	S
Rept	Eastern River Cooter	uncommon but widespread throughout the region	U
Rept	Midland Smooth Softshell	locally common and widespread	U
Rept	Mississippi Map Turtle	uncommon but widespread in the eastern half of the region	U
Rept	Ouachita Map Turtle	uncommon but widespread throughout the region	U
Rept	Razor-backed Musk Turtle	uncommon and secretive; limited to the Red River tributaries	U
Rept	Spiny Softshell Turtle	common and widespread through the region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

1. Ecological and distributional data are incomplete for many species of greatest conservation need, particularly those species that are rare or restricted to one or a few watersheds, thus making it difficult to identify management issues and establish effective corrective strategies.
2. Our historic knowledge of habitat conditions and community composition are incomplete for all of the small river systems.

Conservation Actions:

- Compile existing distribution records and ecological information from museums and publications, and verify the validity of these existing data.
- Complete biological inventories and habitat surveys in order to fill information gaps in the Caney and Boggy rivers. And continue the existing monitoring partnership on the Blue River.
- Develop monitoring programs to track habitat condition/quality in each small river. Where applicable, link these to existing efforts and coordination with other partners.
- Develop monitoring programs to track the status and trends of fish, mussel and aquatic turtle species of greatest conservation need and develop a relational database to house and analyze ecological and distributional data.
- Conduct research to better understand the ecological needs and the factors limiting the populations of Tier I and II species of greatest conservation need.
- Incorporate data from surveys and literature reviews into the next update of the Comprehensive Wildlife Conservation Strategy.
- Conduct genetic studies to assess gene flow among populations of aquatic species.
- Develop an accurate assessment and description of the historic conditions within each small river so that these can be used as conservation target conditions.

Conservation Issues Related to Historic and Current Activities that Alter Flow Patterns and Water Quantity:

3. Aquifer pumping and surface water withdrawals have altered natural flow regimes by reducing base flows during periods of dry weather and reduced runoff.
4. Impoundments have altered natural flow regimes by reducing the frequency and magnitude of high-water events. These changes affect channel morphology and the distribution and structure of in-stream habitats that affect the aquatic community composition.

Conservation Actions:

- Continue to study in-stream flow and ecological flow requirements for sensitive fish and freshwater mussel species, including the on-going study in the Blue River.
- Establish ecologically acceptable minimum flow standards on all small rivers and tributary streams.
- Support the designation of the Blue River as a State Scenic River to prevent potential plans for reservoir construction.
- Encourage water conservation and support research into methods for conserving water including the recycling of gray water for uses such as irrigation.
- Incorporate the needs of fish and wildlife resources into the State Water Plan and regional municipal water plans.
- Research and remain involved with existing recharge rate studies to determine the sustainability of aquifers and springs that support wildlife and fish.
- Research the efficacy and ecological consequences of pumping water from reservoirs into aquifers as a means of recharging them.
- Discourage the development of additional reservoirs that would affect the flow regimes of small rivers that provide important habitat for species of greatest conservation need.
- Encourage programs to improve water quality and maintain more natural flows below reservoirs. Research alternative methods for regulating reservoir discharge that would benefit downstream aquatic systems while still meeting reservoir storage objectives.
- Encourage congressional reprioritizing of the U.S. Army Corps of Engineers projects to include fish, wildlife, and recreation as beneficial uses.
- Cooperate with the U.S. Army Corps of Engineers to establish more natural alternative flow patterns.

- Encourage the development of legislation to establish minimum in-stream flow provisions.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality:

5. Nutrients, pesticides and inorganic chemicals from crop fields, livestock operations and homes/lawns contribute to water pollution through storm water runoff and degrade water quality.
6. The degradation of riparian areas unstabilizes river banks and contributes to erosion and sediment deposition into rivers. Sedimentation and increased sediment loads change channel morphology and flow.
7. There is insufficient control of erosion at the headwaters of streams and intermittent drainages, which contribute sediment and chemical pollutants to aquatic systems.
8. Endocrine disruptors and hormones may be carried into streams and rivers via storm water runoff and point-source discharges from agricultural and urban areas. Some classes of pesticides and some medications act as endocrine system disruptors that potentially interfere with the growth and reproduction of fish, crustaceans and amphibians.

Conservation Actions:

- Support research to develop a better understanding of the effects of water quality degradation, riparian degradation, in-stream flow alteration, and endocrine disruptors on species of greatest conservation need. Support companion research into how the problems that are created by in-stream flow alteration, endocrine system disruptors and riparian degradation can be minimized, mitigated or counteracted in order to conserve species of greatest conservation need.
- Work with ranching groups and cattlemen's association to develop regional workshops for landowners along streams and rivers to provide education about best management practices for home and agricultural activities as well as ecologically-based practices for restoring or maintaining stream and riparian habitat.
- Work with the NRCS to identify priority reaches and encourage landowners to enroll riparian areas into riparian buffers through Farm Bill conservation programs.
- Increase the number of sites at which water quality is monitored so that multiple sites are monitored in all of the small rivers.
- Compile existing studies of the responses of wildlife populations to various land management practices. Use the data from these studies to recommend improvements to management practices. Look for information gaps, such as species of greatest conservation need that have not been studied, to inform future research.

Conservation Issues Related to Habitat Loss and Alteration from Geomorphic Alteration and Instability of River Channels:

9. Geomorphic instability caused by a combination of the degradation of riparian areas, inappropriate management of watersheds, sedimentation and altered flow regimes, has diminished in-stream habitat quality for species of greatest conservation need. These changes affect spawning habitat distribution, thermal refugia during low-flow periods, and substrate stability that is important for freshwater mussels.
10. Erosion and runoff from cities and agricultural fields increases sediment transport and creates problems for certain fish and invertebrates.
11. Grazing and vegetation degradation in riparian areas and flood plains decreases bank stability and increase erosion and sedimentation.
12. Removal and clearing of riparian vegetation contribute to bank instability and increases bank erosion.
13. In-stream and stream-side gravel mining alters the morphology of stream and river channels in ways that negatively affect in-stream habitats for fish and mussels.

Conservation Actions:

- Work with the Army Corps of Engineers to mitigate unnatural flows regimes through the management of water releases from upstream reservoirs. Work with municipalities and ODOT to reduce the pulse of storm water runoff from roads and other impervious surfaces following rainfall events.
- Work with the NRCS to continue to provide financial assistance to landowners to implement management practices that control erosion and reduce sediment in storm water runoff, particularly around headwater streams.
- Provide funding to restore stream channels and riparian areas.
- Expand ODWC's Stream Program statewide.
- Work with county commissioners and ODOT to evaluate road crossings over small rivers to reengineer and reconstruct those that constrain flow in a way that alters channel morphology.
- Provide financial support to programs that restore river channel morphology.
- Encourage and support legislation to establish ecologically acceptable minimum in-stream flow provisions.
- Encourage and support landowners and others efforts to create and maintain riparian buffer zones. Financially support and expand the existing NRCS programs that protect riparian areas from grazing (e.g. cost-share funding for fencing).
- Present workshops for landowners to disseminate information about the historic condition of streams and rivers, best management practices to control sediment, nutrients and chemical pollutants, beneficial management practices to restore or maintain riparian and in-stream habitats, and practices to control invasive species.
- Encourage and support increased use of Farm Bill incentives to protect water quality and riparian habitat.

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

14. Invasive species such as Giant Reed (*Arundo donax*), Common Reed (P*hragmites australis)* and Yellow Flag Iris (*Iris pseudoacorus*) (in the Blue River) can alter riparian habitats and affect habitat quality for native fish and wildlife.
15. Non-native fishes such as Common, Silver and Grass carp can reduce aquatic vegetation and compete for food with juvenile fish and mussel species of greatest conservation need.
16. Parrotfeather Water-Milfoil and other submerged aquatic plants can alter in-stream vegetation and the available habitat for fish.
17. To the extent that are present in the Cross Timbers region of Oklahoma, invasive invertebrates such as European earthworms (which comprise the live bait used across the state) can alter soil structure and nutrients with associated increases in runoff into streams and rivers.

Conservation Actions:

- Increase public education about the potential problems associated with the accidental or purposeful release of bait (e.g. minnows, earthworms, crayfish) into rivers.
- Research the impact that exotic aquatic species may have on native fish and invertebrate populations, and for those that substantially affect native species, research control measures or methods to minimize their impact.
- Increase the funding to implement the Oklahoma Aquatic Nuisance Species management plan to eradicate or control the spread of those exotic species that cause the greatest impact on important populations of species of greatest conservation need. Research the efficacy of the recommended control and management measures.
- Develop invasive species management plans for riparian habitats on public conservation lands.
- Conduct monitoring and surveillance surveys for invasive species in areas such as the Clear Boggy, Muddy Boggy and Caney rivers where few recent data exist.

Conservation Issues Related to Commercial Harvest Practices:

18. The impact of the commercial harvest of certain species of minnows, aquatic turtles and freshwater mussels is difficult to quantify and may affect the sustainability of species of greatest conservation need.
19. Commercial mussel harvest may dislodge or injure co-occurring non-target species.

Conservation Actions:

- Study the effects of commercial harvest on species of greatest conservation need.
- Examine ways to minimize or mitigate any substantial negative effects including the option to close specific waters or species to harvest or to establish season or length limits. Seek to close commercial harvest in species or watersheds where it is demonstrated to be unsustainable.
- Conduct management pilot studies to determine successful management strategies.

Potential indicators for monitoring the effectiveness of the conservation actions:

- population sizes and trends of species of greatest conservation need
- number of degraded and restored river miles of habitat
- number of acres acquired or conserved within a given watershed
- number of acres under easements or conservation practices
- number of landowners participating in conservation practices and the number of acres improved
- number of new local conservation groups or watershed groups
- stream flow and habitat quality (e.g., measure return of stream flow with range of natural variation)

Very High Priority Conservation Landscape: Oak and Hickory Bottomland Hardwood Forest

Relative condition of Oak and Hickory Bottomland Hardwood Forest habitat is currently poor with a declining trend. Bottomland Hardwood forests are found in the floodplains of the larger streams and small rivers throughout the Crosstimbers Region. Between 80,000 and 100,000 acres of bottomland hardwood forest are thought to remain in the region and the largest tracts occur along the Deep Fork, Little, Clear Boggy and Muddy Boggy Rivers. Over the past century, much of the former bottomland hardwood forests in the region has been converted to agricultural land uses (e.g., crop fields or pasture) or permanently inundated by the construction of reservoirs. Bottomland hardwood forests are diverse plant communities and the composition of individual stands varies with soil conditions, the frequency and duration of seasonal flooding, and geographically. Bottomland hardwood forests in this region are dominated by oaks and hickories including Bur Oak (*Quercus macrocarpa*), Pin Oak (*Quercus palustris*), Shumard Oak (*Quercus shumardii*), Chinkapin Oak (*Quercus muehlenbergii*), Pecan (*Carya illinoiensis*), and Black Walnut (*Juglans nigra*). In the Red River watershed in the southern portion of the region, Water Oak (*Quercus nigra*) and Bitternut Hickory (*Carya cordiformis*) are common bottomland forest trees. The canopy trees include Red Elm (*Ulmus rubra*), White Ash (*Fraxinus americana*), Green Ash (*Fraxinus pennsylvanica*), and Sugarberry (*Celtis laevigata*). Common understory vegetation includes Green Hawthorn (*Crataegus viridis*), Deciduous Holly (*Ilex decidua*), and Red Mulberry (*Morus rubra*). An unusual and unique bottomland association occurs in some of the deep canyons in Caddo County where an isolated population of Sugar Maples (*Acer saccharum*) is found growing with Shumard and Chinkapin oaks.

Recognized plant associations within this habitat type include:

- Bur Oak – Shumard Oak – Bitternut Hickory Temporarily Flooded Forest
- Pecan – Sugarberry Temporarily Flooded Forest
- Water Oak – Red Elm – Shumard Oak Temporarily Flooded Forest
- Sugar Maple – Red Elm – Black Walnut Forest

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that occupy bottomland hardwood forests in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Crawfish Frog	uncommon and has a scattered distribution; local populations dependent upon one or a few wetlands for breeding	U
Amph	Hurter's Spadefoot	locally common in the vicinity of breeding ponds in the eastern 3/4 of the region	U
Bird	American Woodcock	widespread but uncommon and secretive; breeding population size unknown	U
Bird	Hooded Warbler	rare and limited to the southeastern corner of the region	U
Bird	Kentucky Warbler	uncommon but widespread summer resident; nests in bottomland forests with well developed woody	S

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
		understories	
Bird	Little Blue Heron	widespread summer resident that occurs in scattered populations centered around nesting colonies	D
Bird	Louisiana Waterthrush	uncommon summer resident; nests in riparian forest habitat along stream channels	S
Bird	Prothonotary Warbler	widespread but uncommon summer resident; nests in larger tracts of mature bottomland forests	U
Bird	Red-headed Woodpecker	widespread year-round resident; populations are often scattered and small	D
Bird	Rusty Blackbird	rare winter resident throughout the region	U
Bird	Solitary Sandpiper	uncommon spring and fall migrant	U
Bird	Wood Thrush	rare and locally occurring summer resident	D
Mamm	Eastern Spotted Skunk	rare and occurs at low densities; current distribution poorly known	U
Mamm	Marsh Rice Rat	locally common but with only a few scattered populations	U
Mamm	Swamp Rabbit	common and locally-occurring in bottomland forests in the eastern half of the region	U
Rept	Northern Scarletsnake	rare and secretive species that occurs in low densities and whose range is poorly delineated	U
Rept	Western Chicken Turtle	uncommon species that occurs locally in the southern half of the region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

1. A large percentage of the historic acreage of bottomland forest has been converted to other land uses, primarily pasture and crop land. This has resulted in an overall loss of habitat for the species of greatest conservation need that rely on bottomland forests.
2. Fragmentation of forest tracts continues to occur due to the creation of pastures, croplands, roads, homes, and utility line & pipeline right-of-ways. This results in a direct loss of some habitat and a lowering of the quality of the remaining habitat which is broken into smaller tracts. Species which rely on large tracts of habitat are more negatively affected by this trend.

Conservation Actions:

- Design landowner incentives to encourage the retention of unfragmented tracts of bottomland hardwood trees.
- Educate landowners about watershed connectivity, the importance of riparian and bottomland habitats and the existing conservation cost-share programs that can help landowners enhance and maintain these habitats.
- Educate landowners about the importance of riparian woodlands for minimizing streambank erosion and stream movement.
- Develop an easement and restoration program that targets bottomland hardwood forests that is similar to the one currently in place for grasslands through Farm Services Agency.
- Place some of the most biologically important bottomland hardwood forests into conservation ownership through land acquisition or conservation easement by natural resource management agencies or private conservation organizations.

- Utilize rest and allow natural succession to revegetate riparian areas that have been cleared and converted to other purposes in the past.
- Restore crop fields and pastures in floodplains back to bottomland hardwood forest habitat through cost sharing, easements, or acquisition.
- Explore economic alternatives to clearing and grazing bottomland hardwoods (e.g. the development of hunting leases, creation of marketable carbon sequestration credits, wetland mitigation or water quality enhancement credits as revenue sources for landowners).
- Use private landowner assistance programs such as U.S. Fish and Wildlife Service's Partners for Fish and Wildlife to provide cost-share funding for private landowners to restore hydrology through the construction of small dams and dikes to seasonally flood bottomlands.
- Advocate for the elimination of federal funding assistance for activities that result in the clearing forests and the establishing introduced grasses.
- Encourage the protection of private forest land through conservation easement programs and information/education programs.

Conservation Issues Related to Current and Historic Activities that Alter Flow Patterns and Water Quantity:

3. Conversion of bottomland forest to pasture or crop may be detrimental to species of greatest conservation need.
4. Inappropriate herbicide use may cause damage to species of greatest conservation need.
5. The construction of reservoirs permanently inundates tracts of bottomland hardwood forests resulting in a direct loss of acreage, and alters the frequency and magnitude of natural, seasonal flood events for additional tracts of bottomland hardwood habitat both upstream and downstream. Upstream from reservoirs, bottomland forests may experience prolonged seasonal flooding, while downstream there is a decrease in the duration and frequency of seasonal flooding.
6. The channelization of streams causes dramatic disconnections between streams and the bottomland forests in their flood plains. Channelization results in the incision of streams which leads to a lowering of the shallow water table in the flood plain and reduces or eliminates periodic flooding and soil saturation in the bottomland forest zone.
7. Loss of temporary wetlands due to the draining of wetlands, a reduction of the frequency of flooding and soil saturation that maintains the hydrology for these wetlands and/or the filling of wetlands by direct human action. Flood plain wetlands serve as breeding areas for amphibians, foraging areas for waterfowl, shorebirds, and herons.

Conservation Actions:

- Modify reservoir management to allow periodic flooding of bottomland hardwood tracts below dams.
- Remove flood control structures that are no longer needed and remove structures that block the movement of fish or prevent natural flooding regimes.
- End the cost-share programs that encourage the construction of new ponds and lakes on perennial streams that would inundate bottomland forests or would alter the hydrology that supports bottomland forests upstream or downstream.
- Develop incentives for land managers to restore the morphology and depth of stream channels and to reconnect streams with their adjacent bottomland forests.
- Seek acquisition and easements of existing habitats to protect and/or expand the remaining tracts of bottom hardwood forest. Work with the joint ventures and other partnerships to leverage state and private funds with North American Wetland Conservation Act funding.

- Use mitigation funds to acquire existing bottomland hardwood forests and to protect them from future development (e.g., urban development, agricultural development, and future reservoir construction).
- Support the development of a state wetland plan and flood plain management plan that includes the conservation of bottomland forest habitats.
- Support water conservation education to decrease the need for additional reservoirs.
- Work with the U.S. Army Corps of Engineers to restore bottom hardwood forest habitat on lands that are under their management and within their authority.
- Provide the results of ecological studies to land and water use planners and encourage the incorporation of them into federal, state and local government management plans as well as those of nongovernmental conservation organizations.
- Restore stream channel structure to reconnect streams with their riparian zones, and reconnect bottomland hardwoods with the river/stream systems along which they developed.
- Use private landowner assistance programs such as U.S. Fish and Wildlife Service Partners for Fish and Wildlife to provide cost-share funding to private landowners to restore hydrology through the construction of small dams and dikes to seasonally flood bottomlands.
- Examine and apply the alternative flood control methods that are used in different parts of the country (e.g., restore bottomland forests inside of existing levees, or create wetland mitigation sites/ banks within river flood plains) if these are advantageous to maintaining or restoring bottomland forest habitat.
- Construct vernal pools or similar small wetlands within bottomland forest sites to enhance their seasonal hydrology and enhance their value to semi-aquatic amphibians and reptiles.
- Restore hydrology and natural standing water to bottomland hardwood habitat.
- Manage for the natural hydro period of bottomland hardwood forests through the restoration of the natural meanders in streams and their historic flooding patterns.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

8. Many bottomland hardwood forest stands were clear cut in the early 1900s for wood, creating unnatural stand ages/structures. The regrowth forests that developed after widespread logging tend to be dense, even-aged stands with poor structural diversity that often have dense midstories, sparse understory vegetation and limited tree regeneration.
9. Inappropriate herbicide use may reduce plant species diversity and alter understory structure that reduces habitat quality for some species of greatest conservation need.

Conservation Actions:

- Promote prescribed burning, thinning or selective tree removal to increase structural diversity within forest stands and increase understory vegetation.
- Develop and promote the use of Best Management Practices for logging bottomland hardwoods that encourage structural diversity and retain understory vegetation.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

10. Data are incomplete for some species of greatest conservation need regarding their distribution, ecological needs and population trends thus making it difficult to identify management issues and establish effective corrective strategies.
11. Baseline knowledge about the historic and current distribution, structural condition and community composition of bottomland hardwoods forests is incomplete.

Conservation Actions:

- Conduct ecological research to determine why species of greatest conservation need have low population sizes and/or declining population trends. Determine which management strategies could be implemented to enhance populations.
- Conduct research on species of greatest conservation need to determine why populations are low and/or declining.
- Conduct research on species of greatest conservation need to establish baseline population data/information.
- Inventory all remaining bottomland hardwoods to determine condition.
- Use surveys, workshops, and data acquisition to update the Comprehensive Wildlife Conservation Strategy.
- Develop a monitoring program to track habitat condition. A recent multi-agency partnership to develop a current land cover map may be a viable starting point.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

12. Several species of non-native plants and animals (e.g., Japanese Honeysuckle, Autumn Olive, Chinese Privet, feral hogs) have become established within bottomland hardwood forest habitat and now compete with native species for food, water and space.
13. Invasive pests such as the Emerald Ash Borer and diseases such as Oak Wilt, threatened to alter bottomland forest communities if they become established.
14. Invasive invertebrates such as European earthworms (which comprise most of the live bait used across the state) alter soil conditions and influence plant germination that can lead to plant community changes. Evidence is mounting that the soil changes caused by non-native earthworms facilitates invasions of non-native understory plants, which can affect density, survival and reproductive success of ground-nesting birds and amphibians.

Conservation Actions:

- Monitor populations of invasive species in the bottomland hardwoods and conduct ecological studies to evaluate the relative impact of exotic species on species of greatest conservation need in bottomland hardwood systems.
- Develop and implement exotic and invasive species management plans and programs to control the spread and/or abundance of harmful species.
- Develop invasive species management plans for all public lands in the region and use these as demonstration areas to show how invasive species can be effectively controlled. Provide cost-share funding to private landowners to encourage them to control exotic vegetation (e.g., privet, honeysuckle).
- Fund monitoring and surveillance programs in areas where invasive species and emerging diseases could become established.

Potential indicators for monitoring the effectiveness of the conservation actions:

- forest stand health as measured through composition and structure
- number of acres of forests converted to pasture or cropland, and cropland or pasture that has been converted back to bottomland forest
- number or percentage of acres acquired or placed into conservation programs (e.g., incentive programs)
- percent of available habitat in conservation programs (e.g., measure net gain or loss of habitat)
- population sizes and trends, and changes in the distributions of species of greatest conservation need
- monitor changes in abundance and distribution of invasive species

High Priority Conservation Landscape: Post Oak/Blackjack Oak/Hickory Woodland and Forest

Forests and woodlands dominated by Post Oak, Blackjack Oak and Black Hickory are the most abundant natural habitat types within the Crosstimbers Region and their acreage has changed very little during the past decade. These dry to mesic woodlands, known locally as "Crosstimbers," historically covered over 2 million acres in the region. The Crosstimbers are a diverse mosaic of oak savannas, oak/hickory woodlands and oak/hickory forests that varied geographically depending upon soil, rainfall, and fire history. Their dominant tree species are the Post Oak (*Quercus stellata*) and Blackjack Oak (*Quercus marilandica*) and these two oaks may comprise as much as 80 percent of the canopy cover. Other common trees include Black Hickory (*Carya texana*), Black Oak (*Quercus velutina*), Chinkapin Oak (*Quercus muehlenbergii*), Chittamwood (*Sideroxylon lanuginosum*), Sugarberry (*Celtis laevigata*), Winged Elm (*Ulmus alata*) and Eastern Redcedar (*Juniperus virginiana*). Black Hickory, Black Oak and Winged Elm are more common in the more mesic sites in the eastern part of the region. Winged Elm and Eastern Redcedar are common throughout the region and have increased in abundance during the past century as a result of the reduction of periodic fires. Prominent understory plants include Eastern Redbud (*Cercis canadensis*), Roughleaf Dogwood (*Cornus drummondii*), and Mexican Plum (*Prunus mexicana*). In sites that are drier and/or have a higher frequency of fire, the Crosstimbers have a more park-like or savanna-like structure. These areas typically have a grassy understory dominated by Little Bluestem (*Schizachyrium scoparium*) in addition to Indiangrass (*Sorghastrum nutans*), Big Bluestem (*Andropogon gerardii*), and Small Panicgrass (*Dichanthelium oligosanthes*).

On the rocky, limestone soils of the Arbuckle Mountains, Texas Red Oak (*Quercus buckleyi*), Chinkapin Oak (*Quercus muehlenbergii*), Ashe Juniper (*Juniperus ashei*), and Texas Ash (*Fraxinus texensis*) are common associates with Post Oak and Blackjack Oak.

The Crosstimbers Woodland remains the most widespread and abundant native habitat type in the Crosstimbers Region; however, many acres were cleared and converted historically to pasture. Much of the remaining Crosstimbers habitat has a more forest-like structure than it did historically as a result of fire suppression that has allowed for increased survival and density of young oaks as well as the dramatic increase in abundance of Eastern Redcedar

Recognized vegetation associations in this habitat type include:

- Chinquapin Oak – Shumard Oak Forest
- Texas Red Oak – Texas Ash – Chinquapin Oak Forest
- Post Oak – Blackjack Oak – Black Hickory Forest
- Post Oak – Shumard Oak – Bitternut Hickory Forest
- Post Oak – Winged Elm Forest
- Post Oak – Eastern Redcedar Forest

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that occupy the oak/hickory woodland and forest habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Hurter's Spadefoot	Locally common in the vicinity of breeding ponds in the eastern 3/4 of the region	U
Bird	American Woodcock	uncommon winter resident; a small number of birds nest in early spring	U
Bird	Bachman's Sparrow	very small and localized nesting populations occur in the southeastern and northern parts of the region	U
Bird	Harris's Sparrow	locally common winter resident in open oak woodlands with herbaceous understories throughout the region	U
Bird	Kentucky Warbler	uncommon and locally occurring summer resident; nests in the more mesic forest tracts that have abundant woody understory vegetation	S
Bird	Northern Bobwhite	locally occurring and somewhat common year-round resident in open oak woodlands & savannas with abundant herbaceous understory vegetation	D
Bird	Painted Bunting	common summer resident throughout the region; nests in tracts with woodlands or savanna characteristics; more common in the southern half	S
Bird	Red-headed Woodpecker	locally common in open oak woodlands with herbaceous understories	D
Inve	American Bumble Bee	uncommon but widespread in open oak woodlands	D
Inve	American Burying Beetle	uncommon but apparently widespread in the eastern half of the region	S
Inve	Byssus Skipper	rare, distribution poorly known	U
Inve	Slope Ambersnail (*Catinella wandae*)	locally-occurring and uncommon; its distribution is poorly documented in Oklahoma	U
Inve	Tulsa Whitelip Snail (*Neohelix liodermа*)	uncommon and locally occurring in the northeastern part of the region	U
Inve	Wyandotte Liptooth Snail (*Millerelix simpsoni*)	uncommon and locally occurring in rocky forests along the eastern edge of the region	U
Mamm	Eastern Spotted Skunk	rare and secretive; distribution poorly known but maybe more common in rocky, forested sites	U
Mamm	Long-tailed Weasel	rare, secretive and occurs in low densities; distribution and habitat needs poorly known	U
Rept	Northern Scarletsnake	uncommon, secretive and appears to occur in low densities	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

1. Data are incomplete for the distributions and ecological needs for several species of greatest conservation need, particularly reptiles, invertebrates and Tier I and Tier II species. This creates an impediment for developing and implementing effective conservation strategies.
2. Baseline knowledge about flora/fauna and both the historic and current distribution and condition of this habitat type are incomplete.

Conservation Actions:

- Assess the current distribution of oak woodlands and forests in the region and model their likely pre-settlement distribution. Assess the structure of oak woodlands and forests to establish a baseline condition for future monitoring.
- Conduct focused inventories to better delineate the geographic ranges and habitat associations of all species of greatest conservation need in the region.

- Compile/collate existing museum data and information from the literature to assess the completeness of our knowledge of the ranges and ecological needs of species of greatest conservation need.
- Research the factors that appear to limit the population sizes of species of greatest conservation need and why some species are rare and/or declining.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversions:

3. Relatively large tracts (> 80 acres) of oak woodland and forest have been cleared and converted to other land uses – primarily introduced pastures planted to tall fescue and Bermuda grass. On sites with level and/or deeper soils, conversion to cropland has occurred but on a smaller scale. Large-scale conversion has dual impact – it results in the direct loss of habitat as well as fragmenting the remaining habitat and isolating tracts of habitat from one another. As the size of habitat tracts decrease, their quality and value to wildlife decreases – in particular to those species whose individuals require a large acreage of land for their home range and those species that have poor dispersal or movement capabilities.
4. Smaller-scale woodland and forest fragmentation occurs through the construction of roads, pipelines, utility lines, drilling pads and rural homes. Cumulatively, these may fragment and isolate tracts of woodland and forest habitat and reduce their quality for species of greatest conservation need.
5. Aerial application of broadleaf herbicides has been used to convert oak woodlands to rangeland for increased cattle production.
6. The construction of rural homes and small hobby ranches have fragmented oak woodlands and forests with many small clearings. These disturbed clearings have facilitated the introduction and spread of exotic and invasive plants.
7. Oil and gas exploration and development results in increased numbers of roads, increased erosion around well sites, increased potential for oil or saltwater spills, and causes other reductions in quantity and quality of this habitat.

Conservation Actions:

- Identify focus areas where conservation practices can be implemented in the most cost-effective manner to enhance or maintain populations of species of greatest conservation need.
- Place biologically important tracts of oak woodlands and forests into conservation ownership or stewardship through conservation easements or fee title where most appropriate and where willing sellers exist in order to maintain these habitats into the future.
- Support research into the ecological effects of habitat fragmentation on species of greatest conservation need.
- Develop and implement local conservation plans that restore pastures and cropland to oak woodlands in order to connect woodland tracts and build larger areas of habitat that can support larger and more complete biological communities.
- Support more outreach to industry and small landowners with management recommendations for reducing the impact of habitat fragmentation through modified site selection for roads, well sites, pipelines and utility lines, and by encouraging the re-establishment of oaks and other deciduous trees to connect forested tracts. Natural succession should be sufficient in most sites, but others may require seeding.
- Utilized rest to allow natural succession to revegetate former pastures and crop fields to Crosstimbers woodlands.
- Encourage the co-location of pipelines, roads and utility lines along the same or adjacent right-of-ways to reduce habitat fragmentation.
- Encourage the placement of drilling pads and infrastructure additions near existing roads and in previously disturbed sites (e.g. crop fields and non-native pastures) to minimize additional habitat loss and fragmentation.

- Develop and provide incentives for landowners and industry to use Best Management Practices for road and well-site construction, right-of-way management and herbicide use.
- Create an incentives program or a cost-share program that will help landowners restore crop fields and pastures back to oak woodland or oak forest habitat.
- Eliminate federal funding assistance for clearing forests and establishing introduced grasses.
- Support research into more effective and less expensive methods for remediating former drilling sites and restoring them to oak woodlands.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

8. Widespread fire suppression has resulted in the loss of the historic (natural) fire regime. Oak woodlands and forests no longer experience burning on a three to five-year interval and this has resulted in many woodland stands becoming denser than they were historically and has increased the abundance of some understory and mid-story woody species such as Eastern Redcedar and Winged Elm.
9. In many woodland and forest tracts there has been a reduction in the density and diversity of native understory (< 5 feet above the ground) due to a combination of factors including denser canopies as a result of fire suppression, continuous grazing by cattle, and the introduction of non-native grasses and forbs.
10. Some owners of oak woodland tracts keep and graze cattle on a small scale in order to qualify for the tax advantages of being a small farm business. These landowners commonly employ continuous grazing practices which differ substantially from the presettlement grazing pattern for the region which was seasonal grazing primarily in the fall and winter. Continuous grazing has subtle effects on habitat structure and species composition by diminishing highly palatable forbs and promoting grasses and forbs that are more characteristic of early successional habitats.

Conservation Actions:

- Establish demonstration areas where landowners can see the results of fire and grazing management practices.
- Monitor the response of wildlife populations to various land management practices such as thinning, deferred grazing, and prescribed late winter or late summer burning.
- Restore woodland community structure on public lands and use these as research and demonstration areas.
- Study the response of cool-season burns on plants and wildlife, especially reptiles, amphibians and invertebrates that may be more active when soil and air moisture are high. Many presettlement fires occurred in late summer and fall when soil and air moisture were low and many of these specie were dormant.
- Work toward restoring historic grazing patterns by assisting in the development of patch-burn grazing systems in which small-scale fire and mineral blocks are used to rotate cattle seasonally over large areas of rangeland such that grazing is light or deferred on some tracts in some seasons or years.
- Disseminate information to landowners about the ecological and economic values of oak woodlands and forests, and best management practices for maintaining these habitats as part of working landscapes.
- Encourage the development of burning cooperatives or contractors including working with rural fire departments, county-based and statewide associations as well as Native American tribes.
- Help write prescribed burn laws that reduce liability and support a landowner's ability to burn.

- Provide financial and technical support (e.g. burn equipment, group insurance) for prescribed burning associations to make the use of fire more affordable to landowners.
- Prepare for and address the air quality issues associated with prescribed burning.
- Disseminate grazing information and Best Management Practices to landowners to reduce overgrazing, maintain diverse native plant communities and control the spread of Eastern Redcedar.

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

11. Invasive species such as sericea lespedeza, tall fescue and Johnson grass are encroaching on native habitats and reducing habitat quality for species of greatest conservation need.
12. The native, but invasive, Eastern Redcedar has increased in abundance dramatically in some areas as a result of fire suppression. This has altered the structure and composition of oak-woodland stands by increasing canopy density and redcedar abundance, while decreasing understory and ground-level vegetation. In sites of extreme redcedar abundance, these trees may displace and outcompete oaks, and increase the risk of stand-altering wildfire.

Conservation Actions:

- Identify areas/watershed/counties where invasive species are the most problematic or where their control could most effectively be achieved in order to prioritize resources.
- Continue to provide cost-share payments for landowners to control invasive species such as Eastern Redcedar.
- Monitor the response of species of greatest conservation need and other wildlife populations to various methods of invasive species control to determine best practices and effectiveness.
- Support the Invasive Species Council's efforts to research the most effective control methods for invasive species and to disseminate information to landowners and public agencies. Conduct management pilot studies to determine successful strategies.
- Advocate for a tax credit program that would encourage landowners to control exotic invasive species and aggressive native species such as Eastern Redcedar.

Potential indicators for monitoring the effectiveness of the conservation actions:

- number of acres protected, acquired, and restored
- number of acres of habitat periodically burned
- amount of wildlife management technical assistance being provided (e.g. number of landowners reached, or number of acres improved)
- number of landowners participating in landowner incentives or assistance programs, and the number or acres that are enhanced through these programs
- population response of species of greatest conservation need and the vegetation (e.g., grasses and woody plants) response to fire
- changes in population sizes and trends for species of greatest conservation need
- relative condition and quantity of oak/hickory woodland and forest habitat

<u>High Priority Conservation Landscape: Tallgrass Prairie</u>

Tallgrass Prairies are herbaceous plant communities dominated by four common, tall grass species: Big Bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), Switchgrass (*Panicum virgatum*), and Little Bluestem (*Schizachyrium scoparium*). This is a widespread habitat in the Crosstimbers Region and is found on a variety of deep, fine textured silt and clay soil types. The structure of this habitat type is maintained by frequently occurring fires that limit the growth of woody plant species and favor grasses and some forbs. All four of the dominant grass species are present in most Tallgrass Prairie sites; however Big Bluestem, Switchgrass and Indiangrass tend to be more prevalent in mesic sites, while Big Bluestem and Little Bluestem are more common on drier sites. In mesic loamy soils such as those found in floodplains and bottomlands, Switchgrass and Big Bluestem are often the dominant grasses. Other widespread or common grasses include Sideoats Grama (*Bouteloua curttipendula*), and Eastern Gamagrass (*Tripsacum dactyloides*). Common forbs include Western Ragweed (*Ambrosia psilostachya*), Rosinweed (*Silphium integrifolium*), Compass Plant (*Silphium laciniatum*), Lead Plant (*Amorpha canescens*), Wild Alfalfa/Scurf Pea (*Psoralidium tenuifolia*), Illinois Bundleflower (*Desmanthus illinoensis*), Blazing Star (*Liatris sp.*), Goldenrod (*Solidago sp.*), Stueve's Lespedeza (*Lespedeza stuvei*), Sessile Tick Clover (*Desmodium sessilifolium*), Indian Paintbrush (*Castilleja coccinea*), and Maximillian Sunflower (*Helianthus maximilliani*).

In the Red River valley, pockets of dark alkaline soils over limestone parent material support a rare and locally-occurring variation of Tallgrass Prairie known as Blackland Prairie. This southern tallgrass prairie community is comprised of Indiangrass, Eastern Gamagrass, Big Bluestem, Tall Dropseed, Longspike Tridens (*Tridens strictus*), Maximillian Sunflower (*Helianthus maximilliani*), Ashy Sunflower (*Helianthus mollis*), and Rattlesnake Master (*Eryngium yuccifolium*). The distribution of Blackland Prairies in Oklahoma is poorly known but appears to be limited to the southern tier of counties along the Red River.

Although tallgrass prairie remains a fairly common and widespread habitat type in the region, much of the habitat has been tilled and converted to introduced pastures of Bermudagrass and other non-native grasses. Further habitat has been converted to cropland for the production of wheat, alfalfa, cotton, or peanuts. The extent of the remaining prairies is unknown but most tracts of native prairie appear to be scattered and relatively small. Where prairie habitat remains, decades of continuous grazing, fire suppression, and encroachment of non-native plants has resulted in changes to the plant community composition and structure. These changes include a greater abundance of Eastern Redcedar and other woody plants, increased abundance of exotic grasses, and decreased abundance of native forbs.

Recognized plant associations within this habitat include:

- Big Bluestem – Switchgrass Grassland
- Big Bluestem – Little Bluestem – Indiangrass Grassland
- Switchgrass – Eastern Gamagrass – Indiangrass – Maximillian Sunflower Grassland
- Little Bluestem – Indiangrass Grassland
- Little Bluestem – Big Bluestem Grassland

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that occupy tallgrass prairies in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status in the Region	Trend in Population Size or Range
Amph	Crawfish Frog	uncommon and locally occurring around breeding pools in the east half of the region	U
Bird	American Golden Plover	common spring/fall migrant that uses burned, grazed and mowed prairie tracts as foraging sites	U
Bird	Barn Owl	rare and locally occurring year-round resident; occurs in the vicinity of buildings that serve as nesting and roosting sites	U
Bird	Bell's Vireo	uncommon summer resident; nests across the region in shrublands at the prairie/woodland interface	D
Bird	Buff-breasted Sandpiper	rare with a small population that migrates through the region and uses burned, mowed and grazed prairies as foraging sites	U
Bird	Greater Prairie Chicken	rare and locally occurring resident in the northern quarter of the region	D
Bird	Harris's Sparrow	common and widespread winter resident; occurs in prairies in association with shrub cover	U
Bird	Henslow's Sparrow	very rare breeding season resident; nests in scattered locations with dense native grass in the northern quarter of the region	S
Bird	LeConte's Sparrow	uncommon and secretive winter resident in sites with tall standing native grass; more common in south half of region	U
Bird	Loggerhead Shrike	uncommon and locally occurring year-round resident across entire region	D
Bird	Northern Bobwhite	locally common year-round resident with scattered populations across the region	D
Bird	Prairie Falcon	very rare winter resident; probably only a few dozen distributed across the region	S
Bird	Short-eared Owl	rare and secretive winter resident in sites with tall standing native grass	U
Bird	Smith's Longspur	uncommon and locally occurring winter resident in grazed and early succession tallgrass sites	U
Bird	Sprague's Pipit	uncommon and secretive spring/fall migrant in grazed sites throughout the region	S
Bird	Swainson's Hawk	rare and locally-occurring breeding resident in the western half of the region	U
Bird	Upland Sandpiper	common spring/fall migrant throughout the region; rare nesting species in the northern third	S
Inve	American Burying Beetle	locally common in the northern and eastern parts of the region	S
Inve	Byssus Skipper	rare; distribution poorly known; dependent upon Gamagrass as the host plant for its larvae	U
Inve	Iowa Skipper	locally common but restricted to larger tracts of native prairie	U
Inve	Prairie Mole Cricket	uncommon and locally-occurring in native prairie tracts in the northern 2/3 of the region	U
Inve	Rattlesnake Master Borer	distribution poorly known, likely to occur in wet prairie sites but not yet documented in the region	U
Inve	Regal Fritillary	rare; found in large prairie tracts in northern quarter of the region	U
Inve	Southern Plains Bumble Bee	uncommon and locally occurring; its distribution is incompletely documented	U
Mamm	Long-tailed Weasel	rare and secretive; may be widespread but occurs in low densities and its habitat needs are poorly known	U
Rept	Texas Horned Lizard	uncommon and locally-occurring in the western half of the region	D

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

1. Data are incomplete regarding the current distribution of tallgrass prairie tracts. Most tallgrass prairie habitat in the region probably occurs as small remnant tracts of varying quality.
2. Data are incomplete regarding the current distributions and ecological needs of most tallgrass prairie-dependent species of greatest conservation need. These data gaps are an impediment to the development and implementation of effective conservation strategies.
3. Baseline knowledge about the presettlement distribution, the physical structure and the biological composition of tallgrass prairie community is incomplete.

Conservation Actions:

- Conduct literature reviews and examine museum data to better determine the historic and current distributions of grassland species of greatest conservation need and determine what information gaps exist.
- Conduct surveys and biological inventories to determine the current distribution/location of tallgrass prairie remnants and the biological communities that they support with an emphasis on species of greatest conservation need.
- Conduct ecological research on species of greatest conservation need to determine the factors that limit their current distribution and abundance.
- Conduct management-based pilot studies to determine successful strategies for restoring and maintaining tallgrass prairie in a condition that will support the largest suite of prairie-dependent species of greatest conservation need.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversions:

4. The majority of historic tallgrass prairie habitat has been converted to other land uses, primarily cropland and introduced pastures of Tall Fescue and Bermudagrass. In many areas, prairie conversion has occurred on the scale of hundreds or thousands of acres. These large-scale conversions had a dual impact; they caused the direct loss of habitat and they isolated the remaining smaller tracts of prairie from one another. As the size of a prairie tract decreases, its quality and value to wildlife decreases. Many prairie-dependent species require large acreages of habitat in order to support sustainable populations because many species occur in low densities and/or have poor dispersal or movement capabilities.
5. Prairies are fragmented by smaller-scale conversions of land for the construction of rural homes, roads, utility lines, wind mills and drilling pads. Cumulatively, these reduce the quality of the habitat and create dispersal/movement barriers for many species of greatest conservation need.
6. Fences, windbreaks and tree planting fragment prairies because they create linear changes in vegetation structure and may serve as pathways for the movement of predators or species that do not commonly inhabit prairies.
7. Urban communities are sprawling into open spaces and agricultural fields and adversely affecting species of greatest conservation need.

Conservation Actions:

- Collaborate with the Natural Resources Conservation Service (NRCS) to find ways to alleviate habitat loss and fragmentation.
- Assess the distribution and quality of tallgrass prairie tracts to determine the most effective potential conservation opportunity areas in which to focus resources.

- Acquire perpetual easements or fee title to biologically important tracts of prairie to enhance or maintain species of greatest conservation need.
- Support private acquisition by land trusts and organizations such as The Nature Conservancy and Land Trust Alliance.
- Increase funding for the Agricultural Conservation Easement Program (includes the former Grassland Reserve Program) and increase the priority given to tallgrass prairies.
- Restore native tallgrass prairie by converting Bermudagrass pastures and tall fescue pastures back to native warm season grasses and forbs. On relatively infertile upland sites, rest, minimal seeding and natural succession can be used restore crop fields and pastures to native prairie species. Incorporate a diversity of forbs into restored prairies to enhance these sites to meet the needs of the pollinator community.
- Remove federal and state cost sharing or funding of projects that cause the loss of or fragmentation of biologically important prairies.
- Reduce oil production impacts using tax or financial incentives and Best Management Practices (BMPs).
- Evaluate the use of impact fees and tax disincentives for practices that cause habitat community fragmentation.
- Eliminate Farm Bill programs that promote the destruction or conversion of native prairie and encourage accountability for Farm Bill conservation practices.
- Develop programs that maintain prairies and community structure so that species of greatest conservation need are protected and restored.
- Create and fund Regional Planning Organizations to address agricultural land, fragmentation, urban sprawl, open space, and watershed protection.
- Cooperate with city and regional planners to conserve prairies in areas where their existence is threatened by urban sprawl.
- Use conservation easements and non-development easements to maintain prairies on both public and private land.
- Use new suburban development techniques (i.e., sustainable development) that minimize impacts such as cluster development and integrated and protected open space. Develop disincentives and safe guards against inappropriate suburban and urban development.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

8. The loss of presettlement fire frequency has altered habitat structure. In some areas of the region, fire suppression has allowed the expansion and proliferation of invasive woody species, primarily Eastern Redcedar, into prairies. In other regions, such as the Flint Hills, fire is used more frequently than the historic two to four-year frequency and this has reduced standing cover in the early spring that is important for nesting birds and other wildlife.
9. Loss of the presettlement grazing pattern that was driven by migrating herds of American Bison has altered the plant community. Bison grazing differs from that of domestic cattle. Bison herds were nomadic and made seasonal movements that were influenced by recent fires (they were often attracted to prairie tracts that had burned in the previous year). Bison also were less selective of forbs and grazed more heavily on grasses such that their impact on plant community composition and structure was different.
10. Broadleaf herbicides are more readily available and used more frequently to control weedy species. There is often co-lateral damage to native perennial forbs that are highly palatable and beneficial to grazers such as cattle. Insect diversity and the populations of specific insect species of greatest conservation need are affected by the decrease in or elimination of native broadleaf forbs.

11. High-intensity rotational grazing programs are often designed to maximize forage utilization at the expense of vegetation heterogeneity. This alters the distribution of nesting cover and thermal refugia for birds, mammals and reptiles.
12. Our knowledge of the impacts of many land management practices on populations of rare, secretive or seasonal species of greatest conservation need in tallgrass prairies is incomplete.

Conservation Actions:

- Provide technical and financial support to prescribed burning association members so that effective and efficient fire management by knowledgeable and trained workers can be accomplished.
- Support the increased use of prescribed burning as a management tool by increasing the amount of prescribed burning education and technical assistance to land owners.
- Encourage limited herbicide use by right-of-way managers.
- Partner with OSU Agricultural Extension and non-governmental organizations such as the Noble Foundation to develop regional demonstration areas/ranches that show and measure the impact of varying grazing and fire regimes on cattle production, plant diversity and populations of key species of greatest conservation need.
- Encourage economic studies that compare the profitability of grazing cattle on introduced pasture grasses versus rangelands that contain a diverse community of native forbs and grasses.
- Provide technical and financial support for ranch diversification. Reduce grazing pressure and off-set stock reductions through better forage production, reduced supplemental feeding, better livestock performance and the reduced need for weed control. Additional income can be derived from compatible uses such as lease hunting and fishing access.
- Research the impact of different fire frequencies and the seasonality of burning on ranching profitability and the population response by key species of concern.
- Support legislation to reduce liability for fire contractors, yet protect the private parties.
- Use patch burning as a tool to rotate cattle around larger pastures rather than building additional fencing to create smaller pastures because additional fences fragment prairie habitat and encourage the growth of tree lines across prairies.
- Work with the NRCS to increase the cost share for tree clipping to encourage redcedar control.

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

13. Invasive species such as Johnson Grass (*Sorghum halepense*) and Sericea Lespedeza (*Lespedeza cuneata*) have become established throughout the region and displace native vegetation that is typically more beneficial to species of greatest conservation need. These invasive species are difficult to control and some control methods (herbicide application) may have detrimental impacts to non-target plants if not carried out with caution.
14. Aggressive native woody species management is required because fire suppression is allowing the establishment, spread and proliferation of Eastern Redcedar that is altering habitat structure and making prairies less suitable for grassland-dependent species of greatest conservation need. Exotic invasive woody plants such as Callery Pear are becoming locally abundant in grasslands near towns and cities.

Conservation Actions:

- Develop management plans to control the abundance and distribution of exotic species and invasive species.
- Develop alternatives to aerial spraying as a control measure for exotic plant species.

- Remove federal subsidies for programs that promote the use of invasive species (e.g., Old World Bluestem, Tall Fescue and Bermudagrass).
- Educate policy makers to have Old World Bluestem classified as a noxious weed.
- Develop a certified hay program that promotes hay that is free from exotic species.
- Continue technical and financial assistance programs for landowners who wish to control exotic and invasive species on their properties.
- Encourage roadside re-vegetation following construction to native species and improve the management of roadsides to allow native grasses and forbs to set seed periodically.
- Research the effectiveness of prescribed fire as a tool for managing exotic and invasive species in tallgrass prairie habitat.
- Encourage rights-of-way managers to manage/control invasive and exotic species.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acres of prairie burned or treated
- changes in acreage/coverage of exotic vegetation
- changes in the acreage of intact or high-quality prairie
- acres of tall grass prairie communities restored
- number of easements secured and acreage conserved
- population sizes and trends for species of greatest conservation need
- relative condition and quantity of tall grass prairie habitat
- vegetation response to prescribed fire or grazing treatments

High Priority Conservation Landscape: Gravel (Hard)-bottom Streams and Associated Riparian Forests

Gravel or hard -bottom streams are uncommon in the Crosstimbers Region and occur locally in and to the east of the Arbuckle Uplift and at the interface between the Crosstimbers Region and the Flint Hills portion of the Tallgrass Prairie Region. The soils in these areas are shallow, rocky and derived from limestone; therefore the streams originating in this landscape have gravel, cobble, or boulder substrates. Many of these streams have well defined riffle and pool sections, well-developed floodplains, high width to depth ratios, and only slightly entrenched channels. Gravel-bottom streams often support diverse riparian forest communities. One unique riparian plant found in several streams originating in the Arbuckle Mountains is the Seaside Alder (*Alnus maritima*) that is found in only three other states along the Atlantic coast.

Recognized riparian plant associations within this habitat type include:

- Sycamore – Boxelder Temporarily Flooded Forest
- American/Red Elm – Sugarberry/Hackberry – Green Ash Temporarily Flooded Forest
- American/Red Elm – Chinquapin Oak Temporarily Flooded Forest
- Seaside Alder – False Indigo Temporarily Flooded Shrubland

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that occupy gravel-bottom streams in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Little Blue Heron	locally common breeding season resident in the vicinity of nesting colonies	D
Bird	Louisiana Waterthrush	occurs in low-densities but is a widespread summer resident; nests in riparian forest habitats	S
Bird	Prothonotary Warbler	uncommon but widespread summer resident; nests in mature riparian forests across the region	U
Fish	Least Darter	uncommon and restricted to the Blue River and its tributaries	U
Fish	Bluntface Shiner	locally common but limited in its distribution; may occur in tributaries of the Caney River	U
Fish	Redspot Chub	locally common but limited to the Blue River and its tributaries	S
Fish	Rocky Shiner	locally common but its distribution is incompletely known; may occur in streams in the Blue and Clear Boggy river watersheds	U
Inve	*Hydroptila protera* (microcaddisfly)	rare and limited to streams in the Arbuckle Uplift; no recent records to confirm its continued presence	U
Inve	Little Dubiraphian Riffle Beetle	rare species with a poorly known distribution; limited to streams in the southern quarter of the region	U
Inve	Little Spectaclecase	uncommon and its distribution in streams is uncertain; may occur in tributaries of the Blue and Clear Boggy rivers	S

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Inve	*Mayatrichia ponta* (microcaddisfly)	uncommon and endemic to streams in the Arbuckle Uplift	U
Inve	*Metrichia nigritta* (spring caddisfly)	uncommon; the Oklahoma range is limited to streams in the Arbuckle Uplift	U
Inve	Oklahoma Clubtail	uncommon and distribution is poorly known; probably limited to the southern half of the region	U
Rept	Alligator Snapping Turtle	occurs at low densities in forested streams in the Clear Boggy River watershed	U
Rept	Eastern River Cooter	locally common and widespread	U
Rept	Mississippi Map Turtle	small numbers occupy streams in the eastern edge of the region	U
Rept	Ouachita Map Turtle	uncommon but widespread in the region	U
Rept	Razor-backed Musk Turtle	secretive and uncommon; known from streams in the Blue & Boggy river watersheds	U
Rept	Western Chicken Turtle	rare; occurs in scattered populations in the Red, Boggy and Canadian river watersheds	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

1. Data are incomplete for species of greatest conservation need (particularly those whose populations are low or unknown and for those whose status and trends of are declining or unknown) thus making it difficult to identify management issues and establish effective corrective strategies.
2. There are limited historic data from which to evaluate the condition of streams and riparian forests prior to large scale human alteration of this habitat.
3. The resources of riparian forests and streams are difficult to monitor because most of the habitat occurs on private land and is distributed in small tracts across many individual landowners.

Conservation Actions:

- Conduct research on species of greatest conservation need to determine what factors limit their population size and distribution.
- Conduct research on species of greatest conservation need to establish baseline population size, density, and distribution and habitat relationships.
- Conduct biological inventories of amphibian, fish, crayfish, and mussel populations in streams to increase the knowledge of biological communities within specific watersheds.
- Conduct literature reviews and focused studies to establish what stream and riparian habitats looked like historically to establish a target condition for stream and riparian restoration efforts. Verify the accuracy of historic data.
- Develop and support relational databases (e.g., Natural Heritage Inventory element occurrence database) to examine wildlife populations and the conditions of their habitats.
- Publish the results of aquatic ecological studies so that these data are available to conservation and water planners. Use survey data to update the Comprehensive Wildlife Conservation Strategy.
- Develop local watershed councils, stream teams, and citizen's groups to address local concerns through education and to monitor water quality and wildlife populations.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality:

4. The presence of confined animal feeding operations such as cattle feedlots, poultry houses, hog farms, and waste application fields close to streams and drainages may be detrimental to species of greatest conservation need.
5. Additional nutrients enter streams as a result of cattle/livestock watering in streams and grazing in riparian areas.
6. Increased nutrient levels in streams increases the abundance of algae which can result in other water quality impacts such as increased fluctuations in dissolved oxygen.
7. Pollutants from pesticides, including endocrine disruptors, enter streams in storm water runoff from agricultural fields, altering the growth, reproduction and/or survival of fish, amphibians, and invertebrates in the streams.

Conservation Actions:

- Reduce nutrient inputs (i.e., point and non-point sources) through Best Management Practices (BMPs), Farm Bill cost-share programs, and landowner incentive programs.
- Provide alternative water sources for livestock to keep them out of streams.
- Increase landowner education efforts regarding the watershed concept, importance of riparian habitat, BMPs for controlling nutrients, and existing Farm Bill conservation programs to control nutrients.
- Develop conservation easements or acquire land to maintain or restore natural riparian vegetation along streams to reduce or limit agricultural development in and adjacent to riparian areas.
- Establish set-back distances and BMPs between streams and confined animal feeding operations, their waste lagoons, and associated land application areas.
- Continue to provide cost-share funding to construct fencing along streams and riparian areas to control/limit their access by cattle.
- Provide cost-share funding or increase promotion of existing programs to restore riparian vegetation along streams.
- Expand cost sharing programs to increase the application of BMPs to control nutrients and pesticides by landowners.
- Reduce the use of herbicides and other pesticides in floodplains and riparian areas.
- Develop local watershed councils, stream teams, and citizen's groups to address local concerns through education and to monitor water quality and wildlife populations.
- Improve the knowledge of and access to Farm Bill incentives and cost-share programs to improve water quality through the implementation of BMPs and establishment of streamside buffer zones.

Conservation Issues Related to Activities that Alter Flow Patterns and Water Quantity:

8. Many streams in the region have been channelized or straightened, causing them to become incised and no longer connected with their riparian vegetation.
9. Streams with incised channels have cut banks that are prone to erosion, which then increase sediment loads in the streams.
10. A disconnection exists between many streams and their riparian vegetation due to the channelization and incising of streams. The incision of streams contributes to a reduction in the width and abundance of riparian vegetation and a reduction in the number and acreage of wetlands within the streams' floodplains.
11. In-stream gravel mining reduces bank stability upstream and downstream of the mining area and increases bank erosion and alters the width to depth ratio of the stream by making it wider and shallower.
12. In-stream gravel mining can remove or reduce riffles, gravel beds, and other stream structures that are important habitat for aquatic wildlife.

13. Water is being pumped from streams and from groundwater in the surrounding shallow aquifers for municipal and agricultural purposes. This potentially lowers the water tables and reduces the flow volume of springs and seeps that feed streams.
14. Increased pond construction may be lowering the inflow that sustains streams.
15. Some types of culverts can become barriers to the movement of fish during low-flow conditions.
16. Dams across streams create fish barriers that can separate upstream and downstream populations of fish and freshwater mussels.
17. Dams and diversion structures alter the natural flow patterns and other processes of streams, especially the frequency and magnitude of natural flooding events.

Conservation Actions:

- Provide cost-share funding or grants to restore stream channels and establish natural vegetation on stream banks for stability (e.g. reconnect streams and riparian vegetation where these have become separated due to channel incision).
- Restore or construct seasonal wetlands/vernal pools within the riparian zones or floodplains of streams.
- Work collaboratively with public managers and Legislature to develop regulations to reduce gravel mining from within streams.
- Work with local communities and counties to reduce stream channel impacts including in-stream gravel mining, placement of rip-rap on stream banks at bridge crossings, and recreational use of streams by off-road vehicles.
- Establish ecologically acceptable minimum in-stream flow standards for all biologically important streams (e.g., those streams that support populations of species of greatest conservation need or diverse aquatic communities).
- Manage water withdrawals to have the least impact on aquatic biota.
- Research alternative methods for managing reservoir discharge that would benefit downstream aquatic systems while still meeting reservoir storage objectives.
- Educate that public about the negative consequences of selling water outside of the state or the transfer of water between basins within Oklahoma. Work to prevent the transfer of water between basins.
- Provide information to water-use planners and permit writers on the ecology of streams and riparian systems, and the importance of their work in protecting species of greatest conservation need and the habitats on which they depend.
- Support the development of a state water management plan with sound biological data that demonstrates the ecological impact of water sales, water withdrawals, and interbasin transfers of water.
- Work collaboratively with landowners to remove ponds and impoundments which are obsolete but have been shown to block the movement of fish species of conservation need.
- Work collaboratively with landowners, county commissioners and state agencies to remove or rehabilitate culverts and road crossings with new structures that do not create barriers for fish passage.
- Work collaboratively with landowners to replace ponds that have been constructed on streams with alternative water sources (e.g., for livestock).
- Work collaboratively with public land managers to modify pond and reservoir management to ensure that minimum in-stream flows are maintained below these structures.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

18. The abundance and diversity of understory vegetation has declined in riparian areas as a result of livestock grazing, especially during the growing season.
19. Riparian forests have been cleared and converted to crop fields or introduced pastures of exotic grasses such as Fescue and Bermuda.

20. Riparian forests have been and continue to be fragmented by roads, houses, pastures, and utility right-of-ways.
21. The clearing of riparian vegetation reduces streambank stability which subsequently increases erosion and alters the width/depth ratios of streams.
22. Streams and riparian habitats are fragile and easily disturbed or modified.
23. The loss of riparian vegetation increases erosion and sedimentation, which can fill the interstitial spaces in riffles and gravel beds that serve as spawning substrates for fish and habitats for freshwater mussels.
24. The clearing of riparian vegetation around the headwaters of streams allows for increased amounts of sediment, nutrients, pesticides, and other pollutants to enter streams.
25. The reduction in stream shading as a result of reduced riparian vegetation, can increase water temperatures and affect the composition of the aquatic community.

Conservation Actions:

- Continue to provide cost-share funding or grants to fence riparian forests to control/limit their access by cattle.
- Purchase easements to protect or enhance existing riparian vegetation or to restore riparian forests.
- Encourage the maintenance of or the planting of trees in uplands to provide an alternative source of shading for livestock to reduce their use of riparian areas.
- Provide landowner incentives or cost-share programs to protect or restore riparian forests, stream banks, and in-stream habitat.
- Acquire conservation easements or fee title from willing sellers to stream and riparian habitats to place them into conservation ownership in order to conserve or enhance existing habitat.
- Acquire conservation easements or fee title from willing sellers for acreage around the headwaters of steams in order to control/limit the introduction of sediment, nutrients, and chemical pollutants.
- Promote BMPs for the grazing of cattle in or adjacent to riparian zones.
- Increase the availability of aquatic resource information in the public schools and at landowner venues to increase appreciation and awareness of the importance of riparian vegetation to aquatic resources and water quality.

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

26. Exotic plant species such as Chinese Privet, Salt Cedar and Japanese Honeysuckle have become established and are becoming more abundant in riparian forests, and are competing with native plants and altering the structure of the habitat that can be used by animals.
27. Feral hogs that forage in streams and along stream banks damage riparian vegetation and reduce bank stability.
28. Some native plants and animals have become more abundant in riparian forests.
    - Eastern Redcedar has increased in abundance due to reduced fire frequency in riparian areas.
    - Brown-headed Cowbirds have become more abundant in riparian areas due to cattle grazing. Brown-headed Cowbirds lay their eggs in the nests of other songbirds, which lowers their reproductive success, population recruitment and population size.

Conservation Actions:

- Develop management plans to control the abundance and distribution of exotic species and invasive species.

- Conduct monitoring and surveillance surveys for invasive species in areas where few recent data exist and in areas where human activity makes them vulnerable to invasive species introduction.
- Conduct studies to quantify the impact of exotic species on riparian forest communities (i.e., plants and animals) or on aquatic animal communities.
- Increase educational efforts and public awareness of the ecological and economic impacts of exotic plant and animal populations.
- Conduct pilot studies to determine successful management strategies for the control or eradication of invasive species.

Potential indicators for monitoring the effectiveness of the conservation actions:

- changes in population sizes and trends of fish and wildlife species with emphasis on species of greatest conservation need
- acres of riparian forest with diverse structure and species composition
- number of local conservation / watershed groups
- degraded and restored miles of stream habitat
- number of acres acquired or proportion of acres protected/acquired within a given watershed
- number of acres under easements or conservation practices
- number of enhanced or restored acres of high-quality riparian habitat or miles of streams
- number of landowners participating in conservation practices
- changes in public opinion toward conservation actions
- stream flow and habitat quality (e.g., measure return of stream flow with range of natural variation)
- water quality parameters and sediment loads

High Priority Conservation Landscape: Limestone Caves and Karst Aquifers

The presence of caves and karst formations in the Crosstimbers Region is limited to the Arbuckle Mountains in portions of Murray, Pontotoc, Johnston and Carter counties. The Arbuckle Mountains are a limestone karst formation with numerous underground aquifers and a few surface caves. Cave locations are poorly known and poorly studied, but have the potential to harbor breeding or hibernating colonies of several bat species. There are no known vertebrate species endemic to the Arbuckle Mountains but at least three cave/groundwater dwelling crustaceans are found only in this area.

The species of greatest conservation need that occupy limestone caves and karst aquifers in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Inve	*Amerigoniscus centralis* (cave isopod)	rare and endemic to the Arbuckle uplift; documented at only one location	U
Inve	*Caecidotea acuticarpa*	groundwater-dwelling isopod that is endemic to the Arbuckle uplift and its aquifer; distribution poorly known but found in most accessible places	U
Inve	*Miktoniscus oklahomensis* (cave isopod)	uncommon and endemic to caves and aquifers in the Arbuckle Uplift	U
Inve	Oklahoma Cave Amphipod	groundwater-dwelling amphipod that is endemic to the Arbuckle uplift and its aquifer; distribution poorly known but found in most accessible places	S

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Habitat:

1. Data are incomplete regarding the distribution and ecology of many cave and aquifer-dwelling species of greatest conservation need, limiting the potential effectiveness of conservation actions.
2. Caves are difficult to locate and the extent of karst formations is difficult to map. As a result, the distribution of biologically important caves, karst formations and subterranean waterways are poorly known.

Conservation Action:

- Conduct a thorough review of existing literature and location records and follow up with biological surveys of caves to improve the knowledge of the distribution and abundance of bats and subterranean invertebrates, and to develop status assessments and establish a baseline condition for future monitoring efforts.
- Evaluate techniques for conducting biological surveys in shallow aquifers and measure the degree of connection between the apparent populations that are found in association with caves and springs.
- Conduct surveys to locate and map biologically important caves and aquifers.

- Develop a database to track the location and biological composition of caves. To protect cave fauna and private landowners from unwanted trespass, information regarding cave locations should be kept confidential and secure.
- Study the ecological needs and population dynamics of species of greatest conservation need such as the Oklahoma Cave Amphipod.

Conservation Issues that Impair Groundwater Quality and Quantity:

3. Groundwater passes through porous limestone in karst systems very quickly and the soil provides very little filtration. As a result, groundwater in karst aquifers are easily polluted by water-soluble pollutants and water quality degradation is a serious problem for aquatic species. Potential pollutants in this region include nutrients from septic systems and livestock/poultry operations, pesticides and endocrine system disruptors that are applied to crops and livestock.
4. There is a risk that water could be withdrawn from the Arbuckle-Simpson Aquifer at a faster rate than it can be recharged. This would affect the depth of the water table, as well as the volume of water that supplies springs and streams.
5. The potential for the sale of water to users outside of the region would increase the risk of groundwater depletion that would affect subterranean and aquatic species.
6. Limestone quarrying may alter cave habitats and the level of water in portions of the aquifer.

Conservation Actions:

- Develop monitoring programs to measure groundwater quality and track populations of aquatic organisms in the aquifers.
- Delineate and map the recharge areas surrounding biologically important caves such as those containing populations of Tier I and Tier II species of greatest conservation need. Evaluate sites that pose potential problems for water quality maintenance (e.g. potential sources of pollutants).
- Develop public education and awareness materials to alert residents in biologically important karst areas about the:
    - sensitivity of groundwater (their drinking water) to pollutants
    - the biological diversity of the cave/aquifer ecosystem, and
    - landowner assistance programs and Best Management Practices that may maintain or improve water quality.
- Place caves and the land surrounding caves into conservation programs (e.g., purchase of conservation easements or fee title acquisition by conservation agencies or non-governmental organizations such as TNC) to protect water quality in the recharge areas.
- Work with local landowners that are interested in the conservation of groundwater to develop a regional partnership that manages the rate of groundwater withdrawal in order to provide flow for surface springs and streams while maintaining the working landscape.
- Establish water quality standards for subterranean streams and associated shallow aquifers.
- Acquire interest in land and minerals surrounding biologically important caves through fee title acquisition, conservation easements or leases to prevent the mining of limestone in those areas.
- Maintain the security of cave locations to protect cave organisms as well as landowners from unwanted visitation.
- Evaluate the impact of limestone quarrying on ground water volume, quality and flow.
- Monitor aquifer parameters (e.g. depth, water quality) and work with the Oklahoma Water Resources Board (OWRB) to establish a groundwater management plan.
- Map the areas within the Arbuckle Uplift and Plain that have known caves and springs or the potential for caves in order to establish conservation priority areas.

Potential indicators for monitoring the effectiveness of the conservation actions:

- number of developments within the recharge area of caves known to be used by species of greatest conservation need.
- groundwater quantity and quality
- population sizes and trends for species of greatest conservation need

High Priority Conservation Landscape: Springs

Springs are rare within the Crosstimbers Region, and the majority of the biologically significant springs occur in the Arbuckle Uplift where the limestone karst geology supports a large groundwater aquifer and several surface springs. This aquifer is the only habitat for the regionally endemic Oklahoma Cave Amphipod (*Allocragonyx pellucidus*).

The species of greatest conservation need that occupy springs and seeps in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Louisiana Waterthrush	occurs in low densities throughout the region	S
Fish	Least Darter	rare and limited in this region to the Blue River watershed	U
Fish	Orangebelly Darter	common but restricted to the Red River watershed in the southern quarter of the region	S
Fish	Redspot Chub	uncommon and restricted to the Blue River watershed in this region	S
Inve	*Caecidotea acuticarpa*	endemic to the aquifer in the Arbuckle Mountains; abundance unknown	U
Inve	*Metrichia nigritta* (caddisfly)	uncommon; its Oklahoma range is limited to the Arbuckle Uplift	
Inve	Oklahoma Cave Amphipod	endemic to the shallow aquifer within the Arbuckle Mountains, abundance unknown	S
Inve	Oklahoma Clubtail	uncommon and locally occurring; distribution poorly known	S

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Habitat:

1. Distribution and ecological data are incomplete for species of greatest conservation need, particularly invertebrates, making it difficult to identify conservation focus areas and establish effective conservation strategies.
2. The knowledge of spring locations and their biological compositions is incompletely known. Springs and seeps are small and are found primarily on private property, thus making them difficult to locate and monitor.
3. Population monitoring data are lacking for most spring-dependent species.

Conservation Actions:

- Research existing literature and museum records to determine what distribution data exist for species of greatest conservation need and for the possible locations of springs. Use historic data and site descriptions to assess the likely historic condition of springs, and create a confidential database to track the location, land ownership and biological data for springs.
- Survey local residents and use aerial photography to locate potential springs.

- Conduct ecological studies on Tier I and Tier II species of greatest conservation need to identify factors that limit population sizes.
- Create local citizen teams to monitor springs (e.g., biota, habitat, flow, and water quality).

Conservation Issues Related to Activities that Alter Flow Patterns and Water Quantity:

4. The potential for excessive groundwater withdrawal (water withdrawal at a rate that is greater than the recharge rate) could lead to the lowering of the water table around springs and thus reduce their flow.

Conservation Actions:

- Place land surrounding springs into conservation easements or leases to preclude activities that might require groundwater withdrawal to protect the immediate recharge area around springs.
- Encourage programs to conserve groundwater.
- Discourage the selling of groundwater to users outside of the region.
- Develop monitoring programs for populations of species of greatest conservation need, water quality, and water quantity to assess the effectiveness of groundwater conservation programs. Where feasible, involve the landowners by providing them with the equipment and supplies to conduct monitoring activities or encourage the development of local citizen volunteer groups to conduct monitoring.
- Provide the results of water quality and quantity monitoring programs to the appropriate regulatory or landowner assistance agencies (e.g., Oklahoma Water Resources Board, Oklahoma Department of Environmental Quality, Oklahoma Corporation Commission, local Conservation District, and Natural Resources Conservation Service).
- Manage water withdrawals to have the least impact (e.g., in-stream flow protection).

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality:

5. Polluted groundwater surfaces at springs and can affect aquatic life in springs and streams. In areas of karst geology, rain water quickly enters the groundwater with very little filtration by the soil, allowing rainwater to easily carry pesticides, fertilizers, animal waste, and water-soluble chemicals into the groundwater.
6. Some landowners are unaware of how easily groundwater can be polluted by surface activity in the Springfield Plateau and other sites with karst geology.
7. Increases of nutrients in the groundwater can create problems with excessive algae where the water surfaces at springs and headwater streams.
8. Water quality within springs can be affected by cattle watering in and grazing around springs, and feral hogs watering and wallowing in springs and seeps by increasing siltation of springs and adding nutrients to the water.

Conservation Actions:

- Delineate recharge areas of springs to protect water quality.
- Identify springs and seeps that support populations of species of greatest conservation need and assess their current water quality/quantity and evaluate sources of existing or potential future water quality/quantity degradation.
- Conduct hydrological studies to delineate the recharge area surrounding biologically important springs to determine the surface acreage that needs the attention of conservation programs.
- Develop, publish, and distribute information about Best Management Practices (BMPs) and conservation recommendations for landowners to implement in order to protect groundwater quality/quantity around springs.
- After evaluating the importance of individual springs to the conservation of species of greatest conservation need, acquire fee title or conservation easements from

willing sellers to the land surrounding the most important springs to protect their recharge areas and watersheds.
- Encourage the use of landowner incentive programs to protect and restore springs, water quality, and riparian habitat.
- Educate landowners about how easily groundwater can be polluted by surface activities and septic systems.
- Provide funding to construct fencing to keep livestock and feral hogs out of springs, and support feral hog control efforts.

Conservation Issues Related to the Modification of Springs and Surrounding Vegetation:

9. Some springs have been physically modified by the installation of pipes or the construction of low concrete dams to create pools for recreation uses or to water livestock.
10. Livestock in springs is detrimental to the sustainability and protection of species of greatest conservation need.
11. Riparian and aquatic vegetation has been mechanically cleared around some springs, and grazed/browsed by livestock around others increasing their susceptibility to siltation and changes in water temperature.
12. Loss of shade over springs should have little effect on water temperatures. Springs are too close to the groundwater source to be affected. Spring brooks, on the other hand, may be affected especially as distance from the spring increases.
13. Man-made ponds and lakes have been constructed over springs and seeps, thereby inundating them with deep water and altering their normal habitat structure.
14. Flooding of springs by reservoirs may alter water chemistry, change hydrology, or introduce species- including microbes.
15. Springs are a fragile habitat and are easily disturbed or modified by human activity and exotic plant invasion (e.g. Yellow Flag Iris).

Conservation Actions:

- Identify those springs and seeps that support species of greatest conservation need and are sites of high conservation priority.
- Develop a program to provide landowners with financial incentives to protect springs, or place springs under conservation programs through the purchase of conservation easements on springs or acquisition of springs from willing sellers.
- Provide cost-share funding or grants to landowners to restore the structure of springs and the riparian vegetation around them. These actions can include removal of pipes, concrete, and low dams or fencing of springs to limit livestock access.
- Develop a monitoring program to measure the effectiveness of efforts to protect or restore springs and seeps on populations of species of greatest conservation need.
- Develop and distribute educational materials to landowners including BMPs for use around springs, the biological diversity of springs, and the interconnection of springs, groundwater, and surface streams.
- Evaluate the existing conservation assistance programs for landowners (e.g., Farm Bill programs) to determine the applicability of these to the protection of springs and the quality of groundwater around springs.
- Construct fences around springs and provide alternative water sources for livestock in order to keep livestock and feral hogs out of springs.

Potential indicators for monitoring the effectiveness of the conservation actions:

- number of easements obtained that protect springs
- number of springs for which the recharge area has been delineated
- number of protected springs/streams
- populations of spring/stream organisms
- changes in spring flow rates and water quality
- water quality improvements

Moderate Priority Conservation Landscape: Herbaceous Wetlands

Herbaceous wetlands are rare and their distribution and biological characteristics are poorly known within the Crosstimbers Region. Herbaceous wetlands in this region are often small seasonally flooded, depressions between dunes or in relatively level floodplains of rivers. The conditions that lead to the development of herbaceous wetlands are poorly understood. Herbaceous wetlands are maintained by the interplay of fluctuating water levels and fire which limit the encroachment of wood vegetation into seasonally flooded areas. Other herbaceous wetlands are found in association with streams where beaver activity impounds small reaches and creates permanently flooded marshes that support emergent vegetation.

Recognized herbaceous wetland plant associations within this habitat include:

- Ravenfoot Sedge Seasonally Flooded Marsh
- Common Rush Seasonally Flooded Marsh
- Common Reed Semi-permanently Flooded Marsh
- Softstem Bulrush – Common Spike Rush Semi-permanently Flooded Marsh
- Narrowleaf Cattail – Southern Cattail Semi-permanently Flooded Marsh
- Broadleaf Cattail Semi-permanently Flooded Marsh
- Broadleaf Cattail – Powdery Thalia Semi-permanently Flooded Marsh
- Broadleaf Arrowhead – Longbar Arrowhead Semi-permanently Flooded Marsh
- Prairie Cordgrass Temporarily Flooded Marsh

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that occupy herbaceous wetlands in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Crawfish Frog	uncommon and locally occurring species in the extreme eastern portion of the region	U
Bird	American Golden Plover	common spring/fall migrant across the region	U
Bird	American Woodcock	uncommon winter resident and common spring/fall migrant; a small population breeds across the region in the early spring	U
Bird	Black Rail	very rare spring/fall migrant through the region	U
Bird	Buff-breasted Sandpiper	uncommon spring/fall migrant throughout the region	U
Bird	Canvasback	uncommon winter resident through the region	D
Bird	Hudsonian Godwit	uncommon spring/fall migrant throughout the region	U
Bird	Interior Least Tern	rare spring/fall migrant; small population breeds on large rivers in the region	S
Bird	King Rail	rare and locally occurring; found in only a few wetland complexes near rivers	U
Bird	LeConte's Sparrow	uncommon migrant throughout and uncommon winter resident in southern half of the region	U
Bird	Lesser Scaup	uncommon winter resident, mainly seen on large wetlands	D
Bird	Little Blue Heron	locally common breeding species in the vicinity of nesting colonies	D

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Long-billed Curlew	rare spring/fall migrant; this region lies on the eastern edge of its range	U
Bird	Nelson's Sharp-tailed Sparrow	very rare spring/fall migrant through the region	U
Bird	Northern Pintail	uncommon winter resident throughout the region	D
Bird	Peregrine Falcon	rare spring/fall migrant throughout region	I
Bird	Piping Plover	very rare spring/fall migrant; primarily found near large rivers	U
Bird	Solitary Sandpiper	uncommon but widespread spring/fall migrant	U
Bird	Trumpeter Swan	rare winter resident throughout the region	I
Bird	Upland Sandpiper	common spring/fall migrant through the region	S
Bird	Western Sandpiper	rare spring/fall migrant; primarily in wetlands near large rivers	U
Bird	Whooping Crane	very rare spring/fall migrant; at the eastern edge of migration corridor	I
Bird	Wilson's Phalarope	common spring/fall migrant throughout the region	U
Bird	Yellow Rail	rare spring/fall migrant through the region; only documented a few times	U
Inve	Oklahoma Clubtail	uncommon and locally-occurring dragonfly	S
Mamm	Marsh Rice Rat	uncommon and locally occurring in the southern quarter of the region	S
Mamm	Swamp Rabbit	uncommon and locally-occurring in the eastern half of the region	U
Rept	Midland Smooth Softshell	locally common throughout the region	U
Rept	Spiny Softshell Turtle	locally common throughout the region	U
Rept	Texas Gartersnake	rare; distribution is poorly known; taxonomic uncertainties exist	U
Rept	Western Chicken Turtle	rare and locally occurring in the southern third of the region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Habitat:

1. Incomplete information exists regarding wetland locations and the distributions of some wetland-dependent species of conservation need amphibians, invertebrates and marsh birds. The small size and seasonal nature of herbaceous wetlands makes them difficult to locate and conserve within larger habitat types such as prairies and woodlands.
2. The responses of wetland-dependent species to wetland management practices and wetland restoration or enhancement techniques is incompletely understood.

Conservation Actions:

- Use the National Wetland Inventory data to provide baseline information for the distribution and acreage of wetlands and potential wetland sites. Where needed to fill gaps and confirm wetland presence, conduct wetland surveys using remote imaging and extensive ground verification.
- Develop a database of wetland locations and their conditions. Could be done in partnership with the Oklahoma Conservation Commission, Ducks Unlimited or the Oaks and Prairies Joint Venture.
- Conduct biological inventories of wetlands to determine their plant community compositions and the distribution and abundances of wetland-dependent wildlife species of conservation need.

- Conduct studies to determine the ecological needs of wetland wildlife species (e.g., types of plant communities and the timing and duration of flooding needed for each wildlife species) to aid in making effective management recommendations.
- Produce educational information for landowners and conservation agency staff regarding the ecology of herbaceous wetlands by region and wetland type.
- Develop descriptions of what quality wetland habitats look like. These can serve as the target condition for wetland restoration and enhancement efforts.
- Conduct management pilot studies to determine successful management strategies incorporating Department of Agriculture and Natural Resources Conservation Service wetland information/data for Oklahoma.
- Develop a monitoring program for wetlands that measures their distribution, structural condition and hydrologic condition. Develop a companion monitoring program for the distribution and abundance of rare wetland-dependent species.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality:

3. Many wetlands lack buffer vegetation around them to control the movement of sediment, pesticides, and nutrients into the wetlands through storm water runoff from pastures, crop fields, and residential areas.
4. Animal wastes from feedlots, dairies, hog farms, and chicken houses contain excessive nutrients and often contain hormones and pesticides. Land application of animal waste on fields adjacent to or near wetlands can result in nutrients and chemicals being carried in storm water runoff and deposited into wetland basins and closed depressions through storm water runoff.
5. Endocrine disrupters from animal hormones, pesticides, and agricultural chemicals that enter wetlands in storm water runoff may negatively affect the growth, reproduction, and survival of amphibians, fish, and invertebrates.
6. Increased nutrient inputs due to crop/pasture fertilizers and land application of animal waste result in increased algae and bacterial concentrations in wetlands.
7. Grazing of wetlands by cattle increases nutrient inputs and alters the structure and diversity of wetland vegetation.

Conservation Actions:

- Increase the knowledge of and utilization of Farm Bill conservation programs that improve water quality and protect wetlands through the planting of vegetated buffer strips and the development of conservation easements.
- Develop new or update existing Best Management Practices (BMPs) for controlling nutrients, chemicals and sediment around wetlands.
- Expand the cost-share and incentives programs for private landowners to aide in the implementation of conservation practices, such as vegetated buffers and fencing, which protect wetlands and the watershed surrounding them.
- Provide cost-share funding to landowners to construct fencing around wetlands to control access by cattle.
- Restore/plant native vegetation around wetlands to serve as a filter for storm water runoff to aid in the removal of sediment and nutrients in storm water runoff.
- Develop certification programs to recognize conservationists and land stewards of wetlands. Work with agriculture and ranching producer groups to incorporate wetland conservation and stewardship into their recognition and certification programs.
- Support the use of prescribed burning in and around herbaceous wetlands during dry periods to inhibit the establishment of woody plants.

Conservation Issues Related to Activities that Alter Flow Patterns and Water Quantity:

8. Wetlands are drained or filled in order to convert these lands to residential, agricultural, or industrial uses.

9. Water may be pumped from wetlands, or from the shallow water table around them, for irrigation. This reduces the frequency or the amount of time that wetlands hold water or maintain saturated soil, which can alter vegetation structure and the suitability of wetlands for wildlife. Less frequent or shorter flooding durations can reduce amphibian and invertebrate populations.
10. Some wetlands are dredged or deepened to create ponds to hold irrigation water, to store water for cattle or to create ponds for recreational fishing. This results in a loss of the shallow water habitats and emergent vegetation that are needed by migratory birds or may result in the introduction of predatory fish that can negatively affect amphibian and some invertebrate populations.

Conservation Actions:

- Continue proving cost-share funding or grants to restore wetlands that have been altered, or to enhance and maintain existing wetlands with value to species of conservation need.
- Provide information to landowners and the public regarding the ecological values of wetlands, especially seasonal wetlands.
- Improve the technology of irrigation to conserve water and reduce groundwater withdrawals.
- Produce education and outreach materials about swamp buster laws and practices.
- Increase the knowledge of and utilization of cost-share programs to restore, enhance or conserve wetlands (e.g., Agricultural Conservation Easement Program and Partners for Fish and Wildlife).
- Use land acquisition and conservation easement programs to place some herbaceous wetlands under conservation ownership or stewardship.
- Acquire former wetlands and restore them through a combination of dredging, diking, and re-vegetation.
- Improve landowner use of wetland conservation cost-share programs by improving cost-share ratios, providing economic incentives, or increasing the total amount of funding available.
- Develop incentives such as tax breaks for landowners that maintain wetlands.
- Enhance the economic value of wetlands to wetland owners by connecting them with entities that are seeking to purchase wetland mitigation credits.
- Develop a Conservation Reserve Enhancement Program initiative focused on flood plain wetlands.
- Support the efforts of the waterfowl joint ventures, wildlife agencies and the Natural Resources Conservation Service to develop comprehensive wetland and waterbird conservation plans.
- Conduct management pilot studies to determine the habitat management strategies that are most successful in enhancing and maintaining populations of species of conservation need.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

11. Invasive and exotic plant species such as Giant Cane (Arundo donax) become established in wetlands and compete with native vegetation.
12. Exotic plant species can dominate wetlands and reduce overall plant diversity and structural diversity. This reduces the wetlands' value as wildlife habitat.

Conservation Actions:

- Develop management plans to control exotic plants and reduce their abundances and distributions. Develop invasive species management plants for all public lands that support wetlands.
- Conduct monitoring and surveillance surveys for invasive species in areas where few recent data exist.

- Remove exotic wetland plants and restore native plant communities.
- Monitor response of wildlife populations and habitat to various management practices.

Conservation Issues Related to Land Management Practices that Result in Habitat Loss and the Reduction of Habitat Quality:

13. Woody plants such as willows and salt cedar are encroaching upon and dominating herbaceous wetlands because of fire suppression.
14. Heavy grazing of wetlands by cattle removes plant cover for wildlife, reduces the abundance of some wetland plants, and can lower overall plant diversity.
15. Seasonal wetlands are plowed and cropped, reducing perennial vegetation and altering plant community composition and structure.

Conservation Actions:

- Use fire or mechanical cutting to remove woody vegetation that has encroached upon herbaceous wetlands.
- Provide cost-share funding or grants to construct fencing around wetlands to control access to this habitat by cattle.
- Use land acquisition, perpetual easement programs, or non-development easement programs to place wetlands into conservation ownership or stewardship.
- Acquire fee title to wetlands from willing seller or purchase conservation easements on wetlands. Develop management plans to restore or enhance wetlands that have been grazed or cropped.
- Provide cost-share funding for the maintenance and enhancement of wetlands.
- Improve the economic incentive to retain wetlands within agricultural areas.
- Improve the incentives for the Wetland Reserve Program to encourage more enrollments.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acreage and distribution of wetlands
- acres of restored wetlands from former agricultural land
- acres of wetland habitat enrolled in conservation easement programs
- changes in water quality parameters in wetlands (e.g. nutrients and sediment)
- changes in wetland acreage; this can be monitored using geographic information systems (GIS) analysis of the National Wetland Inventory (NWI) data base
- changes in the population sizes and trends of wetland dependent species of greatest conservation need
- acres of vegetated wetland buffers created and maintained
- groundwater level around biologically important wetlands

<u>Moderate Priority Conservation Landscape: Post Oak and Blackjack Oak Shrubland on Sandstone and Limestone Hills and Canyons</u>

Post Oak and Blackjack Oak Shrublands occur locally throughout the Crosstimbers Region in areas where the soil is thin, rocky and underlain by either sandstone (in most of the region) or limestone (in the Arbuckle Uplift). Oak shrubland communities are a mosaic of oak thickets and tallgrass or mixed-grass prairies dominated by Little Bluestem (*Schizachyrium scoparium*), Indiangrass (*Sorghastrum nutans*), and Big Bluestem (*Andropogon gerardii*), whose structure is maintained by periodic fires and drought conditions. Post Oak (*Quercus stellata*) is the dominant woody species, but Blackjack Oak (*Quercus marilandica*), Chittamwood (*Bumelia lanuginosa*), Eastern Redbud (*Cercis canadensis*), Roughleaf Dogwood (*Cornus drummondii*), Mexican Plum (*Prunus mexicana*), and Winged Sumac (*Rhus copallina*) are also common. Historically, these shrublands supported nesting populations of the endangered Black-capped Vireo, but fire suppression has altered the structure of many patches of oak shrubland habitat and allowed for an increase in the abundance and dominance of junipers such as Eastern Redcedar (*Juniper virginiana*) and Ashe Juniper (*Juniper ashei*).

Recognized plant associations within this habitat include:

Post Oak – Eastern Redcedar Woodland

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that occupy oak shrublands in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Bell's Vireo	locally common breeding-season resident in transition areas with an abundance of sand plum thickets	D
Bird	Black-capped Vireo	historically occurred as an uncommon breeding species; but is probably extirpated from the region	D
Bird	Northern Bobwhite	locally common, year-round resident	D
Bird	Painted Bunting	common breeding species throughout the region	S
Inve	Dotted Skipper	uncommon and locally occurring; distribution poorly known	U
Inve	Southern Plains Bumble Bee	uncommon and locally occurring; its distribution is incomplete documented in Oklahoma	U
Mamm	Ringtail	rare and locally-occurring; occurs at low density in the Arbuckle Uplift	U
Rept	Texas Horned Lizard	uncommon and locally-occurring in only a few scattered populations; distribution in this region is poorly known.	D
Rept	Western Diamond-backed Rattlesnake	locally common; found primarily in the Arbuckle Uplift	U
Rept	Western Massasauga	uncommon and locally-occurring in the northern quarter of the region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Habitat:

1. Data are incomplete for species of greatest conservation need making it difficult to identify conservation priority areas and to develop effective conservation strategies.
2. Historic data are scarce regarding the plant and animal associations in this habitat type and the presettlement fire patterns and geologic conditions that maintained this habitat.

Conservation Actions:

- Examine existing literature, museum records and historic reports to determine the likely historic extent of oak shrublands in the region and the distributions of the species that occur within them. Evaluate the potential factors that limit the populations of species of greatest conservation need in this habitat, especially those that appear to be rare or have a declining population trend.
- Conduct field surveys to determine the current extent of oak shrublands and the Tier I and Tier II species of greatest conservation need that are associated with these. Use these data to inform regional conservation planning and to identify the geographic areas where conservation efforts should be directed to provide the greatest benefit for these species.
- Research the historic condition of this habitat in order to develop a realistic and biologically meaningful description for how high quality habitat should look. This should serve as the range of target conditions for habitat restoration and enhancement efforts.
- Develop population and habitat monitoring programs for representative species of greatest conservation need.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

3. Mechanical clearing and herbicide treatment of oaks and deciduous shrubs has been used to convert shrublands to grass-dominated rangelands and introduced pastures.
4. The construction of roads, rural homes, oil & gas development and wind energy development has fragmented the remaining oak shrubland habitat.
5. Long-term heavy grazing potentially increases the risk of erosion. Some oak shrublands occur on thin, sloping soils that are prone to water and wind erosion. Erosion can cause permanent or long-term loss of habitat and the creation of "badlands" through the removal of essential topsoil.

Conservation Actions:

- Identify focus areas that have the greatest potential for the restoration or maintenance of oak shrubland communities in order to get the greatest benefit for the cost.
- Provide grants or cost-share payments to private landowners to encourage habitat restoration.
- Conserve biologically important tracts of oak shrubland through the acquisition of fee title or conservation easements from willing sellers.
- Successful restoration of oak shrublands on highly eroded sites may take decades and involve the establishment of herbaceous cover first that is then followed by the planting of oaks and shrubs.
- Restore oak shrubland habitat on suitable sites on public lands.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

6. Eastern Redcedar has encroached and become more abundant within the remaining tracts of oak shrubland due to a combination of long-term fire suppression.
7. Inappropriately heavy grazing may facilitate the spread of exotic grasses (e.g. brome) and weedy winter annual forbs.
8. Fire suppression has allowed for a dramatic increase in Eastern Redcedar and a moderate increase in oak height and density. This unnaturally high amount of woody vegetation growing on thin, dry soils makes the trees more susceptible to disease and drought stress. Dead and stressed trees may create an opportunity for wildfire that can dramatically alter habitat structure.

Conservation Actions:

- Study the response of vegetation and key species to different frequencies of fire to determine the most effective fire management strategies to restore or maintain oak shrublands.
- Establish demonstration areas to show the results of successful management strategies for controlling invasive species to interested landowners and managers.
- Implement land management practices such as cedar removal, thinning, deferred grazing, and prescribed winter burning to maintain appropriate habitat conditions.
- Develop technical assistance publications regarding grazing practices, prescribed fire, and invasive species management that help landowners maintain or enhance oak shrubland habitat.

Potential indicators for monitoring the effectiveness of the conservation actions:

- population sizes and trends for species of greatest conservation need
- application of prescribed fire on the landscape (e.g., number of acres burned)
- number of acres acquired for conservation and the number of acres of oak shrubland habitat restored
- number of landowners participating in conservation programs
- population responses of species of greatest conservation need to management prescriptions

Moderate Priority Conservation Landscape: Sandy (Soft)-bottom Streams and Associated Riparian Forest

The majority of streams in the Crosstimbers Region have predominantly sandy or silty substrates, although these same streams may have relatively small sections with gravel or rock substrates in the vicinity of runs and riffles. Narrow forests of often fast-growing trees grow along the banks of most streams and these forests are comprised of a diverse tree community including American Elm (*Ulmus americana*), Sugarberry (*Celtis laevigata*), Green Ash (*Fraxinus pennsylvanica*), Eastern Cottonwood (*Populus deltoides*), Black Willow (*Salix nigra*), Sycamore (*Platanus occidentalis*), and Boxelder (*Acer negundo*). Historically, larger streams in the eastern part of the region supported extensive shrublands of Giant Cane (*Arundinaria gigantea*), but these have been greatly reduced due to habitat conversion and continuous grazing practices.

More work is needed to examine the historic condition of streams in the region but at one time many streams appear to have had shallow, meandering channels that moved through small, forested floodplains. These streams were only slightly entrenched, had moderate to high degrees of sinuosity and relatively low width to depth ratios. Currently, many streams in the region are in poor structural condition because they have been altered by human activity such as the removal of riparian vegetation and the straightening of the channels to remove stream meanders. These efforts to reduce the amount of acreage occupied by streams and flooded during rainfall events have resulted in many streams cutting deep incised channels that separate the stream from its former riparian zone. In some cases, these streams have been eroded down to the level of bed rock and their current bottom substrate no longer resembles their historic condition.

This habitat section is focused on stream channels and their immediate riparian zones (generally speaking the area that is, or historically was, adjacent to the stream and flooded regularly during normal rainfall events). Bottomland forests and herbaceous wetlands, which are often associated with streams, are addressed in other sections of this chapter.

Recognized terrestrial plant associations within this habitat include:

- Silver Maple – Boxelder Temporarily Flooded Forest
- River Birch – Sycamore Temporarily Flooded Forest
- Sycamore – Boxelder Temporarily Flooded Forest
- Eastern Cottonwood – Black Willow Temporarily Flooded Forest
- Eastern Cottonwood – American Elm – Sugarberry Temporarily Flooded Forest
- American/Red Elm – Sugarberry/Hackberry – Green Ash Temporarily Flooded Forest
- American/Red Elm – Chinquapin Oak Temporarily Flooded Forest
- Green Ash – American Elm Temporarily Flooded Forest
- Green Ash – Cedar Elm – Sugarberry Temporarily Flooded Forest
- Eastern Cottonwood – Black Willow Temporarily Flooded Forest
- Green Hawthorn – Cockspur Hawthorn – Downy Hawthorn Temporarily Flooded Shrubland
- Sandbar Willow/Switchgrass Temporarily Flooded Shrubland
- Buttonbush Semi-permanently Flooded Shrubland
- Giant Cane Temporarily Flooded Shrubland

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that occupy soft-bottom streams and riparian habitats in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Western Lesser Siren	uncommon; distribution poorly known but may occur in tributaries to the Red and Boggy rivers	U
Bird	American Woodcock	uncommon migrant and winter resident; small numbers of birds nest in the region in early spring	S
Bird	Bell's Vireo	uncommon summer resident; nests locally in riparian thickets of willows and plums	D
Bird	Canvasback	uncommon winter resident in wide sections of streams with submerged vegetation	D
Bird	Little Blue Heron	summer resident that occurs in the vicinity of scattered nesting colonies and forages in streams	D
Bird	Louisiana Waterthrush	summer resident that nests in low densities along stream channels throughout the region	S
Bird	Northern Pintail	uncommon winter resident throughout the region	D
Bird	Prothonotary Warbler	summer resident that breeds in riparian wetlands throughout the region	U
Bird	Red-headed Woodpecker	locally-occurring year-round resident that is found in areas with standing dead trees	D
Bird	Snowy Egret	locally common breeding-season resident in the vicinity of nesting colonies	U
Bird	Solitary Sandpiper	uncommon but widespread spring/fall migrant	U
Fish	Blackspot Shiner	rare, may occur in tributaries of to the Red and Boggy rivers	U
Fish	Pallid Shiner (Chub)	rare species with poorly delineated distribution; may occur in larger stream tributaries to the Red River	U
Fish	Plains Minnow	locally common in larger streams	D
Fish	Western Sand Darter	uncommon and restricted to sandy tributaries of the Red River	U
Inve	American Bumble Bee	Uncommon but widespread in the region	D
Inve	*Orconectes difficilis*	uncommon and limited to tributaries to the Red and Boggy rivers in the south part of the region	U
Mamm	Eastern Harvest Mouse	very rare, know from only a few sites near riparian areas in the eastern edge of the region	U
Mamm	Marsh Rice Rat	uncommon and occurs in scattered populations in the southern quarter of the region	S
Mamm	Meadow Jumping Mouse	very rare, know only from a few historic records in the Tulsa area	U
Mamm	Swamp Rabbit	locally common in scattered populations in bottomland forests across the region	U
Rept	Alligator Snapping Turtle	occurs in low densities within forested stream tributaries to the Deep Fork and Boggy rivers	U
Rept	Eastern River Cooter	locally common in larger streams in the eastern half of the region	U
Rept	Midland Smooth Softshell	locally common throughout the region	U
Rept	Mississippi Map Turtle	small numbers occupy streams along the eastern edge of the region	U
Rept	Ouachita Map Turtle	uncommon but widespread across the region	U
Rept	Razor-backed Musk Turtle	secretive and uncommon; known from a few scattered streams in the southern quarter of the region	U
Rept	Spiny Softshell Turtle	common and widespread across the region	U
Rept	Western Chicken Turtle	rare; occurs in scattered populations in the Red, Boggy and Canadian river watersheds	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Habitat:

1. Data are incomplete for some Tier I and Tier II species of fish, invertebrates, amphibians, reptiles and small mammals, thus making it difficult to identify effective conservation opportunity areas and establish effective corrective strategies.
2. There is limited historic data from which to evaluate the condition of streams and riparian forests prior to large scale human alteration of this habitat.
3. The resources of riparian forests and streams are difficult to monitor because most of the habitat occurs on private land and is distributed in small tracts across many individual landowners.

Conservation Actions:

- Conduct research on species of greatest conservation need to determine what factors limit their population size and distribution.
- Conduct research on species of greatest conservation need to establish baseline population size, density, distribution, and habitat relationships.
- Conduct biological inventories of amphibian, fish, crayfish, and mussel populations in streams to increase the knowledge of biological communities within specific watersheds.
- Conduct literature reviews and focused studies to establish what stream and riparian habitats looked like historically to establish a target condition for stream and riparian restoration efforts.
- Develop relational databases (e.g., in partnership with the Oklahoma Natural Heritage Inventory) to monitor wildlife populations and the conditions of their habitats.
- Develop local watershed councils, stream teams, and citizen's groups to address local concerns through education and to monitor water quality and wildlife populations.
- Conduct management pilot studies to determine successful management strategies for enhancing or maintaining riparian and in-stream habitats.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality:

4. The presence of concentrated animal feeding operations (e.g., cattle feedlots, poultry houses, hog farms, and waste application fields) may contribute nutrients to the water through storm water runoff into streams and drainages.
5. Additional nutrients enter streams as a result of cattle and livestock watering in streams and grazing in riparian areas.
6. Increased nutrient levels in streams increases the abundance of algae, resulting in other water quality impacts such as increased fluctuations in dissolved oxygen.
7. Pollutants, including endocrine disruptors, enter streams in storm water runoff from agricultural fields altering the growth, reproduction and/or survival of fish, amphibians, and invertebrates in the streams.

Conservation Actions:

- Reduce nutrient inputs (i.e., point and non-point sources) through Best Management Practices (BMPs), Farm Bill cost-share programs, and landowner incentives programs.
- Provide alternative water sources for livestock to keep them out of streams.
- Increase landowner education efforts regarding watershed concepts, importance of riparian habitat, BMPs for controlling nutrients, and existing Farm Bill conservation programs to control nutrients.

- Develop conservation easements or acquire land to maintain or restore natural riparian vegetation along streams to reduce or limit agricultural development in and adjacent to riparian areas.
- Establish set-back distances between streams and confined animal feeding operations, waste lagoons, and land application areas.
- Provide cost-share funding to construct fencing along streams and riparian areas to control/limit access by cattle.
- Provide cost-share funding or increase the application of existing programs to restore riparian vegetation along streams.
- Develop financial incentives to increase the application of BMPs to control nutrients and pesticides.
- Reduce the use of herbicides and other pesticides in floodplains and riparian areas.
- Conduct management pilot studies to determine successful strategies.
- Develop local watershed councils, stream teams, and citizen's groups to address local concerns through education and to monitor water quality and wildlife populations.
- Improve landowner knowledge of and access to Farm Bill incentives and cost-share programs to improve water quality through the implementation of BMPs and establishment of streamside buffer zones.

Conservation Issues Related to Activities that Alter Flow Patterns and Water Quantity:

8. Many streams in the region have been channelized and straightened, becoming deeply incised and no longer connected with riparian vegetation.
9. Streams with incised channels have cut banks that are prone to erosion that increases sediment loads in the streams.
10. A disconnection has developed between many streams and their riparian vegetation due to the channelization and incising of the streams. This has secondary impacts to the habitat including a reduction in the width and diversity of riparian vegetation and the reduction in the number of wetlands within the streams' floodplains.
11. Water is being pumped from streams for irrigation without full consideration of the potential impact to the aquatic communities.
12. Groundwater is being pumped from shallow aquifers for municipal and agricultural purposes, lowering water tables and reducing the flow volume of springs and seeps that feed streams.
13. Increased pond construction may be lowering the inflow that sustains streams.
14. Bridges can impact streams by altering stream channels, erosion, and flow.
15. Some types of culverts can become barriers to the movement of fish during low-flow conditions.
16. Dams and bridges across streams can create fish barriers that affect the populations of fish and freshwater mussels.
17. Dams and diversion structures alter the natural flow patterns and other processes of streams, especially the frequency and magnitude of natural flooding events that are required to maintain downstream channels and banks.

Conservation Actions:

- Provide cost-share funding or grants to restore stream channels and establish natural vegetation on stream banks for stability (e.g. reconnect streams and riparian vegetation where these have become separated due to channel incision).
- Restore or construct seasonal wetlands/vernal pools within the riparian zones or floodplains of streams to enhance flood storage and create shallow water habitat for shorebirds, waterfowl, and amphibians.
- Establish ecologically acceptable minimum in-stream flow standards for all biologically important streams (e.g., those streams that support populations of species of greatest conservation need or diverse aquatic communities).

- Manage the timing and volume of water withdrawals to have the least impact on aquatic biota.
- Anticipate and articulate to the Legislature and the Congressional delegation the potential effects of proposals to sell water outside of the state or the transfer of water between basins within Oklahoma.
- Provide the results of ecological studies to water use planners and those who issue permits.
- Support the development of a state water management plan with sound biological data that demonstrates the ecological impact of water sales, water withdrawals, and interbasin transfers of water.
- Work collaboratively with landowners to remove ponds and impoundments that are obsolete and have been shown to block the movement of fish species of conservation need.
- Work collaboratively with landowners, county commissioners, conservation districts and state agencies to remove or rehabilitate culverts and road crossings with new structures that do not create barriers to fish passage.
- Work collaboratively with landowners to replace ponds that have been constructed on streams with alternative water sources (e.g., for livestock).
- Research alternative methods for regulating reservoir discharges that would benefit downstream aquatic systems while still meeting reservoir storage objectives.
- Work collaboratively with public managers to modify pond and reservoir management to ensure that minimum in-stream flows are maintained below these structures.

Conservation Issues Related to Land Management Practices that Result in Habitat Loss and Alteration:

18. The abundance and diversity of understory vegetation has declined in riparian areas as a result of livestock grazing, especially during the growing season.
19. Riparian Forests have been cleared and converted to crop fields or introduced pastures of exotic grasses such as Fescue and Bermuda.
20. Fragmentation of riparian forests by roads, houses, pastures, and utility right-of-ways.
21. Clearing of riparian vegetation reduces stream bank stability which subsequently increases erosion and alters the width/depth ratios of streams.
22. Streams and riparian habitats are fragile and easily disturbed or modified.
23. The loss of riparian vegetation increases erosion and sedimentation.
24. Lack of headwater protection allows for more sediment, nutrients, pesticides, and other pollutants to enter streams.
25. Livestock grazing along stream banks increases bank erosion.
26. Loss of stream shading as a result of reduced riparian vegetation, increasing water temperatures and affecting the aquatic animal community.

Conservation Actions:

- Provide cost-share funding or grants to fence riparian forests to control/limit their access by cattle.
- Purchase easements to protect or enhance existing riparian vegetation or to restore riparian forests.
- Encourage ranchers to maintain some upland trees or plant trees in uplands as an alternative source of shading for livestock to reduce their use of riparian areas.
- Provide landowner incentives or cost-share programs to protect or restore riparian forests, stream banks, and in-stream habitat.
- Use fee-title purchase of stream and riparian habitat from willing sellers to place this into conservation ownership to conserve or enhance existing habitat.
- Fee-title acquisition or conservation easement acquisition of land surrounding the headwaters of streams to control or limit the introduction of sediment, nutrients, and

chemical pollutants into streams that are important for the conservation of species of greatest conservation need.

- Develop new and promote existing BMPs for the grazing of cattle in or adjacent to riparian zones.
- Develop riparian research and demonstration areas to evaluate alternative management strategies for maintaining riparian habitat and showing the results of the most successful strategies to interested landowners and managers.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

27. Exotic plant species such as Chinese Privet, Salt Cedar and Japanese Honeysuckle have become established and are becoming more abundant in riparian forests, competing with native plants and altering the structure of the habitat that can be used by animals.
28. Feral hogs that forage in streams and along stream banks damage riparian vegetation and reduce bank stability.
29. Some native plants and animals have become more abundant in riparian forests due to habitat alterations from human activities.
    - Eastern Redcedar has increased in abundance due to reduced fire frequency in riparian areas.
    - Brown-headed Cowbirds have become more abundant in riparian areas due to cattle grazing. Brown-headed Cowbirds lay their eggs in the nests of other songbirds thus reducing their reproductive success and population recruitment.

Conservation Actions:

- Develop management plans to control the abundance and distribution of exotic species and invasive species.
- Conduct monitoring and surveillance surveys for invasive species in areas where few recent data exist or where human activity increases the potential for invasive species introduction.
- Conduct studies to quantify the impact of exotic species on riparian forest communities (e.g., plants and animals) or on aquatic animal communities.
- Conduct pilot studies to determine the most cost-effective and successful management strategies for eradicating or controlling invasive species.
- Increase educational efforts and public awareness of the ecological and economic impacts of exotic plant and animal populations.
- Develop and implement invasive species management plans on all public lands in the region. Provide cost-share funding to private landowners to encourage them to control invasive species.

Potential indicators for monitoring the effectiveness of the conservation actions:

- populations and trends of fish and wildlife species of greatest conservation need
- acres of riparian forest with diverse vegetation structure
- creation of new local conservation groups
- degraded and restored stream miles for habitat
- number of acres acquired for habitat conservation
- number of acres under easements or conservation practices
- number of enhanced or restored acres of quality habitat
- number of landowners participating in conservation practices
- proportion of acres protected/acquired within a given watershed
- public opinion toward conservation actions
- stream flow and habitat quality (e.g., measure return of stream flow with range of natural variation)

- changes in surface flow and ground water volume as measured by the United State Geological Survey at their stream-gage stations and monitoring wells
- water quality parameters

Moderate Priority Conservation Landscape: Mixed-grass Prairie

Mixed-grass prairies occur locally on upland sites with relatively thin and drought-prone clay soil. Most of these sites are scattered along the western edge of the Crosstimbers Region and in the southern part of the region within and surrounding the Arbuckle Uplift. This habitat type is maintained by a combination of soil conditions and periodic fire. Mixed-grass prairies are dominated by Little Bluestem (*Schizachyrium scoparium*) and Sideoats Grama (*Bouteloua curtipendula*). Other grasses that may be common include Big Bluestem (*Andropogon gerardii*) and Blue Grama (*Bouteloua gracilis*). Forbs are often abundant and include Poppy Mallow (C*allirhoe involucrata*), Heath Aster (*Symphyotrichum ericoides*), and Dotted Blazing Star (*Liatris punctata*). Despite their limited distribution within this region, the acreage comprised of mixed-grass prairies has changed very little during the past decade.

Recognized plant associations within this habitat type include:

Little Bluestem – Big Bluestem - Switchgrass Grassland
Little Bluestem – Sideoats Grama – Blue Grama Grassland

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that occupy mixed-grass prairies in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or regional data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size and Range
Bird	American Golden Plover	common spring/fall migrant that may use burned or mowed sites for foraging	U
Bird	Buff-breasted Sandpiper	rare spring and fall migrant that uses burned or grazed tracts as foraging sites	U
Bird	Chestnut-collared Longspur	winter resident that is rare and at the eastern edge of its range in this region	U
Bird	Harris's Sparrow	common and widespread winter resident in this region	U
Bird	LeConte's Sparrow	uncommon and locally-occurring winter resident in tracts that have moderately tall standing grass	U
Bird	Loggerhead Shrike	uncommon and locally-occurring year-round resident; winter population may be augmented by wintering northern birds	D
Bird	Northern Bobwhite	locally common and widespread year-round resident.	D
Bird	Prairie Falcon	rare winter resident; population occurs at a very low density	S
Bird	Smith's Longspur	uncommon and secretive winter resident; occurs primarily in disturbed and early succession sites	U
Bird	Sprague's Pipit	rare and secretive spring/fall migrant	S
Bird	Swainson's Hawk	common spring/fall migrant; a small breeding population occurs in the southern part of the region	U
Bird	Upland Sandpiper	common spring/fall migrant throughout the region	S
Inve	Dotted Skipper	uncommon and locally occurring at scattered locations; appears to be found primarily in the Arbuckle uplift	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size and Range
Inve	Prairie Mole Cricket	nocturnal, early season insect whose range is poorly known in the southern part of this region.	D
Rept	Texas Horned Lizard	uncommon and locally-occurring; its current distribution is poorly known in this region	D
Rept	Western Diamond-backed Rattlesnake	locally common in rocky slopes and canyons with little woody overstory	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Habitat:

1. Distribution and ecological needs data are incomplete for many prairie-dependent species of greatest conservation need, thus making it difficult to identify conservation focus areas and establish effective conservation strategies.
2. Baseline information about community composition, historic distribution and both the historic and current condition of mixed-grass prairie in this region are incomplete.
3. A better understanding is needed of the soil, microhabitat and climate conditions that shape and maintain this habitat on the landscape.

Conservation Actions:

- Conduct surveys of existing literature, reports, and museum records to evaluate the historic extent of mix-grass prairie and the distributions and abundances of species of greatest conservation need. Examine possible causes of suspected population declines and the factors that limit the populations of species of greatest conservation need.
- Conduct field studies to determine baseline conditions for distributions, abundances, and habitat affinities of species of greatest conservation need and to assess changes over time.
- Develop and maintain databases to store and analyze distributional and ecological data for prairie-dependent species of greatest conservation need.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

4. The loss of historic fire frequencies has facilitated changes in vegetation structure such as the expansion and proliferation of the native but invasive Eastern Redcedar. The structural changes caused by the increase in junipers has negatively affected some species such as grassland birds.

Conservation Actions:

- Develop demonstration areas that show and describe grazing and fire regimes in the region that benefit species of greatest conservation need.
- Facilitate burn schools and workshops to provide technical and educational training for landowners and support for prescribed fire associations and contractors.
- Pursue land acquisitions and conservation easements for placing the most biologically important tracts of prairie into conservation ownership or management.
- Develop or update Best Management Practices (BMPs) for practices including grazing management and herbicide application.
- Encourage and promote alternative grazing practices that use patch burning and mineral blocks to control the movement of cattle rather than using fencing.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

5. Introduced exotic species such as Old World Bluestem, Japanese Brome and Bermudagrass compete with native vegetation, alter current plant community structure and provide poorer quality habitat for species of greatest conservation need.
6. Invasive species such as Johnson Grass (*Sorghum halepense*) and Sericea Lespedeza (*Lespedeza cuneata*) have become established throughout the region and displace native vegetation that is typically more beneficial to species of greatest conservation need. These invasive species are difficult to control and some control methods (herbicide application) may have detrimental impacts to non-target plants if not carried out with caution.

Conservation Actions:

- Conduct studies to identify and prioritize core areas of habitat and corridors to connect the core tracts.
- Update the BMPs for the use of fire for grassland management.
- Continue to provide cost-share funding for the cutting of Eastern Redcedar on sites that historically supported mixed-grass prairies.
- Develop and distribute informational materials that increase landowner knowledge of and use of Farm Bill conservation programs to maintain prairie habitat.
- Encourage and support ranch diversification to allow for lower grazing pressure by off-setting stock reductions through gains in better forage production, reduced supplemental feeding, better livestock performance and a reduced need for weed control. Additional income can be derived from compatible activities such as lease hunting and fishing access.
- Cooperate with appropriate entities (e.g., energy companies, federal and state agencies, and individual landowners) to site energy developments in a way that will minimize restrictions on species of greatest conservation need use of this habitat.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

7. Mixed-grass prairie habitat has been lost as a result of residential development and ranch infrastructure (e.g. corrals and barns) Conversion results in the direct loss of habitat and also reduces the quality of the remaining habitat by reducing tract sizes and isolating tracts of prairie from one another. This has a greater affect on species with larger acreage requirements and species with poor dispersal and movement abilities.
8. Energy exploration and development, including wind power development, can reduce the suitability of this habitat for species of greatest conservation need by fragmenting or creating barriers for the movement of prairie species.

Conservation Actions:

- Acquire fee-title from willing sellers and conservation easements for placing some of the most biologically important tracts of prairie into conservation management.
- Encourage and support private land acquisition to protect important tracts in this habitat (e.g., by land trusts and non-governmental organizations such as The Nature Conservancy (TNC)).
- Encourage the retention and enhancement of native mixed-grass prairie tracts through the Agricultural Conservation Easement Program (includes the former Grassland Reserve Program).
- Encourage the conversion of cropland to diverse mixed-grass prairie forbs and grasses through enrollment in the Conservation Reserve Program (CRP). Use restoration tracts to connect prairie fragments or increase prairie tract sizes.

- Support adjustments in the Agricultural Conservation Easement Program that make it more favorable to maintain and enhance prairie habitat.
- Encourage the removal of residual fences.
- Encourage both on-site and off-site mitigation for energy development.
- Increase funding for the Agricultural Conservation Easement Program (contains the former Grassland Reserve Program) and increase the priority given to mixed-grass prairie habitat.
- Identify and prioritize core areas of habitat and corridors to connect to get the efficient use of funds.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acres of prairie that have undergone prescribed burns
- acres of removed invasive woody vegetation (e.g. Eastern Redcedar)
- acres of native mixed-grass prairie restored
- acres of habitat occupied and impacted by wind and gas development
- acres under easements or enrolled in conservation programs that maintain mixed-grass prairie habitat
- changes in acreage/coverage of exotic vegetation
- degree of habitat fragmentation based upon an analysis of aerial imagery
- population sizes and trends for species of greatest conservation need
- relative condition and quantity of mixed-grass prairie habitat

Potential partnerships to deliver conservation for Crosstimbers Region:

State Government

- Oklahoma Department of Wildlife Conservation
- Oklahoma Biological Survey
- Oklahoma Corporation Commission
- Oklahoma Department of Agriculture and Forestry
- Oklahoma Department of Environmental Quality
- Oklahoma Department of Transportation
- Oklahoma Energy Resources Board
- Oklahoma Legislature
- Oklahoma Natural Heritage Inventory
- Oklahoma State University, Cooperative Extension Service
- Oklahoma State University, Department of Ecology and Natural Resources Management
- Oklahoma Tourism and Recreation Department
- Oklahoma Transportation Authority
- Oklahoma Water Resources Board
- Other state universities and departments
- University of Arkansas, Ancient Crosstimbers Tree-Ring Laboratory
- University of Oklahoma, Oklahoma Biological Station
- University of Oklahoma, Sam Noble Oklahoma Museum of Natural History

Federal Government

- U.S. Army Corps of Engineers
- U.S. Bureau of Reclamation
- U.S. Department of Agriculture, Farm Service Agency
- U.S. Department of Agriculture, Forest Service
- U.S. Department of Agriculture, Natural Resources Conservation Service
- U.S. Department of Defense, Tinker Air Force Base
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service - Gulf Prairies Landscape Conservation Cooperative
- U.S. Fish and Wildlife Service - Deep Fork and Tishomingo NWRs
- U.S. Geological Survey - Cooperative Fish and Wildlife Research Unit, Water Science Center and South Central Climate Science Center

Local Government

- County Conservation Districts
- County Commissioners
- Municipalities in Oklahoma, Arkansas, Missouri
- Oklahoma Association of Regional Councils
- Tribal governments

Businesses, on-profit Organizations and Citizen Groups

- Audubon Society Local Chapters
- Bat Conservation International
- Chambers of Commerce
- Citizens for the Protection of the Arbuckle-Simpson Aquifer
- Ducks Unlimited and local Oklahoma chapters
- Farm Bureau
- Farmers Union
- Hunting cooperatives
- Izaak Walton League
- Land Trusts

- Local citizens groups
- Logging industry
- National Wild Turkey Federation and local Oklahoma chapters
- Oaks and Prairies Joint Venture
- Oklahoma Anglers United
- Oklahoma Cattlemen's Association
- Oklahoma Native Plant Society
- Oklahoma Ornithological Society
- Oklahoma Prescribed Fire Council
- Oklahoma Section of the Society for Range Management
- Sportsmen's groups
- Private landowners, farmers and ranchers
- Producer Cooperatives
- Railroad Companies
- Sierra Club
- Speleological Societies
- Southeast Aquatic Resource Partnership
- The Nature Conservancy
- The Samuel Roberts Noble Foundation, Inc.
- The Wildlife Society
- Urban development groups
- Wetland mitigation bankers

Ozark Region

The Ozark Region is comprised of the Ozark Highlands and the Boston Mountains. The counties included in this ecological region are Ottawa, Delaware, Mayes, Cherokee, Adair, and Sequoyah.

The best professional judgment of the advisory group and technical experts was used to identify each Conservation Landscape's status and trend. And, even though some issues and actions apply to multiple regions, each regional chapter is designed to stand-alone.

Conservation Landscapes listed in general priority order:

- Very High priority Conservation Landscapes:
  - Small Rivers
  - Limestone Caves
  - Springs
  - White Oak/Hickory Mesic Forest
  - Gravel-bottom Streams and Associated Riparian Forests
- High priority Conservation Landscapes:
  - Shortleaf Pine-Oak-Hickory Woodlands
  - Oak/Hickory Bottomland Hardwood Forest
- Moderate priority Conservation Landscapes:
  - Post Oak/Blackjack Oak-Hickory Woodlands and Forests
  - Herbaceous Wetland
  - Tallgrass Prairie

Very High Priority Conservation Landscape: Small Rivers

Small river habitat in the Ozark Region of Oklahoma is limited to the Spring, Elk and Illinois rivers, each of which is a tributary of the Neosho/Grand River. The lower portions of all three rivers have been affected by impoundments that have reduced their effective lengths. The Spring River flows for approximately 15 miles into Oklahoma before reaching Grand Lake of the Cherokees. The Elk River is the shortest of the three and flows approximately two miles into the state from its origin in Missouri before being impounded by Grand Lake. The lower part of the Illinois River has been impounded by the construction of Tenkiller Reservoir, which has reduced its length to approximately 40 miles of flowing water. Both the Spring and the Illinois are clear swiftly-flowing rivers with gravel to cobble substrates. Flow rates are typically greater during the winter and spring months and lower during the summer and fall. These small rivers contain gravel bars and sloughs but not the dynamic mosaic of sandbars, mudflats and sloughs that are found within the large river systems. Sloughs along these rivers are typically rocky and surrounded by woody vegetation including River Birch (*Betula nigra*), Sycamore (*Platanus occidentalis*), and Red Maple (*Acer rubra*).

The species of greatest conservation need that are found in the Small Rivers of the Ozark Region are listed in the following table. A narrative description is provided for each species' distribution/status and population trend. Status and trend descriptions are based upon the existing literature and the best professional judgment of the technical experts that were consulted. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. The estimated trend is based upon the statewide population size (if known) or change in the species geographic range. Trend codes are: U = Unknown, S = Stable, D = Decreasing, and I = Increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population or Range
Amph	Oklahoma Salamander	locally common in the Spring and Illinois rivers	S
Bird	Bald Eagle	year-round resident that occurs in low densities along each river.	I
Bird	Canvasback	uncommon winter resident occupying pools, sloughs and side channels region-wide	S
Bird	Lesser Scaup	uncommon winter resident occupying pools, sloughs and side channels region-wide	D
Bird	Little Blue Heron	summer resident throughout the region; locally uncommon near nesting colonies	U
Bird	Louisiana Waterthrush	uncommon summer resident that nests along forested stream and river channels region-wide	S
Bird	Prothonotary Warbler	uncommon summer resident that nests in riparian forests throughout the region	D
Bird	Snowy Egret	rare summer resident throughout the region; occurs locally near nesting colonies	U
Bird	Solitary Sandpiper	uncommon spring and fall migrant throughout the region	U
Fish	Alabama Shad	probably extirpated from the region; small population may occur in lower Illinois River	U
Fish	Blue Sucker	uncommon and difficult to detect because of their deep channel habitat; found in the Spring River and possibly the Illinois River	U
Fish	Bluntface Shiner	locally common in the Illinois and Spring rivers	U
Fish	Least Darter	uncommon in the Illinois and Spring rivers	U
Fish	Paddlefish	locally common in the Spring and Illinois rivers, especially during spawning	I

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population or Range
Fish	Redspot Chub	locally common throughout the region	S
Fish	River Darter	uncommon and difficult to detect; occurs in deeper portions of the Spring and Illinois river channels	U
Fish	Shorthead Redhorse	rare but widespread at low-density throughout the region	D
Fish	Southern Brook Lamprey	locally occurring and uncommon; its presence in small rivers is poorly documented	U
Fish	Spotfin Shiner	uncommon and restricted to the Illinois River	U
Fish	Wedgespot Shiner	common and widespread within the region	U
Inve	Elktoe	uncommon; occurs in the Spring and Illinois rivers	D
Inve	Neosho Mucket	listed as an endangered species; uncommon in the Illinois River and very rare in the Spring River	D
Inve	Ouachita Kidneyshell	uncommon and locally occurring in mussel beds in the Illinois River	D
Inve	Ozark Pigtoe	occurrence not confirmed but likely to occur in small numbers in the Illinois and Elk rivers	U
Inve	Plain Pocketbook	locally common; found throughout the region	U
Inve	Purple Lilliput	potential occurrence but has not been documented in Oklahoma; may occur in the Elk and Illinois rivers	U
Inve	Rabbitsfoot	rare and restricted to the Illinois River; listed as a federally threatened species	D
Rept	Alligator Snapping Turtle	very rare in this region; may occur in the Illinois and Spring rivers	U
Rept	Eastern River Cooter	locally common throughout the region	D
Rept	Mississippi Map Turtle	uncommon, occurs locally region-wide	U
Rept	Ouachita Map Turtle	common throughout the region	D
Rept	Spiny Softshell Turtle	uncommon, found in the Spring and Illinois rivers	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality:

1. Concentrated animal operations (e.g., dairies, poultry houses and their land application fields), septic systems from houses near streams and rivers, nursery operations, fertilized crop fields, introduced pastures, lawns, and golf courses have the potential to contribute additional nutrients to river systems via storm water runoff.
2. Sediment, nutrients and chemical pollutants are more likely to enter aquatic systems and end up in rivers in areas where human activity has reduced the abundance of riparian vegetation and/or reduced the widths of vegetated buffers along tributary streams and their headwaters.
3. Discharges from municipalities and industries into streams and rivers directly contribute to increased nutrient loads.
4. Endocrine system disruptors (e.g., some classes of pesticides, hormones and antibiotics) can enter the river in storm water runoff from agricultural fields and concentrated animal operations. These have the potential to disrupt the reproduction and development of crustaceans, freshwater mussels, amphibians and fish.
5. Where landowners do not control the access that their livestock have to the river, the activities of cattle grazing in the riparian zone can result in the trampling and destabilizing of riverbanks thereby contributing sediment to the river.

6. Nutrients and pollutants may enter the river via groundwater where septic systems and animal waste application fields occur in or on the porous soils in stream and river floodplains and short connections occur between groundwater and surface waters.
7. Excessive concentrations of heavy metals are a local but serious issue in the Spring River watershed.
8. Wetlands within river and stream floodplains have been filled or drained to create land that is suitable for agricultural and residential purposes and are thus not available to act as natural filters of storm water runoff to help keep sediment and nutrients out of rivers and streams nor to provide important breeding areas for amphibians and feeding areas for waterfowl and shorebirds.

Conservation Actions:

- Increase promotion and use of Best Management Practices and conservation cost-share programs to control nutrients and sediment in storm water runoff.
- Evaluate the need for better cost-share arrangements, more acceptable landowner incentives and revision of Best Management Practices to increase use of existing programs.
- Continue to provide cost-share funding for the construction of fences and alternative sources of water for livestock in order to keep cattle out of rivers and riparian areas.
- Develop and distribute educational materials to schools and landowners about Best Management Practices to control nutrients and sediment, the interconnection of rivers, wetlands and groundwater, and the importance of riparian vegetation and wetlands as filters for nutrients and sediment.
- Increase the use of existing cost-share programs to restore riparian habitat and wetlands that serve as filters of storm water and as wildlife habitat; as needed, improve the acceptability of these programs to private landowners or develop new programs targeted at small rivers.
- Purchase conservation easements or acquire property in title from willing sellers in the floodplains of river and streams and surrounding the headwaters of streams. Restore, enhance or create wetlands and riparian vegetation on these areas to stabilize stream banks and filter sediment, nutrients and other pollutants and to limit development within sensitive floodplains and improve habitat conditions for wildlife species of greatest conservation need.
- Develop monitoring programs for wildlife populations, habitat quality, and water quality to assess the effects of habitat restoration and conservation easement programs.
- Evaluate the efficacy and acceptability of strategies for discouraging residential development and the construction of poultry houses and other concentrated animal operations within river floodplains and near streams in order to protect water quality. This may include the purchase of conservation easements, zoning restrictions, educational information about riverine stewardship or changes in flood insurance programs.
- Develop local stream teams or watershed groups comprised of citizens and/or governmental organizations to address local concerns, monitor water quality, monitor wildlife populations, and provide public outreach and education.
- Support national or state scenic rivers designations.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

9. Existing data are incomplete for species of greatest conservation need with respect to their distributions, ecological needs, and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.

10. Our knowledge about the historic and current physical condition of in-stream habitats and riparian habitats in the small rivers of the Ozarks is incomplete. There is a general scarcity of monitoring data for the biological composition of small rivers (e.g., fish, mussel, and macroinvertebrate communities).

Conservation Actions:

- Conduct reviews of existing literature, reports, and museum records, and interview technical experts to compile historic distributional and ecological information for each species of greatest conservation need.
- Conduct surveys and research to assess the current distribution, abundance and habitat affinities for priority species of greatest conservation need. Use these data to identify the geographic areas and habitat conditions where conservation efforts should be directed to provide the greatest benefit for populations of SGCN.
- Conduct research to identify the factors that limit the distributions and abundances of species of greatest conservation need and examine possible causes of suspected population declines.
- Develop management recommendations to enhance populations of SGCN through improved habitat conditions or enhanced juvenile recruitment, and conduct field studies to establish baseline population data/information.
- Develop monitoring programs for high priority SGCN to measure their abundance, geographic range and the condition of the habitats on which they depend. Develop and maintain databases to store and analyze these distributional and ecological data.
- Research the historic condition of small rivers, using historic literature and maps to evaluate the historic channel morphology and flow patterns in order to develop a realistic and biologically meaningful target condition for habitat restoration, enhancement and maintenance efforts.
- Develop methods to identify and map the distribution of the remaining habitat tracts, then inventory these tracts to determine their condition and the biological community that they support. Where appropriate, identify the conservation practices that could enhance the value of these habitat tracts for SGCN.

Conservation Issues Related to Activities that Alter Flow Patterns, Channel Morphology and Water Quantity:

11. River channels normally meander through their floodplains and maintain stable, vegetated banks, but some human activities alter the channel structure of rivers and contribute to bank instability. These actions include:
    - Efforts to channelize the river and confine the channel to a narrower space.
    - In-stream gravel or sand mining.
    - Creating channel constrictions such as bridges and low water dams.
    - Dredging of river channels to make them deeper and narrower.
12. Channel modifications can result in the river cutting a deeper channel and disconnecting the river from its riparian vegetation, eroding gravel and sediment from the riverbank, and creating bare cut banks that are prone to erosion that will contribute more sediment into the river.
13. Channelization efforts that are undertaken to enhance the movement of storm water (i.e., to reduce flooding) and to allow residential and/or agricultural development within the floodplain often create unstable channels that erode new meanders.
14. Much of the forested riparian vegetation along the small rivers has been removed, often to convert this habitat to pastures, crop fields or riverside residential or recreational developments. The reduction in riparian vegetation contributes to riverbank instability and facilitates bank erosion.
15. Increased deposition of fine sediment from eroding banks settles into gravel beds and riffles, impairing their quality as spawning habitat for fish and their value as habitat for freshwater mussels.

16. Groundwater in shallow aquifers and alluvial deposits that are connected to the river are being pumped for irrigation and residential uses. Depending upon the volume of groundwater used, this can affect water inflows into the river.
17. Reservoirs, flood control impoundments, and recreational ponds hold storm water runoff and can reduce the volume of surface flows that reach rivers and streams even though they may help recharge groundwater supplies.
18. The loss of wetlands and the constriction of floodplains reduce the ability of the land to hold and slowly release water, often resulting in "flashier" stream and river flows in which flow is accelerated during storm events, but then rapidly drops afterward.
19. Reservoir construction on river main stems and major tributaries alters the historic flooding frequencies and flow patterns by reducing the magnitude of small floods, especially the annual spring and early summer floods that naturally occur on rivers and reducing the flow rates during normal summer low-flow periods by holding back water.
20. Dams, culverts, and some bridge designs can act as impediments to the upstream movements of fish and other aquatic wildlife.

Conservation Actions:

- Develop cost-share programs or grant programs to provide funding for landowners and conservation districts to restore the morphology of river channels.
- Support research into efficacy of bank stabilization and channel restoration techniques that incorporate fluvial geomorphology principles.
- Promote the use of existing cost-share programs to restore riparian habitat and floodplain wetlands that stabilize banks, serve as filters of storm water and serve as wildlife habitat. As needed, improve the acceptability of these programs to private landowners or develop new programs targeted at small rivers.
- Purchase conservation easements from private landowners or acquire property in title from willing sellers within the floodplains of rivers and streams and surrounding the headwaters of streams. Restore, enhance or create wetlands and riparian vegetation on these easements in order to stabilize stream banks, filter sediment, limit development within sensitive floodplains and improve habitat conditions for wildlife species of greatest conservation need.
- Develop monitoring programs for wildlife populations, habitat quality, and water quality to assess the effects of habitat restoration and conservation easement programs.
- Evaluate the efficacy and acceptability of strategies for discouraging residential and infrastructure development within river floodplains in order to reduce the incentives to armor banks and modify river channels to protect these structures.
- Develop regulations that restrict or prohibit channel modifications, in-stream gravel and sand mining and channel dredging.
- Conduct studies of the habitat and flow needs for species of greatest conservation need.
- Establish minimum in-stream flow standards/requirement that will meet the needs of species of greatest conservation need and conserve populations with the watershed.
- Conduct studies assessing and comparing current and historic flow patterns on small rivers and evaluate methods to restore historic patterns such as modifying reservoir management to release water to mimic historic flows.
- Purchase conservation easements or acquire property in title from willing sellers in the floodplains of river and streams.
- Restore, enhance or create wetlands on these acres to hold storm water and slowly release it to the river to limit development within sensitive floodplains and improve habitat conditions for wildlife species of greatest conservation need.
- Support and promote water conservation programs and public education efforts directed at water conservation.

- Develop monitoring programs for wildlife populations and habitat quality to assess the effects of flow management, habitat restoration and conservation easement programs.
- Develop local stream teams or watershed groups comprised of citizens and/or governmental organizations to address local concerns, monitor water quality, monitor wildlife populations and provide public outreach and education.
- Remove structures that isolate populations of species of greatest conservation need or prevent these species from reaching segments of rivers.
- Replace culverts and bridges that block the movement of fish with new structures that allow fish to pass through.

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

21. Several exotic plant species such as Japanese Honeysuckle, *Microstegium* grass, and Chinese and Japanese privets have become established in riparian areas where they displace native plants and may alter habitat conditions for wildlife species of greatest conservation need.
22. Zebra Mussels and several exotic aquatic plants have become established in Oklahoma reservoirs and could spread into river and stream channels where they could alter food and habitat for aquatic animal populations.

Conservation Actions:

- Evaluate the severity and magnitude of the ecological damage done by exotic plant and animal species, including displacement of native vegetation/plant communities, predation on native animal populations, or hybridization with native species.
- Identify those exotic species causing the greatest impact to this habitat and species of greatest conservation need and develop control or management plans for the exotic species that cause the greatest ecological damage (e.g., herbicide treatment, biological control, mechanical removal).
- Provide the results of studies of exotic species impacts to landowners and conservation agencies/organizations.
- Improve coordination between wildlife biologists, conservation agencies and agricultural organizations so that these groups can share information about the negative effects of using exotic plant materials.
- Implement the Oklahoma aquatic invasive/nuisance species management plan. Develop monitoring programs to measure and evaluate the effectiveness of control measures.
- Develop cost-share or incentives programs for private landowners to encourage them to control invasive and exotic species.

Conservation Issues Related to Habitat Alteration Caused by Heavy Recreational Use that Negatively Affects Species of Greatest Conservation Need:

23. The impact of canoeing on fish, freshwater mussels, and other wildlife species has not been evaluated. Heavy recreation use may compact gravel bars and disturb mussel beds. The removal of woody debris in the river or localized reduction of riparian vegetation by heavy recreation use may result in subtle channel modifications. Visitors may also contribute trash/litter to the river.
24. Increasing levels of recreational use may result in conflicts among user groups (e.g., canoeists, fishermen, and campers).

Conservation Action:

- Develop studies to evaluate the impact of recreation activities on wildlife.
- Where impacts are found, develop recommendations to reduce impacts using a combination of education and regulations. Education and outreach materials could

include a brochure or booklet describing the stream ecosystem and steps that can be taken to reduce erosion and keep vehicles out of the water.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acres of flood plain habitat acquired or placed under conservation easements
- number or percentage of landowners participating in conservation practices
- miles of degraded and restored river and tributary streams
- number of active local watershed conservation groups (stream teams)
- public opinion toward conservation actions
- changes in population sizes and trends of species of greatest conservation need
- changes in the relative condition and quantity of in-stream habitat (e.g. riffles, gravel bars) and riparian habitats (e.g. riparian forests, sloughs)
- changes in stream flow and hydrogeomorphic structure of river channels
- changes in water quality parameters.

Very High Priority Conservation Landscape: Limestone Cave

Much of the Ozark Region in Oklahoma is underlain by the Springfield Plateau, a formation of porous limestone. Portions of the Springfield Plateau contain deep fissures, numerous caves and springs. These areas are often referred to as karst formations. Slightly acidic groundwater moves through the fissures and cracks in the limestone dissolving and/or eroding subterranean stream channels, and caves. Because of its geology, the Ozark Region contains many complex systems of interconnected aquifers, caves, sinkholes and springs, and these systems in turn support diverse subterranean communities of salamanders, bats, Ozark Cavefish, cave crayfish and other cave and/or aquifer dwelling invertebrates. Caves are openings into the karst formation that connect the above ground community with the subterranean community. In contrast to the Springfield Plateau, the Boston Mountains section of the Ozark Region is a sandstone formation in which very few caves exist. However, caves are numerous in the southern portion of the region where the Springfield Plateau and Boston Mountains meet. The distribution and biological composition of caves is poorly known and in need of further investigation

The species of greatest conservation need that are found in the Limestone Caves and Karst habitat type are listed in the following table. A narrative description is provided for each species' distribution/status and population trend. Status and trend descriptions are based upon the existing literature and the best professional judgment of the technical experts that were consulted. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. The estimated trend is based upon the statewide population size (if known) or change in the species geographic range. Trend codes are: U = Unknown, S = Stable, D = Decreasing and I = Increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population or Range
Amph	Grotto Salamander	uncommon and locally-occurring in shallow aquifers and caves in the Springfield Plateau	U
Amph	Ozark Salamander	locally common; may enter caves as a daytime retreat	U
Inve	Bowman's Cave Amphipod	rare and documented from only one seep in Mayes County	U
Inve	*Caecidotea ancyla*	locally common but restricted to wet caves in the southern 2/3 of the region	U
Inve	*Caecidotea antricola*	uncommon and limited to a few caves in Delaware County	U
Inve	*Caecidotea mackini*	uncommon and limited to one cave complex in central Delaware County; endemic to Oklahoma	U
Inve	*Caecidotea macropropoda*	uncommon and limited to wet caves in the southern half of the region	U
Inve	*Caecidotea simulator*	uncommon but widespread in shallow aquifers and wet caves throughout the region	U
Inve	*Caecidotea stiladactyla*	locally common in springs, seeps and wet caves along the Arkansas state line	U
Inve	Cave Harvestman	uncommon and restricted to a few caves in the Oklahoma portion of the Ozarks	U
Inve	*Crangonyx forbesi*	locally common in the shallow aquifer and caves across the Springfield Plateau	U
Inve	Delaware Co. Cave Crayfish	rare and limited to the shallow aquifer and caves in the northern third of Delaware County	U
Inve	Oklahoma Cave Crayfish	rare and limited to the shallow aquifer and caves in the Spavinaw Creek watershed; state listed as endangered	S
Inve	Ozark Cave Amphipod	locally common in wet caves, springs and seeps throughout the region	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population or Range
Inve	*Pseudosinella dubia* (cave springtail)	locally common cave-dwelling springtail found in the southern half of the region	U
Inve	*Trigenotyla blacki* (cave obligate millipede)	uncommon millipede found only in caves in the Oklahoma Ozarks; distribution poorly known	U
Inve	Ozark Cavefish	rare and federally listed as a threatened species; occupies the shallow aquifer in the northern half of the region	S
Mamm	Gray Bat	locally common but restricted to the vicinity of 9 to 11 caves distributed across the region that support maternity colonies; federally listed as endangered; majority of individuals migrate out of Oklahoma to the east to hibernate	I
Mamm	Indiana Bat	rare spring and fall migrant through the region	D
Mamm	Northern Long-eared Bat	locally common in forested habitats and caves throughout the region	S
Mamm	Ozark Big-eared Bat	rare and federally listed as endangered; restricted to caves and forested landscapes in the southern half of the region	S

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

1. Existing data are incomplete for species of greatest conservation need with respect to their distributions, ecological needs, and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
2. Data regarding the locations of caves and cave-bearing geologic formations are incomplete because of the difficulty in locating caves and gaining access to private property. Most likely there are many more caves in the Ozarks than we currently recognize, and caves may have a greater degree of connectivity through underground connections and groundwater.

Conservation Action:

- Conduct a thorough review of existing literature and location records and follow with biological surveys of caves to improve the knowledge of the distribution and abundance and as assessments and a baseline condition for future monitoring efforts of bats, salamanders, cave fish, and subterranean invertebrates.
- Evaluate techniques to conduct biological surveys in shallow aquifers to measure the degree of connection between populations in neighboring caves. These examinations of connectivity also could be accomplished through genetic evaluation of populations in nearby caves and aquifers.
- Conduct surveys to locate and map biologically important caves and aquifers, and develop a database to track the location and biological composition of these sites. To protect cave fauna and to protect private landowners from unwanted trespass, the information regarding cave locations should be kept confidential and secure.
- Conduct research to identify the factors that limit the distributions and abundances of cave-dependent species of greatest conservation need.
- Develop management recommendations to enhance populations of SGCN through improved habitat conditions and cave security.
- Conduct field studies to establish baseline population data/information, and develop monitoring programs for high priority SGCN to measure their abundance, geographic range.

Conservation Issus Related to Impaired Groundwater Quality in the Aquifers that Support Species of Greatest Conservation Need:

3. Groundwater passes through porous limestone in karst systems very quickly and the soil provides very little filtration. As a result, groundwater in karst aquifers are easily polluted by water-soluble pollutants and water quality degradation is a serious potential problem for aquatic species. Potential pollutants in this Region include ammonia from septic systems and livestock/poultry operations; pesticides, hormones and endocrine system disruptors that are applied to crops or livestock; and toxic chemicals that might leach from household dumps and landfills.

Conservation Actions:

- Develop monitoring programs to measure groundwater quality and track populations of aquatic organisms in the aquifers.
- Establish groundwater water quality standards for subterranean streams and their associated shallow aquifers.
- Delineate and map the primary recharge areas surrounding biologically important caves and aquifers such as those containing populations of Tier I and Tier II species of greatest conservation need.
- Place caves and the land surrounding caves into conservation programs (e.g., purchase of conservation easements, provide payments to landowners to restore or maintain natural vegetation communities, or purchase fee title from willing landowners) to protect water quality in the recharge areas.
- Identify sites within the recharge zones for cave streams and sites that pose potential problems for water quality maintenance and provide cost-share funding to landowners to remedy these.
- Develop public education and awareness materials to alert residents in biologically important karst areas of the:
    - sensitivity of groundwater, their drinking water, to pollutants,
    - the biological diversity of the cave/aquifer ecosystem, and
    - landowner assistance programs and Best Management Practices that may maintain or improve water quality.

Conservation Issues Related to Human Disturbance to Populations of Cave-dwelling Species of Greatest Conservation Need:

4. Populations of cave-dwelling species of greatest conservation need such as bats, cavefish and salamanders, are sensitive to human disturbance within caves and/or habitat alteration surrounding caves (e.g. clearing of forested land and construction of homes). Maternity colonies and hibernating clusters of bats are especially vulnerable to disturbance and habitat change.
5. Uncontrolled recreational use of caves that serve as maternity or hibernation sites may affect local populations of Gray, Ozark Big-eared, Northern Long-eared and other bats. Human disturbance may cause nursing female bats to abandon their dependent young or to abandon suitable caves for less suitable (i.e., cooler) sites for successfully rearing young, or it may cause hibernating bats to awaken and burn fat reserves needed to sustain them through the winter.

Conservation Actions:

- Develop landowner assistance and incentives programs to help private landowners implement cave management measures such as installing internal cave gates or enhancing habitat conditions surrounding caves.
- Because some cave gating designs have the potential to discourage bat use of caves, all cave gates that are installed should be monitored to determine their effectiveness at conserving bat populations.

- Enroll biologically important caves and their surrounding habitat into conservation programs to discourage human use of caves at inappropriate times and to conserve foraging habitat for bats and salamanders. These programs could include conservation easements, cooperative agreements, or fee title acquisition by conservation agencies or non-governmental organizations.
- Prior to initiation of conservation efforts, an evaluation should be made regarding the relative biological importance of specific caves and cave systems within the context of the Ozark Region so that programs can be focused on the sites that are likely to make the most effective use of conservation funds.

Potential indicators for monitoring the effectiveness of the conservation actions:

- changes in the temperature and humidity in caves.
- number of acres or percentage of acres placed into conservation programs within the recharge zone of caves that are known to support species of greatest conservation need.
- effectiveness of cave gates.
- number of cave management plans implemented and the number of caves gated or conserved
- changes in groundwater quality.
- changes in population sizes and trends of representative species of greatest conservation need
- relative condition of the foraging habitat surrounding bat maternity colony caves

Very High Priority Conservation Landscape: Springs

Springs and seeps are common and widespread in the Ozark Region and are often found in association with wetlands, the headwaters of streams and caves. As a result of the limestone karst geology of portions of the Springfield Plateau, groundwater aquifers, subterranean streams, and springs are numerous in that portion of the Region. The Springfield Plateau supports many species of conservation need that inhabit groundwater aquifers and these species may be encountered at springs or within caves (e.g., amphipods, isopods, and Grotto Salamander). Despite the number of springs in the Region, the distribution and biological composition of springs and seeps is poorly known in large part because these habitats are small and difficult to access or to locate within the context of the larger habitat types within which they occur.

The species of greatest conservation need that are found in the Springs and their associated first-order stream habitat type are listed in the following table. A narrative description is provided for each species' distribution/status and population trend. Status and trend descriptions are based upon the existing literature and the best professional judgment of the technical experts that were consulted. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. The estimated trend is based upon the statewide population size (if known) or change in the species geographic range. Trend codes are: U = Unknown, S = Stable, D = Decreasing and I = Increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population or Range
Amph	Grotto Salamander	uncommon and locally occurring in springs/streams associated with caves and karst systems across the Springfield Plateau	U
Amph	Oklahoma Salamander	common and widespread throughout the region	S
Amph	Ringed Salamander	uncommon and locally occurring throughout the region	U
Bird	Louisiana Waterthrush	uncommon summer resident that nests throughout the region in the riparian areas along streams and around springs	S
Fish	Arkansas Darter	uncommon and locally occurring in vegetated springs and seeps in the tributaries of the Spring and Grand rivers	U
Fish	Cardinal Shiner	locally common in springs and streams throughout the region	S
Fish	Ozark Minnow	common in springs and headwater streams throughout the region	S
Fish	Plains Topminnow	uncommon and restricted to a few locations in the Spavinaw Creek watershed	U
Fish	Redspot Chub	locally common in springs and streams throughout the region	S
Fish	Sunburst (Stippled) Darter	uncommon but widespread in springs and headwater streams throughout the region	U
Inve	*Allocapnia jeanae* (stonefly)	locally occurring in Ozark streams but its range is incompletely known	U
Inve	Bowman's Cave Amphipod	rare and documented from only one seep in Mayes County	U
Inve	*Caecidotea macropropoda*	uncommon and limited to wet caves and springs in the southern half of the region	U
Inve	*Caecidotea simulator*	uncommon and locally occurring in springs, seeps and shallow aquifers in the eastern half of the region	U
Inve	*Caecidotea stiladactyla*	locally common in springs, seeps and wet caves along the Arkansas state line	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population or Range
Inve	*Crangonyx forbesi*	locally common in the shallow aquifer and springs across the Springfield Plateau	U
Inve	Kansas Well Amphipod	locally common in seeps, springs and open wells	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

1. Existing data are incomplete for species of greatest conservation need with respect to their distributions, ecological needs, and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
2. The knowledge of spring locations and their biological compositions is incompletely known, because springs and seeps are small and are found primarily on private property, making them difficult to locate and monitor.
3. Our knowledge about the historic and current physical condition of seeps, springs, spring-runs and their associated riparian habitats in the Ozarks is incomplete.

Conservation Actions:

- Conduct reviews of existing literature, reports, and museum records, and interview technical experts to compile historic distributional and ecological information for each species of greatest conservation need.
- Conduct surveys to determine the distributions of seeps and springs and their associated species of greatest conservation need. Use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest benefit for populations of SGCN.
- Conduct research to identify the factors that limit the distributions and abundances of species of greatest conservation need, and examine possible causes of suspected population declines.
- Develop management recommendations to enhance populations of SGCN through improved habitat conditions or enhanced juvenile recruitment.
- Develop monitoring programs for high priority SGCN to measure their abundance, geographic range, the condition of the seeps and springs on which they depend, and water quality in the groundwater that supports these springs.
- Develop and maintain databases to track the locations of springs and the biological communities and water quality associated with them.

Conservation Issues Associated with the Modification of Springs and Surrounding Vegetation:

4. Some springs have been physically modified by the installation of pipes or the construction of low concrete dams to create pools for recreation uses or to water livestock.
5. Riparian and aquatic vegetation has been mechanically cleared around some springs, and grazed/browsed by livestock around others. Removal of this vegetation increases their susceptibility to siltation.
6. Loss of shade over springs should have little effect on water temperatures because springs are too close to the groundwater source to be affected. Spring-fed brooks, on the other hand, may be affected especially as distance from the spring increases.
7. Man-made ponds and lakes have been constructed over springs and seeps, thereby inundating them with deep water and altering their normal habitat structure.

Conservation Actions:

- Identify those springs and seeps that support species of greatest conservation need and are sites of high conservation priority.
- Develop a program to provide landowners with financial incentives to protect springs, or place springs under conservation programs through the purchase of conservation easements on springs or acquisition of springs from willing sellers.
- Provide cost-share funding or grants to landowners to restore the structure of springs and the riparian vegetation around them. These actions can include removal of pipes, concrete, and low dams or the construction of fencing around springs to limit their access by livestock.
- Develop a monitoring program to measure the effectiveness of efforts to protect or restore springs and seeps on populations of species of greatest conservation need.
- Develop and distribute educational materials to landowners including Best Management Practices for use around springs, the biological diversity of springs, and the interconnection of springs, groundwater, and surface streams.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality and Rates of Flow from Springs:

8. Local groundwater withdrawal can reduce the volume of flow from springs.
9. Polluted groundwater surfaces at springs and can affect aquatic life in springs and streams. In areas of karst geology, rain water quickly enters the groundwater with very little filtration by the soil, allowing rainwater to easily carry pesticides, nutrients and water-soluble chemicals into the groundwater.
10. Increased nutrient concentrations in the groundwater can create problems with excessive algae growth in springs and streams.
11. Water quality within springs can be affected by cattle watering in and grazing around springs, and feral hogs watering and wallowing in springs and seeps by increasing the siltation of springs and adding nutrients to the water.
12. Some landowners are unaware of how easily groundwater can be polluted by surface activity in the Springfield Plateau and other sites with karst geology.

Conservation Actions:

- Identify springs and seeps that support populations of species of greatest conservation need and assess their current water quality/quantity and evaluate sources of existing or potential future water quality/quantity degradation.
- Conduct hydrological studies to delineate the recharge area surrounding biologically important springs to determine the surface acreage that needs the attention of conservation programs.
- Develop, publish, and distribute information about Best Management Practices and conservation recommendations for landowners to implement in order to protect groundwater quality/quantity around springs.
- Evaluate the existing conservation assistance programs for landowners (e.g., Farm Bill programs) to determine the applicability of these to the protection of springs and the quality of groundwater around springs.
- Promote existing programs or increase the attractiveness of these programs to landowners by providing better cost-share opportunities, or more acceptable landowner incentives.
- Develop new cost-share programs to help landowners conserve groundwater quantity and protect groundwater quality within the recharge areas of biologically important.
- Construct fences around springs and provide alternative water sources for livestock in order to keep livestock and feral hogs out of springs.
- Develop monitoring programs for populations of species of greatest conservation need, water quality, and water quantity to assess the effectiveness of groundwater conservation programs. Where feasible, involve the landowners by providing them

with the equipment and supplies to conduct monitoring activities or encourage the development of local citizen volunteer groups to conduct monitoring.
- Provide the results of water quality and quantity monitoring programs to the appropriate regulatory or landowner assistance agencies (e.g., Oklahoma Water Resources Board, Oklahoma Department of Environmental Quality, Oklahoma Corporation Commission, local Conservation District, and Natural Resources Conservation Service).
- Acquire fee-title or conservation easements from willing sells who own biologically unique springs that have conservation value to species of greatest conservation need.

Potential indicators for monitoring the effectiveness of the conservation actions:
- number springs/seeps protected through conservation programs (e.g. easements) or ownership
- water quantity (flow) and quality in springs
- changes in population sizes and trends of species of greatest conservation need
- relative condition of habitat in springs and their surrounding riparian zones
- number of modified springs that have been restored
- number of springs that are regularly monitored

Very High Priority Conservation Landscape: White Oak/Hickory Mesic Forest

The Mesic Forest habitat type occurs as linear bands of forest along north-facing and east-facing slopes or as smaller stands of forest in protected ravines, hollows and valleys within the more widespread drier upland oak-hickory forests and woodlands. This habitat is widespread but is restricted to certain physical features of the landscape and sites with favorable moisture and soil conditions. As a result this habitat type can only be managed or restored in specific areas and it rarely occurs as large contiguous landscapes.

Mesic forests have a relatively high diversity of tree species and a diverse vegetative structure. In the Ozark Region, these forests are typically dominated by White Oak (*Quercus alba*), Northern Red Oak (*Quercus rubra*), Mockernut Hickory (*Carya tomentosa*), Bitternut Hickory (*Carya cordiformis*), Sugar Maple (*Acer saccharum*), and White Ash (*Fraxinus americana*). The moist soil conditions often allow the development of abundant understory vegetation including dominant small trees such as Flowering Dogwood (*Cornus florida*), Rusty Blackhaw (*Viburnum rufidulum*), Northern Spicebush (*Lindera benzoin*), Strawberry Bush (*Euonymous atropurpureus*) and Pawpaw (*Asimina triloba*). Other common forest trees include Shumard Oak (*Quercus shumardi*), Chinkapin Oak (*Quercus muehlenbergii*) and American Basswood (*Tilia americana*).

This habitat type is found throughout the Ozark Region and in both the Boston Mountains and Springfield Plateau sections. Sugar Maples are often associated with the most mesic sites and those that experience infrequent fire. The more mesic sites often have greater understory development/ structure.

Recognized plant associations within this habitat include:

- Chinquapin Oak – Shumard Oak Forest
- Chinquapin Oak – Sugar Maple Forest
- Northern Red Oak – Shumard Oak Forest
- Southern Red Oak – Mockernut Hickory Forest
- Sugar Maple – Chinquapin Oak Forest
- Sugar Maple – Northern Red Oak – Bitternut Hickory Forest
- Sugar Maple – White Oak – Mockernut Hickory Forest
- White Oak – Mockernut Hickory – American Basswood Forest

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that are found in the Mesic Forest habitat type are listed in the following table. A narrative description is provided for each species' distribution/status and population trend. Status and trend descriptions are based upon the existing literature and the best professional judgment of the technical experts that were consulted. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. The estimated trend is based upon the statewide population size (if known) or change in the species geographic range. Trend codes are: U = Unknown, S = Stable, D = Decreasing and I = Increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Oklahoma Salamander	common in moist forests near streams that provide habitat for breeding and larval development	S
Amph	Ozark Salamander	locally common in moist forests throughout the region	U
Amph	Ringed Salamander	locally common in forested habitats throughout the region but populations are tied to breeding pools	U
Bird	American Woodcock	uncommon winter resident throughout the region; some birds remain into the nesting season	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Cerulean Warbler	very rare and locally-occurring summer resident that nests in large forest tracts	D
Bird	Hooded Warbler	uncommon summer resident; nests locally in the southern third of the region in areas with abundant woody understory vegetation	U
Bird	Kentucky Warbler	common summer resident; a ground-nesting species that nests throughout the region in areas with abundant understory vegetation	S
Bird	Wood Thrush	rare summer resident; nests locally in large forest tracts in the eastern half of the region	D
Bird	Worm-eating Warbler	rare summer resident; nests locally in forest tracts with tall understory shrubs	U
Inve	American Burying Beetle	uncommon; federally-listed as an endangered species; found in areas with deeper soils in Cherokee County	S
Inve	Diana Fritillary	uncommon and locally occurring in the southern half of the region	U
Inve	Oklahoma Liptooth Snail	widespread endemic land snail; distribution and habitat needs are incompletely known	U
Inve	Ozark Mantleslug	Ozark-endemic land snail that is known from the southern quarter of the region	U
Inve	Wyandotte Liptooth Snail	widespread but uncommon Ozark-endemic land snail	U
Mamm	Eastern Spotted Skunk	uncommon and secretive; its status is poorly known; most records are from the southern third of the region	U
Mamm	Gray Bat	locally common during the summer months in the vicinity of 9 to 11 caves that support maternity or bachelor colonies; federally listed as an endangered species	I
Mamm	Indiana Bat	rare spring and fall migrant through the region; federally listed as an endangered species	U
Mamm	Northern Long-eared Bat	Locally-occurring and common resident throughout the region; federally listed as a threatened species	S
Mamm	Ozark Big-eared Bat	rare and restricted to a few areas in the southern half of the region; federally listed as an endangered species	S
Rept	Northern Scarletsnake	poorly documented in the Ozark region because of its secretive, burrowing habits	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion Conservation Issue:

1. Fragmentation and loss of habitat due to expanding infrastructure including roads, utility lines, and pipelines.
2. Fragmentation and loss of habitat due to increasing number of residential developments (i.e., particularly secondary homes, cabins, retirement homes, and small hobby ranches).
3. Fragmentation and loss of habitat caused by the conversion of mesic oak-hickory forest to other land uses such as introduced pastures that are planted to Tall Fescue. Fragmentation of mesic hardwood forest tracts decreases the quality of the habitat for species that have large spatial requirements (e.g. area-sensitive species such as forest-interior songbirds). Also, it isolates tracts of forest from one another and decreases the ability of animals to disperse between habitat tracts.

Conservation Actions:

- Develop a landowner incentives program to encourage the retention of mesic forest stands to reduce the fragmentation of forest tracts and prevent their conversion to other vegetation types such as introduced pasture.
- Develop programs to maintain biologically meaningful tracts of mesic oak-hickory forests such as conservation easements, conservation leases, purchase of development rights, or willing-seller fee-title land acquisitions. These should be preceded by a regional assessment of habitat conditions to identify focus areas of greatest conservation value in order to get the greatest "bang for the buck" or efficiency.
- Develop wildlife corridors to connect tracts of mesic hardwood forest or to connect mesic forest with other forest habitat types such as riparian forest.
- Evaluate means to make it economically feasible for private landowners to maintain their land in oak-hickory forest (e.g., encourage markets for oak and hickory timber, or encourage groups of landowners to work together as a block to manage habitat for hardwood timber production or hunting leases).
- Evaluate methods to restore mesic oak-hickory forest on introduced pastures or crop fields, and develop cost-share programs, grants, or financial incentives to encourage landowners to restore these areas.
- Support cooperative efforts between government agencies, and research institutions to develop Best Management Practices and management recommendations to minimize the ecological footprint left by road, pipeline, and utility line construction, and the impacts of right-of-way maintenance practices. Develop and distribute informational materials with these Best Management Practices and recommendations to landowners, agencies, and utility companies.
- Develop educational materials for schools and landowners that highlight the value (i.e., ecological and economic) of hardwood trees and mesic forests.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

4. Mesic forests have not been extensively studied in Oklahoma and data are incomplete for many species of greatest conservation need that use this habitat type. In order to establish effective conservation actions, more complete data are needed to determine the population status and trend for many species and a more thorough evaluation is needed to determine the factors that limit population sizes or are responsible for declines.
5. Mesic hardwood forests occur on sites with specific soil, slope and aspect conditions. These locations are not completely known but it may be possible to model the likely distribution of mesic forests. Our knowledge about the historic and current physical conditions of mesic forest habitats in the Ozarks is incomplete.

Conservation Actions:

- Conduct reviews of existing literature, reports, and museum records, and interview technical experts to compile historic and recent distributional and ecological information for each of the species of greatest conservation need (SGCN) in mesic forests.
- Develop methods to identify and map the distribution of the remaining mesic forest tracts and model their probable historic distribution. Inventory the remaining habitat tracts to determine their condition and the biological communities that they support. Where appropriate, identify the conservation practices that could enhance the value of these habitat tracts for SGCN.
- Conduct surveys and research to assess the current distribution, abundance and habitat affinities for priority species of greatest conservation need. Use these data to identify the geographic areas and habitat conditions where conservation efforts should be directed to provide the greatest benefit for populations of SGCN. Identify

and prioritize core areas of habitat and, where needed, corridors to increase habitat connectivity between mesic forest sites and with other forest habitats.
- Develop management recommendations to enhance populations of SGCN through improved habitat conditions or enhanced juvenile recruitment, and conduct field studies to establish baseline population data/information.
- Develop monitoring programs for high priority SGCN to measure their abundance, geographic range and the condition of the forests in which they occur. Develop and maintain databases to store and analyze these distributional and ecological data.
- Research the historic condition of mesic hardwood forest habitats in the Ozarks in order to develop a realistic and biologically meaningful description of high quality habitat that can serve as the target condition for habitat restoration, enhancement and maintenance efforts.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

6. As a result of widespread timber harvest in the early 1900s, many tracts of mesic forest are comprised of dense, even-aged second growth forest resulting in stands that lack the diverse structure of canopy, mid-story, and understory vegetation that is found in the historically occurring uneven-aged forests, with greater tree density and denser canopies or mid-stories that limit the abundance of herbaceous understory vegetation.
7. In local areas, herbaceous understory vegetation may be limited by heavy grazing by cattle.
8. Dense canopy or mid-story conditions can limit light penetration to the forest floor. Sustained shading can limit the recruitment of oak species in favor of more shade tolerant species thus altering the species composition and structure of the forest.
9. The use of off-road vehicles and all terrain vehicles can compact soil, create soil erosion problems, and damage understory vegetation, as well as crush wildlife (e.g., salamanders) that live in the dense leaf litter found in mesic forests.
10. This region supports the greatest diversity of amphibians that depend upon vernal pools and seasonal wetlands for reproduction. Vernal pools have been lost or degraded as a result of sedimentation and/or feral hog activity.

Conservation Actions:

- Evaluate the effectiveness of mid-story thinning and selective canopy thinning as tools to diversify forest structure and increase the diversity and abundance of understory vegetation.
- Provide cost-share funding to install fences to control cattle grazing within mesic forest tracts, or lease grazing rights to remove cattle or reduce stocking rates.
- Develop informational materials about the potential impacts of off-road vehicle use and develop recommendations to minimize these impacts (e.g., time of year when damage is least).
- Identify and develop protection and management plans for vernal pools, seeps and seasonal wetlands that are important to salamander species of greatest conservation need, including such activities such as fencing, dredging/removal of accumulated sediments, development of conservation easements, or construction of new vernal pools.
- Develop monitoring programs to evaluate the success of vernal pool management plans and their effects on local populations of amphibians.
- Purchase conservation easements or fee-title from willing sellers to biologically important tracts of mesic forest to enhance their habitat quality for species of greatest conservation need.

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

11. Exotic plant species such as Sericea Lespedeza, Tall Fescue, *Microstegium* grass, Chinese Privet, Amur Honeysuckle and Japanese Honeysuckle have become established in mesic hardwood forests and are displacing native plants that appear to be altering native plant communities and habitat conditions for wildlife species of conservation need.
12. Feral hogs cause substantial ecological damage to vernal pools and compete with native wildlife for food.
13. Feral cats exert additional predation pressure upon local populations of small reptiles, amphibians, birds, and mammals.
14. The Emerald Ash Borer beetle and exotic tree pathogens, such as those effecting native chestnuts and flowering dogwood, can alter forest structure and diversity.

Conservation Actions:

- Evaluate the severity and magnitude of the ecological damage done by exotic plant and animal species, including displacement of native plant communities, predation on native animal populations, or hybridization with native species.
- Identify those exotic species causing the greatest impact to mesic forests and species of greatest conservation need and develop control or eradication plans for them (e.g., controlled burning programs, herbicide treatment, and mechanical removal). Develop monitoring programs to evaluate the effectiveness of these control measures.
- Promote cost-share or incentives programs for private landowners that encourage the control of invasive and exotic species.
- Develop educational materials about the ecological damage done by invasive and exotic vegetation as well as introduced plant diseases.
- Develop education and outreach materials about the impact that feral cats can have on native wildlife within the forest ecosystem.

Potential indicators for monitoring the effectiveness of the conservation actions:

- landowners/acres involved in conservation programs.
- number or percentage of acres acquired or placed into conservation programs (e.g. easement or incentive programs).
- relative condition (populations/trends) of species of greatest conservation need and key indicator species.
- relative condition (stand health and composition) and acreage of remaining habitat.
- number of acres of mesic forest restored
- number of acres of mesic forest enhanced through sustainable timber management that benefits wildlife and plant communities

Very High Priority Conservation Landscape: Gravel-bottom Streams and Associated Riparian Forests

Most of the streams within the Ozark Region have cobble or gravel substrates. Because of the karst geology of the Springfield Plateau, many surface streams are strongly influenced by groundwater connections and receive a substantial portion of their flow from springs and seeps. Many streams have sections in which the stream loses flow to or gains flow from a shallow, underlying aquifer. Often, streams in areas of low elevational gradient have well developed series of pools and riffles. These streams are typically slightly to moderately entrenched, are much wider than they are deep, and have a well-developed floodplain. Streams in areas with higher elevational gradients are typically about as wide as they are deep, have few meanders, have narrow floodplains, and are structured as a series of pools, riffles and steps. Stands of riparian forests are relatively narrow along high gradient streams but are wide in meandering low-gradient streams. These forests are commonly dominated by River Birch (*Betula nigra*), Silver Maple (*Acer saccharinum*), Red Maple (*Acer rubrum*), and Sycamore (*Platanus occidentalis*) with an understory of Silky Dogwood (*Cornus amomum*), Spring Witch-hazel (*Hamamelis vernalis*), Swamp Indigo (*Amorpha frutescens*), Deciduous Holly (*Ilex decidua*) and St. John's-wort (*Hypericum sp.*).

Recognized riparian plant associations within this habitat include:

American/Red Elm – Chinquapin Oak Temporarily Flooded Forest
American/Red Elm – Sugarberry/Hackberry – Green Ash Temporarily Flooded Forest
Eastern Cottonwood – American Elm – Sugarberry Temporarily Flooded Forest
Giant Cane Temporarily Flooded Shrubland
Green Ash – American Elm Temporarily Flooded Forest
River Birch – Sycamore – Smooth Alder Temporarily Flooded Forest
Silver Maple - Boxelder Temporarily Flooded Forest
Spring Witch-Hazel – Silky Dogwood Temporarily Flooded Shrubland
Swamp Privet - Buttonbush Semi-permanently Flooded Shrubland
Sycamore – Boxelder Temporarily Flooded Forest

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that are found in the Gravel-bottom Stream/Riparian Forest habitat type are listed in the following table. A narrative description is provided for each species' distribution/status and population trend. Status and trend descriptions are based upon the existing literature and the best professional judgment of the technical experts that were consulted. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. The estimated trend is based upon the statewide population size (if known) or change in the species geographic range. Trend codes are: U = Unknown, S = Stable, D = Decreasing and I = Increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Grotto Salamander	uncommon and locally occurring in streams associated with springs and karst systems across the Springfield Plateau	U
Amph	Oklahoma Salamander	widespread and locally common in streams with gravel substrates	S
Bird	American Woodcock	uncommon winter resident throughout the region; some birds remain into the nesting season	U
Bird	Little Blue Heron	locally common summer resident throughout the region in the vicinity of nesting colonies	U
Bird	Louisiana Waterthrush	uncommon summer resident that nests throughout the region	S
Bird	Prothonotary Warbler	uncommon summer resident that nests throughout the	D

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
		region	
Fish	Blackside Darter	rare fish that occurs in low densities; appears to be limited to Lee Creek watershed; state-listed as a threatened species	D
Fish	Bluntface Shiner	uncommon and locally occurring in tributaries of the Grand River	U
Fish	Cardinal Shiner	widespread and common in streams throughout the region	S
Fish	Least Darter	uncommon and locally occurring within the Spring Creek watershed and tributaries of the Spring River	U
Fish	Longnose Darter	state-listed as endangered; rare species that is limited to the Lee Creek watershed	D
Fish	Ozark Minnow	common and widespread Ozark-endemic species that is found throughout the region	U
Fish	Plains Topminnow	uncommon and appears to be restricted to tributaries within the Spavinaw Creek watershed	U
Fish	Redfin Darter	common in low-gradient stream tributaries to the Arkansas and Grand rivers along the southern and western boundary of the region	U
Fish	Redspot Chub	common and widespread Ozark-endemic species found throughout the region	U
Fish	River Darter	uncommon and difficult species to survey due to its deep water habitat preferences; found in large tributary streams to the Grand and Illinois rivers	U
Fish	Shorthead Redhorse	uncommon species found in larger streams throughout the region	U
Fish	Southern Brook Lamprey	uncommon species with poorly defined range; is difficult to survey because of its relatively long larval stage and short adult lifespan.	U
Fish	Sunburst (Stippled) Darter	locally common Ozark-endemic that is found throughout the region	U
Fish	Wedgespot Shiner	common and widespread Ozark-endemic that is found throughout the region	S
Inve	Allocapnia jeannae (stonefly)	locally occurring in Ozark streams but its range is incompletely known	U
Inve	Linda's Roadside Skipper	uncommon species found in riparian forests; larvae feed on *Chasmanthium* grass	U
Inve	*Nixe flowersi* (mayfly)	locally common in the Spring Creek watershed; probably more widespread within the region	U
Inve	*Orconectes macurus*	locally common in direct tributaries on the Ozark Highlands side of the Grand River	U
Inve	*Orconectes meeki*	locally common in tributaries of Spavinaw Creek and the Illinois River	U
Inve	*Orconectes nana*	locally common throughout the Illinois River watershed where it is endemic	S
Inve	Ouachita Kidneyshell	uncommon in larger tributary streams to the Illinois River	U
Inve	Ozark Clubtail	locally common throughout the region	U
Inve	Ozark Emerald	rare and locally occurring in the southern half of the region	U
Inve	Tricorythodes curvatus (mayfly)	probably occurs in scattered locations within the Ozarks, but occurrence not yet confirmed in Oklahoma	U
Mamm	Gray Bat	locally common in the vicinity of 9 to 11 caves that support maternity colonies; frequently forages in riparian forests	S
Mamm	Swamp Rabbit	uncommon and locally occurring in flood plain forests	D

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
		in southern part of the region	
Rept	Eastern River Cooter	common and widespread throughout the region	U
Rept	Mississippi Map Turtle	uncommon but widespread throughout the region	U
Rept	Northern Map Turtle	rare and limited to streams along the Missouri state line	U
Rept	Ouachita Map Turtle	common and found throughout the region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality:

1. The presence of many confined animal feeding operations such as cattle feedlots, poultry houses, hog farms, and waste application fields close to streams and drainages adding excess nutrients to streams.
2. Additional nutrients enter streams as a result of livestock watering in streams and grazing in riparian areas.
3. Increased nutrient levels in streams increases the abundance of algae, resulting in other water quality impacts such as increased fluctuations in dissolved oxygen.
4. Endocrine disrupters and other pollutants from pesticides enter streams in storm water runoff from agricultural fields, altering the growth, reproduction and/or survival of fish, amphibians, and invertebrates in the streams.
5. Lack of headwaters protection allows for more sediment, nutrients, pesticides, and other pollutants to enter streams.
6. Increased sediment in the stream can fill or alter riffles and gravel beds which serve as spawning areas for fish and habitats for freshwater mussels.
7. Loss of stream shading as a result of reduced riparian vegetation increasing water temperatures and altering the aquatic animal community.

Conservation Actions:

- Develop conservation easements or acquire land to maintain or restore natural riparian vegetation along streams to reduce or limit agricultural development in and adjacent to riparian areas.
- Establish set back distances between streams and confined animal farming operations, waste lagoons and land application areas.
- Increase cost-share funding to construct fencing along streams and riparian areas to control/limit access by cattle.
- Increase the funding for and promotion of existing cost-share programs that restore riparian vegetation along streams.
- Increase the acceptability and implementation of Best Management Practices to control nutrients and pesticides in storm water runoff by improving cost-share ratios.
- Develop local watershed councils, stream teams, and citizen's groups to address local concerns through education and monitoring of water quality & wildlife populations.
- Improve the knowledge of and access to Farm Bill incentives and cost-share programs to improve water quality through the implementation of Best Management Practices and establishment of streamside buffer zones.
- Reduce sedimentation that originates from gravel road crossings.

Conservation Issues Related to Land Management Practices that Alter In-stream and Riparian Habitats:

8. The abundance and diversity of understory vegetation has declined in riparian areas as a result of livestock grazing, especially during the growing season. This reduction in the abundance of riparian vegetation increases erosion and sedimentation.

9. Riparian Forests have been cleared and converted to crop fields, or introduced pastures of exotic grasses such as Tall Fescue and Bermudagrass.
10. Riparian forests are being fragmented by roads, bridges, houses, pastures, and utility right-of-ways.
11. Clearing of riparian vegetation reduces stream bank stability which increases erosion and alters the width/depth ratios of streams.
12. Those streams in the region that have been channelized or straightened are becoming incised and no longer connected with their riparian vegetation and flood plain wetlands.
13. Streams with incised channels have cut banks that are prone to erosion which increases sediment loads in the streams.
14. In-stream gravel mining reduces bank stability upstream and downstream of the mining area increasing bank erosion, and altering the width to depth ratio of the stream by making it wider and shallow.
15. In-stream gravel mining can remove or reduce riffles, gravel beds and other stream structures that are important habitat for aquatic wildlife.
16. Bridge and stream crossing designs that incorporate box culverts or tinhorns may impede or block the passage of fish and thereby fragment fish populations.

Conservation Actions:

- Increase cost-share funding or provide grants to landowners to fence riparian forests in order to control/limit their access by cattle.
- Purchase easements to protect or enhance existing riparian vegetation, or to restore riparian forests.
- Encourage the planting/construction of alternative shading for livestock to reduce their use of riparian areas.
- Provide landowner incentives or cost-share programs to protect or restore riparian forests, stream banks and in-stream habitat.
- Use conservation easements, leases or fee-title purchase of stream and riparian habitat to place it into conservation management to conserve or enhance existing habitat and to control/limit the introduction of sediment, nutrients and chemical pollutants.
- Develop new or promote existing Best Management Practices for the grazing of cattle adjacent to riparian zones.
- Restore or construct seasonal wetlands/vernal pools within the riparian zones or floodplains of streams.
- Reconnect stream and riparian vegetation through the restoration of stream channels.
- Develop regulations to eliminate gravel mining from within streams.
- Work with local communities and counties to reduce stream channel impacts including in-stream gravel mining, placement of rip-rap on stream banks at bridge crossings, and recreational use of streams by off-road vehicles.
- Provide technical assistance to counties and landowners regarding bridge designs that will not impede fish movements. Develop a cost-share program to replace bridges and culverts that block the passage of fish species of greatest conservation need.

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

17. Exotic plant species such as Chinese Privet, Tall Fescue, Autumn Clematis, Amur Honeysuckle and Japanese Honeysuckle have become established and are becoming more abundant in riparian forests. These species compete with native plants and alter the physical structure and diversity of the habitat that can be used by animals.
18. Feral hogs that forage in streams and along stream banks damage riparian vegetation and reduce bank stability.

19. Exotic aquatic plants have the ability to over-grow and out-compete native aquatic plants. Their expansion creates local monocultures that reduce the quality of shallow-water habitats for fish and invertebrates.
20. Brown-headed Cowbirds have become more abundant in riparian areas due to cattle grazing. Brown-headed Cowbirds lay their eggs in the nests of other birds thus reducing the number of chicks from the host species.

Conservation Actions:

- Increase funding for the implementation of Oklahoma's aquatic invasive/nuisance species management plan, and update the plan to incorporate riparian species.
- Conduct studies to quantify the impact of exotic species on riparian forest communities (i.e., both plants and animals) and on aquatic animal communities.
- Increase educational efforts and public awareness of the ecological and economic impacts of exotic plant and animal populations.
- Coordinate with all agencies to stop practices and recommendations that encourage the planting of invasive and exotic species.
- Develop and implement plans for the control and management of Brown-headed Cowbirds in riparian areas that support populations of avian SGCN.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

21. Existing data are incomplete for species of greatest conservation need with respect to their distributions, ecological needs, and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
22. Our knowledge about the historic and current physical condition of in-stream habitats and riparian habitats in the small rivers of the Ozarks is incomplete. There is a general scarcity of monitoring data for the biological composition of streams (e.g., fish, mussel, and macroinvertebrate communities) and limited data from which to evaluate the condition of streams and riparian forests prior to large scale human alteration of the landscape.
23. The resources of riparian forests and streams are difficult to monitor because most of the habitat occurs on private land and is distributed in small tracts across many individual landowners.

Conservation Actions:

- Conduct reviews of existing literature, reports, and museum records, and interview technical experts to compile historic distributional and ecological information for each species of greatest conservation need.
- Conduct surveys and research to assess the current distribution, abundance and habitat affinities for priority species of greatest conservation need. Use these data to identify the geographic areas and habitat conditions where conservation efforts should be directed to provide the greatest benefit for populations of SGCN. Inventory amphibian, fish, crayfish, and mussel populations in streams to increase the knowledge of biological communities within specific watersheds.
- Conduct research to identify the factors that limit the distributions and abundances of species of greatest conservation need and examine possible causes of suspected population declines.
- Develop management recommendations to enhance populations of SGCN through improved habitat conditions or enhanced juvenile recruitment, and conduct field studies to establish baseline population data/information.
- Develop monitoring programs for high priority SGCN to measure their abundance, geographic range and the condition of the habitats on which they depend. Develop and maintain databases to store and analyze these distributional and ecological data.

- Research the historic condition of streams using literature and maps to establish what stream and riparian habitats looked like historically in order to establish a target condition for stream and riparian restoration and maintenance efforts.
- Develop methods to identify and map the distribution of the remaining habitat tracts, then inventory these tracts to determine their condition and the biological community that they support. Where appropriate, identify the conservation practices that could enhance the value of these habitat tracts for SGCN.

Conservation Issues Related to Activities that Alter Flow Patterns and Water Quantity:

24. Some types of culverts can become barriers to the movement of fish during low-flow conditions.
25. Dams and bridges across streams can create fish barriers that affect the populations of fish and freshwater mussels.
26. Dams and diversion structures alter the natural flow patterns and other processes of streams, especially the frequency and magnitude of natural flooding events.
27. Water is being pumped from streams for irrigation in some areas during the summer months.
28. Groundwater is being pumped from shallow aquifers for municipal and agricultural purposes, lowering water tables and reducing the flow volume of springs and seeps that feed streams.
29. Increased pond construction may be lowering the inflow of water that sustains the base flow of streams.

Conservation Actions:

- Identify the impoundments which can be shown to block the movement of fish species of conservation need. Evaluate alternatives for re-establishing connectivity with fish populations (e.g. through translocation of fish to mimic gene flow or the construction of fish passage structures).
- Remove or rehabilitate culverts and road crossing with new structures that do not create barriers to fish.
- Modify pond and reservoir management to ensure that minimum in-stream flows are maintained below these structures.
- Provide cost-share or grants to restore the natural cross-section profile to stream channels and establish native vegetation on stream banks for stability.
- Establish minimum in-stream flow levels on all biologically important streams (i.e., those streams that support populations of species of greatest conservation need or diverse aquatic communities) and manage the timing and volume of water withdrawals to have the least impact on SGCN.
- Prevent the sale of water to entities outside of the state and the transfer of water between basins within Oklahoma.
- Provide the results of ecological studies to water use planners and permit issuers.
- Support the development of a state water management plan with sound biological data that demonstrates the ecological impact of water sales, water withdrawals, and inter-basin transfers of water.

Potential indicators for monitoring the effectiveness of the conservation actions:

- number of acres acquired (including easements) within a given watershed
- reduction in the number and size of streamside gravel mining sites
- change in acreage of riparian forests and floodplain wetlands
- number of landowners participating in conservation practices
- miles of restored, and protected streams
- number of active, local conservation groups (stream teams)
- number of conservation-based partnerships with local governments
- changes in population sizes and trends of species of greatest conservation need
- changes in the condition and acreage of forested riparian habitat.

- changes in water quantity/stream flow
- Changes in water quality parameters (e.g. nutrients, pesticides, metals, chlorophyll)
- Change in populations and distribution of invasive aquatic species

High Priority Conservation Landscape: Shortleaf Pine-Oak-Hickory Woodlands

This habitat is uncommon in the Ozark Region and occurs locally in portions of the Springfield Plateau in Cherokee and Delaware counties on ridge tops, and on dry, rocky upper portions of east, south, and west-facing slopes. This habitat type is comprised of a mosaic of woodlands and forests dominated by Shortleaf Pine (*Pinus echinata*), and several species of oaks and hickories. This habitat type is shaped by the combination of dry soils and periodic fire. The plant community is dominated by an association of Shortleaf Pine, Post Oak (*Quercus stellata*) and Blackjack Oak (*Quercus marilandica*) with smaller numbers of Black Hickory (*Carya texana*), Bitternut Hickory (*Carya cordiformis*), Black Oak (*Quercus velutina*) and Chinkapin Oak (*Quercus muehlenbergii*). Beneath the open canopy of pines, oaks and hickories is an herbaceous and short-shrub understory dominated by Little Bluestem (*Schizachyrium scoparium*), Lowbush Blueberry (*Vaccinium pallidum*), False Indigo (*Baptisia alba*), St John's Wort (*Hypericum hypericoides*), and Stiff Sunflower (*Helianthus divaricatus/hirsutus*).

Historically, most of this habitat occurred in a more open woodland condition. However, the combination of large-scale harvesting and decades of fire suppression have resulted in a much of this habitat currently being in a densely stocked, relatively even-aged second-growth forest condition.

Recognized plant associations within this habitat type include:

Shortleaf Pine – Northern Red Oak – Black Oak Forest
Shortleaf Pine – Post Oak – Blackjack Oak Forest
Shortleaf Pine – White Oak – Black Oak Forest

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that are found in the Shortleaf Pine-Oak Woodland habitat type are listed in the following table. A narrative description is provided for each species' distribution/status and population trend. Status and trend descriptions are based upon the existing literature and the best professional judgment of the technical experts that were consulted. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. The estimated trend is based upon the statewide population size (if known) or change in the species geographic range. Trend codes are: U = Unknown, S = Stable, D = Decreasing and I = Increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	American Woodcock	uncommon, secretive winter resident throughout the region; some birds remain into the nesting season	U
Bird	Bachman's Sparrow	rare and locally occurring summer resident; nests in open pine/oak woodlands with a grassy understory	U
Bird	Blue-winged Warbler	rare summer resident; nests in large openings within forested landscapes and open savannahs	U
Bird	Brown-headed Nuthatch	occurred historically in the region, but there are currently no known populations	D
Bird	Kentucky Warbler	uncommon but widespread summer resident; nests in areas with abundant deciduous shrub cover	U
Bird	Northern Bobwhite	uncommon and locally occurring year-round resident; found in open woodlands with a herbaceous understory	D
Bird	Prairie Warbler	uncommon and locally occurring summer resident; nests in open pine/oak woodlands with a grassy and shrubby understory	D
Bird	Red-headed Woodpecker	uncommon year-round resident throughout the region; wintering population is larger	D

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Whip-poor-will	uncommon and locally occurring throughout the region; recent research indicates a preference for woodland habitats with open canopies or close proximity to forest edges	U
Inve	Diana Fritillary	uncommon and locally occurring in open woodlands with mature trees and abundant herbaceous vegetation	U
Mamm	Long-tailed Weasel	rare and secretive; its distribution is poorly known	U
Mamm	Northern Long-eared Bat	common resident throughout the region in areas with mature tree cover; federally listed as a threatened species	S
Rept	Western Diamond-backed Rattlesnake	uncommon and locally occurring in rocky, open-canopy woodlands	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

1. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
2. Data are incomplete regarding both the historic and current distribution and condition of this habitat type, which is typically found embedded within larger mosaics of oak/hickory woodlands and forests.

Conservation Actions:

- Conduct reviews of the existing literature, reports, and museum records to evaluate historic distributions and abundances of species of greatest conservation need, and to compile relevant ecological and life history information.
- Conduct surveys to assess the current distribution and habitat affinities for priority SGCN and use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest benefit for SGCN.
- Conduct research to identify the factors that limit the distribution and abundance of priority SGCN and develop management recommendations to enhance populations through improved habitat conditions.
- Research the historic condition of pine-oak woodland habitats in order to develop realistic and biologically meaningful descriptions for how high quality habitats should look. This should serve as the range of target conditions for habitat restoration, enhancement and maintenance efforts.
- Develop methods to identify and map the distribution of the remaining habitat tracts, then inventory these tracts to determine their condition. Identify the conservation practices that could enhance the value of these habitat tracts to SGCN.
- Develop monitoring programs for selected SGCN populations and for measuring habitat abundance and condition
- Collect information regarding wildlife abundance and density in order to translate acres of habitat changed into wildlife population changed
- Develop and provide long-term funding to maintain databases to store and analyze distributional and ecological data for species of greatest conservation need.
- Publish and make the results of all ecological studies available to land managers and conservation agencies so that they can be incorporated into site-specific, species-specific and regional conservation plans.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

3. Fragmentation and loss of habitat caused by the conversion of oak-hickory woodlands and forests to other land uses such as small-scale loblolly pine plantations, rangeland, or introduced pastures that are planted to monocultures of Tall Fescue.
4. Fragmentation and loss of habitat due to increasing number of residential developments including secondary homes, cabins, and small hobby ranches.
5. Fragmentation and loss of habitat due to expanding infrastructure including roads, utility lines, and pipelines.

Conservation Actions:

- Evaluate means to make it economically feasible for private landowners to maintain their land in shortleaf pine-oak woodlands (e.g., encourage markets for oak and hickory timber, or encourage groups of landowners to work together to manage habitat on adjacent tracts for hardwood timber production or hunting leases).
- Develop programs to maintain large tracts of shortleaf pine-oak-hickory woodlands such as conservation easements, conservation leases, purchase of development rights, or willing-seller land acquisitions. This should be preceded by a regional assessment of habitat distribution and physical condition to identify focus areas of greatest conservation value in order to maximize conservation efficiency.
- Evaluate methods to restore shortleaf pine-oak-hickory woodlands from pastures or crop fields, and develop cost-share programs, grants, or financial incentives to encourage landowners to restore/replant these areas to pine-oak woodlands.
- Coordinate with other agencies and research institutions to develop Best Management Practices and management recommendations to minimize the disturbance caused by and the ecological footprint left by road, pipeline, and utility line construction, and right-of-way maintenance.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

6. Only a small portion of this habitat type exists in a woodland condition. Most of it has gradually changed to a closed-canopy forest-like condition as the result of widespread fire suppression and the loss of the historic fire regime.
7. Much of this habitat type currently exists as even-aged forest. This change from a woodland habitat comprised of trees of diverse ages and heights to a forest of relatively even-aged tress appears to be an artifact of the widespread timber harvest that occurred in the Ozark Region during a relatively short period of time in the late 1800s and early 1900s, followed by decades of fire suppression. The combination of even-aged stands and decades of fire suppression appear to be responsible for greater tree densities than occurred historically. If the lack of periodic fire and dense forest canopy conditions continues, it may reduce the successful recruitment of shortleaf pines and some species of oaks in the future.
8. There are constraints to using management tools such as prescribed burning and such restraints limit the ability to restore woodland conditions to stands that are currently forests. Such constraints include lack of personnel and financial resources, air quality concerns, lack of technical guidance/assistance, logistical difficulties, and landowner liability issues.
9. The effects of prescribed burning on many species of greatest conservation need are poorly known, particularly salamander and terrestrial snails that are active in the leaf litter during the late winter and early spring. Prescribed burning is likely to be beneficial to all or most species; however, the timing, frequency, and size of burns are likely to affect species differently.
10. Many landowners are not aware of the gradual changes that have occurred in the condition of woodland habitat and do not have information or technical assistance

available to them if they want to restore or enhance woodland habitat structure for species of greatest conservation need.

11. In local areas, continuous grazing within shortleaf pine-oak-hickory woodlands may reduce the abundance of herbaceous understory vegetation, limit the recruitment of some forb and tree species, and cause erosion on steep slopes.

Conservation Actions:

- Use studies of historic fire regimes and the historic distribution of this woodland habitat to develop site-specific recommendations for the use of prescribed burning. These recommendations should evaluate the timing (i.e., season), sizes and frequencies of prescribed burns to balance the needs of fire dependent species (e.g., pines, some birds) and fire sensitive species (e.g., amphibians).
- Evaluate ways to reduce the impediments and constraints that reduce the use of prescribed fire as a management tool. These may include:
    - providing funding to agencies to assist with conducting controlled burns on private property,
    - developing technical assistance materials for landowners (e.g., publications, burning guidelines, workshops, equipment rentals, and demonstration areas),
    - providing financial assistance or incentives to landowners to encourage woodland restoration,
    - developing burn cooperatives to work with agencies and landowners to increase the use of burning, and
    - promoting the use of prescribed burn insurance that cover landowners that conduct prescribed burns.
- Develop monitoring programs to evaluate the effects of management techniques such as prescribed fire and mid-story tree thinning on populations of species of greatest conservation need and vegetation structure.
- Develop informational materials to inform landowners and the general public about the benefits of woodland restoration, the importance of fire in maintaining shortleaf pine-oak-hickory woodlands and the wildlife diversity of this habitat type.
- Evaluate means to make it economically feasible for private landowners to maintain their land in shortleaf pine-oak woodlands such as leasing for hunting, fishing and nature tourism.
- Develop programs to maintain large tracts of shortleaf pine-oak-hickory woodlands such as conservation easements, conservation leases, purchase of development rights, or willing-seller land acquisitions, preceded by a landscape-level assessment of habitat conditions to identify focus areas of greatest conservation value in order to get the greatest “bang for the buck” or conservation efficiency.
- Evaluate methods to restore shortleaf pine-oak-hickory woodlands from pastures or crop fields, and develop cost-share programs, grants, or financial incentives to encourage landowners to restore/replant these areas to pine-oak woodlands.
- Purchase grazing rights to remove cattle or establish rotational grazing programs to defer grazing on some areas during the growing season or during some years, while still providing income for landowners.

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

12. Several exotic plant species such as Sericea Lespedeza, Tall Fescue, *Microstegium* grass, and Japanese Honeysuckle have become established outside of cultivation and appear to be displacing native plants and altering habitat conditions for wildlife species of conservation need.
13. Cattle grazing may enhance the spread of undesirable exotic vegetation such as brome, cinquefoil and other pasture weeds, and it may attract Brown-headed Cowbirds that parasitize the nests of songbirds.

Conservation Actions:

- Conduct research into the land practices that facilitate the dispersal and establishment of invasive exotic species in the region.
- Evaluate the severity and magnitude of the ecological damage done by exotic plant and animal species in order to identify those species causing the greatest impact to woodland habitats and their associated species of greatest conservation need.
- Develop control or management plans for the exotic species that cause the greatest ecological damage (e.g., controlled burning programs, deferred grazing, herbicide treatment, or mechanical removal), and develop monitoring programs to evaluate the effectiveness of these control measures.
- Develop invasive/nuisance species management plans for all public conservation lands.
- Develop cost-share, or incentives programs for private landowners to encourage them to control invasive and exotic species.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acres burned regularly and/or thinned
- changes in acreage/coverage of exotic vegetation
- easements secured and acreage placed under conservation programs or ownership
- acres of native pine/oak woodland plant communities restored
- changes in population sizes and trends for representative species of greatest conservation need
- changes in the canopy closure and abundance of understory vegetation in woodlands and savannahs

High Priority Conservation Landscape: Oak/Hickory Bottomland Hardwood Forest

Bottomland hardwood forests are found within the floodplains of the rivers and larger streams throughout the region. However, rough topography and rocky soils limit the size and distribution of bottomland hardwood forests in the Ozark Region more than in the adjacent regions. Less than 50,000 acres of this habitat type are thought to be present in the region. Much of the historic bottomland habitat in the Ozark Region has been converted to agricultural uses (e.g., crop fields or introduced pasture) or permanently inundated by the construction of reservoirs on Spavinaw Creek, and on the Illinois and Grand-Neosho River systems. The largest remaining stands of this habitat in the region occur in the floodplain of the Grand-Neosho River and its larger tributary streams. Bottomland hardwood forests are diverse plant communities and their species composition varies with soil conditions and with flooding frequency and duration. Bottomland hardwood forests in this region are dominated by oak species (e.g., Bur Oak (*Quercus macrocarpa*), Pin Oak (*Quercus palustris*), Shumard Oak (*Quercus shumardii*) and Chinkapin Oak (*Quercus muehlenbergii*), but other common canopy trees include Pecan (*Carya illinoiensis*), Black Gum (*Nyssa sylvatica*), White Ash (*Fraxinus americana*), Red Maple (*Acer rubra*) and Sugarberry (*Celtis laevigata*). Common understory vegetation includes Green Hawthorn (*Crataegus viridis*), Deciduous Holly (*Ilex decidua*), Sassafras (*Sassafras albidum*) and Spicebush (*Lindera benzoin*)

Recognized plant associations within this habitat include:

- Black Gum – Red Maple Temporarily Flooded Forest
- Bur Oak – Shumard Oak – Bitternut Hickory Temporarily Flooded Forest
- Pecan – Sugarberry Temporarily Flooded Forest
- Pin Oak – Pecan/Deciduous Holly Seasonally Flooded Forest

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that are found in the Bottomland Hardwood Forest habitat type are listed in the following table. A narrative description is provided for each species' distribution/status and population trend. Status and trend descriptions are based upon the existing literature and the best professional judgment of the technical experts that were consulted. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. The estimated trend is based upon the statewide population size (if known) or change in the species geographic range. Trend codes are: U = Unknown, S = Stable, D = Decreasing and I = Increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Oklahoma Salamander	common in mature forests near streams that provide suitable habitat for breeding and larval development	S
Amph	Ringed Salamander	uncommon, secretive and difficult to survey; its distribution is poorly known but likely to occur locally throughout the region	U
Bird	American Woodcock	common but nocturnal and secretive migrant and winter resident throughout the region; small numbers remain to nest	U
Bird	Cerulean Warbler	rare summer resident; nests in large tracts of tall, mature deciduous forests; potentially occurs near Spavinaw Creek and Boston Mtns.	D
Bird	Hooded Warbler	rare and locally-occurring summer resident; nests in the southern quarter of the region	U
Bird	Louisiana Waterthrush	uncommon summer resident; nests throughout the region	S

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Prothonotary Warbler	uncommon summer resident; nests throughout the region	U
Bird	Rusty Blackbird	uncommon winter resident throughout the region	D
Bird	Swainson's Warbler	rare and locally-occurring summer resident; known to nest in bottomland habitat along Greenleaf Creek	U
Bird	Wood Thrush	rare summer resident; nests in mature forest tracts at scattered locations region wide	D
Mamm	Gray Bat	locally common in the vicinity of 9 to 11 caves that support maternity colonies; frequently forages in riparian forests; federally listed as an endangered species	I
Mamm	Northern Long-eared Bat	locally common resident in mature forests throughout the region; federally-listed as a threatened species	S
Mamm	Swamp Rabbit	uncommon and locally occurring in flood plain forests along the southern edge of the region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Habitat Loss and Modification as a Result of Altered Patterns of Seasonal Flooding due to Stream and River Channel Modifications:

1. Reservoir construction and stream channelization projects have reduced the frequency and magnitude of flooding which is necessary to maintain bottomland hardwood forests, and in some areas channel modifications have resulted in deep incised stream channels and created a disconnection between the streams and their bottomland forests.
2. Vernal pools and seasonally flooded wetlands within bottomland forests have been lost or degraded as a result of sedimentation and/or reduction in periodic flooding reducing their value as important breeding areas for a diversity of amphibians and feeding areas for waterfowl.

Conservation Actions:

- Where modifications have occurred, restore hydrology to tracts of bottomland hardwood forest by managing for the historic hydroperiod reconnecting streams with their floodplain forests. Restoration efforts may include restoring the structure of stream or river channels, restoring stream meanders, or creating low dikes to retain seasonal storm water.
- Conduct surveys to identify vernal pools, seeps, and seasonal wetlands that are important to salamander species of greatest conservation need. Develop management plans for these sites that may include activities such as fencing, dredging/removal of accumulated sediments or the development of conservation easements.
- Develop a cost-share program in suitable landscapes for the construction of new vernal pools or the rehabilitation of former vernal pools.
- Develop monitoring programs to evaluate the success of vernal pool management plans and their effects on local populations of amphibians.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

3. Existing data are incomplete regarding the distributions and ecological needs of several species of greatest conservation need that depend upon the bottomland hardwood vegetation community.

4. In order to establish effective conservation actions, more complete data are needed to determine the population status and trend for many species and more thorough evaluations are needed to determine the factors that limit population sizes or are responsible for suspected declines.
5. Bottomland hardwood forest communities typically occur in predictable locations with specific soils and proximity to streams and rivers; therefore, they should be relatively easy to model and map. However, the current and historic distributions and conditions of this community have not been completely assessed.

Conservation Actions:

- Conduct reviews of existing literature, reports and museum records, and interview technical experts to compile historic and recent distributional and ecological information for species of greatest conservation need.
- Conduct research to identify the factors that limit the distribution and abundance of priority SGCN and develop management recommendations to enhance populations through improved habitat conditions.
- Conduct surveys to assess the current distributions of priority SGCN and use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest conservation benefit.
- Research the historic condition of this habitat in order to develop realistic and biologically meaningful descriptions for how high quality habitat should look. These should serve as the range of target conditions for habitat restoration and enhancement efforts.
- Develop methods to identify and map the distribution of the remaining habitat tracts, then inventory these tracts to determine their condition. Identify the conservation practices that could enhance the value of these habitat tracts to SGCN.
- Develop monitoring programs for selected SGCN populations and for measuring habitat abundance and condition, and maintain databases to store and analyze distributional and ecological data for bottomland hardwood forests and their associated species of greatest conservation need.
- Publish and make the results of all ecological studies available to land managers and conservation agencies so that they can be incorporated into site-specific, species-specific and regional conservation plans.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

6. Fragmentation and loss of bottomland hardwood communities has resulted from the conversion of these forests to other land uses such as crop fields, pine plantations, and Tall Fescue pasture monocultures.
7. Forest tracts are being fragmented by an increasing numbers of roads, utility lines, and pipelines. This has the greatest negative effect on species which rely on relatively large unbroken tracts of forest and/or have poor dispersal abilities and difficulty moving across altered habitat.
8. In some areas, chemical herbicides are being aerially applied to thin or eradicate bottomland hardwood vegetation to convert the land to other uses such as pasture.

Conservation Actions:

- Develop a landowner incentive program to encourage the retention of bottomland hardwood forest stands and not convert these to other vegetation such as Fescue pasture.
- Develop programs to maintain biologically meaningful tracts of bottomland oak-hickory forests such as conservation easements, conservation leases, or willing-seller land acquisitions, preceded by a landscape-level assessment of habitat conditions to identify focus areas of greatest conservation value in order to get the greatest "bang for the buck" or conservation efficiency.

- Evaluate methods to restore bottomland hardwood forests on pastures or crop fields and develop cost-share programs or grants to assist and encourage willing landowners who wish to restore/replant these areas.
- Support cooperative efforts between government agencies and research institutions to develop or update Best Management Practices and management recommendations to minimize the ecological footprint left by road, pipeline, and utility line construction, and the impacts of right-of-way maintenance practices.
- Develop and distribute informational materials with these Best Management Practices and recommendations to landowners, agencies, and utility companies.
- Develop educational materials for schools and landowners that highlight the value (i.e., ecological and economic) of hardwood trees and the bottomland forest community.
- Develop wildlife corridors to connect disjunctive tracts of bottomland hardwood forest or to connect these forest tracts with other important forest communities

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

9. Several exotic plant species including Sericea lespedeza, *Microstegium* grass, Amur Honeysuckle, Chinese Privet and Japanese Honeysuckle have become established in mesic hardwood forests, and appear to be displacing native understory plants and may alter native plant communities and habitat conditions for wildlife species of conservation need.
10. Feral hogs may be causing substantial ecological damage to vernal pools within bottomland forests and may compete with native wildlife for food.

Conservation Actions:

- Evaluate the severity and magnitude of the ecological damage done by exotic plant and animal species (e.g., displacement of native vegetation, predation on native animal populations, or hybridization with native species) to identify those exotic species causing the greatest impact to species of greatest conservation need.
- Develop control or management plans (e.g. controlled burning programs, herbicide treatment, or mechanical removal) for the exotic species that cause the greatest ecological damage and develop monitoring programs to evaluate the effectiveness of control measures.
- Develop cost-share or incentives programs for private landowners to encourage them to control invasive and exotic species.
- Develop educational materials about the ecological damage done by invasive and exotic species.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

11. Many bottomland forest stands are comprised of dense even-aged, second growth forest as a result of widespread timber harvest in the early 1900s, resulting in stands that lack the diverse structure of canopy, mid-story and understory vegetation that existed historically in uneven-aged forests. The shading caused by dense canopies in these even-aged forests may limit the abundance and diversity of understory vegetation and sustained shading may limit the recruitment of oak species in favor of more shade tolerant species over time.
12. Because of historic stream channelization efforts, some Ozark stream channels have become incised and a disconnection has developed between these streams and their historic bottomland hardwood forests. These forests are not inundated by flood events as frequently as they were historically and this can alter their species composition and understory structure.

Conservation Action:

- Evaluate the effectiveness of mid-story thinning or timber stand improvement as a tool to diversify forest structure and increase understory vegetation.
- Where feasible, restore the hydrological connection between bottomland forests and their stream channels through the restoration of stream channel structure or the construction of low dikes and shallow channels to inundate forests during heavy rainfall events.

Potential indicators for monitoring the effectiveness of the conservation actions:

- number or percentage of acres acquired or placed into conservation programs (i.e., incentive programs)
- changes in the acreage and distribution of flood plains in hardwood forest vegetation (i.e. a measure of net gain or loss of habitat)
- number of acres placed into conservation ownership or management
- changes in the population sizes or trends of representative species of greatest conservation need
- relative condition and quantity of bottomland forest habitat
- snag count, tree species diversity, woody understory diversity and average tree diameter as components of habitat quality and stand health monitoring
- frequency of inundation or soil saturation as a measure of connectivity between bottomland forest stands and their streams/rivers

Moderate Priority Conservation Landscape: Post Oak/Blackjack Oak-Hickory Woodland and Forest

Dry to mesic, oak-dominated woodlands and forests are widespread in the Ozark Region and typically occur on upper slopes, ridges, bluff escarpments, and slopes with a southern, eastern or western aspect. This plant community represents the majority of upland woodland and forest in the Ozark Region and is structured by topographic position and naturally occurring fire. This habitat type usually develops on sites with shallow or well-drained soils, and is dominated by only a few species of trees but is a structurally diverse mosaic of oak/hickory woodlands and oak/hickory forests that vary geographically depending upon soil conditions, aspect, and fire history. The dominant tree species are Post Oak (*Quercus stellata*), Blackjack Oak (*Quercus marilandica*), Black Oak (*Quercus velutina*), and Black Hickory (*Carya texana*). Other less common canopy trees include Chinkapin Oak (*Quercus muelhenbergii*) and Mockernut Hickory (*Carya tomentosa*) and Bitternut Hickory (*Carya cordiformis*). Sites that are more mesic and subject to infrequent fire take on the more closed-canopy structure of a forest and support greater numbers of hickories and Black Oaks. Sites that have drier soil conditions or are more frequently exposed to fire have the more open characteristics of woodlands and have an understory of grasses and forbs that is dominated by Little Bluestem (*Schizachyrium scoparium*) and Indiangrass (*Sorghastrum nutans*). Common woody understory species, especially on more mesic sites, include Eastern Redbud (*Cercis canadensis*), Farkleberry (*Vaccinium arborea*), Mexican Plum (*Prunus mexicana*), and Winged Elm (*Ulmus alata*). Eastern Redcedar (*Juniperus virginiana*) and Ashe Juniper (*Juniperus ashei*) were historically uncommon in this habitat type and largely confined to bluffs and ravines. But both species have increased in abundance during the past century as a result of the reduction in periodic fires.

Over the past century, some Post Oak/Blackjack Oak dominated woodland acreage has been lost to human development such as residential and second home development and conversion to pastureland. However, structural changes to the habitat as a result of reduced fire frequencies appear to be the greatest agent of change in this habitat. Much of this habitat exists in a more closed-canopy forest condition rather than in an open woodland condition, and certain species such as Eastern Redcedar and Winged Elm appear to occur in greater abundance than historically in some areas.

Recognized plant associations within this habitat include:

- Post Oak – Blackjack Oak – Black Hickory (Farkleberry) Forest
- Post Oak – Blackjack Oak – Black Hickory Forest
- Post Oak – Shumard Oak – Bitternut Hickory Forest
- Post Oak – Winged Elm Forest

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that are found in the Oak Woodlands and Forest habitat type are listed in the following table. A narrative description is provided for each species' distribution/status and population trend. Status and trend descriptions are based upon the existing literature and the best professional judgment of the technical experts that were consulted. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. The estimated trend is based upon the statewide population size (if known) or change in the species geographic range. Trend codes are: U = Unknown, S = Stable, D = Decreasing and I = Increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population or Range
Amph	Crawfish Frog	uncommon and locally occurring where seasonal ponds and wetlands provide breeding habitat within open woodlands with a herbaceous understory	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population or Range
Amph	Ringed Salamander	uncommon, secretive and locally occurring near breeding ponds, but widespread in oak woodlands throughout the region	U
Bird	American Woodcock	uncommon, secretive winter resident throughout the region; some birds remain into the nesting season	U
Bird	Bachman's Sparrow	rare and locally occurring summer resident; nests in open oak woodlands with a grassy understory	U
Bird	Blue-winged Warbler	rare summer resident; nests in large openings within forested landscapes and in open savannahs	U
Bird	Harris's Sparrow	rare winter resident; found in open oak woodland/savannah habitats	U
Bird	Kentucky Warbler	uncommon but widespread summer resident; nests in areas with an abundant shrubby understory	U
Bird	Northern Bobwhite	uncommon and locally occurring year-round resident; found in open woodlands and savannahs with a herbaceous understory	D
Bird	Painted Bunting	uncommon and locally occurring summer resident that nests in open, dry oak woodlands	U
Bird	Prairie Warbler	uncommon and locally occurring summer resident; nests in open oak woodlands and clearings with a grassy and shrubby understory	U
Bird	Red-headed Woodpecker	uncommon year-round resident throughout the region; wintering population is larger; occupies open, mature, woodlands	D
Bird	Whip-poor-will	uncommon and locally occurring throughout the region; recent research indicates a preference for woodland habitats with open canopies or close proximity to forest edges	U
Inve	American Burying Beetle	uncommon; federally-listed as an endangered species; found in open woodlands in areas with deeper soils in Cherokee County	S
Inve	Oklahoma Liptooth Snail	widespread endemic land snail; distribution and habitat needs are incompletely known	U
Inve	Shadow Gloss Snail	occurs locally in scattered woodlands; documented in Mayes County	U
Mamm	Eastern Spotted Skunk	uncommon, secretive and partially arboreal; its status is poorly known; most records are from forest stands in the southern third of the region	U
Mamm	Long-tailed Weasel	rare difficult to locate due to its secretive, nocturnal behavior; its distribution is poorly known	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

1. Relatively little of this habitat exists in a woodland condition, probably the result of a loss of historic fire regimes due to active fire suppression. Much of it has gradually changed to a more forest-like condition, even on sites that were probably woodlands.
2. Many acres of habitat exist as even-aged forests. This change from woodlands and forests comprised of trees of diverse ages and heights to large even-aged stands is probably the result of widespread timber harvest during a relatively short period of time in the late 1800s or early 1900s.
3. The combination of even-aged stands and decades of fire suppression appear to be responsible for greater tree densities than probably occurred historically, and for an increase in abundance of some tree species such as Eastern Redcedar and possibly other invasive native species. The reduction in fire frequency has facilitated an

increase in canopy closure that may reduce the successful recruitment of oak trees in future generations of forest.

4. There are constraints (e.g., lack of personnel and financial resources, air quality concerns, lack of technical guidance/assistance, logistical difficulties, and landowner liability issues) to using management tools such as prescribed burning and selective tree harvest, limiting the ability to restore woodland conditions to stands that are currently forests and to diversify the structure of existing forests and woodlands.
5. Many landowners, particularly absentee owners and owners of small tracts, are not aware of the gradual changes that have occurred in the condition of oak woodlands and are not aware of the information and technical assistance available to them if they want to restore and maintain woodland habitat structure for wildlife species of greatest conservation need.
6. In some areas, continuous grazing within oak-hickory woodlands and forests may reduce the abundance of understory development limiting the recruitment of sapling trees and causing erosion on steep slopes.
7. Cattle grazing may enhance the spread of undesirable exotic vegetation such as brome and Sericea Lespedeza or attract Brown-headed Cowbirds which parasitize the nests of songbirds.

Conservation Actions:

- Use studies of historic fire regimes and the historic distributions of woodlands and forests to help develop site-specific recommendations for the use of prescribed burning. These recommendations should evaluate the timing (i.e., season), sizes and frequencies of prescribed burns to balance the needs of fire dependent and fire sensitive species (e.g., amphibians).
- Evaluate ways to increase the use of prescribed fire as a management tool by providing technical assistance materials for landowners (e.g., publications, burning guidelines, workshops, equipment rentals, and demonstration areas), developing burn cooperatives to work with agencies and landowners to increase the use of burning, and developing ways to reduce landowner liability while conducting burns (e.g., use of official burn protocols).
- Provide financial assistance or incentives to landowners to encourage woodland restoration.
- Develop monitoring programs to evaluate the effects of management techniques such as prescribed fire and selective tree harvest on populations of species of greatest conservation need and vegetation structure.
- Purchase grazing rights to remove cattle or establish rotational grazing programs that defer grazing on some areas during the growing season. Develop a landowner assistance program that provides financial incentives to defer grazing periodically.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

9. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
10. Because this habitat type is a mosaic of woodlands and forests with varying degrees of canopy closure and understory development, more information is needed to determine the factors that shape vegetation structure and where forests and woodlands occurred historically. These factors also influence the wildlife community on a given site because some species are more woodland-adapted, while others are more forest-adapted.

Conservation Actions:

- Conduct reviews of existing literature, reports and museum records, and interview technical experts to compile historic and recent distributional and ecological information for SGCN.
- Conduct research to identify the factors that limit the distribution and abundance of priority SGCN and develop management recommendations to enhance populations through improved habitat conditions.
- Conduct surveys to assess the current distribution and habitat affinities for priority SGCN and use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest benefit for SGCN.
- Research the historic condition of this habitat in order to develop a realistic and biologically meaningful description for how high quality habitat should look. This should serve as the range of target conditions for habitat restoration and enhancement efforts.
- Develop methods to identify and map the distribution of the remaining habitat tracts, then inventory these tracts to determine their condition. Identify the conservation practices that could enhance the value of these habitat tracts to SGCN.
- Develop monitoring programs for selected SGCN populations and for measuring habitat abundance and condition
- Collect information regarding wildlife abundance and density in order to translate acres of habitat changed into wildlife population changed
- Develop and provide long-term funding to maintain databases to store and analyze distributional and ecological data for species of greatest conservation need.
- Publish and make the results of all ecological studies available to land managers and conservation agencies so that they can be incorporated into site-specific, species-specific and regional conservation plans.
- Assess historic literature and conduct field studies to determine the probable historic locations and distributions of oak-hickory forests, woodlands and savannahs to evaluate the historic relative abundances of these community types.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

11. Fragmentation and loss of habitat caused by the conversion of oak-hickory woodlands and forests to other land uses such as loblolly pine plantations, rangeland, or introduced pastures that are planted to Tall Fescue monocultures.
12. Fragmentation and loss of habitat due to increasing number of residential developments including secondary homes, cabins, and small hobby ranches.
13. Fragmentation and loss of habitat due to expanding infrastructure including roads, utility lines, and pipelines
14. Fragmentation of land ownership (i.e., more individuals owning smaller tracts of land).

Conservation Actions:

- Develop programs to maintain large tracts of oak-hickory woodlands and forests such as conservation easements, conservation leases, purchase of development rights, or willing-seller land acquisitions, preceded by a landscape-level assessment of habitat conditions to identify focus areas of greatest conservation value in order to get the greatest "bang for the buck" or efficiency.
- Evaluate methods to restore oak-hickory woodlands from pastures or crop fields, and develop cost-share programs, grants, or financial incentives to encourage landowners to restore/replant these areas to oak-hickory woodlands.
- Coordinate with other agencies and research institutions to develop Best Management Practices and management recommendations to minimize the ecological footprint left by road, pipeline, utility line construction, and right-of-way maintenance.

- Develop and distribute informational materials with Best Management Practices and recommendations to landowners, agencies, and utility companies for their consideration and use.
- Evaluate means to make it economically feasible for private landowners to maintain their land in oak-hickory forest (e.g., encourage markets for oak and hickory timber, or encourage groups of landowners to work together as a block to manage habitat for hardwood timber production or hunting leases).

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

15. Several exotic plant species such as Sericea Lespedeza, tall fescue, Callery pear and Japanese honeysuckle have become established outside of cultivation and appear to be displacing native plants, altering plant community composition and altering the habitat conditions for wildlife species of greatest conservation need.
16. Several exotic animal species appear to be causing substantial ecological damage, including feral hogs that damage seeps and vernal pools which are important to amphibians, or compete with native wildlife for food, and feral cats that exert additional predation pressure upon local populations of small reptiles, birds and mammals.
17. The native Brown-headed Cowbird has increased in abundance and appears to be exerting greater nest parasitism and chick mortality pressure on songbird populations.

Conservation Actions:

- Evaluate the severity and magnitude of the ecological damage done by exotic plant and animal species (i.e., displacement of native vegetation/plant communities, predation on native animal populations, or hybridization with native species).
- Identify those exotic species causing the greatest impact to this habitat and species of greatest conservation need.
- Develop control or management plans for the exotic species that cause the greatest ecological damage (e.g., controlled burning programs, herbicide treatment, and mechanical removal), and develop monitoring programs to evaluate the effectiveness of these control measures.
- Develop invasive and exotic species management plans for all public conservation areas.
- Develop cost-share or incentives programs for private landowners to encourage them to control invasive and exotic species.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acres periodically burned to restore open oak woodlands
- acreage of habitat in open woodland conditions versus closed canopy forest conditions
- number of acres enrolled in conservation programs (e.g. easements) or placed into conservation ownership
- total acres, tract size and distribution of restored woodland/savannah complexes with herbaceous understory vegetation
- changes in population sizes and trends of species of greatest conservation need
- changes in the condition and quantity of habitat
- changes in the number of acres affected by exotic or invasive vegetation

Moderate Conservation Landscape: Herbaceous Wetland

The relative condition of Herbaceous Wetland habitat is currently poor with a declining trend. Herbaceous wetlands are small, uncommon and locally-occurring plant communities in the Ozark Region and are usually found in association with the flood plains of rivers and streams, or embedded within larger habitats and fire-maintained plant communities such as Tallgrass Prairies. The distribution, abundance and biological composition of herbaceous wetlands is poorly known in this region and is in need of further study. Wetlands most frequently develop within or near the floodplains of streams and rivers, however in the Ozark Region, many floodplains are forested and are not conducive to the maintenance of herbaceous wetlands. Herbaceous wetlands are often seasonally flooded depressions within prairies and floodplains where periodic disturbances such as fire and flooding limit the encroachment of woody plant species. As a result of fire suppression and habitat loss, it is likely that much of the current herbaceous wetland habitat exists in human-maintained areas such as pastures in both uplands and floodplains.

Recognized plant associations within this habitat include:

- American Water-willow Temporarily Flooded Wetland
- Broadleaf Arrowhead – Longbar Arrowhead Semi-permanently Flooded Wetland
- Broadleaf Cattail Semi-permanently Flooded Marsh
- Common Reed Semi-permanently Flooded Marsh
- Common Rush Seasonally Flooded Marsh
- Pennsylvania Smartweed – Curlytop Smartweed Semi-permanently Flooded Wetland
- Prairie Cordgrass Temporarily Flooded Marsh
- Ravenfoot Sedge Seasonally Flooded Marsh
- Softstem Bulrush - Common Spike Rush Semi-permanently Flooded Marsh
- Water Smartweed Semi-permanently Flooded Wetland

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that are found in the Herbaceous Wetlands habitat type are listed in the following table. A narrative description is provided for each species' distribution/status and population trend. Status and trend descriptions are based upon the existing literature and the best professional judgment of the technical experts that were consulted. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. The estimated trend is based upon the statewide population size (if known) or change in the species geographic range. Trend codes are: U = Unknown, S = Stable, D = Decreasing and I = Increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Crawfish Frog	uncommon and secretive; scattered populations occur in association with seasonal wetlands and open, herbaceous habitats	U
Bird	American Golden Plover	rare spring and fall migrant through the region	U
Bird	American Woodcock	uncommon, secretive winter resident throughout the region; some birds remain into the nesting season	U
Bird	Canvasback	uncommon winter resident throughout the region; occupies large wetlands and impoundments	S
Bird	LeConte's Sparrow	uncommon winter resident; occupies tall grass cover around herbaceous wetlands	U
Bird	Lesser Scaup	uncommon winter resident throughout the region; occupies large wetlands and impoundments	D
Bird	Little Blue Heron	locally common summer resident throughout the region in the vicinity of nesting colonies	U
Bird	Nelson's Sharp-tailed Sparrow	rare spring and fall migrant through the region	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Northern Pintail	uncommon winter resident throughout the region; occupies wetlands and impoundments	S
Bird	Snowy Egret	uncommon summer resident; occurs locally in the vicinity of nesting colonies along the western and southern edges of the region	S
Bird	Solitary Sandpiper	uncommon spring and fall migrant through the region	S
Bird	Trumpeter Swan	rare winter resident occupying impoundments bordered by herbaceous wetlands	I
Bird	Upland Sandpiper	common spring and fall migrant throughout the region	S
Bird	Willow Flycatcher	rare spring and fall migrant throughout the region	U
Bird	Yellow Rail	has not been documented within the Ozark Region but assumed to migrate through in the spring and fall	U
Inve	Ozark Clubtail	locally common throughout the region	S
Mamm	Swamp Rabbit	uncommon and apparently limited to the southern edge of the region	U
Rept	Spiny Softshell Turtle	uncommon but widespread across the region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Condition and/or Water Quality:

1. Feedlots, dairies, hog farms, and chicken houses are often located near wetlands, and the animal waste from these operations collects in wetlands basins and closed depressions.
2. Land application of animal wastes often occurs on fields near wetlands or that drain into wetlands where nutrients, hormones, pesticides, and other waste products collect.
3. Many wetlands lack buffer vegetation around them to control the movement of sediment, pesticides, and nutrients into the wetlands through storm water runoff from pastures, crop fields, and residential areas.
4. Endocrine disrupters from animal hormones, pesticides, and agricultural chemicals enter wetlands in storm water runoff, thus disrupting growth, reproduction and survival of amphibians, fish and invertebrates.
5. Increased nutrient inputs due to crop/pasture fertilizers and land application of animal waste result in increased algae and bacteria in wetlands.
6. Grazing of wetlands by cattle increases nutrient inputs and alters the structure and diversity of wetland vegetation.

Conservation Actions:

- Increase the knowledge of and utilization of Farm Bill programs that improve water quality and protect wetlands (e.g., Wetland Reserve Program, planting of buffer strips, and buffer vegetation).
- Continue cost-share funding to landowners to construct fencing around wetlands to control access by cattle.
- Restore native vegetation around wetlands to serve as a filter for storm water runoff to aid in the removal of sediment and nutrients.
- Develop certification programs to recognize conservationists and land stewards of wetlands.
- Improve small landowner knowledge of and use of existing cost-share programs.
- Develop new or update existing Best Management Practices for controlling nutrients and sediment around wetlands.

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

7. Invasive/exotic plant species become established in wetlands and compete with native vegetation.
8. Exotic plant species can dominate wetlands and reduce overall plant diversity and structural diversity, reducing the wetlands' value as wildlife habitat.

Conservation Actions:

- Evaluate the relative impact of specific exotic and invasive species on species of greatest conservation need. Develop management plans to reduce the abundances and distribution of the exotic plants and animals that cause the greatest habitat damage.
- Increase funding to implement the Oklahoma Aquatic Nuisance Management Plan
- Remove exotic wetland plants and restore native plant communities.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

9. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
10. The small size of wetlands makes them difficult to locate, especially wetlands that are embedded within larger habitat types such as forests and woodlands. Therefore, our information regarding the locations and conditions of wetlands is incomplete.

Conservation Actions:

- Conduct region-wide surveys to locate wetlands, and develop a database to store wetland locations, conditions and biological community compositions.
- Conduct biological inventories of wetlands to determine their community compositions with an emphasis on the distributions and abundances of wildlife species of greatest conservation need.
- Conduct studies to determine the ecological needs of wetland wildlife species (e.g., types of plant communities and the timing and duration of flooding needed for each wildlife species).
- Produce educational information for landowners and conservation agency staff regarding the ecology of herbaceous wetlands by region and wetland type. Publish and make the results of all ecological studies available to land managers and conservation agencies so that they can be incorporated into site-specific, species-specific and regional conservation plans.
- Develop monitoring programs for selected SGCN populations and for measuring habitat abundance and condition
- Research the historic condition of this habitat in order to develop a realistic and biologically meaningful description for how high quality habitat should look. This should serve as the range of target conditions for habitat restoration and enhancement efforts.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

11. Heavy grazing of wetlands by cattle removes plant cover for wildlife, reduces the abundance of some wetland plants, and lowers overall plant diversity.
12. Seasonal wetlands are plowed/cropped which reduces perennial vegetation and alters plant community composition and structure.
13. Because of fire suppression and/or past overgrazing, woody plants such as willow have encroached upon herbaceous wetlands.

Conservation Actions:

- Use fire or mechanical cutting to remove woody vegetation that has encroached upon herbaceous wetlands.
- Continue to provide cost-share funding or grants to construct fencing around wetlands to control the access to this habitat by cattle.
- Use land acquisition, perpetual easement programs, or non-development easement programs to place wetlands into conservation ownership or stewardship.
- Acquire easements or fee-title to wetlands to conserve and enhance them. Purchase conservation easements on cropped wetlands and then restore them to their former condition.
- Provide funding to preserve or enhance wetlands.
- Improve the economic incentive to retain wetlands in agricultural areas.
- Improve the incentives for landowners to enroll in the Agricultural Conservation Easement Program (includes the former Wetland Reserve Program) to conserve and enhance wetlands.
- Provide incentives or funding to cover the costs of maintaining wetlands.

Conservation Issues Related to Activities that Alter Hydrology and Water Quantity:

14. Wetlands are drained or filled to convert these lands to residential or agricultural uses.
15. Water may be pumped from wetlands or diverted from wetlands for irrigation.
16. Irrigation around wetlands may lower the water table in some areas and alter the time during which the soil is saturated.
17. Some wetlands are dredged or deepened to create ponds to hold irrigation water, to store water for cattle, or to create ponds for fishing, resulting in a loss of shallow water habitat and may result in the introduction and establishment of predatory fish.

Conservation Actions:

- Provide cost-share funding or grants to restore and maintain farmed wetlands and connect wetland owners with entities seeking wetland mitigation credits.
- Assess the distribution and condition of herbaceous wetland habitat to identify wetland complexes and wetlands of high quality and/or biological diversity.
- Provide information to landowners and the public regarding the ecological values of wetlands, especially seasonal wetlands.
- Increase the knowledge of and utilization of Farm Bill programs to conserve wetlands such as the Agricultural Conservation Easements Program that includes the former Wetland Reserve Program.
- Use land acquisition and conservation easement programs to place herbaceous wetlands under conservation ownership or stewardship.
- Acquire former wetlands and restore them through a combination of dredging, diking and revegetation.
- Improve landowner knowledge of and use of existing cost-share programs to conserve wetlands such as the Agricultural Conservation Easements Program.
- Develop tax breaks for landowners that maintain wetlands and improve the economic incentive to retain wetlands in agricultural areas.
- Assist the Natural Resources Conservation Service in their wetland conservation planning to target federal dollars toward projects and sites that will have the greatest benefit to species of greatest conservation need.

Potential indicators for monitoring the effectiveness of the conservation actions:

- changes in acreage/coverage of exotic vegetation.
- number of conservation easements secured
- acreage placed in conservation programs or under conservation ownership
- habitat and species responses to wetland management practices

- changes in population sized and trends of representative species of greatest conservation need
- changes in the structural condition and acre of herbaceous wetland habitat
- changes in the number of wetland acres and the connectivity of wetlands into complexes

Moderate Priority Conservation Landscape: Tallgrass Prairie

The relative condition of Tallgrass Prairie habitat is currently poor with a declining trend. Tallgrass Prairies occur locally within the Springfield Plateau section of the Ozark Region over sites with deep, well-drained soils on level portions of the plateau. These prairies are herbaceous plant communities dominated by Big Bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), Switchgrass (*Panicum virgatum*) and Little Bluestem (*Schizachyrium scoparium*) and are maintained by relatively frequent fires that suppress woody vegetation. Other widespread or common plants include Eastern Gamagrass (*Tripsacum dactyloides*), Rosinweed (*Silphium integrifolium*), Lead Plant (*Amorpha canescens*), Illinois Bundleflower (*Desmanthus illinoensis*), Blazing Star (*Liatris sp.*), Goldenrod (*Solidago sp.*), and Maximillian Sunflower (*Helianthus maximilliani*). Tallgrass Prairies were among the first sites settled in the Ozark Region and historically occurred in the vicinity of the larger communities such as Tahlequah, Stillwell, Jay, and Grove. Much of the habitat has been converted to residential developments, cropland, or introduced pastures planted to Tall Fescue.

Recognized plant associations within this habitat include:

- Big Bluestem – Little Bluestem – Indiangrass Grassland
- Big Bluestem – Switchgrass Grassland
- Little Bluestem – Big Bluestem Grassland
- Little Bluestem – Indiangrass Grassland
- Switchgrass – Eastern Gamagrass Grassland

(Vegetation associations are based on Hoagland 2000; see Appendix C for reference.)

The species of greatest conservation need that are found in the Tallgrass Prairie habitat type are listed in the following table. A narrative description is provided for each species' distribution/status and population trend. Status and trend descriptions are based upon the existing literature and the best professional judgment of the technical experts that were consulted. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. The estimated trend is based upon the statewide population size (if known) or change in the species geographic range. Trend codes are: U = Unknown, S = Stable, D = Decreasing and I = Increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Crawfish Frog	uncommon and locally occurring throughout the region around seasonal breeding ponds	U
Bird	American Golden Plover	uncommon spring and fall migrant throughout the region; may use burned or hayed prairies as stopover habitat	U
Bird	Bell's Vireo	rare and locally occurring summer resident in deciduous shrub thickets adjacent to grasslands	D
Bird	Harris's Sparrow	rare winter resident in western edge of region	U
Bird	Henslow's Sparrow	rare migrant throughout the region; a few potential breeding reports along western edge	U
Bird	LeConte's Sparrow	uncommon migrant and winter resident throughout the region	U
Bird	Loggerhead Shrike	uncommon, locally-occurring year-round resident throughout the region	D
Bird	Northern Bobwhite	uncommon, locally-occurring year-round resident throughout the region	D
Bird	Short-eared Owl	rare winter resident	U
Bird	Smith's Longspur	rare winter resident in large tracts of early succession native grasslands	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Upland Sandpiper	common spring and fall migrant across the region	S
Inve	Arogos Skipper	uncommon and restricted to prairie remnants scattered throughout the region	U
Inve	Byssus Skipper	rare and limited to prairie remnants that support Gamma Grass (*Tripsacum dactyloides*)	U
Inve	Prairie Mole Cricket	uncommon and locally occurring in prairie remnants in the northern half of the region	D
Inve	Rattlesnake Master Borer Moth	potentially occurs in moist, native prairies but has not been documented in this region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat:

1. Data are incomplete for some species of greatest conservation need with respect to their distributions, ecological needs and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies.
2. Much of the Tallgrass Prairie habitat type in the Ozarks has been settled and converted to other uses. Better data are needed regarding the historic extent of Tallgrass Prairies and the current locations of Tallgrass Prairie remnants and restorable grasslands.
3. More information is needed regarding the factors that determine vegetation structure and maintained prairies historically.

Conservation Actions:

- Conduct reviews of existing literature, reports and museum records, and interview technical experts to compile historic and recent distributional and ecological information for species of greatest conservation need.
- Conduct research to identify the factors that limit the distribution and abundance of priority SGCN and develop management recommendations to enhance populations through improved habitat conditions.
- Conduct surveys to assess the current distributions of priority species of greatest conservation need and use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest conservation benefit.
- Research the historic condition of this habitat in order to develop a realistic and biologically meaningful description for how high quality habitat should look. This should serve as the target condition for habitat restoration and enhancement efforts.
- Develop methods to identify and map the distribution of the remaining habitat tracts, then inventory these tracts to determine their condition. Identify the conservation practices that could enhance the value of these habitat tracts for SGCN.
- Develop monitoring programs for selected SGCN populations and for measuring habitat abundance and condition, and maintain databases to store and analyze distributional and ecological data for species of greatest conservation need.
- Publish and make the results of all ecological studies available to land managers and conservation agencies so that they can be incorporated into site-specific, species-specific and regional conservation plans.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

4. Conversion of tallgrass prairies to other land uses - primarily crop land and introduced pasture grasses. Tallgrass prairies historically occurred on deep, level soils, which are desirable places for agriculture and residential uses. Tallgrass Prairies have been converted to and fragmented by residential developments, conversion to crop fields, and introduced pastures planted to Tall Fescue.
5. Expanding infrastructure such as roads, utility lines and pipelines contribute to the fragmentation and loss of prairie habitat.

Conservation Actions:

- Evaluate means to make it economically attractive for private landowners to maintain prairie habitat on their land or to restore introduced pastures to native grasses and forbs (e.g., publicize the results of studies on the cost/benefit ratio of raising livestock on native prairie versus introduced pasture, encourage markets for native prairie hay, and encourage groups of landowners to work together to manage large blocks of prairie habitat for hunting leases).
- Develop programs to maintain biologically meaningful tracts of native prairie habitat such as conservation easements, conservation leases, and purchase of development rights or willing-seller land acquisitions. This should be preceded by a regional assessment of habitat conditions on a landscape scale to identify focus areas of greatest conservation value in order to get the greatest "bang for the buck."
- Evaluate alternative methods for restoring Tall Fescue pastures and crop fields to native prairie grasses and forbs. Develop cost-share programs, grants, or financial incentives to encourage landowners to restore sites that have been modified for agricultural uses to native prairies with diverse grass and forb communities.
- Coordinate with other agencies and research institutions to develop Best Management Practices and management recommendations to minimize the disturbance caused by and the ecological footprint left by road, pipeline, utility line construction, and right-of-way maintenance activities such as herbicide use and mowing.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

6. The pre-settlement fire regime has been lost from most of the Ozark Region. Naturally occurring fires at intervals of two to seven years would have maintained tallgrass prairie habitats on relatively level sites with deep soils. Decades of fire suppression has facilitated the gradual change in the structure of most of the remaining tallgrass prairies and allowed increases in woody plant including sumacs, Winged Elm and Eastern Redcedar.
7. Several limitations discourage landowners from using prescribed burning as a land management tool. These include limited financial and personnel capacity to conduct prescribed burns, landowner liability issues, air quality concerns, and limited technical assistance in conducting burns.
8. While fire is a natural process and needed to maintain prairies, there is a scarcity of data from which to evaluate the effects of prescribed burning on species of greatest conservation need and common species whose populations are increasingly spatially limited in fragmented landscapes. Prairie species should be adapted to periodic fires, but populations of individual species are likely to respond differently to the timing, frequency and spatial scale of prescribed burns.
9. Herbicide use in pasture and right-of-way management negatively affects native forbs and low woody plants that are food resources and cover for wildlife.
10. Continuous grazing has the potential to alter the condition of native tallgrass prairies. It often leads to a local decline in the abundance of certain grasses and forbs that are especially palatable to cattle and horses (e.g. Eastern Gama Grass and Compass Plant).

11. Continuous grazing can facilitate the spread of invasive, non-native grasses and forbs (e.g. Japanese Brome) by reducing the competition created by more palatable native plants and by dispersing the seeds of weedy species.
12. Tallgrass prairies were shaped primarily by periodic fire and fire plays a greater role than grazing in maintaining the structure and species diversity of these prairies.
13. Some landowners in the region use herbicides, rather than fire, to reduce woody plants on their grazing lands. This reduces the abundance of shrubs and of native broadleaved forbs that are natural components of Ozark prairies.

Conservation Actions:

- Develop programs to maintain biologically meaningful tracts of native prairie habitat such as conservation easements, conservation leases, and purchase of development rights or willing-seller land acquisitions, preceded by a landscape-level assessment of habitat conditions to identify focus areas of greatest conservation value in order to get the greatest "bang for the buck" or conservation efficiency.
- Use existing studies of the historic Ozark Region fire regime and the historic distribution of prairies to develop site-specific recommendations for the use of prescribed burning. These studies and recommendations should evaluate the timing (i.e., season), sizes and frequencies of prescribed burns to balance the needs of the range of fire dependent species (e.g., prairie grasses and birds).
- Evaluate ways to increase the use of prescribed fire as a management tool. These may include:
    - providing funding to agencies to assist with conducting controlled burns on private property,
    - developing technical assistance materials for landowners (e.g., publications, burning guidelines, workshops, equipment rentals, and demonstration areas),
    - developing additional burn cooperatives that work with agencies and landowners to increase the use of burning, and
    - promoting the availability of prescribed burn insurance to willing landowners.
- Evaluate the use of mowing or brush-hogging as alternatives to conducting burns in order to maintain prairies in developed areas.
- Develop monitoring programs to evaluate the effects of prescribed fire on populations of species of greatest conservation need, prairie diversity, and vegetation structure.
- Develop informational materials to inform landowners and the general public about the importance of fire in maintaining prairie communities and the biological diversity of this habitat type.
- Purchase grazing rights to reduce the stocking rates on prairies with a history of heavy grazing while still providing income for landowners.
- Establish rotational grazing programs to defer grazing on some areas during the growing season or for periods of one or more years.

Conservation Issues Related to Invasive Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

14. Several exotic plant species such as Sericea Lespedeza, Tall Fescue, have become established on sites that were historically tallgrass prairies and these are displacing native plants and altering the structure of prairies that negatively affect habitat suitability for many prairie-dependent species of greatest conservation need.
15. Tall Fescue and Bermudagrass have been planted to create managed, monoculture pastures, but these have spread beyond pastures and into other habitats where they've displaced native vegetation and reduced the overall diversity of the plant community.

16. Some agencies and organizations promote the use of exotic plants for erosion control, livestock forage, beautification programs, and wildlife habitat that are actually invasive.
17. Cattle grazing may enhance local populations of Brown-headed Cowbirds, which parasitize the nests of songbirds and decrease songbird population recruitment.

Conservation Actions:

- Evaluate the severity and magnitude of the ecological damage done by exotic plant and animal species, including displacement of native vegetation/plant communities, predation on native animal populations, or hybridization with native species in order to identify those species that have the greatest impact on tallgrass prairie habitat and its associated species of greatest conservation need.
- Improve coordination between wildlife biologists, conservation agencies, and agricultural organizations so that these groups can share information about the negative effects of using exotic plant materials.
- Reduce the number of invasive and exotic species being recommended for erosion control (e.g., Sericea Lespedeza, Bermudagrass) and other uses. Examine the applicability of the Natives First Initiative to Oklahoma.
- Develop control or management plans for the exotic species that cause the greatest ecological damage (e.g., controlled burning programs, herbicide treatment, and mechanical removal), and develop monitoring programs to evaluate the effectiveness of these control measures.
- Develop invasive/nuisance species management plans for all public conservation lands.
- Develop cost-share or incentives programs for private landowners to encourage them to control invasive and exotic species.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acres burned periodically to maintain prairie structure
- changes in acreage affect by invasive exotic vegetation
- number of acres of prairie restored from former cropland and pasture
- number of acres enrolled into conservation easements or placed into conservation ownership and management
- native plant diversity and number of prairie-dependent plants in prairie tracts as a measure of prairie condition
- changes in population sizes and trends of representative species of greatest conservation need
- changes in the structural condition and acreage of tallgrass prairie habitat
- distribution and connectivity of the remaining prairie tracts

Potential partnerships to deliver conservation for Ozark Region:

<u>State Government</u>

- Arkansas Natural Heritage Commission
- Arkansas/Oklahoma Compact Commission
- Grand River Dam Authority
- Oklahoma Dept. of Wildlife Conservation
- Oklahoma Biological Survey
- Oklahoma Corporation Commission
- Oklahoma Department of Agriculture, Food and Forestry
- Oklahoma Department of Environmental Quality
- Oklahoma Natural Heritage Inventory
- Oklahoma Scenic Rivers Commission
- Oklahoma State University, Cooperative Extension Service
- Oklahoma State University, Department of Ecology and Natural Resources Management
- Oklahoma Tourism and Recreation Department
- Oklahoma Water Resources Board
- Other state universities and departments
- State wildlife and forestry agencies of Arkansas and Missouri

<u>Federal Government</u>

- U.S. Army Corps of Engineers
- U.S. Department of Agriculture, Forest Service
- U.S. Department of Agriculture, Natural Resources Conservation Service
- U.S. Department of the Interior, National Park Service
- U.S. Fish and Wildlife Service Ozark Ecosystem Team
- U.S. Fish and Wildlife Service Ozark Plateau National Wildlife Refuge
- U.S. Fish and Wildlife Service Partner for Fish and Wildlife Program
- U.S. Geological Survey

<u>Local Government</u>

- Municipalities in Oklahoma, Arkansas, Missouri
- Tribal governments

<u>Businesses, Citizens and Citizen Groups</u>

- Local Audubon Chapters
- Bat Conservation International
- Canoe Operators Association
- Central Hardwoods Joint Venture
- Chambers of Commerce
- Ducks Unlimited and local Oklahoma chapters
- Farm Bureau
- Central Hardwoods Joint Venture
- Hunting cooperatives
- Karst Initiative
- Kerr Center for Sustainable Agriculture
- Land Legacy
- National Rivers Society
- National Wild Turkey Federation and local Oklahoma chapters
- Oklahoma Anglers United
- Oklahoma Cattlemen's Association
- Oklahoma Forestry Association

- Oklahoma Native Plant Society
- Oklahoma Ornithological Society
- Oklahoma Section of the Society for Range Management
- Other sportsmen’s groups
- Ozark Regional Land Trust
- Ozark Society
- Private landowners
- Quail Forever
- Sierra Club
- Small Woodland Owner’s Association
- Speleological Societies
- Spring Creek Coalition
- The Nature Conservancy
- The Wildlife Society
- Urban development groups
- Vernal Pool Society

Ouachita Mountains, Arkansas River Valley and Western Gulf Coastal Plain Region

This ecological region is comprised of three similar physiographic areas - the Ouachita Mountains, Arkansas Valley and the West Gulf Coastal Plain. The counties included within this region are: Sequoyah, Haskell, LeFlore, Latimer, Pittsburg, Atoka, Pushmataha, Choctaw, and McCurtain.

The best professional judgment of the advisory group and technical experts was used to identify each Conservation Landscape's status and trend. And, even though some issues and actions apply to multiple regions, each region chapter is designed to stand-alone.

Conservation Landscapes listed in general priority order:

- Very High priority Conservation Landscapes:
  - Small River
  - White Oak/Hickory Mesic Forest
  - Oak/Hickory Bottomland Hardwood Forest
  - Gravel (hard)-bottom Stream and Associated Riparian Forest
  - Shortleaf Pine/Oak Open Woodland
- High priority Conservation Landscapes:
  - Mesic Loblolly Pine/Oak Forest
  - Springs and Seeps
  - Sandy (soft)-bottom Streams and Associated Riparian Forests
- Moderate priority Conservation Landscapes:
  - Herbaceous Wetland
  - Shortleaf Pine/Oak and Post Oak/Blackjack Oak Woodland and Forest
  - Tallgrass Prairie

Very High Priority Conservation Landscape: Small River

Five small rivers are found in the region of the Ouachita Mountains, West Gulf Coastal Plain (WGCP) and Arkansas Valley. Each river originates in the Ouachita Mountains then flows either north into the Arkansas River (Poteau River) or south to eventually enter the Red River (Kiamichi, Little, Glover, and Mountain Fork rivers). The Glover and Mountain Fork rivers are tributaries of the Little River, and collectively these three small rivers are known as the Little River system. The three rivers that comprise the Little River system are similar in structure and share many of the same aquatic species including the federally threatened Leopard Darter (*Percina pantherina*) and the endemic Ouachita Mountain Shiner (*Lythrurus snelsoni*).

The upper reaches of all five small rivers are relatively shallow, clear, and fast moving with a substrate of cobble or bedrock. The lower reaches of these rivers are relatively turbid and slow moving and meander over a sandy substrate in broad, forested floodplains. Flow rates are typically greater during the winter and spring and lower during the summer and fall; however, the seasonal variation is less than that which is seen on the Oklahoma's larger rivers. The small rivers contain gravel bars and sloughs but not the dynamic mosaic of sandbars, mudflats, and sloughs found on the larger river systems. Most sloughs along the smaller rivers are dominated by woody vegetation including River Birch (*Betula nigra*), Sycamore (*Platanus occidentalis*), Water Oak (*Quercus nigra*), and Red Maple (*Acer rubra*).

The species of greatest conservation need that occupy the small rivers in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or national data over the past 50 years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown, I = increasing and Ex = probably extirpated.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Three-toed Amphiuma	rare and secretive species that appears to be limited to the West Gulf Coastal Plain (WGCP) portion of the Little River	U
Amph	Western Lesser Siren	locally common but secretive; found in shallow, heavily vegetated sites within low-gradient reaches of the rivers in the WGCP	U
Bird	Bald Eagle	uncommon year-round resident along all of the small rivers in the region; common winter resident due to a seasonal influx of birds from northern populations	I
Bird	Canvasback	uncommon winter resident throughout the region	S
Bird	Little Blue Heron	common summer resident in the low-gradient reaches of each small river in the region	U
Bird	Louisiana Waterthrush	uncommon but widespread in the Ouachita Mts. and Arkansas Valley portions of the region	S
Bird	Northern Pintail	uncommon winter resident throughout the region	D
Bird	Prothonotary Warbler	locally common in riparian forests along all of the small rivers in the region	U
Bird	Snowy Egret	common summer resident in the low-gradient reaches of each small river in the region	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Solitary Sandpiper	common spring and fall migrant across the region	S
Bird	Wood Stork	rare summer visitor; after the nesting season, birds wander north from their coastal colonies into the West Gulf Coastal Plain	S
Fish	Alabama Shad	probably extirpated from this region; occurred historically in the Little and Poteau rivers	Ex
Fish	Alligator Gar	rare but regularly occurring in the lower Poteau River	D
Fish	Black Buffalo	uncommon in the low-gradient reaches of the Kiamichi, Little and Poteau rivers	U
Fish	Blackside Darter	rare and known from the Poteau and Little rivers; Oklahoma represents the southwestern edge of its large range; state listed as threatened	U
Fish	Blackspot Shiner	rare and found in the lower reaches of the Kiamichi and Little rivers	U
Fish	Bluehead Shiner	uncommon and only documented in Oklahoma since the early 1980s; found in sluggish backwaters of the lower Little River	U
Fish	Blue Sucker	an uncommon species associated with deeper channels; found in the Poteau River below Wister Reservoir and the Kiamichi River below Hugo Reservoir	U
Fish	Brown Bullhead	uncommon and limited to the West Gulf Coastal Plain portion of Little River	U
Fish	Crystal Darter	very rare and documented at only a few sites in the Little and Kiamichi rivers	U
Fish	Cypress Minnow	uncommon species found in the backwaters of the lower Mt. Fork & Little rivers	U
Fish	Harlequin Darter	locally common in riffles in the lower Poteau and Little rivers	U
Fish	Ironcolor Shiner	very rare in Oklahoma and restricted to the lower Little River	U
Fish	Kiamichi Shiner	common in the headwaters of the Kiamichi, Little and Poteau rivers	U
Fish	Leopard Darter	uncommon and restricted to the rocky reaches of the Little, Glover and Mt. Fork rivers; endemic to the central Ouachita Mts.; federally listed as threatened	D
Fish	Longnose Darter	potentially extirpated from the region; occurred historically in the Poteau River and its tributaries; state listed as an endangered species	Ex
Fish	Mooneye	uncommon and limited to the Little River system	D
Fish	Mountain Madtom	uncommon in the higher gradient reaches in the Little River system (Glover, Mt. Fork and Little)	U
Fish	Orangebelly Darter	common and widespread in the Red River watershed portion of the region; endemic to Oklahoma and Arkansas	S
Fish	Paddlefish	rare in the lower parts of the Kiamichi, Little and Poteau rivers	S
Fish	Pallid Shiner	uncommon but widespread in low-gradient reaches of the lower Poteau, Kiamichi and Little rivers	U
Fish	Peppered (Colorless) Shiner	rare species that appears to be limited to the Little River; a small population may occur in	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
		the Kiamichi River	
Fish	Plains Minnow	uncommon and found only in the low-gradient portions of each small river in the region	D
Fish	Rocky Shiner	common in the Kiamichi and Little rivers; endemic to the Red River tributaries in the Ouachita Mts.	U
Fish	Taillight Shiner	uncommon species restricted to backwaters and tributaries of the lower Little River	U
Fish	Western Sand Darter	locally common in river reaches with sandy substrate in the lower Kiamichi River	U
Inve	Black Sandshell	probably extirpated; weathered shells suggest that Black Sandshells may have occurred in the Poteau River prior to modern settlement	Ex
Inve	Butterfly mussel	uncommon; found in the lower reaches of the Kiamichi and Little rivers	D
Inve	*Faxonella blairi*	Uncommon species that is endemic to the WGCP; has been documented only in the lower Littler River in Oklahoma	U
Inve	Little Spectaclecase	common in the Red River tributaries – the Little, Glover, Mt. Fork and Kiamichi rivers	S
Inve	Louisiana Fatmucket	common in the small rivers that are tributaries of the Red River (e.g. Little and Kiamichi)	D
Inve	Ouachita Creekshell	taxonomic uncertainties surround this species and genetic work suggests that what we call the Ouachita Creekshell in the Little River in Oklahoma may be the Southern Hickorynut	U
Inve	Ouachita Kidneyshell	common in the Glover River, uncommon elsewhere in the Littler River system and the Kiamichi River	U
Inve	Ouachita Rock Pocketbook	very rare and restricted to the Kiamichi River and the lower Little River; federally listed as an endangered species	D
Inve	Ozark Emerald	Locally occurring in the upper reaches of small rivers in the Ouachita Mountains	U
Inve	Plain Pocketbook	common and widespread in all of the rivers in the region	U
Inve	Pyramid Pigtoe	not documented in Oklahoma, but suspected to be present in the Littler River in small numbers based upon mussels with similar shell characteristics	U
Inve	Purple Lilliput	occurrence not confirmed in Oklahoma; potentially occurs as a rare species in the Poteau River above Wister Lake	U
Inve	Rabbitsfoot	uncommon species; found in the lower Little River; federally listed as a threatened species	U
Inve	Scaleshell	very rare and possibly extirpated; known only from the Kiamichi and Little rivers; federally listed as an endangered species	D
Inve	Southern Hickorynut	common in the Kiamichi, Little, Glover and Mt. Fork rivers	U
Inve	Texas Lilliput	not confirmed in Oklahoma but may be present in the Little River watershed	U
Inve	Washboard	common in the Poteau River, uncommon in the Kiamichi and Little rivers	S
Inve	Winged Mapleleaf	a small population is present in the lower Little River; federally listed as an endangered species	D

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Mamm	Northern Long-eared Bat	uncommon but widespread in the Ouachita Mountains in LeFlore, Pushmataha and McCurtain counties; forages over rivers and streams; federally listed as a threatened species	U
Mamm	Southeastern Bat	rare and limited to the Little River watershed; often forages over rivers and streams	U
Rept	Alligator Snapping Turtle	rare and secretive; small numbers are found in the low-gradient reaches of the Kiamichi, Little and Poteau rivers	D
Rept	American Alligator	rare but seen with increasing frequency in the lower reaches of the Little and Kiamichi rivers	I
Rept	Eastern River Cooter	common in all of the small rivers throughout the region	D
Rept	Midland Smooth Softshell	uncommon but widespread throughout the region	D
Rept	Mississippi Map Turtle	uncommon but widespread in the low-gradient portions of the small rivers in this region	U
Rept	Ouachita Map Turtle	locally common and widespread throughout the region	D
Rept	Razor-backed Musk Turtle	uncommon and generally found in the higher-gradient reaches of each of the small rivers in the region	U
Rept	Spiny Softshell Turtle	locally common and found primarily in the low-gradient reaches of each small river	D

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Geomorphic Alteration and Instability of River Channels, Altered Patterns of Flow and Decreasing Water Quantity:

1. River channels normally meander through their floodplains and maintain stable, vegetated banks, but some human activities alter the channel structure of rivers and contribute to bank instability. These actions include:
    - efforts to channelize rivers,
    - in-stream gravel or sand mining,
    - creating channel constrictions at bridges and low water dams, and
    - dredging river channels to make them deeper and narrower to convey water more quickly.

   These actions can result in the river cutting a deeper channel and creating a disconnection between the river and its riparian vegetation. Channel cutting erodes gravel and sediment from the river bank and deposits it into the river.
2. In relatively low-gradient reaches of rivers, riparian and flood plain vegetation has been removed and habitat converted to pastureland, pine plantations, riverside cabin developments. Reduction in riparian vegetation, sloughs and wetlands contribute to river bank instability and facilitates bank erosion.
3. The loss of wetlands and the constriction of floodplains reduce the ability of the land to hold and slowly release water, often resulting in “flashier” stream and river flows in which flow is accelerated during storm events, but then rapidly drops afterward.
4. Reservoir construction on river main stems (e.g. Pine Creek, Broken Bow and Wister reservoirs) and on major tributaries (Sardis Reservoir) alters the historic flooding frequencies and flow patterns of small rivers. Reservoirs have inundated long reaches of rivers and altered these from shallow, flowing habitats to deep, still habitats. Reservoirs hold back water and can alter the seasonal fluctuations in flow downstream by reducing the magnitude of high flow events following storms,

prolonging moderate flow events between storms, and decreasing flow during droughts.

5. Water is withdrawn from river systems at impoundments for residential and agricultural uses. Proposals have been discussed to construct additional impoundments in the region in order to hold and then sell the water to municipalities outside of the region. If implemented, these would increase the amount of water withdrawn from rivers and leave less water for fish and wildlife populations.
6. Dams, culverts, and low-water road crossings can act as impediments to the upstream movement of fish and other aquatic wildlife. These impediments can fragment populations and isolate populations in the upper-most reaches.

Conservation Actions:

- Support research into and possible use of alternative bank stabilization and channel restoration techniques that incorporate fluvial geomorphology principles.
- Increase the use of existing cost-share programs to restore riparian habitat and wetlands that stabilize banks, serve as filters of storm water and as wildlife habitat. Increase the funding for cost-share programs that provide financial resources to landowners and conservation districts to restore the morphology of river channels.
- Improve landowner acceptability of conservation easement and habitat restoration programs targeted at small rivers and flood plains.
- Purchase conservation easements from private landowners or acquire property in fee-title from willing sellers within the floodplains of rivers and streams and in the headwaters of streams. Restore, enhance, or create wetlands and riparian vegetation on these acres to stabilize stream banks and filter sediment. Additionally, conservation easements will reduce development within sensitive floodplains and improve habitat conditions for species of greatest conservation need.
- Conduct studies assessing and comparing current and historic flow patterns on small rivers and how changes in flow may affect species of greatest conservation need.
- Where changes in flow patterns are documented, evaluate methods to restore historic patterns such as modifying reservoir management to release water to mimic historic flows.
- Develop monitoring programs for wildlife populations, habitat quality, and water quality to assess the effects of habitat restoration and conservation easement programs.
- Discourage residential and infrastructure development within river floodplains to reduce the incentives for local governments and landowners to initiate bank armament and channelization projects.
- Increase awareness of the existing regulations that restrict or prohibit channel modifications, in-stream gravel and sand mining, and dredging.
- Conduct studies of the habitat and flow needs for species of greatest conservation need. Establish adequate in-stream flow standards/requirements that will meet the needs of these species and conserve aquatic and riparian populations.
- Develop local stream teams or watershed groups comprised of citizens and/or governmental organizations to address local concerns, monitor water quality, monitor wildlife populations, and provide public outreach and education.
- Remove or redesign structures that isolate populations of species of greatest conservation need or prevent these species from recolonizing reaches of rivers (e.g., replace culverts and road crossing that block the movement of fish with new structures that allow fish to pass through).

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality:

7. Concentrated animal operations (e.g., dairies, poultry houses, and their waste application fields), septic systems from houses near streams and rivers, and fertilized crop fields each have the potential to contribute nutrients via storm water runoff.

8. Headwater streams with insufficient riparian vegetation can contribute sediment, nutrients, and pollutants that end up in rivers.
9. Although they are regulated, municipal and industrial discharges may contribute ammonia, pesticides, and endocrine system disruptors to rivers in sufficient quantities to create problems for aquatic species during low-flow events.
10. Some pesticides act as endocrine system disrupters and growth inhibitors. These can enter aquatic systems through storm water runoff from agricultural fields and concentrated animal operations, or from municipal discharges, and can disrupt the reproduction and development of freshwater mussels, amphibians, and fish.
11. Some landowners do not control the access that their livestock have to the river. This results in livestock grazing and watering in river channels and riparian areas where they contribute nutrients, damage riparian vegetation, and potentially destabilize river banks thereby releasing sediment.
12. Increased deposition of fine sediment from eroding banks settles into gravel beds and riffles which impair their quality as spawning habitat for fish and habitat for freshwater mussels.
13. Septic systems and animal waste application fields that occur in porous soils in stream and river floodplains can contribute nutrients via groundwater connections.
14. Wetlands within river and stream floodplains have been filled or drained for agricultural and residential purposes, removing important filters of storm water runoff and increasing sediment and nutrients inputs. Removed wetlands also decrease the availability of important breeding areas for amphibians and feeding areas for waterfowl and shorebirds.
15. The impact of canoeing on fish, freshwater mussel, and other wildlife species has not been evaluated. Heavy recreational use may compact gravel bars, disturb mussel beds, alter channel structure due to the removal of stabilizing woody debris, and cause the local loss of riparian vegetation.

Conservation Actions:

- Increase the implementation of Best Management Practices (BMPs) and conservation cost-share programs to control the quantities of nutrients and sediment in storm water runoff.
- Continue to provide cost-share funding for the construction of fences and alternative sources of water for livestock to exclude them from rivers and riparian areas.
- Develop and distribute educational materials to schools and landowners about BMPs to control nutrients and sediment, the interconnection of rivers, wetlands and groundwater, and the importance of riparian vegetation and wetlands as filters for nutrients and sediment.
- Promote the existing cost-share programs that restore riparian habitat and wetlands, which serve as filters of storm water and as wildlife habitat.
- Purchase conservation easements from private landowners or acquire property in title from willing sellers in the floodplains of river and streams and in the headwaters of streams. Restore, enhance, or create wetlands and riparian vegetation on these acres to stabilize stream banks, filter sediment and nutrients.
- Evaluate the efficacy and acceptability of strategies for discouraging residential development, and the construction of poultry houses and other concentrated animal operations within river floodplains. These could include purchase of conservation easements, environmental stewardship education, zoning regulations and changes in flood insurance programs.
- Develop local stream teams or watershed groups comprised of citizens and/or governmental organizations to address local concerns, monitor water quality, monitor wildlife populations and provide public outreach and education.
- Develop studies to evaluate the impact of recreation activities on fish and wildlife populations. Where impacts are found, develop recommendations to reduce these impacts using a combination of education and regulations.

- Support state or national scenic river designation for biologically important waters such as the Glover River.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat that Create Impediments to Effective Conservation Planning and Implementation:

16. Existing data are incomplete regarding the distributions and ecological needs of many Tier I and Tier II species of greatest conservation need within the small river habitat type. Several of these species are highly mobile and occur in water too deep to easily sample or survey. In order to establish effective conservation actions, more complete data are needed to determine the status and trend for many species and more thorough evaluations are needed to determine the factors that limit population sizes or are responsible for apparent declines.
17. Few data exist regarding the historic (i.e., presettlement) condition of small river habitat in Oklahoma. This information is important because it can serve as a desired condition when establishing goals for conservation efforts.
18. There are few monitoring data for the fish, mussel, and macroinvertebrate communities found in small rivers.

Conservation Actions:

- Review existing literature, reports, and museum records to evaluate the historic distributions, abundances, and habitat needs of Tier I and Tier II species of greatest conservation need.
- Conduct field surveys to establish baseline conditions for the current distributions, abundances, and habitat affinities of species of greatest conservation need. Taxonomic groups in greatest need of survey attention include freshwater mussels, crayfish, and fish.
- Develop and maintain a database to store and analyze distributional and ecological data for species of greatest conservation need, and make these data available to natural resource planners (e.g., wildlife agencies and environmental agencies).
- Conduct ecological studies on Tier I and Tier II species of greatest conservation need to:
    - identify factors that limit population sizes,
    - evaluate factors that may be responsible for population declines, and
    - develop recommendations to enhance populations (i.e., through enhancement of habitat conditions).
- Use historic literature and maps in conjunction with present day field studies to evaluate the historic and present conditions (e.g., channel morphology, flow patterns, and water quality) of small rivers. Use this information to inform small river restoration and management.
- Develop a monitoring program to track habitat condition/quality and the status of species of greatest conservation need over time. Use the results of these surveys and studies to update the Comprehensive Wildlife Conservation Strategy via adaptive resource management.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

19. Exotic aquatic plants including *Hydrilla*, *Azolla* and *Salvinia* have the potential to become widely established in small rivers, especially in the West Gulf Coastal Plain.
20. Exotic plant species such as Japanese Honeysuckle and Chinese Privet have become established in riparian areas where they displace native plants and may alter habitat conditions for wildlife species of greatest conservation need.
21. Some agencies, organizations, and businesses promote exotic plants for erosion control, livestock forage, beautification programs, and wildlife habitat that are actually invasive.

Conservation Actions:

- Evaluate the severity and magnitude of the ecological damage done by exotic plant and animal species (e.g., displacement of native vegetation/plant communities, predation on native animal populations, or hybridization with native species) to identify those exotic species causing the greatest impact.
- Provide the results of studies of exotic species impacts to landowners and conservation agencies/organizations.
- Improve coordination between wildlife biologists, conservation agencies, and agricultural organizations to facilitate the exchange of information about the negative effects of using exotic plants.
- Increase the funding for implementation of the Oklahoma Aquatic Nuisance Species Management Plan.
- Develop control or management plans for the exotic species that cause the greatest ecological damage (e.g., herbicide treatment and mechanical removal) and develop monitoring programs to measure and evaluate the effectiveness of these control measures.
- Promote cost-share programs for private landowners to encourage them to control invasive and exotic species.

Conservation Issues Related to the Commercial Harvest of Freshwater Mussels and Turtles:

22. Freshwater mussels have been harvested commercially for over a century but little is known about the population structure and biology of many mussel species. Commercial harvest is restricted to common species, yet the harvest of common mussels can dislodge, injure, or kill non-target rare mussels that co-occur with them.
23. Freshwater mussel populations are difficult and costly to monitor. As a result, monitoring is often limited to harvest levels with little assessment of in-stream populations.
24. Some mechanical methods of mussel harvest can impair water quality and affect mussel habitat. Additionally, the reduction of mussel populations can decrease water quality because freshwater mussels are filter feeders that remove suspended algae, plankton, and detritus from the river.
25. Little is known about the effects of harvest pressure on aquatic turtle populations. Aquatic turtles were harvested in public waters for approximately 15 years, and although these waters are now closed, catch per unit effort appears to have declined.

Conservation Actions:

- Develop a monitoring program for mussel species in rivers that are open to harvest and evaluate the impact of harvest on mussel populations.
- Conduct ecological studies of both rare and harvested mussel species to determine possible conservation actions that may be taken to maintain stable or improve depleted populations.
- Develop a monitoring program for aquatic turtles and assess the mortality factors that affect population size and growth.
- Support the continued restriction on turtle harvest in public waters and length limits in private waters that conserve large, breeding females.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acres acquired (including easements) or proportion of acres protected/acquired within a focal watershed
- number of landowners participating in conservation practices
- acres of degraded river flood plain that have been restored
- number of miles of restored river channel
- number watersheds addressed by an active local conservation group

- changes in the population sizes and trends of representative species of greatest conservation need that serve as indicators of small river health
- changes in the structural condition of riparian habitat
- changes in the proportion of pools and riffles in a focal river
- changes in river flow
- changes in water quality parameters such as nutrients, pesticides, chlorophyll, pH

Very High Priority Conservation Landscape: White Oak/Hickory Mesic Forest

White Oak/Hickory Mesic Forest, or more properly Western Mesophytic Forest, is currently restricted to the Ouachita Mountains in southern LeFlore, northern McCurtain, and possibly northeastern Pushmataha counties. They occur locally on sites with favorable moisture and soil conditions including the north-facing slopes of the higher mountain ridges and in narrow sheltered ravines. As a result of their restricted distribution, mesic forests typically occur as patches or bands of habitat embedded within a larger landscape of mixed pine-hardwood forests and woodlands. Mesic forests have a high diversity of tree species and often have well developed canopies, mid-stories and understories. Dominant canopy trees include White Oak (*Quercus alba*), Northern Red Oak (*Quercus rubra*), and Mockernut Hickory (*Carya tomentosa*). Other widespread canopy species include Black Gum (*Nyssa sylvatica*), Carolina Basswood (*Tilia caroliniana*), Bitternut Hickory (*Carya cordiformis*), Sugar Maple (*Acer saccharum*), Black Cherry (*Prunus serotina*), Black Oak (*Quercus velutina*), and Black Walnut (*Juglans nigra*). The diverse mid-stories and understories are comprised of Flowering Dogwood (*Cornus florida*), Downy Serviceberry (*Amelanchier arborea*), Eastern Hop Hornbeam (*Ostrya virginiana*), Carolina Silverbell (*Halesia carolina*), American Beautyberry (*Callicarpa americana*), Littlehip Hawthorn (*Crataegus spathulata*), American Holly (*Ilex opaca*), Rusty Blackhaw (*Viburnum rufidulum*), Strawberry Bush (*Euonymous americanus*), Pawpaw (*Asimina triloba*), and Ozark Chinquapin (*Castanea ozarkensis*). In isolated areas (e.g., Beech Creek, Walnut Mountain, upper Mill Creek, upper Big Creek, and the Glover and Mt. Fork River corridors), American beech (*Fagus grandifolia*) is a dominant overstory species. Mesic forests on north-facing mountain slopes in LeFlore County also support the only known populations of Cucumber Magnolia (*Magnolia acuminata*) and Umbrella Magnolia (*Magnolia tripetala*) in Oklahoma.

Western mesophytic forest is considered a late-succession forest type and is maintained by infrequent small-scale disturbances (e.g., wind events and glaze storms). Large-scale stand replacement events such as high intensity burning and timbering tend to favor the regeneration of early-succession species, resulting in a loss of late-succession habitat. The extent of western mesophytic forest in the Ouachita Mountains of Oklahoma is unknown due primarily to the paucity of research on the subject and lack quality historical documentation. It is likely that the extent of western mesophytic forest varied prior to European settlement, depending on the intensity of anthropogenic disturbance. Unregulated timbering in the late 19th and early 20th centuries resulted in the loss of most of the old-growth mesophytic forest in southeastern Oklahoma. Public acquisition of a large block of cut-over land in the Ouachita Mountains (now part of the Ouachita National Forest) in the mid 1930's and subsequent fire suppression and grazing control policies slowed the loss of mesophytic habitats allowing some degraded areas to recover. An accurate survey of the extent of mesophytic forest in southeastern Oklahoma at present is not available.

Recognized vegetation associations within this habitat include:

- American Beech – White Oak – American Holly Forest
- Northern Red Oak – Shumard Oak Forest
- Southern Red Oak – Mockernut Hickory Forest
- Sugar Maple – Chinquapin Oak Forest
- Sugar Maple – Northern Red Oak – Bitternut Hickory Forest
- Sugar Maple – White Oak – Mockernut Hickory Forest
- White Oak – Mockernut Hickory – American Basswood Forest

(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or national data over the past 50 years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Four-toed Salamander	rare and locally occurring in seeps and bogs in high-elevation forests in the Ouachita Mts.	U
Amph	Kiamichi Slimy Salamander	uncommon and limited to forests in the upper Kiamichi River watershed	U
Amph	Many-ribbed Salamander	common stream-breeding salamander found throughout the Ouachita Mts.	U
Amph	Ouachita Dusky Salamander	locally occurring but can be common; largely aquatic as an adult; found in springs and small streams scattered through the Ouachita Mts.	U
Amph	Rich Mountain Salamander	locally common but restricted to high-elevation forests on Winding Stair, Kiamichi and Rich Mountains	U
Amph	Ringed Salamander	locally occurring in the eastern half of the region; secretive and nocturnal	U
Amph	Sequoyah Slimy Salamander	common but locally occurring in the southern Ouachita Mts in McCurtain County	U
Amph	Southern Red-backed Salamander	common in the Ouachita Mts. in the eastern half of the region (LeFlore & McCurtain Cos)	U
Bird	American Woodcock	common winter resident throughout the region; small numbers may remain into the nesting season but are difficult to document	S
Bird	Cerulean Warbler	rare and locally occurring summer resident in mature mesic forest in the Ouachita Mts.; nesting only documented on and around Kiamichi Mountain, southern LeFlore Co.	D
Bird	Hooded Warbler	common summer resident across the eastern 2/3 of the region; nests in low-elevation mesic forests with a dense woody understory	S
Bird	Kentucky Warbler	uncommon but widespread summer resident; nests in mesic forests across the entire region	U
Bird	Wood Thrush	rare and locally-occurring summer resident; nests in low-elevation mesic forests	D
Bird	Worm-eating Warbler	uncommon summer resident; nests in mature forests with abundant woody understory cover	U
Inve	American Burying Beetle	uncommon with scattered records across the region but found primarily in the Arkansas Valley; federally listed as endangered	U
Inve	Lidded Oval	widespread in forested habitats throughout the Ouachita Mountains	U
Inve	Ouachita Mantleslug	widespread in forested habitats throughout the Ouachita Mountains	U
Inve	Ouachita Slitmouth Snail	locally-occurring in the higher ridges of the Ouachita Mountains in LeFlore County	U
Inve	Rich Mountain Slitmouth Snail	uncommon and locally occurring on talus slopes and high-elevation, forested slopes on Rich, Black Fork and Winding Stair Mts.	S
Mamm	Eastern Small-footed Bat	very rare, recorded fewer than five times in the region; associated with rocky slopes and mature forests in the eastern Ouachita Mts.	U
Mamm	Eastern Spotted Skunk	uncommon; found in rocky, forested habitats primarily in the Ouachita Mts.	U
Mamm	Golden Mouse	uncommon resident of mesic and riparian sites in the eastern half of the region	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Mamm	Indiana Bat	rare spring and fall migrant through the eastern half of the region; winter records on Winding Stair Mt.; federally listed as endangered	U
Mamm	Northern Long-eared Bat	uncommon resident of forested habitat in the Ouachita Mts.; federally listed as threatened	U
Mamm	Rafinesque's Big-eared Bat	rare and locally occurring in low-elevation mesic forests and river/creek valleys; recent records only from the Little River watershed	U
Mamm	Southeastern Bat	rare and locally occurring in low-elevation mesic forests and river/creek valleys; documented only in the Little River watershed	U
Rept	Louisiana Milksnake	an uncommon species with a poorly defined range in Oklahoma; occurs in moist forest habitats in the WGCP and Ouachita Mountains	U
Rept	Northern Scarletsnake	a rare, secretive burrowing species; most records originate from the western and northern portions of this region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat that Create Impediments to Effective Conservation Planning and Implementation:

1. Mesic forests have not been extensively studied in Oklahoma. Ecological and distributional data are incomplete for many species of greatest conservation need that depend upon this community. In order to establish effective conservation actions, more complete data are needed to determine the population status and trends for many species. More thorough evaluations are needed to determine the factors that limit population sizes or are responsible for suspected declines.
2. The mesic forest community is restricted to specific conditions of slope and aspect and is therefore limited in acreage. The current and historic distributions and conditions of this community have not been assessed.

Conservation Actions:

- Conduct reviews of the existing literature and field surveys to determine the current distributions, abundances, and ecological needs of species of greatest conservation need.
- Develop databases to store and analyze distributional and ecological data for species of greatest conservation need.
- Conduct ecological studies on Tier I and Tier II species of greatest conservation need (e.g., salamanders, songbirds, and bats) to:
    - identify factors that limit population sizes,
    - evaluate factors that may be responsible for population declines, and
    - develop recommendations to enhance populations (i.e., through enhancement of habitat conditions).
- Develop a method to accurately identify and map the distribution and the condition of this community to establish a current baseline.
- Assess historic literature and conduct field studies to evaluate the probable historic distribution and condition of this habitat type in conjunction with a landscape-level evaluation of the probable locations and distributions of all forest, woodland, and savannah community types.
- Use the results of these surveys and studies to update the Comprehensive Wildlife Conservation Strategy via adaptive resource management.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

3. Habitat has been lost and fragmented by the conversion of mesic oak-hickory forest to other land uses such as pine plantations that are monocultures of Loblolly Pines.
4. Habitat is being lost and fragmented by an increasing number of secondary home developments and cabins, coinciding with the trend for increasing fragmentation of land ownership with more individuals owning smaller tracts of land.
5. Fragmentation and loss of habitat is occurring due to expanding infrastructure (e.g. roads, utility lines, and pipelines.)

Conservation Actions:

- Develop a landowner incentive program to retain mesic forest stands and prevent the conversion of these forests to other vegetation such as Loblolly Pine plantations.
- Develop programs to maintain biologically meaningful tracts of mesic oak-hickory forests such as conservation easements or willing-seller land acquisitions. This should be preceded by a landscape-level assessment of habitat conditions and existing mesic forest tract to identify focus areas with the greatest conservation value to species of greatest conservation need.
- Evaluate methods to restore mesic deciduous forest from land that has been converted to pine plantations and develop cost-share programs or grants to assist willing landowners who wish to restore/replant these sites back to their historic plant community.
- Support cooperative efforts between government agencies and research institutions to develop or update Best Management Practices and management recommendations to minimize the ecological footprint left by road, pipeline, and utility line construction, and the impacts of right-of-way maintenance practices.
- Develop educational materials for schools and landowners that highlight the value (i.e., ecological and economic) of hardwood trees and the mesic forest community.
- Develop wildlife corridors to connect tracts of mesic hardwood forest or to connect mesic forest with other important communities such as riparian forest.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

6. Exotic plant species including Sericea Lespedeza, Autumn Olive, Chinese Privet and Japanese Honeysuckle have become established in mesic hardwood forests and may be displacing native understory plant communities and altering habitat conditions for species of greatest conservation need.
7. Feral hogs may cause substantial damage to seeps, springs, and vernal pools which are important breeding areas for amphibians.
8. Exotic tree pathogens, such as those affecting native chestnuts (Chestnut Blight), oaks (Oak Wilt) and Flowering Dogwood (Dogwood Anthracnose), can alter forest structure and diversity.

Conservation Actions:

- Evaluate the severity and magnitude of the ecological damage done by exotic plant and animal species (e.g., displacement of native vegetation, predation on native animal populations, or hybridization with native species) to identify those causing the greatest impact to species of greatest conservation need.
- Develop control or management plans (e.g., controlled burning programs, herbicide treatment, and mechanical removal) for the exotic species that cause the greatest ecological damage, and develop monitoring programs to evaluate the effectiveness of these control measures.
- Promote existing cost-share programs for private landowners to encourage them to control invasive and exotic species.

- Develop educational materials about the ecological damage done by invasive and exotic vegetation and introduced plant diseases.
- Minimize damage to trees (e.g., during right-of-way maintenance and to seed trees during timber harvest) to lessen the chance of infection by pathogens and the spread of disease. Work with the Oklahoma Division of Forestry to implement management practices to stop the introduction and spread of emerging forest diseases.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality and Forest Structure:

9. Many mesic forest stands are comprised of dense even-aged second growth forest as a result of widespread timber harvest in the early 1900s. These forest stands lack the diverse structure of canopy, mid-story and understory vegetation that existed historically in uneven-aged forests. The dense canopies or mid-stories in these even-aged forests may limit the abundance and diversity of understory vegetation.
10. Dense canopy or mid-story conditions can limit light penetration to the forest floor, which can limit the recruitment of oak species/oak regeneration in favor of more shade tolerant species.
11. Excessive use of prescribed fire in mesic habitats can result in the xerification of these areas causing further loss and fragmentation of this limited habitat type; altering the plant community and possibly fostering the spread of exotic disturbance-dependent species.
12. Vernal pools are a common and important component of mesic hardwood forests. Mesic forests support the greatest diversity of amphibians in the region and many of these depend upon vernal pools and seasonal wetlands for reproduction. These vernal pools have been lost or degraded as a result of sedimentation, the alteration of drainage patterns by road construction, and feral hog activity
13. The use of off-road and all-terrain vehicles can compact soil, create soil erosion problems, damage understory vegetation and crushing nests and wildlife (e.g. bird nests and salamanders) that occur in the dense leaf litter found in mesic forests.
14. Excessive equestrian use of the habitat can create erosion problems or facilitate the spread of exotic weedy herbaceous plants as a result of seeds carried in horse feed and the soil disturbance cause by horses.

Conservation Actions:

- Evaluate the effectiveness of mid-story thinning or timber stand improvement as a tool to diversify forest structure and increase understory vegetation.
- Restrict the frequency and size of prescribed burns in mesic forest sites through education. Produce informational materials to landowners regarding fire frequency and how it relates to different habitat types within the region.
- Identify and develop protection and management plans for vernal pools, seeps, and seasonal wetlands that are important to salamander species of greatest conservation need. These plans can include activities such as fencing, dredging/removal of accumulated sediments, development of conservation easements, or construction of new vernal pools. Provide educational materials for landowners regarding the importance of vernal pools, and develop a cost-share program to incentivize the conservation of vernal pools.
- Develop monitoring programs to evaluate the success of vernal pool management plans and their effects on local populations of amphibians.
- Continue to control off-road vehicle use on public lands and close or gate roads to limit access by all-terrain vehicles.
- Develop informational materials about the potential impacts of off-road vehicles and equestrian use and develop recommendations to minimize these impacts.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acres of restored or enhanced habitat

- changes in habitat quality such as changes in forest tract size, forest structure, and total acreage
- number of landowners and number of acres involved in conservation programs
- number of acres acquired or placed into conservation programs (e.g. easements)
- changes in the population sizes and trends of representative species of greatest conservation need that serve as indicators of mesic forest health and habitat quality
- changes in tree diversity and age-structure at the stand level

Very High Priority Conservation Landscape: Oak/Hickory Bottomland Hardwood Forest

Bottomland Hardwood Forests occur locally within the floodplains of rivers and large streams. A large percentage of this habitat, probably more than 50 percent, has been either converted to agricultural uses (e.g., crop fields or introduced pasture) or permanently inundated by the construction of reservoirs. Approximately 175,000 acres of this habitat type are likely to remain in the region, with the largest tracts of bottomland forest documented to occur in the floodplains of the Little River, Kiamichi River, upper Poteau River, and Gaines Creek. Bottomland hardwood forests are diverse plant communities and their species composition varies with soil conditions and flooding frequency and duration. Most bottomland hardwood forests are dominated by oak species such as Water Oak (*Quercus nigra*), Willow Oak (*Quercus phellos*), and Shumard Oak (*Quercus shumardii*). Other common deciduous trees include Black Gum (*Nyssa sylvatica*), Sweetgum (*Liquidambar styraciflua*), Red Maple (*Acer rubra*), and Sugarberry (*Celtis laevigata*). Common understory vegetation includes American Hornbeam (*Carpinus caroliniana*), Parsley Hawthorn (*Crataegus marshallii*), Deciduous Holly (*Ilex decidua*), and Spicebush (*Lindera benzoin*). Dwarf Palmetto (*Sabal minor*) grows in the understory of bottomland forests at a few sites in southeastern McCurtain County.

This habitat type includes semi-permanently flooded forests of Bald Cypress (*Taxodium distichum*) and seasonally flooded forests of Overcup Oak (*Quercus lyrata*) and Water Hickory (*Carya aquatica*) which occur in the floodplains of the Little River and some Red River tributaries in the West Gulf Coastal Plain section. In the floodplain of the Arkansas River and its tributaries bottomland forests are dominated by Pin Oak (*Quercus palustris*), Pecan (*Carya illinoiensis*), Sugarberry (*Celtis laevigata*), and Shumard Oak (*Quercus shumardii*).

Recognized plant associations within this habitat type include:

- Bald Cypress Semi-permanently Flooded Forest
- Black Gum – Red Maple Temporarily Flooded Forest
- Black Gum – Sweetgum Temporarily Flooded Forest
- Overcup Oak – Water Hickory Seasonally Flooded Forest
- Pecan – Sugarberry Temporarily Flooded Forest
- Pin Oak – Pecan/Deciduous Holly Seasonally Flooded Forest (Arkansas River Valley)
- Red Maple – Sweetgum Seasonally Flooded Forest
- Sweetgum – Water Oak/American Hornbeam Seasonally Flooded Forest
- Sweetgum – Willow Oak/American Hornbeam Seasonally Flooded Forest
- Water Oak – Red Elm – Sweetgum/American Hornbeam Temporarily Flooded Forest
- Water Oak – Willow Oak/American Hornbeam Temporarily Flooded Forest
- Willow Oak – Black Gum/American Hornbeam Temporarily Flooded Forest

(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or national data over the past 50 years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status with the Region	Trend in Population Size or Range
Amph	Crawfish Frog	locally occurring in the transition between bottomland forests and open, grassy habitats	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status with the Region	Trend in Population Size or Range
Amph	Kiamichi Slimy Salamander	uncommon and limited to moist forests in the upper Kiamichi River watershed	U
Amph	Many-ribbed Salamander	common and widespread in moist forest habitats near streams and rivers region wide	U
Amph	Mole Salamander	rare, secretive burrowing species; known only from a few flood plain forest sites	U
Amph	Ringed Salamander	locally occurring in moist forests near breeding ponds and vernal pools	U
Amph	Sequoyah Slimy Salamander	locally common but limited to moist forests in the southern Ouachita Mts. in McCurtain County	U
Amph	Three-toed Amphiuma	rare and secretive in sloughs and swamps in the flood plains of the Red and Little rivers in the West Gulf Coastal Plain	U
Amph	Western Bird-voiced Treefrog	uncommon and locally occurring in flood plain forests in the lower Little River	S
Amph	Western Lesser Siren	uncommon in streams and bottomlands across the West Gulf Coastal Plain	U
Bird	American Woodcock	common winter resident; a few birds remain in the state through the nesting season	S
Bird	Cerulean Warbler	rare summer resident; potentially breeds in bottomland forests on the Poteau & Little rivers	D
Bird	Hooded Warbler	uncommon summer resident; nests in flood plain forests across the eastern 2/3 of the region	S
Bird	Kentucky Warbler	uncommon but widespread summer resident; nests in forests with abundant, low understory vegetation across the entire region	U
Bird	Little Blue Heron	common summer resident region wide in the vicinity of nesting colonies; forages in pools and moving water in bottomland forests	U
Bird	Louisiana Waterthrush	uncommon summer resident; nests along moving water in bottomland forests region wide	S
Bird	Northern Pintail	uncommon winter resident in wetlands and flooded bottomland forests	D
Bird	Prothonotary Warbler	locally common summer resident; nests in bottomland forests region wide	U
Bird	Red-headed Woodpecker	uncommon year-round resident region wide	D
Bird	Rusty Blackbird	uncommon winter resident in bottomland forests and swamps region wide	D
Bird	Solitary Sandpiper	common spring and fall migrant that forages in pools and moving water within bottomland forest	S
Bird	Swainson's Warbler	rare and locally occurring in dense thickets of shrubs and canebrakes (*Arundinaria gigantea*) within bottomland forests along small rivers	U
Bird	Swallow-tailed Kite	rare spring and fall migrant, but historically nested in large tracts of bottomland forests	D
Bird	Wood Stork	rare but regular summer visitor; birds from coastal nesting colonies disperse into the WGCP after the breeding season	S
Bird	Wood Thrush	rare and locally-occurring summer resident; nests in mature bottomland forests along small rivers	D
Inve	Lidded Oval	widespread but endemic to this region; status is poorly known	U
Inve	Ouachita Mantleslug	widespread in forested habitats throughout the Ouachita Mountains	U
Mamm	Golden Mouse	rare resident in sites with thickets and dense understory within bottomland forests	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status with the Region	Trend in Population Size or Range
Mamm	Marsh Rice Rat	uncommon in transitions between bottomland forests and herbaceous wetlands	U
Mamm	Northern Long-eared Bat	uncommon resident in flood plain forests in the Ouachita Mts.; federally listed as threatened	U
Mamm	Rafinesque's Big-eared Bat	rare resident of bottomland forests in the Little River and possibly Poteau River watersheds	U
Mamm	Southeastern Bat	rare resident of bottomland forests in the Little River watershed	U
Mamm	Swamp Rabbit	uncommon but widespread in bottomland forests throughout the region	U
Rept	American Alligator	rare and secretive in sloughs and swamps in the flood plains of the Red and Little rivers	I
Rept	Eastern River Cooter	common in sloughs and wetlands within bottomland forests across the entire region	S
Rept	Louisiana Milksnake	rare resident of bottomland forests in the West Gulf Coastal Plain	U
Rept	Midland Smooth Softshell	common in sloughs and wetlands within bottomland forests across the entire region	U
Rept	Mississippi Map Turtle	uncommon resident of sloughs and wetlands along the Red and Arkansas rivers	U
Rept	Ouachita Map Turtle	common in sloughs and wetlands within bottomland forests across the entire region	U
Rept	Western Chicken Turtle	uncommon in sloughs and forested wetlands mainly in the West Gulf Coastal Plain	U
Rept	Western Mudsnake	rare in sloughs and forested wetlands in the West Gulf Coastal Plain	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

1. Fragmentation and loss of bottomland hardwood communities has resulted from the widespread conversion of these forests to other land uses such as crop fields, pine plantations, and fescue pastures.
2. Bottomland forest tracts are continuing to be fragmented by increasing numbers of roads, utility lines, pipelines; and cabins. Those species that rely on relatively large unbroken tracts of forest are most susceptible to this trend.
3. Tracts of bottomland forest have been lost permanently through inundation by reservoir construction.

Conservation Actions:

- Develop a landowner incentive program to retain bottomland hardwood forest stands and to prevent the conversion of these forests to other land uses such as crop fields, pine plantations and tall fescue pastures.
- Develop programs to maintain biologically meaningful tracts of bottomland oak-hickory forests such as conservation easements, or willing-seller land acquisitions. This should be preceded by a landscape-level assessment of habitat conditions and the remaining tracts of bottomland forests to identify focus areas of greatest conservation value for species of greatest conservation need.
- Evaluate methods to restore bottomland hardwood forests on pastures or crop fields and develop cost-share programs or grants to assist and encourage willing landowners who wish to restore these areas.
- Support cooperative efforts between government agencies and research institutions to develop or update Best Management Practices and management recommendations

to minimize the ecological footprint left by road, pipeline, and utility line construction, and the impacts of right-of-way maintenance practices.

- Develop educational materials for schools and landowners that highlight the value (i.e., ecological and economic) of hardwood trees and the bottomland forest community.
- Develop wildlife corridors to connect isolated tracts of bottomland hardwood forest with one another or with other important forest communities.

Conservation Issues Related to Habitat Loss and Modification as a Result of Altered Patterns of Seasonal Flooding:

4. Reservoir construction and stream channelization projects have reduced the frequency and magnitude of flooding which is necessary to maintain bottomland hardwood forests. In some areas, channel modifications have resulted in deep incised stream channels and created a disconnection between the streams and their bottomland forests.
5. Vernal pools and seasonally flooded wetlands within bottomland forests have been lost or degraded as a result of sedimentation and/or reduction in periodic flooding, resulting in losses of important breeding areas for amphibians.

Conservation Actions:

- Where modifications have occurred, restore hydrology to tracts of bottomland hardwood forest by managing for the historic hydroperiod reconnecting streams with their floodplain forests. Restoration efforts may include restoring the structure of stream or river channels, restoring stream meanders, or creating low dikes to retain seasonal storm water.
- Identify and develop protection and management plans for vernal pools, seeps, and seasonal wetlands that are important to salamander species of greatest conservation need. These plans can include activities such as fencing, dredging/removal of accumulated sediments, development of conservation easements, or construction of new vernal pools.
- Develop monitoring programs to evaluate the success of vernal pool management plans and their effects on local populations of amphibians.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat that Create Impediments to Effective Conservation Planning and Implementation:

6. Data are incomplete regarding the distributions and habitat needs of species of greatest conservation need.
7. Baseline knowledge about flora/fauna and both the historic and current distribution and condition of this habitat type is incomplete.

Conservation Actions:

- Conduct surveys of existing literature, reports, and museum records to evaluate historic distributions, abundances, and habitat affinities of species of greatest conservation need. Then conduct field surveys to establish the current distributions and abundances of these species.
- Develop and maintain databases to store and analyze distributional and ecological data for species of greatest conservation need.
- Conduct ecological studies on Tier I and Tier II species of greatest conservation need (e.g., songbirds, amphibians, and bats) to:
    - identify factors that limit population sizes,
    - evaluate factors that may be responsible for population declines, and
    - develop recommendations to enhance populations (i.e., through enhancement of habitat conditions).

- Use the results of these surveys and studies to update the Comprehensive Wildlife Conservation Strategy via adaptive resource management.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality and Alter Forest Structure:

8. Many bottomland forest stands are comprised of dense even-aged second growth forest as a result of widespread timber harvest in the early 1900s. These forest stands lack the diverse structure of canopy, mid-story and understory vegetation that existed historically in uneven-aged forests. The shading caused by dense canopies in these even-aged forests may limit the abundance and diversity of understory vegetation and sustained shading may limit the recruitment of oak species in favor of more shade tolerant species over time.

Conservation Action:

- Evaluate the effectiveness of mid-story thinning or timber stand improvement as a tool to diversity forest structure and increase understory vegetation.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

9. Several exotic plant species including Sericea lespedeza, Nepalese Browntop Grass, Autumn Olive, Chinese Privet and Japanese Honeysuckle have become established in bottomland hardwood forests that appear to be displacing native understory plants and may alter native plant communities and habitat conditions for wildlife species of conservation need.
10. Feral hogs may be causing substantial ecological damage to vernal pools within bottomland forests and may compete with native wildlife for food.

Conservation Actions:

- Evaluate the severity and magnitude of the ecological damage done by exotic plant and animal species (e.g., displacement of native vegetation, predation on native animal populations, or hybridization with native species) to identify those exotic species causing the greatest impact to species of greatest conservation need.
- Develop control or management plans (e.g., prescribed burning programs, herbicide treatment, and mechanical removal) for the exotic species that cause the greatest ecological damage and develop monitoring programs to evaluate the effectiveness of these control measures.
- Develop and implement invasive and exotic species management plans for all conservation areas.
- Promote cost-share programs that encourage private landowners to control invasive and exotic species.
- Develop educational materials about the ecological damage done by invasive and exotic vegetation and introduced plant diseases.

Potential indicators for monitoring the effectiveness of the conservation actions:

- number of acres of bottomland hardwood forest restored and the population response by species of greatest conservation need to the new habitat
- number or percentage of acres acquired or placed into conservation programs (e.g. easement programs) on both a regional and a local watershed scale
- measure the net gain or loss of habitat over time
- changes in the population sizes and trends of representative species of greatest conservation need that serve as indicators of bottomland hardwood forest quality
- number of snags per acre in bottomland hardwood forest under conservation management as a way of monitoring habitat quality for species such as bats
- connectivity between bottomland forests and their adjacent streams
- number of days per year and in the growing season during which the soil is saturated

Very High Priority Conservation Landscape: Gravel (hard)-bottom Streams and Associated Riparian Forests

Streams with bedrock, cobble, or gravel substrates are common in the Ouachita Mountains portion of this region and are typically found above the 500 foot elevation contour. Most streams in the Ouachita Mountains flow over sections of bedrock, boulders, or cobble and few of these streams could accurately be considered gravel-bottom streams. The hard-bottom streams in this Region are diverse but most have well defined pool and riffle sections. They are moderately entrenched and are wider than they are deep. Most have relatively few meanders and narrow floodplains and riparian zones. Riparian forests are dominated by Red Maple (*Acer rubrum*), Sycamore (*Platanus occidentalis*), River Birch (*Betula nigra*), and Sweetgum (*Liquidambar styraciflua*) with an understory dominated by Silky Dogwood (*Cornus amomum*), Spring Witch-hazel (*Hamamelis vernalis*), Smooth Alder (*Alnus serrulata*), wild indigo (*Amorpha sp.*), Deciduous Holly (*Ilex deciduas*), and St. John's-wort (*Hypericum sp.*).

Recognized riparian plant associations in this habitat type include:

- American/Red Elm – Chinquapin Oak Temporarily Flooded Forest
- American/Red Elm – Sugarberry/Hackberry – Green Ash Temporarily Flooded Forest
- Giant Cane Temporarily Flooded Shrubland
- Green Hawthorn – Cockspur Hawthorn – Downy Hawthorn Temporarily Flooded Shrubland
- River Birch – Sycamore – Smooth Alder Temporarily Flooded Forest
- Smooth Alder – False Indigo Temporarily Flooded Shrubland
- Spring Witch-Hazel – Silky Dogwood Temporarily Flooded Shrubland

(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or national data over the past 50 years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Kiamichi Salamander	uncommon and limited to riparian forests along the headwater tributaries of the Kiamichi River	U
Amph	Many-ribbed Salamander	common and widespread in streams and riparian areas throughout the Ouachita Mountains	U
Amph	Ouachita Dusky Salamander	locally common in rocky, high-gradient headwater streams in the Ouachita Mountains in the eastern half of the region	U
Amph	Ringed Salamander	uncommon and locally occurring in the vicinity of breeding ponds	U
Amph	Sequoyah Slimy Salamander	locally common in riparian areas along stream tributaries to the Glover and Mt. Fork rivers	U
Bird	Hooded Warbler	uncommon summer resident; nests in low elevation, riparian sites with abundant understory shrub cover	S
Bird	Kentucky Warbler	uncommon summer resident; nests in riparian sites with abundant understory vegetation	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Louisiana Waterthrush	uncommon summer resident; nests in riparian forests along streams throughout the region but most common in the Ouachita Mountains	S
Bird	Prothonotary Warbler	common summer resident near water; nests in riparian and flood plain forests along low-gradient streams	U
Fish	Harlequin Darter	locally common in low-elevation, rocky tributaries of the Poteau and Little Rivers	U
Fish	Kiamichi Shiner	uncommon but widespread in rocky streams throughout the Ouachita Mountains	U
Fish	Orangebelly Darter	common and widespread in rocky, Ouachita Mountain streams in the Red River watershed portion of the region	S
Fish	Ouachita Mountain Shiner	locally common in the headwater streams of the Little River in the Ouachita Mountains	S
Fish	Redfin Darter	locally common in low-gradient rocky tributaries of the Poteau River	U
Fish	Rocky Shiner	common in larger streams in the Kiamichi and Little river watersheds	U
Inve	*Apobaetis futilis* (mayfly)	in Oklahoma, known only from streams in the upper Kiamichi River watershed	U
Inve	*Caecidotea occulata* (isopod)	endemic to and widespread in streams and springs in the Ouachita Mountains	U
Inve	Cherokee Needlefly	locally common but known from few sites in the Arkansas Valley and Ouachita Mts.	U
Inve	Kiamichi Crayfish	uncommon and locally occurring in seven streams in the headwaters of the Kiamichi River; endemic to Oklahoma	S
Inve	*Ochrotrichia weddleae* (microcaddisfly)	rare and documented only in the Ouachita Mountains in Latimer County	U
Inve	*Orconectes difficilis* (crayfish)	occurs in scattered stream watersheds in lower elevations of the Ouachita Mountains	U
Inve	*Orconectes menae* (crayfish)	locally common crayfish found in tributary streams of the Little and Kiamichi rivers in the Ouachita Mountains	U
Inve	Ozark Emerald	locally occurring in rocky streams throughout the Ouachita Mountains	U
Inve	*Procambarus tenuis* (crayfish)	uncommon and locally-occurring crayfish of clear, rocky streams in the Ouachita Mountains	U
Inve	Toothed Stonefly	rare and documented only in the Ouachita Mountains	U
Inve	Truncate Stonefly	rare and probably restricted to the Ouachita Mountains within this region; its range is poorly documented	U
Mamm	Northern Long-eared Bat	uncommon but widespread in forested habitats in the Ouachita Mountains in the eastern half of the region; federally listed as threatened	U
Rept	Alligator Snapping Turtle	uncommon; found in low-gradient streams with woody debris / cover	U
Rept	Eastern River Cooter	common and found throughout the region	D
Rept	Mississippi Map Turtle	uncommon; occurs in larger, low-gradient streams; primarily in the West Gulf Coast Plain	D
Rept	Ouachita Map Turtle	common; occurs throughout the region	U
Rept	Razor-backed Musk Turtle	uncommon and secretive; found in rocky streams in the Ouachita Mountains	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Habitat Loss and Fragmentation (In-stream and Riparian) due to Historic and Current Management Practices:

1. The abundance and diversity of understory vegetation has declined in riparian areas as a result of livestock grazing, especially during the growing season. Livestock grazing along stream banks increases bank erosion and increases the sediment load in the stream.
2. Riparian Forests have been cleared and converted to crop fields or introduced pastures of exotic grasses such as Tall Fescue and Bermudagrass.
3. Riparian forests have been fragmented by roads, houses, pastures, and utility right-of-ways.
4. The clearing of riparian vegetation reduces stream bank stability which subsequently increases erosion, sedimentation and the width/depth ratios of streams.
5. Lack of headwaters protection allows for more sediment, nutrients, pesticides, and other pollutants to enter streams.
6. Loss of stream shading, as a result of reduced riparian vegetation increases water temperatures and affects the composition of the aquatic community.
7. Increased sediment in the stream can fill or alter riffles and gravel beds which serve as spawning areas for fish and habitats for freshwater mussels.
8. Bridges and culverts can impact alter stream channel morphology and facilitate the development of drop-cuts in channels. Some culverts can become barriers to the movement of fish either through the development of drop-cuts or by distributing water over a broad surface that becomes too shallow for fish to traverse during low-flow conditions.
9. Dams and bridges can create dispersal barriers that isolate populations of fish, crayfish and freshwater mussels.

Conservation Actions:

- Continue to provide cost-share funding to landowners for the fencing of riparian forests to control access by cattle.
- Purchase easements to protect or enhance existing riparian vegetation or to restore riparian forests.
- Provide landowner incentives or cost-share programs to protect or restore riparian forests, stream banks and in-stream habitat.
- Use fee-title purchase from willing sellers to place streams and riparian habitats into conservation ownership and to maintain or enhance their existing quality.
- Purchase conservation easements or fee-title from willing sellers on headwater steams to control the introduction of sediment, nutrients, and chemical pollutants.
- Develop new and promote existing Best Management Practices (BMPs) for the grazing of cattle adjacent to riparian zones.
- Increase the availability of aquatic resource educational information in the public schools.
- Work with other natural resource agencies to develop appropriate riparian buffer recommendations, including buffers for intermittent tributaries to steams that support aquatic species of greatest conservation need.
- Identify dams, culverts and road crossings that can be shown to block the movement of aquatic species of greatest conservation need. Remove or rehabilitate culverts and road crossing with new structures that are not barriers to fish passage. Evaluate alternatives to restore dispersal and gene flow between fish and invertebrate populations that are fragmented or isolated by barriers.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat that Create Impediments to Effective Conservation Planning and Implementation:

10. Data are incomplete regarding the distribution and habitat needs of species of greatest conservation need.
11. Limited historic data exist from which to evaluate the condition of streams and riparian forests prior to large scale human alteration of the region.
12. The resources of riparian forests and streams are difficult to monitor because most of the habitat occurs on private land and is distributed in small tracts across many individual landowners.
13. Incomplete information exists from which land managers can predict the effect of habitat changes on populations of species of greatest conservation need.

Conservation Actions:

- Conduct research on species of greatest conservation need to determine what factors limit their population size and distribution.
- Conduct research on species of greatest conservation need to establish baseline population size, density, distribution, and habitat relationships.
- Conduct biological inventories of amphibian, fish, crayfish, and mussel populations in streams to increase the knowledge of biological communities within specific watersheds.
- Conduct literature reviews and focused studies to determine what stream and riparian habitats looked like historically to establish a target condition for stream and riparian restoration efforts.
- Promote the addition of data to the Oklahoma Natural Heritage Inventory Database for both existing and future data concerning species of greatest conservation need and other rare species.
- Use surveys, workshops, and data acquisition to update the Comprehensive Wildlife Conservation Strategy.
- Develop local watershed councils, stream teams, and citizen's groups to address local concerns through education and to monitor water quality and wildlife populations.

Conservation Issues Related to Geomorphic Alteration and Instability of River Channels, Altered Patterns of Flow and Decrease Water Quantity:

14. Increased pond construction on intermittent tributaries to streams may be lowering the inflow that sustains streams.
15. Dams alter the natural flow patterns and other processes of streams, especially the frequency and magnitude of natural flooding events.
16. In-stream gravel mining reduces bank stability upstream and downstream of the mining area. Mining also can increase bank erosion, alter the width-to-depth ratio of the stream by making it wider and shallower, and may remove or reduce riffles, gravel beds, and other in-stream structures that are important habitats for aquatic species.

Conservation Actions:

- Establish minimum in-stream flow levels on all biologically important streams (e.g., those streams that support populations of species of greatest conservation need or diverse aquatic communities).
- Manage water withdrawals from reservoirs to have the least impact on aquatic biota (e.g. withdraw and store water during periods of abundance).
- Stop the proposals to sell water outside of the state or the transfer of water between basins within Oklahoma.
- Provide results of ecological studies to water use planners and those who issue permits.
- Produce educational materials for the public, landowners, government policy makers and water managers to convey sound biological data that demonstrate the ecological effects of water withdrawals and inter-basin transfers of water.

- Replace ponds that have been constructed on streams for livestock watering with alternative water sources such as solar pumps with stock tanks.
- Modify reservoir management to ensure that minimum in-stream flows are maintained below these structures.
- Provide cost-share funding or grants to restore stream channels and establish natural vegetation on stream banks for stability.
- Restore or construct seasonal wetlands/vernal pools within the riparian zones and floodplains of streams to help manage and filter runoff after heavy rain events.
- Develop regulations to eliminate gravel mining from within streams.
- Work with local communities and counties to reduce stream channel impacts including in-stream gravel mining, placement of rip-rap on stream banks at bridge crossings, and recreational use of streams by off-road vehicles.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

17. Exotic plant species such as Chinese Privet, Kudzu, and Japanese Honeysuckle are becoming more abundant in riparian forests and are competing with native plants and altering the structure of the habitat.
18. Feral hogs that forage in streams and along stream banks damage riparian vegetation and reduce bank stability.

Conservation Actions:

- Increase funding to implement the Oklahoma Aquatic Nuisance Species Management Plan.
- Conduct studies to quantify the impact of exotic species on riparian forest and aquatic communities
- Increase educational efforts and public awareness of the ecological and economic impacts of exotic plant and animal populations as well as the unintended consequences of bait-bucket releases and the inter-basin movement of fish and crayfish.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality:

19. The placement of animal feeding operations, such as poultry houses and their waste application fields, close to streams increases the risk that ammonia, pesticides and excessive nutrients will enter streams through accidental spills or storm water runoff.
20. Livestock watering in streams and grazing in riparian areas contribute additional nutrients to these waters.
21. Increased nutrient levels in streams increases the abundance of algae, which can result in other water quality impacts such as increased fluctuations in dissolved oxygen.
22. Endocrine disrupters and other pollutants from pesticides enter streams in storm water runoff from agricultural fields and alter the growth, reproduction and/or survival of fish, amphibians, and invertebrates.

Conservation Actions:

- Develop conservation easements or acquire land to maintain, or restore natural riparian vegetation along streams to reduce or limit agricultural development in and adjacent to riparian areas.
- Establish set back distances between streams and captive animal farming operations, waste lagoons, and land application areas.
- Continue to provide cost-share funding to landowners for the construction of fences along streams and riparian areas to control their access by livestock.
- Provide cost-share funding or increase promotion of existing programs to restore riparian vegetation along streams.

- Promote the existing cost sharing programs that help landowners implement BMPs, such as streamside buffer zones, for controlling nutrients and pesticides.
- Develop local watershed councils, stream teams, and citizen's groups to address local concerns through education and to monitor water quality and wildlife populations.

Potential indicators for monitoring the effectiveness of the conservation actions:

- number of or proportion of acres acquired or placed into conservation easements within a given watershed
- change in the number of in-stream and streamside gravel mining operations
- number of landowners participating in conservation practices
- number of streams in which in-stream flows are reserved for aquatic ecosystem conservation
- miles of streams that are degraded or restored
- number of streams monitored by an active local conservation group
- number of partnerships with local governments
- changes in landowner opinions toward conservation actions for streams and riparian habitat
- changes in the number of recreational users of streams
- changes in the population sizes and trends for representative species of greatest conservation need that serve as indicators for stream and riparian forest quality
- changes in the acreage of riparian and flood plain habitat occupied by forest
- changes in the condition of riparian habitat (e.g. tract size, species diversity, age diversity)
- changes in the proportion of in-stream habitats that fall into the pool or riffle category
- changes in stream flow
- changes in water quality parameters such as nutrients, metals, pH

Very High Priority Conservation Landscape: Shortleaf Pine/Oak Open Woodland

The Shortleaf Pine (*Pinus echinata*) /Oak Open Woodland is currently a rare and locally occurring plant community that is found on gentle slopes with southern or western aspects in the Ouachita Mountains. This is a fire-maintained community in which frequent fires eliminate species that are fire intolerant and reduce the density of fire tolerant species such as Shortleaf Pines and Post Oaks (*Quercus stellata*). Pines create an open canopy over an understory that is dominated by grasses and forbs, particularly Little Bluestem (*Schizachyrium scoparium*), Narrowleaf Woodoats (*Chasmanthium sessiliflorum*), Panic Grasses (*Dichanthelium sp.*), Pale Purple Coneflower (*Echinacea pallida*), Beebalm (*Monarda russeliana*), and Elmleaf Goldenrod (*Solidago ulmifolia*). Understory shrub density is related to fire frequency.

Historically, open pine woodlands were common and widespread in the Ouachita Mountains, often occurring in large tracts along the drier slopes of mountain ridges. Increased woody understory development and canopy closure has occurred rapidly during the past century as a result of fire suppression. Much of this habitat has changed, as a result of fire suppression and succession, to mixed Shortleaf Pine/oak (*Quercus sp.*) forest or has been converted to commercial pine plantations.

Recognized plant associations within this habitat type include:

Shortleaf Pine/Little Bluestem Woodland

(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or national data over the past 50 years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Relative Priority	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Bachman's Sparrow	rare, locally occurring summer resident; nests in open shortleaf pine woodlands and savannahs with abundant warm-season grass understory	D
Bird	Brown-headed Nuthatch	rare and locally occurring in mature pine forests and woodlands; year-round resident	U
Bird	Northern Bobwhite	locally occurring but can be common; found in open woodlands and savannahs with an abundance of herbaceous understory vegetation	D
Bird	Prairie Warbler	uncommon summer resident; nests in shortleaf pine savannahs as well as openings and clear-cuts in forested landscapes	D
Bird	Red-cockaded Woodpecker	very rare year-round resident; only known population occurs in pine woodlands in north-central McCurtain County; federally listed as an endangered species	D
Bird	Red-headed Woodpecker	uncommon year-round resident; widespread in the region were open pine woodlands occur	D
Bird	Whip-poor-will	uncommon summer resident; nests in open pine woodlands and woodland edges in the eastern half of the region	U
Inve	American Burying Beetle	uncommon; documented in landscapes with pine and pine-oak woodlands, primarily in the	U

Relative Priority	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
		northern half of the region; federally endangered	
Rept	Western Diamond-backed Rattlesnake	uncommon and locally occurring in open, rocky sites in the Ouachita Mountains	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality:

1. Relatively little of this plant community currently exists in an open woodland condition. Open woodlands have gradually changed to a more uniform forest-like condition with increased abundances of oaks, hickories and pines in both the canopy and the mid-story. Historically, these trees would have been suppressed by frequent fires which are now rare.
2. Management tools such as prescribed burning and selective timber harvest are needed to restore open woodland conditions for the benefit of species of greatest conservation need from tracts of land that are now pine/oak forests. Habitat restoration is constrained by insufficient personnel and financial resources, insufficient technical guidance/assistance, logistical difficulties, and landowner liability issues that limit the use of prescribed burning.
3. Prescribed burning is likely to be beneficial to all or most species in this conservation landscape, but the timing, frequency, and size of burns affect species differently and these differences are not fully understood.
4. In local areas, heavy cattle grazing within Shortleaf Pine/Oak woodlands may reduce the abundance and diversity of understory vegetation, contribute to erosion on steep slopes and enhance the spread of undesirable exotic vegetation such as Japanese Brome and other weeds.

Conservation Actions:

- Use historic fire regimes and the historic distribution of this woodland habitat to develop site-specific recommendations for the use of prescribed burning. These recommendations should evaluate the timing (i.e., season), sizes and frequencies of prescribed burns to balance the needs of fire dependent species (e.g., pines and some birds) and fire sensitive species (e.g., amphibians).
- Evaluate ways to reduce the impediments and constraints that reduce the use of prescribed fire as a management tool. These may include:
    - providing funding to organizations (e.g. burning associations) or agencies to assist with conducting controlled burns on private property
    - developing technical assistance materials for landowners (e.g., publications, burning guidelines, workshops, and equipment rentals)
    - developing demonstration areas on public lands to show the results of management practices
    - providing financial assistance to landowners that will use prescribed burning as a tool for managing and restoring pine/oak woodlands
- Where appropriate, use regeneration cutting, thinning, or mid-story reduction to diversify stand ages and/or decrease tree densities.
- Develop monitoring programs to evaluate the effects of management techniques such as prescribed fire and mid-story tree thinning on populations of species of greatest conservation need and vegetation structure.
- Develop informational materials to inform landowners and the general public about the benefits of woodland restoration, the importance of fire in maintaining shortleaf pine-oak-hickory woodlands, and the wildlife diversity of this habitat type.

- Study the compatibility of timber management and livestock grazing management in open Shortleaf Pine woodlands. If feasible, develop demonstration areas to showcase sustainable forestry and cattle management in open pine woodland systems.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

5. Habitat loss and fragmentation has occurred because of the conversion of Shortleaf Pine/Oak woodlands to other land uses - primarily to Loblolly Pine plantations.
6. Increasing numbers of cabins, secondary homes and small hobby ranches are fragmenting the remaining pine-dominated woodlands and forests.
7. The regional timber market is based upon saw and pole timber trees. Many landowners believe that they can earn higher profits converting their forests to pine plantations than they can from managing them as mixed-aged and mature woodlands.

Conservation Actions:

- Evaluate means to make it economically feasible for private landowners to maintain their land in Shortleaf Pine/Oak woodlands such as selling hunting leases or providing nature-based recreational opportunities as alternatives for supplementing their income.
- Develop programs to maintain large tracts of Shortleaf Pine/Oak woodlands such as conservation easements, conservation leases, or willing-seller land acquisitions. This should be preceded by a landscape-level assessment of habitat conditions to identify focus areas with the greatest conservation value for SGCN.
- Evaluate methods to restore Shortleaf Pine/Oak open woodlands from pastures or pine plantations, and develop cost-share programs, grants or financial incentives to encourage willing landowners to restore/replant these areas to pine/oak woodlands in order to increase acreage or tract size.
- Coordinate with other agencies and research institutions to develop Best Management Practices and management recommendations to minimize the disturbance and ecological footprint left by road, pipeline, and utility line construction and right-of-way maintenance.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat that Create Impediments to Effective Conservation Planning and Implementation:

8. Data are incomplete regarding the current geographic distributions of open pine woodlands and many of the Tier I and Tier II species of greatest conservation need that depend upon them.
9. The Shortleaf Pine/Oak community historically existed as a mosaic of woodlands and forests. Additional information is needed to more accurately determine the historic and current distribution of this habitat type, and the factors that influence its vegetation structure.

Conservation Actions:

- Review existing literature, reports, and museum records to evaluate historic distributions, abundances, and ecological needs of Tier I and Tier II species of greatest conservation need.
- Conduct field surveys to establish baseline conditions for the current distributions, abundances, and habitat affinities of species of greatest conservation need.
- Develop and maintain a database to store and analyze distributional and ecological data for species of greatest conservation need.

- Conduct ecological studies of Tier I and Tier II species of greatest conservation need (e.g., Bachman's Sparrow, Brown-headed Nuthatch, and Northern Long-eared Bat) to:
    - identify factors that limit population sizes,
    - evaluate factors that may be responsible for population declines, and
    - develop recommendations to enhance populations (i.e., through enhancement of habitat conditions).
- Develop a method to accurately identify and map the distribution and the condition of this habitat to establish a current baseline.
- Assess historic literature and conduct field studies to evaluate the probable historic distribution and condition of this habitat type, to include the identification of a range of target vegetation conditions for restoration or management efforts.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

10. Exotic plant species such as Sericea Lespedeza, Tall Fescue, and Japanese Honeysuckle have become established outside of cultivation and appear to be displacing native plants and altering habitat conditions.

Conservation Actions:

- Evaluate the severity and magnitude of the ecological damage done by exotic plant and animal species (e.g., displacement of native plant communities or predation on native animal populations).
- Identify those exotic species causing the greatest impact to species of greatest conservation need and develop control or management plans for them (e.g., prescribed burns, herbicide treatment, and mechanical removal).
- Promote existing cost-share programs that encourage private landowners to control invasive and exotic species. Develop monitoring programs to evaluate the effectiveness of these control measures.

Potential indicators for monitoring the effectiveness of the conservation actions:

- number of acres acquired (including those enrolled into easements) and number of acres restored
- number of technical assistance visits provided and the number of acres of Shortleaf Pine/oak habitat assessed
- number of landowners participating in conservation programs
- changes in population sizes and trends of representative species of greatest conservation need that serve as indicators for pine woodland/savannah quality
- changes in the condition and quality of pine woodland/savannah habitat (e.g. average tract size and connectivity, average percentage of canopy closure, abundance and diversity of understory vegetation)
- number of acres placed into prescribed burning management program
- measures of the vegetation response to fire (both herbaceous and woody plants)

High Priority Conservation Landscape: Mesic Loblolly Pine/Oak Forest:

This habitat type is confined to the West Gulf Coastal Plain (WGCP) portion of the region in southern McCurtain and eastern Choctaw counties. It occurs on relatively level, dry to mesic loamy and sandy soils. The dominant canopy trees include Loblolly Pine (*Pinus taeda*), Southern Red Oak (*Quercus falcata*), Water Oak (*Quercus nigra*), American Elm (*Ulmus americana*), Sweetgum (*Liquidambar styraciflua*), Green Ash (*Fraxinus pennsylvanica*), and Shumard Oak (*Quercus shumardii*). Common understory plants include Southern Waxmyrtle (*Myrica cerifera*), American Holly (*Ilex opaca*), Red Maple (*Acer rubra*), and Parsley Hawthorn (*Crataegus marshallii*), and Rattan Vine. In the Red River Valley, much of this habitat type has been converted to Loblolly Pine plantation or cleared for pasture and crop land.

Recognized plant associations include:

Loblolly Pine – Green Ash - American Elm Forest Association

Loblolly Pine – Sweetgum Forest Association

(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or national data over the past 50 years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Mole Salamander	rare and locally occurring in the vicinity of breeding ponds in the WGCP; secretive burrowing species and difficult to document	U
Amph	Sequoyah Slimy Salamander	common but locally occurring in the southern Ouachita Mts in McCurtain County	U
Bird	American Woodcock	common winter resident throughout the region; small numbers may remain into the nesting season but are difficult to document	S
Bird	Brown-headed Nuthatch	rare and locally occurring year-round resident in sites with mature pines	U
Bird	Hooded Warbler	uncommon summer resident across the eastern 2/3 of the region; nests in low-elevation mesic forests with a dense woody understory	S
Bird	Kentucky Warbler	uncommon but widespread summer resident; nests in mesic forests across the entire region	U
Bird	Prairie Warbler	uncommon and locally occurring within clearings, clear-cuts and the edges of mesic pine forests	D
Inve	American Burying Beetle	occurs at low density in mesic forests in the WGCP of southern McCurtain Co.; federally listed as an endangered species	U
Inve	Diana Fritillary	locally common in mature mesic forests in LeFlore and McCurtain counties	U
Mamm	Golden Mouse	locally-occurring resident in sites with understory thickets and dense shrubs	U
Mamm	Rafinesque's Big-eared Bat	very rare and locally occurring in mesic forests with mature trees	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Mamm	Seminole Bat	rare summer resident; occurs in pine-dominated forests in the WGCP	U
Mamm	Southeastern Bat	rare and locally occurring in low-elevation forests in the Little River watershed	U
Rept	Northern Scarletsnake	rare, secretive burrowing species; most records originate from the western and northern portions of this region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat that Create Impediments to Effective Conservation Planning and Implementation:

1. Data are incomplete regarding the current distributions and ecological needs of some of the Tier I and Tier II species of greatest conservation need making it difficult to identify management recommendations.
2. Existing data are incomplete regarding both the historic and current distribution and condition of this habitat type.

Conservation Actions:

- Review existing literature, reports, and museum records to evaluate the historic distributions and abundances of species of greatest conservation need.
- Conduct field surveys to establish baseline conditions for the current distributions, abundances and habitat needs of Tier I and Tier II SGCN, as well as to determine the current distribution of mesic Loblolly Pine/oak forests.
- Develop and maintain a database to store and analyze distributional and ecological data.
- Assess existing literature to determine the historic structure and species composition of mesic pine/oak forests to identify a range of target conditions for habitat restoration and management.
- Conduct ecological studies on Tier I and II species of greatest conservation need to:
    - identify factors that limit population sizes, and evaluate those that may be responsible for population declines, and
    - develop recommendations to enhance populations (i.e., through enhancement of habitat conditions).

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

3. Habitat loss and fragmentation has occurred as a result of the conversion of loblolly pine/oak forest to other land uses such as Loblolly Pine plantations and pastures that are planted to Tall Fescue and Bermudagrass.
4. The construction of secondary homes, cabins, roads, and utility lines have further fragmented this habitat type.

Conservation Actions:

- Work with landowners who have purchased property for its recreational value and are not dependent upon income derived from their property. Develop informational materials to inform landowners about the ecology and wildlife diversity of these forests and recommended management techniques to encourage them to manage for mesic pine/oak/hickory forests.
- Evaluate methods to restore mixed Loblolly Pine-hardwood forests on land previously converted to pastures, crop fields and pine plantations. Develop cost-

share programs, grants, or financial incentives to encourage landowners to restore/replant these areas to pine-oak forest.

- Develop programs to maintain relatively large tracts of mixed loblolly pine-oak-hickory forest such as conservation easements, conservation leases, or willing-seller land acquisitions. This should be preceded by a landscape-level assessment of current habitat conditions and existing forest tracts in order to identify focus areas where the greatest conservation benefits can be gained.
- Evaluate means to make it economically feasible for private landowners to maintain their land in mixed loblolly pine-oak forest such as encouraging markets for mature oak and hickory timber to create an incentive to manage for both pines and hardwood trees, or to encourage landowners to offer hunting leases or nature-based tourism opportunities to supplement their income.
- Coordinate with other agencies and research institutions to develop Best Management Practices and management recommendations to minimize the disturbance and ecological footprint left by road, pipeline, and utility line construction, and right-of-way maintenance.
- Develop monitoring programs to evaluate the effects of management techniques such as selective tree thinning on populations of species of greatest conservation need and vegetation structure.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

5. Exotic plant species including Sericea Lespedeza, Chinese Privet, Japanese Honeysuckle and Kudzu have become established outside of cultivation and appear to be displacing native plants and altering habitat conditions for wildlife species of greatest conservation need.

Conservation Actions:

- Evaluate the severity and magnitude of the ecological damage done by exotic plant and animal species including displacement of native vegetation/plant communities, predation on native animal populations, or hybridization with native species.
- Identify those exotic species causing the greatest impact to this habitat and species of greatest conservation need and develop control or eradication plans for them (e.g., controlled burning programs, herbicide treatment, and mechanical removal).
- Develop monitoring programs to evaluate the effectiveness of these control measures.
- Develop and implement an invasive/nuisance species management plan for every public conservation area in the region.
- Continue to provide financial assistance to private landowners to encourage them to control invasive and exotic species.

Potential indicators for monitoring the effectiveness of the conservation actions:

- changes in acreage that is affected by exotic, invasive vegetation
- number of conservation easements secured and acreage enrolled
- change in acreage of native mesic pine/oak forest
- number of acres restored to mesic pine/oak forest from pasture, cropland and pine plantation
- change in population sizes and trends of representative species of greatest conservation need that serve as indicators of mesic pine/oak forest quality
- change in relative condition/quality of forest habitat (e.g. tree species diversity, abundance of understory vegetation, average tract size)

High Priority Conservation Landscape: Springs, Seeps and Associated Streams:

Springs and Seeps are uncommon and very localized habitats that are typically found in association with wetlands or the headwaters of streams. Relative to the karst formations of the Ozark Plateau and the Arbuckle Mountains, the Ouachita Mountains have relatively few groundwater aquifers and springs. The few springs that are found at the headwaters of Ouachita Mountain streams are important to regionally endemic amphibians and invertebrates including the Ouachita Dusky Salamander (*Desmognathus brimelyorum*). Other springs and seeps occur in the West Gulf Coastal Plain portion of this Region in southern McCurtain, eastern Choctaw, and southern Atoka counties. These springs are typically found in areas of sandy soil near the bases of ridges and sandhills. These springs often support bog-like plant communities of ferns, aroids, orchids and Sphagnum Moss. The distribution and biological composition of springs and seeps is poorly known throughout this Region.

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or national data over the past 50 years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Four-toed Salamander	rare and locally occurring in high elevation seeps and bogs in the Ouachita Mts; known from less than five sites in Oklahoma	U
Amph	Many-ribbed Salamander	common and widespread in small streams and forested riparian areas in the Ouachita Mts.	U
Amph	Ouachita Dusky Salamander	common but locally occurring in rocky springs, seeps & headwater streams in the Ouachita Mts.	U
Amph	Ringed Salamander	locally occurring in the eastern half of the region; secretive and nocturnal	U
Bird	Louisiana Waterthrush	uncommon summer resident; nests in riparian forests along streams throughout the region but most common in the Ouachita Mountains	S
Fish	Goldstripe Darter	rare and found in only a few spring-fed streams in the West Gulf Coast Plain in Choctaw and McCurtain counties	U
Fish	Orangebelly Darter	common and widespread in springs and spring runs in the Red River watershed portion of the Ouachita Mountains	S
Fish	Redspot Darter	common in low-gradient streams and springs in the West Gulf Coast Plain part of the region	U
Inve	*Caecidotea oculata*	endemic to and widespread in streams and springs in the Ouachita Mountains	U
Inve	Kiamichi Crayfish	uncommon and locally occurring in seven streams in the headwaters of the Kiamichi River; endemic to Oklahoma	S
Inve	*Orconectes menae*	locally common crayfish; found in the tributary streams of the Little and Kiamichi rivers in the Ouachita Mountains	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat that Create Impediments to Effective Conservation Planning and Implementation:

1. Existing data are incomplete regarding the distributions and ecologies of species of greatest conservation need that depend upon springs and seeps. In order to establish effective conservation actions, data are needed to determine the population status and trends for these species.
2. Because springs and seeps are small locally-occurring habitats found primarily on private property, they are difficult to locate and monitor. Additionally, springs and seeps are often overlooked in landscape planning because of their small size and difficulty to locate and map. As a result, the knowledge of spring locations and their biological compositions is incompletely known. Surveys and biological inventories of springs are needed for better conservation planning and implementation.

Conservation Actions:

- Conduct field surveys informed by historic literature and current maps in order to locate, inventory and assess the current condition of springs and seeps throughout the region.
- Review the existing literature, reports, and museum records to evaluate historic distributions, abundances, and ecological needs of the spring/seep-dependent Tier I and Tier II species of greatest conservation need with a special emphasis on salamanders, crayfish, and fish.
- Develop and maintain a database to track the locations of springs, their biological communities, and water quality. Data should remain confidential to protect sensitive species and the privacy of landowners.
- Conduct ecological studies on Tier I and Tier II SGCN to:
    - identify factors that limit population sizes,
    - evaluate factors that may be responsible for population declines, and
    - develop recommendations to enhance populations.
- Use the results of surveys and studies to update the Comprehensive Wildlife Conservation Strategy via adaptive resource management.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Quality at Springs and Seeps:

3. Some springs have been physically modified by the installation of pipes or the construction of low concrete dams to create pools for recreation uses or to water livestock.
4. Springs are small fragile habitats that can be easily modified by activities around them. Riparian and aquatic vegetation has been mechanically cleared around some springs, and grazed/browsed by livestock around others. Loss or degradation of vegetation surrounding springs and seeps increases their susceptibility to siltation and changes in water temperature.
5. Man-made ponds and lakes have been constructed over springs and seeps, inundating them with deeper water, and altering their normal habitat structure.

Conservation Actions:

- Identify those springs and seeps that currently and/or historically support species of greatest conservation need and are sites of high conservation value that could serve as focal areas for spring and seep management.
- Develop a program to provide landowners with financial incentives to protect springs or place springs under conservation programs through the purchase of conservation easements on springs or acquisition of springs from willing sellers.

- Provide cost-share funding or grants to landowners to restore the structure of springs and the riparian vegetation around them. These actions can include removal of pipes, concrete, low dams, or fencing of springs to limit access by livestock.
- Develop a monitoring program to measure the effectiveness of efforts to protect or restore springs and seeps on populations of species of greatest conservation need.
- Develop a Conservation Reserve Enhancement Program project for springs in the Ouachita Mountains
- Develop a conservation easement program for springs or acquire fee-title to springs from willing sellers in order to place biologically unique sites into conservation ownership.
- Develop and distribute educational materials to landowners including Best Management Practices (BMPs) for use around springs, the biological diversity of springs, and the interconnection of springs, groundwater, and surface streams.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality and Flow at Springs and Seeps:

6. Excessive local groundwater withdrawal can reduce the flow of springs and streams.
7. In areas with coarse rocky or sandy soils, surface water enters the water table with very little filtration by the soil, easily carrying pesticides, fertilizers, animal wastes, and other water-soluble chemicals into the groundwater. These contaminants can then resurface at springs and negatively affect aquatic life in springs and streams.
8. Water quality within springs may be affected by cattle and feral hogs watering in and grazing around springs and seeps through increased siltation and nutrient input.

Conservation Actions:

- Identify springs and seeps that support populations of species of greatest conservation need, assess their current water quality/quantity, and evaluate the sources of existing or potential future water quality/quantity degradation.
- Conduct hydrological studies to delineate the recharge area surrounding biologically important springs to determine the surface acreage that needs the attention of conservation programs.
- Develop, publish, and distribute information about BMPs and conservation recommendations for landowners to implement in order to protect groundwater quality/quantity around springs.
- Promote the cost-share programs that help landowners conserve groundwater quantity within the recharge areas of biologically important springs and remove financial assistance programs that encourage groundwater withdrawal around these springs.
- Construct fences around springs and provide alternative water sources for livestock (e.g. solar pumps or windmills with stock tanks) to exclude livestock and feral hogs from springs.
- Develop monitoring programs for populations of species of greatest conservation need, water quality and water quantity to assess the effectiveness of groundwater conservation programs.
- Where feasible, involve the landowners by providing them with the equipment and supplies to conduct monitoring activities, or encourage the development of local citizen volunteer groups to conduct monitoring.
- Provide the results of water quality and quantity monitoring programs to the appropriate regulatory or landowner assistance agencies (e.g., Oklahoma Water Resources Board, Oklahoma Department of Environmental Quality, Oklahoma Conservation Commission, local Conservation District, and Natural Resources Conservation Service).

Potential indicators for monitoring the effectiveness of the conservation actions:

- number of easements or cooperative agreements obtained to conserve springs that support species of greatest conservation need
- number of springs restored
- number of springs and seeps for which biological surveys have been conducted
- number of springs and seeps regularly monitored (e.g. biological monitoring, flow monitoring, water quality monitoring)
- changes in population sizes and trends of representative species of greatest conservation need that serve as indicators for the quality of springs and seeps
- changes in the relative condition of riparian vegetation surrounding springs (e.g. plant diversity or plant abundance)
- number of acres affected by exotic invasive species
- acres of riparian habitat surrounding springs and seeps that are covered by native vegetation
- changes in stream and spring flow

High Priority Conservation Landscape: Sandy (soft)-bottom Streams and Associated Riparian Forests

Streams with a sandy, silty, or other fine substrate are found in relatively level, low-elevation landscapes throughout the region including broad valleys between mountain ridges in the Ouachita Mountains and most of the West Gulf Coastal Plain (WGCP) and Arkansas River Valley areas. Although data are limited, the majority of these streams appear to have once been slightly entrenched with a low width to depth ratio and with a moderate to high number of meanders (i.e., degree of sinuosity). While some streams retain this structure, others have been modified or channelized during the past century. These streams support riparian forests along their banks, but the width of these riparian forests is often narrower now than historically due to the conversion of forest to other land uses. Riparian forests in this habitat type are variable in their species composition, but are typically dominated by Sycamore (*Platanus occidentalis*), Black Willow (*Salix nigra*), Sugarberry (*Celtis laevigata*), River Birch (*Betula nigra*), Red Elm (*Ulmus rubra*), Water Oak (*Quercus nigra*), and Green Ash (*Fraxinus pennsylvanica*). Understory vegetation is often abundant and includes Deciduous Holly (*Ilex decidua*), Hawthorns (*Crataegus sp.*), Buttonbush (*Cephalanthus occidentalis*), Smooth Alder (*Alnus serrulata*), and Roughleaf Dogwood (*Cornus drummondii*). Extensive shrublands of Giant Cane (*Arundinaria gigantea*) once occurred along many of the larger soft-bottom streams but the extent of this plant community is currently much reduced.

Recognized riparian plant associations within this habitat include:

- American/Red Elm – Chinquapin Oak Temporarily Flooded Forest
- American/Red Elm – Sugarberry/Hackberry – Green Ash Temporarily Flooded Forest
- Eastern Cottonwood – American Elm – Sugarberry Temporarily Flooded Forest
- Eastern Cottonwood – Black Willow Temporarily Flooded Forest
- Giant Cane Temporarily Flooded Shrubland
- Green Ash – American Elm Temporarily Flooded Forest
- Green Ash – Cedar Elm – Sugarberry Temporarily Flooded Forest
- Green Hawthorn – Cockspur Hawthorn – Downy Hawthorn Temporarily Flooded Shrubland
- River Birch – Sycamore – Smooth Alder Temporarily Flooded Forest
- Smooth Alder – False Indigo Temporarily Flooded Shrubland
- Spring Witch-Hazel – Silky Dogwood Temporarily Flooded Shrubland
- Swamp Privet – Buttonbush Semi-permanently Flooded Shrubland
- Sycamore – Boxelder Temporarily Flooded Forest

(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or national data over the past 50 years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Little Blue Heron	common summer resident in the vicinity of its nesting colonies; primarily found in the Arkansas Valley and West Gulf Coast Plain (WGCP)	U
Bird	Louisiana Waterthrush	uncommon summer resident; nests in riparian forests along streams throughout the region	S

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Northern Pintail	uncommon winter resident throughout the region	D
Bird	Snowy Egret	common summer resident in the vicinity of its nesting colonies; primarily found in the Arkansas Valley and West Gulf Coast Plain	U
Bird	Solitary Sandpiper	common spring and fall migrant throughout the region	S
Fish	Blackspot Shiner	rare and found in low-gradient tributaries of the Red, Kiamichi and Little rivers in the WGCP	U
Fish	Creole Darter	rare and documented only in a few stream tributaries of the lower Little River	U
Fish	Cypress Minnow	uncommon species restricted to forested, low-gradient tributaries of the Little River	U
Fish	Goldstripe Darter	Rare and found in only a few spring-fed streams in the West Gulf Coast Plain in Choctaw and McCurtain counties	U
Fish	Pallid Shiner (Chub)	uncommon in large, low-gradient streams in the Arkansas Valley and West Gulf Coastal Plains	U
Fish	Redspot Darter	common in low-gradient streams and springs in the West Gulf Coast Plain part of the region	U
Fish	Taillight Shiner	common but limited to low-gradient tributaries of the Little River in the West Gulf Coastal Plain; associated with aquatic vegetation	U
Inve	Three-tooth Trianodes Caddisfly	Distribution and status is poorly documented in the region; may occur as a rare species in streams in the West Gulf Coastal Plain	U
Mamm	Southeastern Bat	rare and reported only from the Little River watershed; often forages over streams	U
Mamm	Swamp Rabbit	uncommon but widespread in low elevation riparian forests throughout the region	U
Rept	Alligator Snapping Turtle	rare and secretive species found in low-gradient streams in the Arkansas Valley and West Gulf Coastal Plain	D
Rept	American Alligator	rare but being reported more frequently as animals re-colonize their historic range in streams across in the WGCP	I
Rept	Eastern River Cooter	Common in streams throughout the region	D
Rept	Midland Smooth Softshell	locally common in low-gradient streams throughout the region	D
Rept	Mississippi Map Turtle	uncommon but widespread in soft-bottom streams in the Arkansas Valley and WGCP	D
Rept	Spiny Softshell Turtle	locally occurring in low-gradient streams in the Arkansas Valley and WGCP	D

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat that Create Impediments to Effective Conservation Planning and Implementation:

1. Data are incomplete regarding the distribution and status of species of greatest conservation need.
2. Baseline knowledge about flora/fauna and both the historic and current distribution and condition of sandy-bottomed streams is incomplete.

Conservation Actions:

- Conduct research on species of greatest conservation need to determine why populations area low and/or declining.
- Conduct research to identify the factors that limit the distribution and abundance of Tier I and Tier II species of greatest conservation need and develop management recommendations to enhance their populations through improved habitat conditions or recruitment.
- Conduct surveys to assess the current distribution and habitat needs of Tier I and Tier II species of greatest conservation need and use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest benefit for these species.
- Develop population and habitat monitoring programs for representative species of greatest conservation need.
- Develop and provide long-term funding to maintain databases to store and analyze distributional and ecological data for species of greatest conservation need.
- Publish and make the results of all ecological studies available to land managers and conservation agencies so that they can be incorporated into site-specific, species-specific and regional conservation plans including future updates to the OCWCS.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Flow Patterns and Habitat Quality:

3. Increased pond construction may be lowering the inflow that sustains streams.
4. Bridges and culverts can affect streams by altering stream channel morphology or enhancing erosion and the development of drop cuts. Some types of culverts can become barriers to the passage of fish during low-flow conditions or if head-cutting occurs.
5. Dams and diversion structures alter the natural flow patterns and other processes of streams, especially the frequency and magnitude of natural flooding events that are required to maintain downstream channels and banks.
6. Some streams in agriculturally-dominated landscapes such as the West Gulf Coastal Plain and the Arkansas River Valley, have been channelized and dredged to speed the drainage and passage of water. As a result of mechanical alteration, these streams have lost much of their natural riparian vegetation and the diversity of their in-stream habitats such as pools and riffles.

Conservation Actions:

- Provide cost-share funding or grants to restore stream channels and establish natural vegetation on stream banks for stability.
- Restore or construct seasonal wetlands/vernal pools within the riparian zones or floodplains of streams to manage and filter runoff following storm events.
- Conduct pilot studies and demonstration areas to evaluate the effectiveness of alternative management practices and to showcase successful management strategies.
- Establish minimum in-stream flow levels on all biologically important streams (e.g., those streams that support populations of species of greatest conservation need or diverse aquatic communities).
- Ensure that sound biological data, which demonstrate the ecological impacts of water sales, water withdrawals, and inter-basin transfers of water, are incorporated into the Oklahoma Water Management Plan.
- Work collaboratively with landowners to remove or modify impoundments that have been shown to block the movement of fish species of greatest conservation need.
- Provide grants or cost-share funding to landowners and local government agencies to remove or rehabilitate culverts and bridges with new structures that facilitate the passage of fish.
- Work collaboratively with public managers to modify impoundment management to maintain an adequate environmental flow.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality:

7. Where confined animal feeding operations such as cattle feedlots, poultry houses, and hog farms or their waste application fields are sited near streams, the risk exists for excessive nutrients to enter the streams through storm water runoff and shallow groundwater connections.
8. Additional nutrients enter streams as a result of cattle and livestock watering in streams and grazing in riparian areas.
9. Increased nutrient levels in streams increases the abundance of algae, which can result in other water quality impacts such as increased fluctuations in dissolved oxygen.
10. Endocrine disrupters and other pollutants enter streams in storm water runoff from agricultural fields which alter the growth, reproduction and/or survival of fish, amphibians and invertebrates in the streams.

Conservation Actions:

- Reduce nutrient inputs (i.e., point and non-point source) through BMPs, Farm Bill cost-share programs, and landowner incentives programs.
- Provide alternative water sources for livestock, such as solar pumps with stock tanks, to keep them out of streams.
- Purchase conservation easements or acquire fee-title from willing sellers to land to maintain, or restore forested riparian vegetation along streams and to reduce or limit agricultural development adjacent to streams.
- Establish set-back distances between streams and confined animal feeding operations, waste lagoons, and land application areas.
- Provide cost-share funding to construct fencing along streams and riparian areas to control/limit access by livestock.
- Provide cost-share funding or increase promotion of existing programs to restore riparian vegetation along streams. Develop a Conservation Reserve Enhancement Program project for streams in the West Gulf Coastal Plain that support fish and invertebrate species of greatest conservation need.
- Develop local watershed councils, stream teams, and citizen's groups to address local concerns through education and to monitor water quality and wildlife populations.
- Improve the knowledge of and access to Farm Bill incentives and cost-share programs that improve or maintain water quality through the implementation of BMPs and establishment of streamside buffer zones.
- Reduce the use of herbicides and other pesticides in floodplains and riparian areas.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

11. Exotic plant species such as Chinese Privet, Kudzu and Japanese Honeysuckle are becoming more abundant in riparian forests, competing with native plants and altering the structure and quality of the habitat.
12. Feral hogs that forage in streams and along stream banks damage riparian vegetation and reduce bank stability.

Conservation Actions:

- Increase funding to implement the Oklahoma Aquatic Nuisance Species Management Plan.
- Conduct studies to quantify the impact of exotic species on streams and riparian forest communities. Develop control or eradication programs for those species causing the greatest ecological damage.
- Increase educational efforts and public awareness of the ecological and economic impacts of exotic plant and animal populations.

Potential indicators for monitoring the effectiveness of the conservation actions:

- changes in the population sizes and trends of representative species of greatest conservation need that serve as indicators of soft-bottom stream quality
- changes in the condition and quality of riparian habitat (e.g. plant diversity and structural diversity)
- changes in the number of acres of riparian habitat that are dominated by native forest plant communities
- number of stream miles that are not impaired by water quality issues
- changes in water quality parameters (e.g. dissolved oxygen, nutrients, turbidity, chlorophyll, salinity) in streams that support populations of SGCN
- changes in stream flow

Moderate Priority Conservation Landscape: Herbaceous Wetland

The relative condition of Herbaceous Wetland habitat is currently poor with a declining trend. Herbaceous wetlands in this region are typically small patches of seasonally flooded habitat embedded within bottomland forests, prairies, and river floodplains. Vernal pools, which are seasonally flooded wetlands, could also be considered herbaceous wetlands though they do not often support diverse plant communities. Common herbaceous wetland plant associations include Ravensfoot Sedge (*Carex crus-corvi*) seasonally flooded marsh, Common Rush (*Juncus effusus*) seasonally flooded marsh, Softstem Bullrush (*Scripus tabernaemontani*), Spikerush (*Eleocharis sp.*) semi-permanently flooded marsh, and Broadleaf Cattail (*Typha latifolia*) semi-permanently flooded marsh. Other important herbaceous wetland plants include Barnyard Grass (*Echinochloa crus-galli*), Marsh Willowprimrose (*Ludwigia palustris*), and Sweetscent (*Pluchea odorata*) in seasonally flooded wetlands and Torrey Rush (*Juncus torreyi*), Broadleaf Arrowhead (*Sagittaria latifolia*), and Pickerelweed (*Pontederia cordata*) in semi-permanently flooded wetlands. More work is needed to identify the spatial distribution of herbaceous wetlands and the wildlife that use them.

Recognized herbaceous plant associations within this habitat include:

- American Water-willow Temporarily Flooded Wetlands
- Broadleaf Arrowhead – Longbar Arrowhead Semi-permanently Flooded Wetland
- Broadleaf Cattail – Powdery Thalia Semi-permanently Flooded Marsh
- Broadleaf Cattail Semi-permanently Flooded Marsh
- Common Reed Semi-permanently Flooded Marsh
- Common Rush Seasonally Flooded Marsh
- Narrowleaf Cattail – Southern Cattail Semi-permanently Flooded Marsh
- Pennsylvania Smartweed – Curlytop Smartweed Semi-permanently Flooded Wetland
- Ravenfoot Sedge Seasonally Flooded Marsh
- Softstem Bulrush – Common Spike Rush Semi-permanently Flooded Marsh
- Water Smartweed Semi-permanently Flooded Wetland

(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or national data over the past 50 years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Crawfish Frog	locally occurring in wetlands/marshes in and adjacent to grasslands and open woodlands; most suitable habitat occurs in low-elevation areas	U
Amph	Mole Salamander	rare and locally occurring in the vicinity of breeding ponds in the WGCP; secretive burrowing species and difficult to document	D
Amph	Three-toed Amphiuma	rare and limited to tributaries of the Little and Red rivers in McCurtain County; may occur in the flood plain wetlands of streams and rivers	U
Amph	Western Lesser Siren	uncommon; found in flood plain wetlands associated with streams and rivers	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	American Golden Plover	uncommon spring and fall migrant; uses wetlands in the Arkansas and Red river valleys as foraging and roosting sites	U
Bird	American Woodcock	common winter resident; a few birds remain in the region through the spring to breed	S
Bird	Black Rail	rare spring and fall migrant through the region but has been documented only in the WGCP	U
Bird	Buff-breasted Sandpiper	rare spring and fall migrant through the region in the Arkansas Valley and WGCP	D
Bird	Canvasback	uncommon winter resident throughout the region	S
Bird	Hudsonian Godwit	uncommon spring migrant; reported from the Arkansas Valley and WGCP	U
Bird	King Rail	rare summer resident; nests in wetland complexes in the Arkansas and Red river valleys	D
Bird	LeConte's Sparrow	common winter resident in tall herbaceous vegetation in and adjacent to wetlands	U
Bird	Lesser Scaup	uncommon winter resident throughout the region	D
Bird	Little Blue Heron	common summer resident in the Arkansas Valley and West Gulf Coastal Plain	U
Bird	Nelson's Sharp-tailed Sparrow	rare spring and fall migrant; documented only in wetlands of the West Gulf Coastal Plain	U
Bird	Northern Pintail	uncommon winter resident throughout the region	D
Bird	Peregrine Falcon	rare spring and fall migrant throughout the region; hunts around wetlands where shorebirds and teal congregate	I
Bird	Piping Plover	rare spring and fall migrant; uses wetlands in the Arkansas and Red river valleys as foraging and roosting sites; federally listed as threatened	D
Bird	Snowy Egret	common summer resident in wetlands in the Arkansas Valley and West Gulf Coastal Plains	U
Bird	Solitary Sandpiper	common spring and fall migrant throughout the region	S
Bird	Trumpeter Swan	rare winter visitor; occurs primarily in the Arkansas Valley	I
Bird	Upland Sandpiper	common spring and fall migrant throughout the region	I
Bird	Western Sandpiper	rare spring and fall migrant across the region	U
Bird	Willow Flycatcher	uncommon spring and fall migrant; a few pairs nest in wetland shrubs in the WGCP	D
Bird	Wilson's Phalarope	common spring and fall migrant; uses wetlands in the Arkansas and Red river valleys as foraging and roosting sites	S
Bird	Wood Stork	rare summer visitor; after the nesting season, bird wander north from their coastal colonies into the West Gulf Coastal Plain	S
Bird	Yellow Rail	rare and secretive migrant; rare winter resident in wetlands in the West Gulf Coastal Plain	U
Inve	Oklahoma Clubtail	common and locally occurring in wetlands and streams throughout the region	U
Inve	Ozark Clubtail	uncommon and locally occurring in streams and wetlands throughout the region	U
Mamm	Marsh Rice Rat	uncommon and locally occurring in marshes in the WGCP and Arkansas Valley sections	S
Mamm	Northern Long-eared Bat	uncommon in forest habitats in the Ouachita Mts.; forages over wetlands and streams; federally listed as threatened	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Mamm	Southeastern Bat	rare and limited to the Little River watershed; often forages over wetlands and streams	U
Mamm	Swamp Rabbit	uncommon but widespread in shrubby wetlands throughout the region	U
Rept	Alligator Snapping Turtle	rare and limited to sloughs and wetlands that are at least seasonally connected to streams & rivers	D
Rept	American Alligator	rare but seen with increasing frequency in wetlands in the West Gulf Coastal Plain	I
Rept	Gulf Crayfish Snake	rare and secretive; limited to wetlands in southern McCurtain County	U
Rept	Midland Smooth Softshell	uncommon but widespread throughout the region in sloughs and flood plain wetlands	D
Rept	Mississippi Map Turtle	uncommon but widespread in the Arkansas Valley and the West Gulf Coastal Plain	U
Rept	Spiny Softshell Turtle	locally common and found primarily in the low-gradient reaches of each small river	D
Rept	Western Chicken Turtle	rare and locally occurring in flood plain wetlands along the Red River and its tributaries	U
Rept	Western Mudsnake	rare; found in flood plain wetlands in the West Gulf Coastal Plain	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

1. Woody plants such as willows and ash encroach on and dominate herbaceous wetlands because of fire suppression, siltation and/or past heavy grazing.
2. Heavy grazing of wetlands by cattle removes plant cover for wildlife, reduces the abundance of some wetland plants, and can lower overall plant diversity.
3. Seasonal wetlands in flood plains have been plowed and cropped. This reduces the abundance and diversity of perennial vegetation and alters the plant community composition and structure toward one that is dominated by annuals and opportunistic species.
4. A substantial percentage of wetlands have been drained or filled to convert these lands to residential and agricultural uses.
5. Some wetlands are dredged or deepened to create ponds to hold irrigation water, to store water for cattle, or to create ponds for fishing resulting in a loss of shallow water habitat and may result in the introduction and establishment of predatory fish.

Conservation Actions:

- Use fire or mechanical cutting to remove woody vegetation that has encroached upon herbaceous wetlands.
- Continue to provide cost-share funding to landowners for the construction of fencing around wetlands to control cattle access.
- Work with willing landowners to acquire fee-title, perpetual easements or non-development easements on existing wetlands that support species of greatest conservation need to place those wetlands into conservation ownership or stewardship.
- Acquire or purchase conservation easements on cropped wetlands then restore them to their historic condition via a combination of dredging, diking, and re-vegetation.
- Increase the funding available for wetland easements and encourage increased enrollment of existing and restorable wetlands into the Agricultural Conservation Easements Program (includes the former Wetland Reserve Program).

- Include financial assistance to cover the costs of maintaining herbaceous wetlands in conservation easement contracts.
- Provide information to landowners and the public regarding the ecological values of wetlands, especially seasonal wetlands, to increase appreciation for wetland conservation.
- Develop tax breaks for landowners that maintain wetlands.
- Connect wetland owners with entities seeking wetland mitigation credits.
- Improve the economic incentive to retain wetlands in agricultural areas.
- Develop a Conservation Reserve Enhancement Program project to enroll and restore wetlands in the West Gulf Coastal Plain of McCurtain and Choctaw counties.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat that Create Impediments to Effective Conservation Planning and Implementation:

6. Existing data are incomplete regarding the distributions, ecological needs and population trends of most of the Tier I and Tier II species of greatest conservation need that depend upon herbaceous wetlands.
7. Our understanding is incomplete with respect to the current and historic locations and structural conditions of wetlands across this region. This is in part because of the small sizes of most wetlands which makes them difficult to locate within the larger habitat mosaics in which they are embedded.
8. We have an incomplete knowledge about wetland ecology and the needs of some wetland-dependent wildlife.

Conservation Actions:

- Conduct a region wide field survey for wetlands that is informed by hydrologic data, topographic maps, aerial imagery and the previous work of the USFWS's National Wetland Inventory.
- Conduct biological inventories of wetlands to determine their plant community composition and the distribution and abundances of wildlife species of conservation need. Develop a database of wetland locations and conditions to organize the biological data produced through these surveys.
- Conduct studies to determine the ecological needs of wetland wildlife species (e.g., types of plant communities and the timing and duration of flooding needed for each wildlife species).
- Synthesize existing and new literature to produce informational reports for landowners and conservation agency staff regarding the ecology of herbaceous wetlands and their associated wildlife by wetland type.
- Develop a range of descriptions that cover the diversity of wetland types that could serve as the target conditions for wetland restoration and enhancement efforts. Previous work conducted by the NRCS's Ecological Site Description program should be reviewed as a starting point in this effort.
- Use surveys and new data to update the Comprehensive Wildlife Conservation Strategy.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

9. Invasive and exotic plants such as Alligator Weed (*Alternanthera philoxeroides*), Hydrilla (*Hydrilla verticillata*) have become established in wetlands where they compete with and displace native vegetation.
10. Exotic plant species can dominate wetlands and reduce overall plant diversity and structural diversity reducing the wetlands' value as wildlife habitat.

Conservation Actions:

- Increase the funding available to implement Oklahoma Aquatic Nuisance Species Management Plan and encourage landowners and anglers to be vigilant to and report introductions of exotic wetland plants.
- Develop and implement invasive/nuisance species management plans on federal refuges and other conservation lands.
- Provide cost-share funding to landowners to encourage the removal and control of exotic wetland plants and the restoration of native wetland plant communities.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Water Quality:

11. Where feedlots, dairies, hog farms, and chicken houses are located near wetlands, the risk exists for excessive nutrients from these operations to travel in storm water runoff and collects in wetlands basins and closed depressions. Increased nutrient inputs due to crop/pasture fertilizers and land application of animal waste result in increased algal and bacteria growth in wetlands that may reduce water quality and dissolved oxygen.
12. Many wetlands lack buffer vegetation around them to control the movement of sediment, pesticides, and nutrients into the wetlands through storm water runoff from pastures, crop fields and residential areas.
13. Endocrine disrupters from animal hormones, pesticides, and agricultural chemicals enter wetlands in storm water runoff negatively affecting the growth, reproduction, and survival of amphibians, fish, and invertebrates.
14. Livestock grazing in wetlands increase nutrient inputs and potentially alter the structure and diversity of wetland vegetation.

Conservation Actions:

- Increase the knowledge of and utilization of Farm Bill programs that improve water quality and protect wetlands (e.g., the wetland component of the Agricultural Conservation Easements Program for the planting of buffer vegetation around wetlands and the restoration of wetland plant communities).
- Continue to provide cost-share funding to landowners for the construction of fencing around wetlands to control access by livestock.
- Restore/plant native vegetation around wetlands to serve as a filter for storm water runoff to aid in the removal of sediment and nutrients in storm water runoff.
- Develop a recognition program to acknowledge and reward conservationists, landowners and businesses who are good stewards of wetland habitats.
- Use targeted outreach efforts to improve small landowner awareness and use of existing cost-share programs that help implement Best Management Practices for controlling nutrients and sediment in storm water runoff draining into wetlands.

Potential indicators for monitoring the effectiveness of the conservation actions:

- number of acres placed into conservation programs including easements and fee-title acquisition by conservation organizations
- changes in wetland acreage as measured by the National Wetland Inventory
- changes in the population sizes and trends of representative species of greatest conservation need that can serve as indicators of high quality wetland habitat across the range of wetland community types
- changes in the vegetation structure of wetlands
- changes in the geographic distribution of wetlands
- changes in the population sizes and trends of wetland-dependent plants

Moderate Priority Conservation Landscape: Tallgrass Prairie

Tallgrass Prairie habitat is uncommon in this region and occurs locally in areas of deep soil in the Arkansas River Valley, Red River Valley, and the broad valleys that separate the western ridges of the Ouachita Mountains. Additional research is needed to evaluate the historic distribution and composition of tallgrass prairies in the region and to identify the remaining tracts of native prairies. Historically, tallgrass prairie occurred on sites that possessed deep soils and were relatively level and subject to frequent fires. The tallgrass prairie community is dominated by Big Bluestem (*Andropogon gerardii*) and Indiangrass (*Sorghastrum nutans*). Other common grasses and forbs include Eastern Gamagrass (*Tripsacum dactyloides*), Switchgrass (*Panicum virgatum*), Tall Dropseed (*Sporobolus asper*), Little Bluestem (*Schizachyrium scoparium*), Purple Prairie Clover (*Dalea purpurea*), Blazing Star (*Liatris pycnostachya*), Narrow-leaved Sunflower (*Helianthus angustifolius),* Rosinweed (*Silphium laciniatum*), Giant Coneflower (*Rudbeckia grandiflora*), and Wild Indigo (*Baptisia alba*). Untilled tallgrass prairies are locally referred to as pimpled prairies because they frequently contain regularly-spaced, short, raised mounds of soil.

Recognized plant associations within this habitat type include:

- Big Bluestem – Little Bluestem – Indiangrass Grassland
- Big Bluestem – Switchgrass Grassland
- Little Bluestem – Big Bluestem Grassland
- Little Bluestem – Indiangrass Grassland
- Switchgrass – Eastern Gamagrass Grassland

(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or national data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Crawfish Frog	locally occurring in grasslands that contain appropriate breeding ponds and wetlands in landscapes the historically supported prairies	U
Bird	American Golden Plover	uncommon spring and fall migrant through the region that may use burned or grazed prairies as foraging sites	U
Bird	Barn Owl	rare year-round resident; locally occurring in grassland and agricultural landscapes that contain structures that provide nesting and roosting sites	U
Bird	Bell's Vireo	uncommon and locally occurring in low-elevation prairies in river flood plains; typically associated with deciduous thickets in prairies	D
Bird	Buff-breasted Sandpiper	rare spring and fall migrant that may used grazed or recently burned prairie has foraging habitat	D
Bird	Harris's Sparrow	uncommon winter resident along the northern and western edges of the region	U
Bird	Henslow's Sparrow	rare spring and fall migrant through the region	U
Bird	LeConte's Sparrow	common winter resident in native prairies with tall standing vegetation	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Bird	Loggerhead Shrike	uncommon year-round resident in grassland and agricultural landscapes in the Arkansas River and Red River valleys	D
Bird	Northern Bobwhite	locally common year-round resident in native grasslands, shrublands and open woodlands across the region	D
Bird	Smith's Longspur	rare winter resident; difficult to locate due to its secretive behavior; its range in the region is poorly defined	U
Bird	Sprague's Pipit	rare spring and fall migrant; has only been documented in the Arkansas Valley	S
Bird	Upland Sandpiper	common spring and fall migrant throughout the region	I
Inve	Big Cedar Grasshopper	Rare; documented from only one location in the Kiamichi River valley in LeFlore County	U
Inve	Byssus Skipper	Rare; present in ungrazed or lightly grazed prairies in the Arkansas Valley; depends on Eastern Gama Grass as its larval food plant	U
Inve	Oklahoma Spur-throat Grasshopper	Uncommon and locally occurring in prairies in valleys within the Ouachita Mts.	U
Mamm	Eastern Harvest Mouse	uncommon and locally occurring; known from fewer than five locations along the northern and western borders of the region	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat that Create Impediments to Effective Conservation Planning and Implementation:

1. Data are incomplete regarding the status and distribution of several species of greatest conservation need that occur in Tallgrass Prairie communities. In order to establish effective conservation actions, more complete data are needed to determine the population status and trend for many species, and more thorough evaluations are needed to determine the factors that limit population sizes or are responsible for apparent population declines.
2. Much of the tallgrass prairie community has been altered or converted to other uses. Better data are needed regarding the current and historic extent and location of Tallgrass Prairie and the factors that determine vegetation structure and maintained prairies historically.

Conservation Actions:

- Review existing literature, reports, and museum records to evaluate historic distributions, abundances, and fine-scale habitat needs of Tier I and Tier II species of greatest conservation need.
- Conduct field surveys to establish baseline conditions for the current distributions, abundances and ecological needs of species of greatest conservation need.
- Develop a database to store and analyze distributional and ecological data for prairie-dependent species of greatest conservation need.
- Conduct ecological studies on Tier I and II species of greatest conservation need to:
  - identify factors that limit population sizes,
  - evaluate factors that may be responsible for suspected population declines, and
  - develop recommendations to enhance populations (e.g., through enhancement of habitat conditions or improved reproduction).

- Develop a method to accurately identify and map the distribution and the condition of present-day tallgrass prairie habitat tracts to establish a current baseline.
- Assess historic literature and conduct field studies to evaluate the probable historic distribution and condition of prairies across the region. Soil survey maps should be important tools in conducting this process.
- Use the results of these surveys and studies to update the Comprehensive Wildlife Conservation Strategy via adaptive resource management.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

3. Prairies are often level and possess deep or rich soils which make them desirable areas for residential and agricultural uses. Much of the historic tallgrass prairie acreage in this region has been converted to crop fields or Tall Fescue pastures resulting n a direct loss of habitat and fragmentation of the remaining prairies.
4. Prairies are continuing to be fragmented by expanding infrastructure including roads, utility lines, rural homes and pipelines.
5. Herbicide use in right-of-way management may reduce the abundance and diversity of native forbs and shrubs that are food and habitat for some species of greatest conservation need (e.g., Bell's Vireo and Northern Bobwhite).
6. Fragmentation of land ownership, with a trend for more individuals owning smaller tracts of land, is a local problem in the valleys of the Ouachita Mountains where ranching is an important land use.

Conservation Actions:

- Evaluate means to make it economically attractive for private landowners to maintain prairie habitat on their land or to restore introduced pastures to native grasses and forbs. For example promote the cost benefits of raising livestock on a combination of native prairie and introduced pasture grasses, encourage markets for native prairie hay, or encourage large landowners to diversify their businesses by incorporating hunting leases and nature-based tourism that benefit from maintaining native prairie plants.
- Develop programs to maintain biologically meaningful tracts of native prairie habitat such as conservation easements, conservation leases, or willing-seller land acquisitions. These should be preceded by a landscape-level assessment of existing habitat conditions and remaining prairie habitat in order to identify focus areas that will provide the greatest conservation benefit to SGCN.
- Evaluate techniques for restoring Tall Fescue pastures and crop fields to native prairie grasses and forbs. Then, develop a cost-share program, grant program, or financial incentives to assist willing landowners who wish to restore converted lands back to native tallgrass prairie.
- Coordinate with other agencies and research institutions to develop or update Best Management Practices and management recommendations to minimize the disturbance caused by and the ecological footprint left by road, pipeline, and utility line construction as well as right-of-way maintenance activities such as herbicide use and mowing.
- Modify or eliminate any provisions from government loan programs and cost-share or subsidy programs that require or encourage private landowners to convert native prairies and shrublands to tame pastures.
- Encourage the use of native grasses and forbs in the reclamation of surface coal mines and natural gas drilling sites.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Structure and Quality:

1. Long-term fire suppression and the loss of historic fire regimes have changed the structure of many prairies by allowing for increases in some prolific woody plant

species including sumacs, Winged Elm, and Eastern Redcedar, and have fostered the spread of invasive non-native grasses and forbs (e.g., Sericea Lespedeza and Tall Fescue). Fire probably played a greater role than grazing in maintaining the structure and species diversity of tallgrass prairies in Oklahoma.

2. Several constraints discourage landowners and agencies from using prescribed burning as a land management tool to maintain prairies. These constraints include limited personnel and financial capacity to conduct burns, landowner liability issues, air quality concerns, logistical difficulties conducting burns in developed areas, and lack of technical assistance in conducting burns.
3. There is a scarcity of data from which to evaluate the effects of controlled burning on many species of greatest conservation need. Because periodic fire is required to maintain prairie habitats, it is almost certain that most prairie-dependent species will benefit from prescribed burning, but the populations of individual species are likely to respond differently to the timing, frequency, and spatial scale of prescribed burns.
4. Aerial applications of herbicides have been used to control/remove shrubs and oaks from prairies, and prairie edges. Herbicide use may decrease native forb abundance and diversity. Shrub and forb diversity are important components of tallgrass prairies in this region and are required by several species of conservation need including Bell's Vireo and Northern Bobwhite.
5. Most pre-settlement grazing activity was seasonal or occurred sporadically, while present day livestock grazing is often continuous. Continuous grazing by livestock often results in declines in abundance of some highly palatable grasses and forbs (e.g., Eastern Gamagrass and Compass Plant) and may result in increases in less desirable species (e.g., winter annuals, exotic pasture weeds, and Japanese Brome).

Conservation Actions:

- Use studies of historic fire regimes and the historic distribution of this woodland habitat to develop site-specific recommendations for the use of prescribed burning based on evaluations of the timing (i.e., season), sizes and frequencies of prescribed burns to balance the needs of the range of fire dependent species (e.g., prairie grasses and birds).
- Modify or remove federal cost-share and subsidy programs that encourage the application of herbicides on prairies in ways that reduce native plant diversity or negatively alter prairie structure.
- Support herbicide use to control exotic and invasive vegetation, but not to encourage tame grasses at the expense of native grasses.
- Evaluate ways to reduce the impediments and constraints that reduce the use of prescribed fire as a management tool. These may include:
    - developing technical assistance materials for landowners (e.g., publications, burning guidelines, workshops, and equipment rentals),
    - developing demonstration areas on public lands to show the results of prescribed burning and other land management recommendations,
    - providing financial assistance or incentives to landowners to encourage prairie restoration, and
    - developing burn cooperatives to work with agencies and landowners to increase the use of burning.
- Evaluate the use of late summer haying as an alternative to conducting prescribed burns in urbanizing areas within the Arkansas Valley and WGCP where smoke management is a concern.
- Develop monitoring programs to evaluate the effects of prescribed fire on populations of species of greatest conservation need, prairie diversity, and vegetation structure.
- Develop informational materials to inform landowners and the general public about the biological diversity of native Tallgrass Prairies and the importance of fire in maintaining prairie communities.

- Provide payments to defer grazing while still providing income for landowners or to establish rotational grazing programs to defer grazing on some areas during the growing season or for periods of one or more years.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need:

6. Several exotic plant species such as Sericea Lespedeza and Tall Fescue have become established in prairie habitats and are displacing native plants and altering prairie habitat conditions for wildlife species of conservation need.
7. Tall Fescue that has been planted for introduced pastures has spread beyond pastures and into native habitats.
8. Some agencies and organizations are promoting exotic plants for erosion control, livestock forage, beautification programs, and wildlife habitat that are invasive.
9. Livestock grazing may enhance local populations of Brown-headed Cowbirds, which parasitize the nests of shrubland and forest birds where those habitats occur adjacent to rangeland. Songbird species of greatest conservation need in the region that may be affected include Prairie Warbler, Bell's Vireo, Bachman's Sparrow, Kentucky Warbler and Hooded Warbler.

Conservation Actions:

- Evaluate the severity and magnitude of the ecological damage done by exotic plant and animal species (e.g., displacement of native vegetation/plant communities, predation on native animal populations, or hybridization with native species) to identify those exotic species causing the greatest impact to prairie communities and species of greatest conservation need.
- Provide the results of studies of exotic species impacts to landowners and conservation agencies/organizations.
- Improve coordination between wildlife biologists, conservation agencies, and agricultural organizations so that these groups can share information about the negative effects of using exotic plant materials.
- Reduce the number of invasive and exotic species being recommended for erosion control (e.g., Sericea Lespedeza, Crown Vetch, and Bermudagrass) and other uses.
- Develop control or management plans (e.g., prescribed burning programs, herbicide treatment, and mechanical removal) for the exotic species that cause the greatest ecological damage.
- Develop monitoring programs to measure and evaluate the effectiveness of these control measures.
- Promote cost-share funding that encourages private landowners to control invasive and exotic species.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acres periodically burned and under a conservation management plan
- changes in acreage covered by exotic, invasive vegetation
- number of acres placed under conservation easements or conservation ownership
- acres of native tallgrass prairie communities restored
- changes in connectivity of tallgrass prairie tracts
- changes in the population sizes and trends of species of greatest conservation need that serve as indicators of prairie community quality
- changes in the relative condition and quality of prairie habitats (e.g. diversity of native grasses and forbs, presence of rare or uncommon plant species, percent cover by woody plant species)

Moderate Priority Conservation Landscape: Shortleaf Pine/Oak/Hickory Woodlands and Forest & Post Oak/Blackjack Oak Woodlands and Forest

Complex mosaics of forests and woodlands cover most of the Ouachita Mountains portion of this region as well as the rocky ridges and hills within the Arkansas Valley. These forests and woodlands are dominated by several species of oaks (e.g. Quercus stellata, Q. velutina, Q. marilandica, Q. alba), Shortleaf Pine (*Pinus echinata*), Black Hickory (Carya texana) and Mockernut Hickory (Carya tomentosa). Collectively, these forests and woodlands comprise the region's most widespread and abundant habitat type. The degree of canopy closure and the species composition of each woodland and forest stand are variable and dependent upon slope, aspect, soil type, fire history and rainfall. The highest ridges within the Ouachita Mountains are oriented east to west or northeast to southwest; thus creating long north-facing and south-facing slopes.

Conditions favor the development of woodland communities on gentle slopes and slopes that were exposed to drying winds (e.g. southern and western slopes). Woodlands are tree-dominated communities with relatively open canopies that allowed sunlight to penetrate to the ground and support herbaceous and low-shrub understory vegetation. Historically, periodic fires and drought kept half or more of this habitat type in a woodland condition. The woodland communities in this habitat type are dominated by an association of Shortleaf Pine, Post Oak (*Quercus stellata*) and Blackjack Oak (*Quercus marilandica*) with a lesser abundance of Black Hickory (*Carya texana*) and Black Oak (*Quercus velutina*). The understory is comprised of herbaceous vegetation and low shrubs dominated by Little Bluestem (*Schizachyrium scoparium*), Lowbush Blueberry (*Vaccinium pallidum*), False Indigo (*Baptisia alba*), St John's Wort (*Hypericum hypericoides*), and Stiff Sunflower (*Helianthus hirsutus*).

On slopes that were protected from drying winds, as well as steep slopes and ridge tops, the conditions are not as favorable for frequent fire. Therefore, these areas burned less frequently and conditions are more favorable for the development of forest communities. Mature forest communities typically have closed canopies (80% to 100% canopy closure). Where trees of varying ages co-occur, there are variations in the canopy that allow light to penetrate to the forest floor and support understory vegetation. But, when forests are comprised of trees of approximately the same age, as occurs in re-growth forests following logging or wild fire, the canopy can be a uniformly closed system that allows little light penetration. These types of forests often have sparse understory vegetation. Mature forest communities, with trees of mixed ages, are often dominated by associations of White Oak (*Quercus alba*), Black Oak (*Quercus velutina*), Northern Red Oak (*Quercus rubra*), Shortleaf Pine, Mockernut Hickory (*Carya tomentosa*) and Black Hickory (*Carya texana*). The understory is often dominated by shrubs including blueberry (*Vaccinium arboreum / V. pallidum*), Winged Sumac (*Rhus copallina*), blackberries (*Rubus sp.*), and American Beautyberry (*Callicarpa americana*).

In the western and northern transition areas between the Ouachita Mountains and the Crosstimbers, the woodland/forest community often lacks Shortleaf Pine and is dominated by Post Oak (*Quercus stellata*), Black Hickory (Carya texana) and Blackjack Oak (*Quercus marilandica*). This deciduous association is found on rocky sandstone ridges in the Arkansas River valley. Where these forests occur, the dominant Post Oaks, Blackjack Oaks and Black Hickories often co-occur with Winged Elm (*Ulmus alata*), Sugarberry (*Celtis laevigata*) and Black Oak (*Quercus velutina*). Common understory plants include Lowbush Blueberries (*Vaccinium pallidum*), Mexican Plum (*Prunus mexicana*), and Winged Sumac (*Rhus copallina*). This habitat type is essentially an extension of the Post Oak/Blackjack Oak woodlands that are the dominant habitat in the Crosstimbers Region.

Within the mosaic of woodlands and forests, the most mesic forests and the most open woodlands are treated has separate habitat types elsewhere in this chapter. Mesic forests are comprised of a wide diversity of trees of which nearly all are deciduous species. Open woodlands often occur on dry or fire-prone slopes and are dominated by only a few species - primarily Shortleaf Pine or a mix of Shortleaf Pines and Post Oaks.

Although data are incomplete, historic accounts and fire scar analyses of very old trees indicate that much of this habitat type once occurred in the more open woodland condition. The widespread tree harvest that occurred in the Ouachita Mountains in the early decades of the 1900s was followed by nearly a century of reduced fire frequency due to active fire suppression. As a result of the combination of large-scale harvesting and fire suppression, most of the current habitat is a more densely stocked, relatively even-aged, second-growth forest. In recent decades, some of these forests have been harvested a second or third time and replaced with Shortleaf Pine or Loblolly Pine plantations.

Recognized plant associations within this habitat type include:

Shortleaf Pine – Northern Red Oak – Black Oak Forest
Shortleaf Pine – Post Oak – Blackjack Oak Forest
Shortleaf Pine – White Oak – Black Oak Forest
Post Oak – Blackjack Oak – Black Hickory (Farkleberry) Forest
Post Oak – Winged Elm Forest

(Vegetation associations are based on Hoagland 2000; see Appendix C for the reference)

The species of greatest conservation need that occupy this habitat type in substantial or manageable numbers are listed in the following table. A narrative description is provided for each species' status within the region that is based upon the existing literature and the professional judgment of the technical experts that were consulted. Each species' population trend was based upon an evaluation of the existing statewide or national data over the past fifty years. The species are sorted alphabetically within larger taxonomic groups: amphibians, birds, fish, invertebrates, mammals, and reptiles for easy reference. Symbols for trends are: D = declining, S = stable, U = unknown and I = increasing.

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Amph	Southern Red-backed Salamander	common but locally occurring in the eastern half of the region in mature oak/hickory/pine forests	U
Bird	American Woodcock	common winter resident; a few birds remain in the state through the early spring nesting season	S
Bird	Brown-headed Nuthatch	rare year-round resident; occurs locally in mature, pine-dominated forests	U
Bird	Harris's Sparrow	uncommon winter resident; locally occurring in oak woodlands in the western half of the region	U
Bird	Kentucky Warbler	Uncommon but widespread; found in mature forests with abundant understory vegetation	U
Bird	Northern Bobwhite	uncommon year-round resident; occurs locally in oak woodlands and woodland edges	D
Bird	Painted Bunting	uncommon summer resident; nests in oak woodlands and early-succession forest regrowth	U
Bird	Prairie Warbler	Uncommon and locally-occurring	D
Bird	Red-headed Woodpecker	Uncommon but locally-occurring year-round resident throughout the region	D
Bird	Whip-poor-will	Rare and locally occurring in open woodlands and forest edges in the eastern half of the region	U
Inve	American Burying Beetle	uncommon but widespread in the Arkansas Valley and the western half of the region	U
Inve	Diana Fritillary	uncommon and locally occurring woodlands in the eastern half of the region	U
Inve	Lidded Oval	widespread in forested habitats throughout the Ouachita Mountains	U

Group	Species of Greatest Conservation Need Common or Scientific Name	Status within the Region	Trend in Population Size or Range
Inve	Ouachita Mantleslug	widespread in forested habitats throughout the Ouachita Mountains	U
Inve	*Trigenotyla vaga* (millipede)	Status unknown; has been found in rocky forested slopes in Latimer and LeFlore counties	U
Mamm	Eastern Spotted Skunk	rare; found in rocky, forested habitats in the Ouachita Mts and Arkansas Valley; difficult to detect due to its secretive, nocturnal behavior	D
Mamm	Northern Long-eared Bat	uncommon resident in woodlands and forests in the Arkansas Valley and Ouachita Mts.; federally listed as threatened	U
Rept	Louisiana Milksnake	uncommon and locally-occurring in forested habitats and rocky slopes in the southern half of the region	U
Rept	Northern Scarletsnake	uncommon, secretive and difficult to document due to its burrowing habits; found in oak woodlands and forests in the Arkansas Valley	U
Rept	Western Diamond-backed Rattlesnake	Locally-occurring in open, rocky woodlands in the Arkansas Valley and Ouachita Mts.	U

The following conservation issues and actions are listed in general priority order.

Conservation Issues Related to Current and Historic Land Use Practices that Alter Habitat Structure and Quality:

1. Relatively little of this habitat exists in a woodland condition. Much of the intact pine/oak/hickory community has gradually changed from a mosaic of woodlands and forests to a more uniformly forest-like condition, most likely because of the loss of historic fire regimes due to active fire suppression and reduced fire frequencies.
2. Many acres of habitat exist as even-aged forests. This change from woodlands and forests comprised of trees of diverse ages and heights to large even-aged stands is probably the result of widespread timber harvest during a relatively short period of time in the late 1800s or early 1900s. The combination of even-aged stand structure and long-term fire suppression appear to be responsible for greater tree densities than occurred historically and for an increase in the abundance of some tree species such as Eastern Redcedar that are not as fire tolerant.
3. Restoration of woodland structural conditions on sites that are currently vegetated by forests requires a combination of tree thinning and prescribed fire. Several constraints limit the use of prescribed burning and selective tree harvest to restore woodland conditions and to diversify the tree age structure. These constraints include: insufficient personnel and financial resources, air quality concerns, insufficient guidance/technical assistance, logistical difficulties (e.g. working on slopes or away from roads), and landowner liability concerns.
4. In some areas, continuous grazing within pine/oak/hickory woodlands and forests appears to have contributed to a reduction in the abundance and diversity of herbaceous understory vegetation.

Conservation Actions:

- Conduct research into historic fire frequencies and magnitudes as well as the historic distributions of woodlands and forests.
- Develop recommendations for the use of prescribed burning for restoring and maintaining both woodland communities and forest communities. These recommendations should evaluate the timing (i.e., season), sizes and frequencies of prescribed burns to balance the needs of fire dependent (i.e., some birds and plants) and fire sensitive species (e.g. amphibians).

- Evaluate ways to reduce the impediments and constraints that reduce the use of prescribed fire as a management tool. These may include:
    - providing financial assistance to prescribed burning associations and private companies that conduct prescribed burns in order to make burring more affordable for landowners,
    - developing technical assistance materials for landowners (e.g., publications, burning guidelines, workshops, and equipment rentals),
    - developing demonstration areas on public lands to show the results of recommended land management practices,
    - providing financial assistance or incentives to landowners to encourage woodland restoration,
    - developing burn cooperatives to work with agencies and landowners to increase the use of burning
- Develop monitoring programs to evaluate the effects of management techniques such as prescribed fire and tree harvest on populations of species of greatest conservation need and vegetation structure.
- Develop informational materials to inform landowners and the general public about the benefits of woodland restoration, the importance of fire in maintaining oak and hickory habitats, and the wildlife diversity of oak/hickory habitats.

Conservation Issues Related to Habitat Loss and Fragmentation as a Result of Large-scale and Small-scale Habitat Conversion:

5. Loss of habitat and habitat fragmentation are occurring due to the conversion of mixed oak/pine/hickory woodlands and forests to other land uses such as Loblolly Pine plantations, rangeland, or introduced pastures that are planted to Tall Fescue.
6. Increasing numbers of secondary home developments, cabins, roads, utility lines and pipelines continue to fragment existing woodland and forest habitats.
7. The continued fragmentation of land ownership is resulting in more individuals owning smaller tracts of land, which affect how tracts are managed.

Conservation Actions:

- Develop ways to help families pass down large tracts of land from one generation to the next.
- Evaluate means to make it economically feasible for private landowners to maintain their land in oak/hickory vegetation (e.g., encourage markets for mature oak and hickory timber or encourage groups of landowners to work together as a block to manage habitat for hardwood timber production or hunting leases).
- Develop programs to maintain large tracts of oak/hickory woodlands and forests such as conservation easements, conservation leases, or willing-seller land acquisitions, preceded by a landscape-level assessment of habitat conditions to identify focus areas of greatest conservation value in order to get the greatest "bang for the buck" or efficiency.
- Evaluate methods to restore oak/hickory woodlands from pastures or crop fields.
- Develop cost-share programs, grants or financial incentives to assist willing landowners who wish to restore/replant these areas to oak/hickory woodlands.
- Coordinate with other agencies and research institutions to develop Best Management Practices and management recommendations to minimize the ecological footprint left by road, pipeline, utility line construction, and right-of-way maintenance.
- Develop and distribute informational materials with Best Management Practices and recommendations to landowners, agencies, and utility companies for their consideration and use.

Conservation Issues Related to Information Gaps Associated with Species of Greatest Conservation Need and Their Habitat that Create Impediments to Effective Conservation Planning and Implementation:

8. Existing data are incomplete regarding the habitat needs, geographic distribution, and population status of many Tier I and Tier II species of greatest conservation need that use the mixed pine/oak/hickory habitat type. In order to establish effective conservation actions, more complete data are needed to determine the population status and trend for many species and a more thorough evaluation is needed to determine the factors that limit population sizes or are responsible for population declines.
9. More complete information is needed to determine the distribution and acreage of this habitat and the factors that shape vegetation structure (i.e., where forests and woodlands occurred historically) in order to assess site-specific habitat conditions and habitat restoration or management goals (e.g. which sites should be forest and which should be woodland).

Conservation Actions:

- Review existing literature, reports, and museum records to evaluate the historic distributions and abundances of species of greatest conservation need. Conduct field surveys to establish a baseline condition for the current distributions and abundances.
- Develop and maintain a database to store and analyze distributional and ecological data for species of greatest conservation need.
- Conduct ecological studies on priority species of greatest conservation need (e.g., Prairie Warbler, Bachman's Sparrow, Eastern Spotted Skunk, and Scarletsnake) to:
    - identify factors that limit population sizes,
    - evaluate factors that may be responsible for population declines, and
    - develop recommendations to enhance populations (i.e., through enhancement of habitat conditions).
- Assess the historic literature; examine slope, aspect and soil conditions across the landscape; and conduct field studies to evaluate the likely historic distribution and condition of this woodland/forest complex and to identify those sites that were likely to support forests and those sites that were likely to support woodlands.
- Use the results of surveys and studies to update the Comprehensive Wildlife Conservation Strategy via adaptive resource management.

Conservation Issues Related to Invasive and Exotic Species that Alter Habitat Quality or Directly Affect Species of Greatest Conservation Need

10. Several exotic plant species such as Sericea lespedeza and Japanese Honeysuckle have become established outside of cultivation and appear to displace native plants and to alter the habitat conditions for wildlife species of conservation need.

Conservation Actions:

- Evaluate the severity and magnitude of the ecological damage done by exotic plant and animal species. These damages may include displacement of native vegetation/plant communities, predation on native animal populations, or hybridization with native species.
- Identify those exotic species causing the greatest impact to this habitat and species of greatest conservation need and develop control or management plans for these species (e.g., prescribed burning programs, herbicide treatment, and mechanical removal).
- Develop monitoring programs to measure and evaluate the effectiveness of these control measures.

Potential indicators for monitoring the effectiveness of the conservation actions:

- acres periodically burned and under a conservation management plan
- changes in acreage affected by or dominated by exotic vegetation
- acres of woodland and forest habitats on the landscape
- number of landowners participating in conservation programs
- number of acres acquired or placed under conservation easements
- number of acres restored from pastureland or pine plantations
- changes in the number of acres of pine/oak habitat that occurs in a woodland structural condition and number of acres in a forest structural condition
- number of conservation easements secured and the total acreage enrolled
- changes in population sizes and trends of species of greatest conservation need
- number of acres restored to pine/oak woodlands from pastures and pine plantations

Potential partnerships to deliver conservation for Ouachita Mountains/West Gulf Coastal Plain Region:

State Government

- Arkansas Natural Heritage Commission
- Arkansas/Oklahoma Compact Commission
- Oklahoma Department. of Wildlife Conservation
- Oklahoma Biological Survey
- Oklahoma Corporation Commission
- Oklahoma Department of Mines
- Oklahoma Department of Food, Forestry and Agriculture
- Oklahoma Department of Environmental Quality
- Oklahoma Legislature
- Oklahoma Scenic Rivers Commission
- Oklahoma State University, Cooperative Extension Service and Department of Natural Resources, Ecology and Management
- Oklahoma Tourism and Recreation Department
- Oklahoma Water Resources Board
- state universities and their biology departments
- SNOMNH and other state-funded museums

Federal Government

- U.S. Army Corps of Engineers
- U.S. Department of Agriculture, Farm Service Agency
- U.S. Department of Agriculture, Forest Service, Ouachita National Forest
- U.S. Department of Agriculture, Natural Resources Conservation Service
- U.S. Department of the Interior, National Park Service
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- U.S. Fish and Wildlife Service, Gulf Coastal Plain and Ozark Landscape Conservation Cooperative
- U.S. Fish and Wildlife Service, Lower Mississippi Valley Joint Venture
- U.S. Fish and Wildlife Service, Little River National Wildlife Refuge
- U.S. Fish and Wildlife Service, Sequoyah National Wildlife Refuge
- U.S. Geological Survey

Local Government

- Municipalities in Oklahoma, Arkansas
- Choctaw and Chickasaw tribal governments

Businesses, Citizens and Citizen Groups

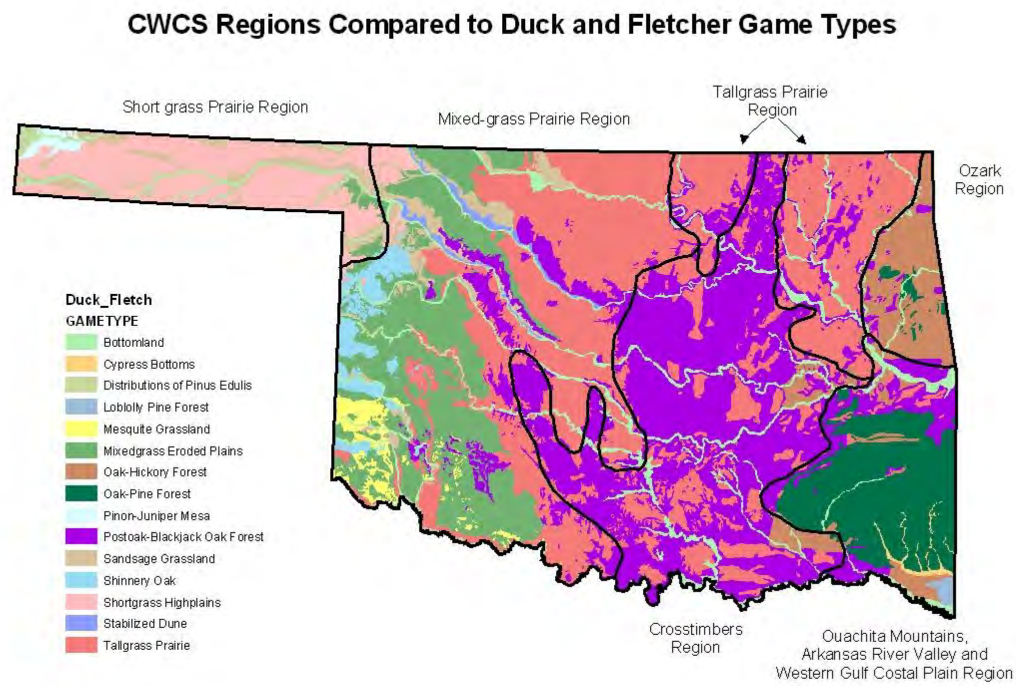
- Audubon Oklahoma
- Bat Conservation International
- Canoe Operators Association
- Chambers of Commerce
- Ducks Unlimited
- Farm Bureau
- Farmers Union
- Hunting cooperatives
- Kerr Center for Sustainable Agriculture
- Land Legacy
- Local citizens groups
- National Wild Turkey Federation
- Oklahoma Anglers United

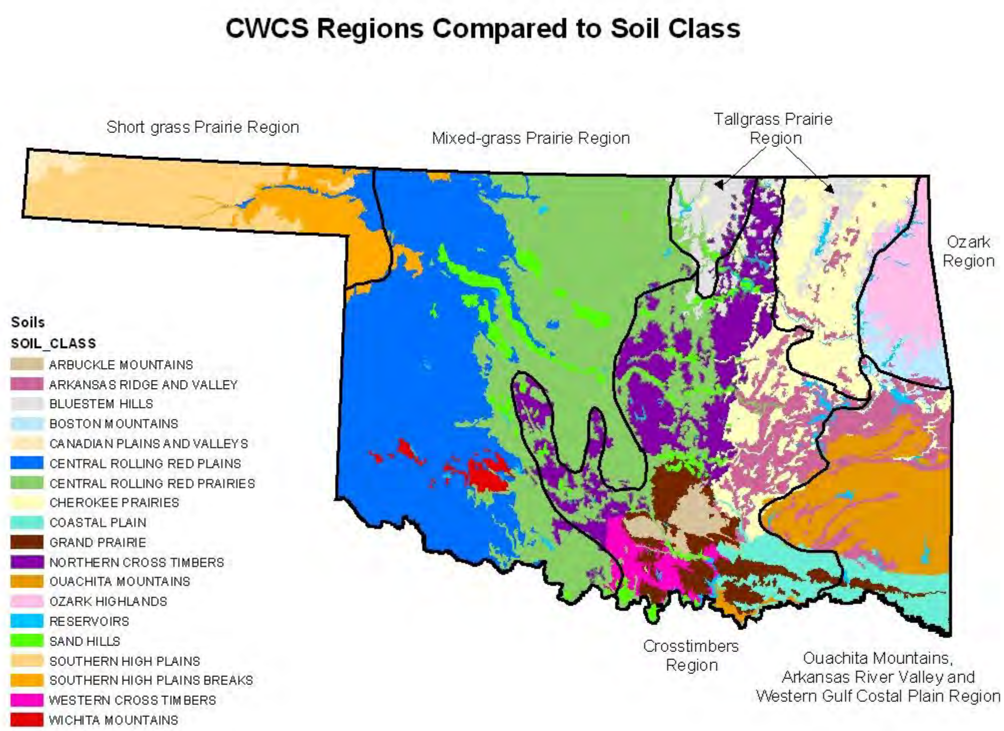
- Oklahoma Bat Coordinating Team
- Oklahoma Cattlemen’s Association
- Oklahoma Forestry Association
- Oklahoma Invasive Plants Council
- Oklahoma Native Plant Society
- Oklahoma Ornithological Society
- Oklahoma sportsmen's groups
- Private landowners
- Sardis Lake Water Alliance
- Sierra Club
- Small Woodland Owner’s Association
- Southern Oklahoma Water Alliance
- The Nature Conservancy
- Timber Companies
- Vernal Pool Society

Appendix A: Glossary of Terms

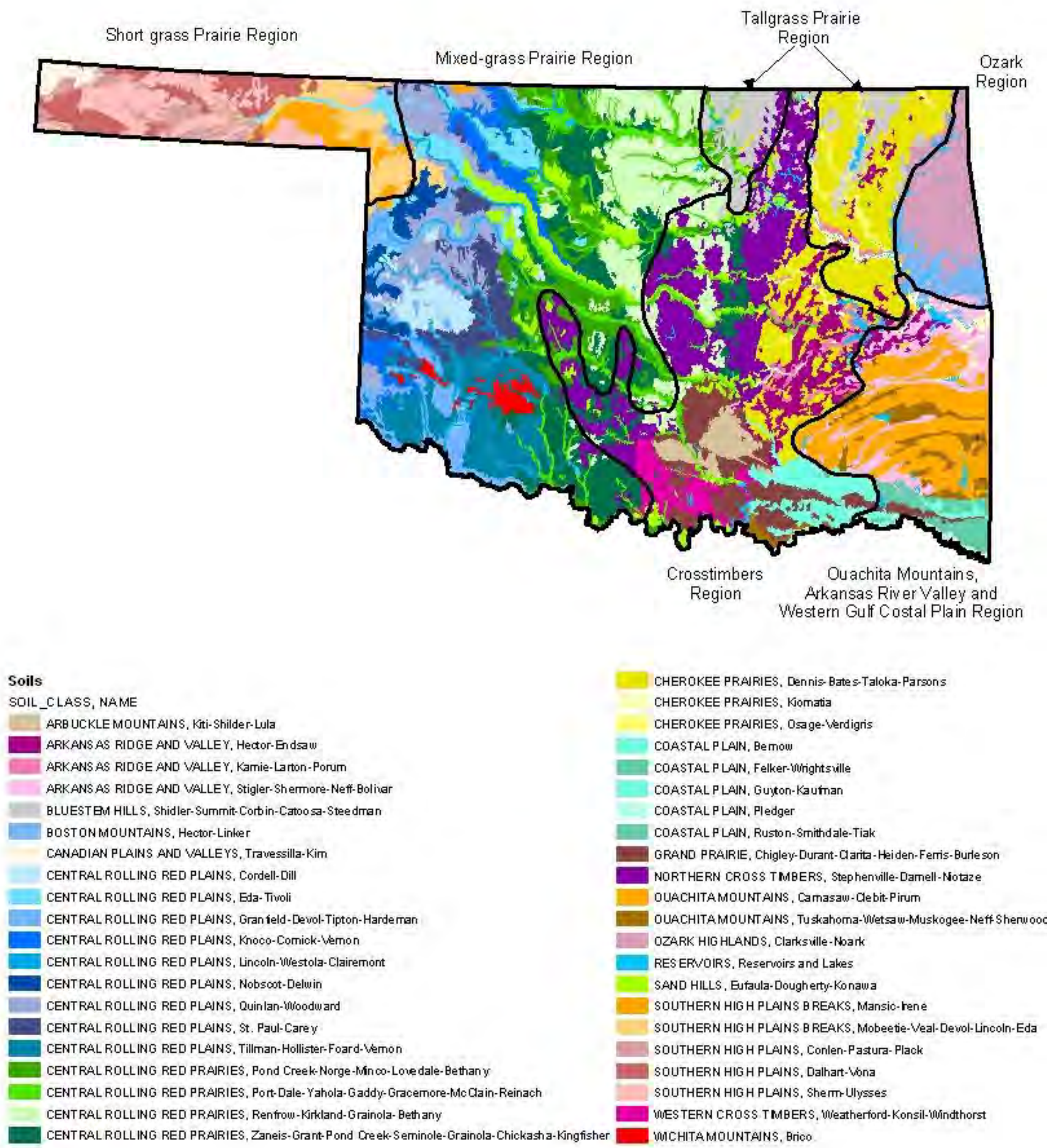
Term	Definition for the Purposes of the Oklahoma Comprehensive Wildlife Conservation Strategy
Common	A species which is likely to be found in its suitable habitat with minimal search effort. Often these species occur in moderate to high densities within their primary habitat.
Comprehensive	Broad in scope and content as related to the conservation, protection, restoration of all species of greatest conservation need and their habitats. Additionally, the term comprehensive applies to the process of considering all identified wildlife species in Oklahoma when selecting species of greatest conservation need.
Conservation Landscape	"Conservation Landscape" in this Strategy is the term used to convey the concepts of "key habitats and community types" identified by Congress. The term Conservation Landscape as used in the document is considered to be synonymous with "habitat types", "vegetation communities", and "aquatic communities".
Issues	"Conservation issues" in this Strategy is the term used for the "conservation problems" identified by Congress. Issues are a source of debate, discussion or difference of opinion. Issues may or may not be a problem; sometimes they are opportunities and challenges. Issues frame threats, weaknesses, challenges and opportunities differently than as problems. The Oklahoma Department of Wildlife Conservation wants the best and most opportunistic way of framing resource challenges so that the best conservation actions can be ranked and a widest array of partners can be brought to the table to resolve conservation challenges and realize opportunities in the future.
Locally-occurring	This term refers to species whose populations exist in scattered or apparently scattered locations. A locally-occurring species is one whose members are not uniformly distributed across the landscape or within the habitat, but instead have a distribution that is concentrated or focused in specific locations such as appropriate breeding sites or roosting sites. It is synonymous with a species whose populations are "patchy" "scattered" or "disjunct."
Rare	A species that occurs in very small numbers or at a very low density even within its primary habitat. These species are unlikely to be found in their habitat without extensive searching.
Species of Greatest Conservation Need	A term used in the authorizing language of the State Wildlife Grants program to identify those species that are in the greatest need of additional conservation attention within the focal state or territory. Typically, these species occur in small numbers, occur in a limited geographic area, or have a substantial declining population trend. For Oklahoma, the selection criteria for identifying these species are described in Appendix D.
Strategy	Strategies are termed "conservation actions" in this document.
Uncommon	A species that occurs at a low to moderate density within its primary habitat. Often, these species require several hours of search time to locate within their occupied habitat.
Wildlife	Animals as a broad, all-inclusive group that live in the water or on land. They include: arthropods, fish, reptiles, amphibians, freshwater mussels, birds and mammals.

Appendix B: Maps used in the Development of the Oklahoma Comprehensive Wildlife Conservation Strategy





CWCS Regions Compared to Soils



Conserving the Biodiversity of the Central Mixed-grass Prairie: A Portfolio Designed for Conservation Action

Summary for Oklahoma's Comprehensive Wildlife Conservation Strategy

- The Central Mixed-grass Prairie ecoregion encompasses 15,500 square miles of western and north-central Oklahoma. It is the second largest ecoregion in the state, and includes a diversity of habitat types.

- This ecoregion is characterized as a transitional zone between the mesic Tallgrass Prairies to the east and the more xeric Shortgrass Prairies to the west. The biodiversity of this area exhibits this transitional nature, and encompasses many species characteristic of other prairie types. The Oklahoma portion of the ecoregion includes large areas of Little Bluestem and Sideoats dominated Mixed-grass Prairie, with areas of Tallgrass Prairie, Post Oak-Blackjack Oak forest, Shinnery Oak shrubland, Mesquite shrubland, and Sand Sage shrubland.

- Climate, grazing, and fire are the key ecological processes that shape the habitats of the Mixed-grass Prairie

- The majority of this Region has been cultivated; only 20 percent of the native vegetation remains in large, untilled parcels. Much of this remaining area is infested with invasive Eastern Redcedar timber, and its wildlife habitat values have been markedly reduced. Habitat fragmentation and altered fire regime are the most serious threats to the biodiversity of the Region. Other threats include altered grazing regime, exotic/invasive plant species, and hydrologic modification.

- The plan identifies 13 areas in the Oklahoma portion of the ecoregion as priorities for conservation (see attached map):

    - **Red Hills** – northern Woods, Woodward, and Harper Counties. Portion of a larger site that extends into south-central Kansas. Characterized by rolling topography, Permian shale and gypsum soils, various Mixed-grass Prairie types. Conservation targets include Lesser Prairie Chicken, Arkansas Darter, bat caves, Townsend's Big-eared Bat, Hall's Bulrush, and Oklahoma Phlox (endemic to Oklahoma).

    - **Great Salt Plains –** Federal wildlife refuge and surrounding private lands in Alfalfa County. Salt flats and marshes, some Mixed-grass Sand Prairie. Conservation targets include Least Tern, Snowy Plover, Whooping Crane, and other migratory waterfowl.

    - **Cimarron River terrestrial site –** high-quality riparian areas and salt flats adjacent to the river.

    - **Woodward Co. Phlox** – isolated population of endemic Oklahoma Phlox located in northern Woodward County.

    - **Glass Mountains** – series of untilled prairie fragments in western Major County. Rough, broken topography, Permian shale and gypsum soils w/Mixed-grass Prairie, several large gypsum dissolution caves housing maternity colonies of Mexican Free-tailed Bats. Site designated primarily for conservation of bat caves.

    - **Salt Creek Canyon –** isolated population of federally endangered Black-capped Vireo in the Salt Creek Canyon area of Blaine County. Rough, eroded topography, substantial infestation of Eastern Redcedar. Cooperative habitat restoration project underway with U.S. Fish and Wildlife Service, Oklahoma Department of Wildlife Conservation, and The Nature Conservancy to restore habitat.

    - **Canadian River Terrestrial site** – high quality riparian areas associated with the Canadian River.

    - **Black Kettle** – Series of untilled prairie fragments near the Black Kettle Nat'l Grassland in the Washita River drainage of Roger Mills County. Characterized by Mixed-grass Prairie with some

Shinnery Oak shrubland to the west. Species targets include Texas Gartersnake and Texas Horned Lizard.

- **Washita Nat'l Wildlife Refuge** – Federal wildlife refuge near Foss Reservoir in Custer County. Important area for migratory waterfowl.

- **Elm Fork Breaks** – large tract of intact rough, broken land in the "breaks" of the upper Red River in Beckham, Greer, and Harmon Counties. Vegetation dominated by Mesquite and Redberry Juniper shrublands. Several gypsum dissolution caves in the area house maternity colonies of Mexican Free-tail and other bats.

- **Quartz Mountain State Park** – isolated granite peaks at the western terminus of the Wichita Mountains in Greer and Kiowa Counties. These hills support the only known extant occurrences of Long-hair Phlox, a state endemic plant.

- **Wichita Mountains** – these ancient mountains form a unique ecological system in Comanche, Kiowa, and Caddo Counties of southwestern Oklahoma. Characterized by a mosaic of vegetation types including Post Oak-Blackjack Oak forest and Mixed-grass Prairie. Species targets include Hall's Bulrush, Oklahoma Beardtongue (state endemic), Black-capped Vireo, and Whooping Crane.

- **Hackberry Flat** – restored wetland complex in Tillman County, supports large numbers of migratory waterfowl.

- Many aquatic sites designated for various fishes, insects, etc. Main species targets include Red River Pupfish, Arkansas Darter, Arkansas River Shiner, Plains Killifish, Plains Minnow, Flathead Chub, and Red River Shiner

Ouachita Mountains and Upper West Gulf Coastal Plain ecoregion assessments

Summary for Oklahoma's Comprehensive Wildlife Conservation Strategy

- The Ouachita Mountains and Upper West Gulf Coastal Plain ecoregions encompass 5,900 and 1,400 square miles of southeast Oklahoma, respectively.

- The Oklahoma portions of these ecoregions are characterized by rugged, Pine-Oak forested mountains, rolling hills, narrow mountain river valleys, and broad floodplains associated with the Red River and other major river systems. Marshes, oxbow lakes, and cypress swamps are found along the Little River and other drainages to the south.

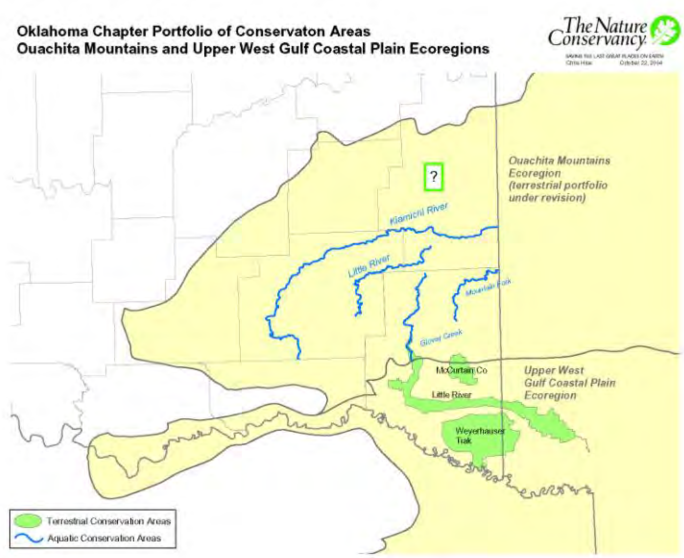
- Fires, both natural and those set by Native Americans are believed to have been a profound influence on the natural vegetation of this area.

- While fairly substantial areas of native vegetation remain in the Ouachita Mountains, the vast majority of the Upper West Gulf Coastal Plain ecoregion in Oklahoma have been cultivated.

- Major threats to biodiversity include habitat fragmentation by development and agricultural conversion, incompatible timber harvest, altered fire regime, and hydrologic modification.

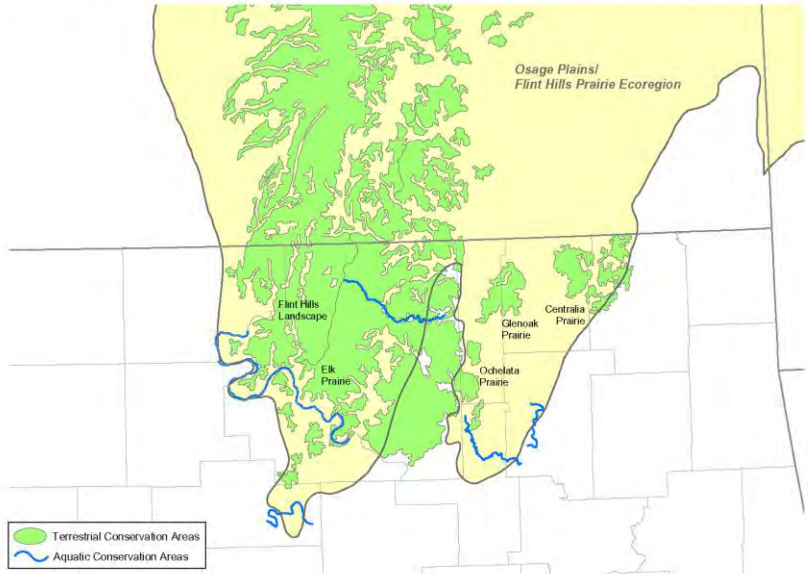
- The plans for the Ouachita Mountains and Upper West Gulf Coastal Plain ecoregions identify several areas of conservation significance in Oklahoma.

    - **Weyerhaeuser Tiak, Little River, and McCurtain Co.** (Upper West Gulf Coastal Plain) **–** areas in southern McCurtain County. Species of importance include Bluejack Oak, Central Newt, American Alligator, and additional plants, amphibians, and birds.
    - The terrestrial portfolio for the Ouachita Mountains ecoregion is currently under revision. Several aquatic sites in Oklahoma protect habitat for numerous species of conservation concern, including Ouachita Shiner, Ouachita Rock Pocketbook, Arkansas Fatmucket, Winged Mapleleaf, and other mussels and fish. Surrounding high-quality terrestrial areas provide habitat for Black Bear, Cerulean Warbler, Ouachita Dusky Salamander, and other species.



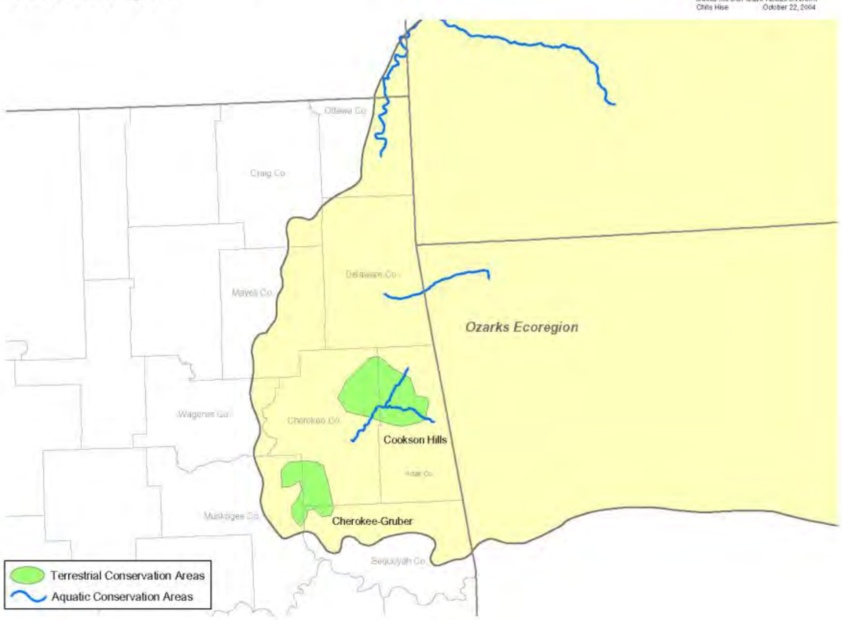
Oklahoma Chapter Portfolio of Conservaton Areas
Osage Plains / Flint Hills Prairie Ecoregion

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH
Chris Hise October 22, 2004



Oklahoma Chapter Portfolio of Conservaton Areas
Ozarks Ecoregion

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH
Chris Hise October 22, 2004



A Biodiversity and Conservation Assessment for the Southern Shortgrass Prairie

Summary for Oklahoma's Comprehensive Wildlife Conservation Strategy

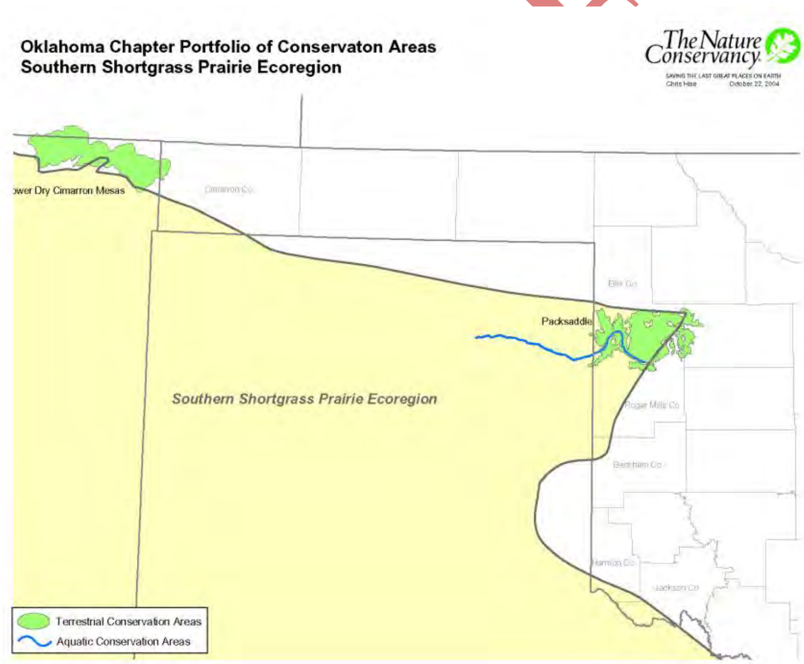
- The Southern Shortgrass Prairie ecoregion encompasses 1,500 square miles of Cimarron, Ellis, Roger Mills, Beckham, Harmon, and Jackson Counties in far western Oklahoma. This represents the "edge" of a much larger region of xeric Shortgrass Prairie that lies to the west in Texas and eastern New Mexico.

- The Region is characterized by the plateaus, escarpments, and rolling prairies of the High Plains.

- While completion of the plan document is pending; two areas of conservation significance have been designated for the Oklahoma portion of the ecoregion:

    - **Packsaddle** – southern Ellis, northern Roger Mills, and western Dewey Counties. Characterized by rolling Sand Sage shrubland, Shinnery Oak shrubland, and Mixed-grass Prairie along and north of the Canadian River. Species targets include Bell's Vireo, Lesser Prairie Chicken, Snowy Plover, Least Tern, and Arkansas River Shiner.

    - **Lower Dry Cimarron Mesas** – far western Cimarron County, south of the Black Mesa area. The majority of this site lies in New Mexico. Primary conservation targets are various plant communities that comprise an eastern extension of Rocky Mountain foothills vegetation.



Ecoregion Based Conservation in the Central Shortgrass Prairie

Summary for Oklahoma's Comprehensive Wildlife Conservation Strategy

- The Central Shortgrass Prairie ecoregion encompasses 1,850 square miles of northwest Oklahoma and the Panhandle, a Region commonly known as the "High Plains".

- The Oklahoma portion of the ecoregion is characterized by rolling plains, stabilized dunes, and tablelands, and is dominated by Shortgrass Prairie, Sand Sage grassland, and Pinyon/Juniper mesa type vegetation.

- Climate, grazing, and fire are the key ecological processes that shape the habitats of the Shortgrass Prairie

- The majority of this Region has been cultivated, with approximately 40 percent of the area remaining in large, untilled landscapes. Many species of native wildlife, most notably grassland-obligate birds, have been greatly reduced or extirpated since European settlement.

- Major threats to biodiversity include habitat fragmentation by development and agricultural conversion, altered grazing regime, altered fire regime, and hydrologic modification (groundwater withdrawal).

- The plan identifies three areas in the Oklahoma portion of the ecoregion as priorities for conservation (see attached map):

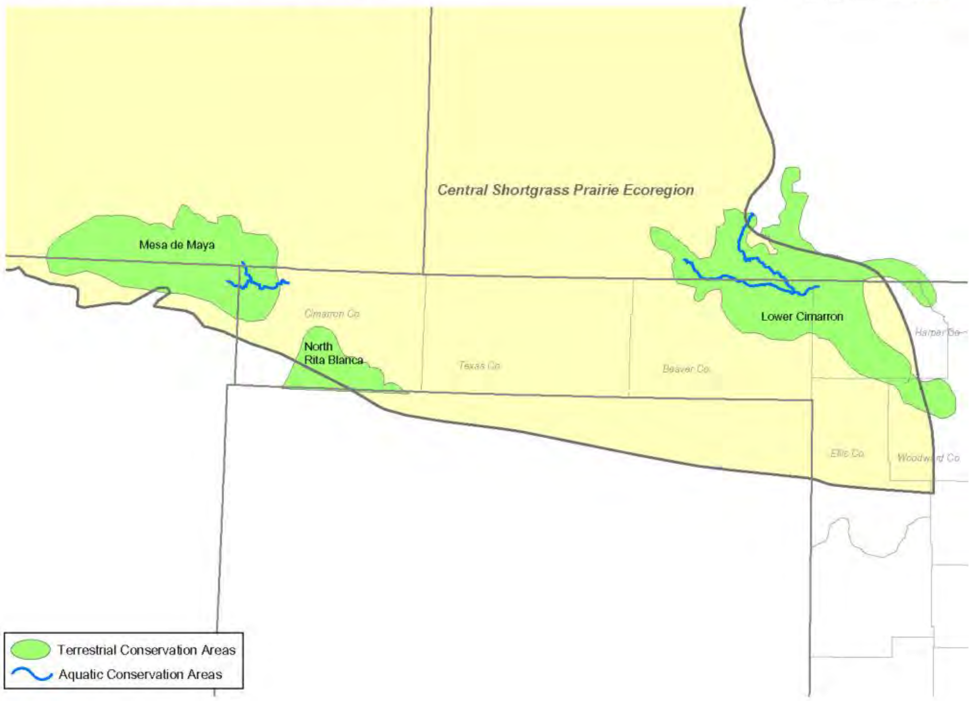
    - **Mesa de Maya** – northwest Cimarron County. Characterized by mesa and butte topography, Pinyon/Juniper woodlands (Rocky Mountain foothills vegetation). Conservation targets include various Shortgrass Prairie plant communities, and the following species: Black-throated Sparrow, Swainson's Hawk, Canyon Wren, Lark Sparrow, Prairie Falcon, Curve-billed Thrasher, Hoary Skimmer, Texas Horned Lizard, Plains Leopard Frog, Green Toad, and Trinidad Milkvetch. Includes reaches of Cimarron River and North Carrizo Creek.

    - **Lower Cimarron –** parts of Beaver, Harper, Woods, and Woodward counties. Characterized by Sand Sage Grassland and Shortgrass Prairie. Conservation targets include various plant communities, and the following species: Lesser Prairie Chicken, Grasshopper Sparrow, Snowy Plover, and Least Tern. Includes reaches of Cimarron River and Crooked Creek for conservation of Arkansas Darter.

    - **North Rita Blanca** – southern Cimarron County. Characterized by Sand Sage Grassland, with playa lakes on flatter sites. Designated primarily for playa lakes on and near federally-owned Rita Blanca National Grassland.

Oklahoma Chapter Portfolio of Conservaton Areas
Southern Shortgrass Prairie Ecoregion

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH
Chris Hise October 22, 2004



Appendix D: Oklahoma's Species of Greatest Conservation Need Selection and Scoring Criteria

Criteria for Identifying and Ranking Species of Greatest Conservation Need:

The Oklahoma species of greatest conservation need were identified based upon the following six criteria:

Selection Criterion 1 – Species listed as federal candidate, threatened or endangered species under the Endangered Species Act.

Selection Criterion 2 – Species classified as state species of special concern, threatened or endangered species in OAC Title 800.

Selection Criterion 3 – Species which have been assigned global ranking scores of G1, G2 or G3 by NatureServe and the network of state Natural Heritage Inventory programs.

Selection Criterion 4 – Species identified as conservation priorities through a peer-reviewed assessment of a large taxonomic division. Examples of these include: assessments of freshwater fish, freshwater mussels and crayfish by the American Fisheries Society, or bird conservation plans such as the national Partners In Flight Conservation Plan, the North American Waterfowl Conservation Plan and the U.S. Shorebird Conservation Plan.

Selection Criterion 5 – Reptile, amphibian, fish and mussel species which are subject to commercial harvest in Oklahoma but are not eligible for cost-share management assistance funding under existing Federal Assistance Programs (funding is needed to monitor or periodically assess status)

Selection Criterion 6 – Regionally endemic species, regardless of their conservation status.

Species that met one or more of the above six criteria, and thus were identified as species of greatest conservation need. No extinct or extirpated species were included in this list; therefore all of the species on this list have or are believed to have extant populations in Oklahoma. The species that met one or more of these criteria were then scored (prioritized) by applying the following criteria:

Ranking Criterion 1 – Natural Heritage Global Rank:
The network of State Natural Heritage Inventory Programs ranks all species on a scale of G1 through G5 with G1 species being the most imperiled and G5 species being the most secure. Each species' Natural Heritage Global Rank is identical across its range in the United States and can be obtained from the Nature Serve Website - http://www.natureserve.org.
3 points - Species has a Global Heritage Rank of G1 or G2
2 points - Species has a Global Heritage Rank of G3 or G4
1 point - Species has a Global Heritage Rank of G5

Ranking Criterion 2 – Availability of Other Federal Assistance Funding Sources:
One of the Congressional purposes of the State Wildlife Grants program is to meet unfunded wildlife conservation needs for rare and declining species. As such, state wildlife agencies have been cautioned against using these funds to supplement traditional management programs such as - endangered and threatened species recovery, sport fish management or game management. Incorporating this criterion does not eliminate endangered, threatened, game and sport fish species from the list of species of greatest conservation need, but it does lower their ranking relative to other species for whom alternate sources of conservation funding do not exist.

3 points - Species is not eligible for management funding under ESA, P-R or D-J Programs (Federal Aid in Sport Fish and Wildlife Restoration programs)
2 points - Species is listed as federally endangered or threatened and is eligible for management funding under the endangered species act
1 point - Species is eligible for management funding as a sport fish, game bird or game mammal

Ranking Criterion 3 – Percent of population size or geographic range within Oklahoma:
A species receives a higher score if it is found only in Oklahoma and/or a few surrounding states and a lower score if Oklahoma is on the periphery of its range.
3 points - Oklahoma encompasses >25% of the species' range or population
2 points - Oklahoma encompasses 5-25% of the species range or population
1 point - Oklahoma encompasses < 5% of the species range or population

Ranking Criterion 4 – Trend in population size or geographic range over the past 50 years:
Fifty years is our recommended window of measurement, because: 1) the best population estimates and records date back only 40 to 60 years depending upon the species, and 2) the narrow time frame is a better reflection of current trends and habitat conditions.
3 points - Species has experienced a well-documented and substantial population and/or range decline during the past 50 Years
2 points - Species is widely believed to be in decline but has only experienced a minor contraction in its geographic range during the past 50 years
1 point - Species appears to have a stable population trend and geographic range, or there is insufficient information to determine whether its population and geographic range have changed during the past 50 years
0 points – Species has expanded its range beyond its historic range.

Ranking Criterion 5 – Length of annual residency in Oklahoma:
3 points – the species is a year-round resident in Oklahoma or occurs in the state during its breeding season (e.g. some migratory bird species)
2 points – the species is an annual winter-season resident that does not breed in Oklahoma but individuals may be present in the state for four months or more out of the year; or the species' continued existence in the state is uncertain and has not been well-documented during the past 50 years
1 point – the species is an annual migrant through the state but most individuals are not present in the state for more than a three to five weeks out of the year

Tier Ranking of Species of Greatest Conservation Need:

Species receiving a combined score of 13 to 15 were classified as Tier I SGCN

Species receiving a combined score of 11 or 12 were classified as Tier II SGCN

Species receiving a combined score of 6 to 10 were classified as Tier III SGCN

Species of Greatest Conservation Need:

Group	Species	Score Criterion 1	Score Criterion 2	Score Criterion 3	Score Criterion 4	Score Criterion 5	Total 15 max	Tier	SGCN Selection Criteria
Amph	Crawfish Frog	2	3	2	2	3	12	II	4
Amph	Four-toed Salamander	1	3	1	1	3	9	III	2
Amph	Grotto Salamander	2	3	3	2	3	13	I	2, 3, 6
Amph	Hurter’s Spadefoot	1	3	2	1	3	10	III	6
Amph	Kiamichi Slimy Salamander	3	3	3	1	3	13	I	3, 6
Amph	Many-ribbed Salamander	1	3	3	1	3	11	II	6
Amph	Mole Salamander	1	3	1	2	3	10	III	2
Amph	Oklahoma Salamander	2	3	3	1	3	12	II	2, 3, 6
Amph	Ouachita Dusky Salamander	2	3	3	2	3	13	I	2, 3, 6
Amph	Ozark Salamander	2	3	3	1	3	12	II	3, 6
Amph	Rich Mountain Salamander	3	3	3	2	3	14	I	2, 3, 6
Amph	Ringed Salamander	2	3	3	1	3	12	II	2, 3, 6
Amph	Sequoyah Slimy Salamander	3	3	3	1	3	13	I	3, 6
Amph	Southern Red-backed Salamander	1	3	3	1	3	11	II	6
Amph	Texas Toad	1	3	2	1	3	10	III	6
Amph	Three-toed Amphiuma	1	3	2	2	3	11	II	2
Amph	Western Bird-voiced Treefrog	1	3	1	1	3	9	III	2
Amph	Western Lesser Siren	1	3	2	2	3	11	II	2
Bird	American Golden Plover	1	3	1	3	1	9	III	4
Bird	American Woodcock	1	1	2	2	3	9	III	4
Bird	Bachman's Sparrow	2	3	2	3	3	13	I	2, 3, 4
Bird	Baird's Sparrow	2	3	1	3	1	10	III	3, 4
Bird	Bald Eagle	1	2	1	1	3	8	III	1
Bird	Barn Owl	1	3	1	2	3	10	III	2
Bird	Bell's Vireo	1	3	2	3	3	12	II	2, 4
Bird	Black Rail	2	3	1	2	3	11	II	3, 4
Bird	Black-capped Vireo	3	2	3	3	3	14	I	1, 3, 4
Bird	Blue-winged Warbler	1	3	2	2	3	11	II	4
Bird	Brown-headed Nuthatch	1	3	2	2	3	11	II	4
Bird	Buff-breasted Sandpiper	2	3	2	3	1	11	II	4
Bird	Bullock's Oriole	1	3	1	1	3	9	III	4
Bird	Burrowing Owl	2	3	1	3	3	12	II	2, 3, 4
Bird	Canvasback	1	1	2	2	2	8	III	4
Bird	Cassin's Sparrow	1	3	2	2	3	11	II	4
Bird	Cerulean Warbler	2	3	1	3	3	12	II	3, 4
Bird	Chestnut-collared Longspur	1	3	2	3	2	11	II	4
Bird	Ferruginous Hawk	2	3	1	1	3	10	III	2, 3
Bird	Golden Eagle	1	3	1	1	3	9	III	2
Bird	Golden-fronted Woodpecker	1	3	2	1	3	10	III	4
Bird	Golden-winged Warbler	2	3	1	2	1	9	III	4
Bird	Greater Prairie Chicken	1	1	2	3	3	10	III	4
Bird	Harris's Sparrow	1	3	2	2	2	10	III	4
Bird	Henslow's Sparrow	2	3	2	3	3	13	I	3, 4
Bird	Hooded Warbler	1	3	2	2	3	11	II	4
Bird	Hudsonian Godwit	1	3	1	2	1	8	III	4
Bird	Interior Least Tern	2	2	2	3	3	12	II	1, 3, 4
Bird	Juniper Titmouse	1	3	1	2	3	10	III	4
Bird	Kentucky Warbler	1	3	2	2	3	10	III	4

Group	Species	Score Criterion 1	Score Criterion 2	Score Criterion 3	Score Criterion 4	Score Criterion 5	Total 15 max	Tier	SGCN Selection Criteria
Bird	King Rail	2	1	2	2	3	10	III	3, 4
Bird	LeConte's Sparrow	1	3	2	1	2	9	II	4
Bird	Lesser Prairie Chicken	2	1	3	3	3	12	II	1, 3, 4
Bird	Lesser Scaup	1	1	2	3	2	9	III	4
Bird	Little Blue Heron	1	3	2	2	3	11	II	4
Bird	Loggerhead Shrike	2	3	2	3	3	13	I	2, 3
Bird	Long-billed Curlew	1	3	2	2	3	11	I	4
Bird	Louisiana Waterthrush	1	3	2	1	3	10	III	4
Bird	McCown's Longspur	1	3	2	3	2	11	II	4
Bird	Mountain Plover	3	3	2	3	3	14	I	1, 3, 4
Bird	Nelson's Sharp-tailed Sparrow	2	3	1	1	1	8	III	4
Bird	Northern Bobwhite	1	1	2	3	3	10	III	4
Bird	Northern Pintail	1	1	2	2	2	8	III	4
Bird	Painted Bunting	1	3	2	2	3	11	II	4
Bird	Peregrine Falcon	2	2	1	1	1	7	III	1, 3
Bird	Pinyon Jay	1	3	1	3	2	10	III	4
Bird	Piping Plover	2	2	1	3	1	9	III	1, 3, 4
Bird	Prairie Falcon	1	3	1	1	3	9	III	2
Bird	Prairie Warbler	1	3	2	2	3	11	II	4
Bird	Prothonotary Warbler	1	3	2	2	3	11	II	4
Bird	Red Knot	2	2	1	2	1	8	III	1, 4
Bird	Red-cockaded Woodpecker	3	2	2	3	3	13	I	1, 3, 4
Bird	Red-headed Woodpecker	1	3	2	2	3	11	II	4
Bird	Rusty Blackbird	1	3	1	3	2	10	III	4
Bird	Scaled Quail	1	1	2	1	3	8	III	4
Bird	Short-eared Owl	1	3	1	1	2	8	III	4
Bird	Smith's Longspur	1	3	3	2	2	11	II	4
Bird	Snowy Egret	1	3	2	1	3	10	III	4
Bird	Snowy Plover	2	3	2	3	3	13	I	2, 4
Bird	Solitary Sandpiper	1	3	1	2	1	8	III	4
Bird	Sprague's Pipit	1	3	2	2	1	9	III	4
Bird	Swainson's Hawk	1	3	2	2	3	11	II	4
Bird	Swainson's Warbler	2	3	2	1	3	11	II	3, 4
Bird	Trumpeter Swan	2	1	1	1	2	7	III	4
Bird	Upland Sandpiper	1	3	2	1	3	10	III	4
Bird	Western Sandpiper	1	3	1	2	1	8	III	4
Bird	Whip-poor-will	1	3	2	2	3	11	II	4
Bird	Whooping Crane	3	2	3	1	1	10	III	1, 3
Bird	Willow Flycatcher	1	3	1	2	3	10	III	4
Bird	Wilson's Phalarope	1	3	2	1	1	8	III	4
Bird	Wood Stork	2	3	1	1	1	8	III	1
Bird	Wood Thrush	1	3	1	3	3	11	II	4
Bird	Worm-eating Warbler	1	3	2	2	3	11	II	4
Bird	Yellow Rail	2	3	1	2	2	10	III	3, 4
Fish	Alabama Shad	2	3	1	3	2	11	II	2, 3, 4
Fish	Alligator Gar	2	1	2	3	3	11	II	2, 3, 4
Fish	American Eel	2	1	1	3	2	9	III	4
Fish	Arkansas Darter	2	3	3	2	3	13	I	1, 2, 3
Fish	Arkansas River Shiner	3	2	3	3	3	14	I	1, 3, 4
Fish	Arkansas River Speckled Chub	3	3	1	2	1	11	III	2, 3

Group	Species	Score Criterion 1	Score Criterion 2	Score Criterion 3	Score Criterion 4	Score Criterion 5	Total 15 max	Tier	SGCN Selection Criteria
Fish	Black Buffalo	1	3	1	1	3	9	III	2
Fish	Blackside Darter	1	3	1	1	3	9	III	2
Fish	Blackspot Shiner	2	3	3	2	3	13	I	3, 4, 6
Fish	Blue Sucker	2	3	1	2	3	11	II	2, 3
Fish	Bluehead Shiner	2	3	3	1	3	12	II	2, 3, 4, 6
Fish	Bluntface Shiner	1	3	2	2	3	11	II	2
Fish	Brown Bullhead	1	3	1	1	3	9	III	2
Fish	Cardinal Shiner	2	3	3	1	3	12	II	6
Fish	Chub Shiner	1	3	3	1	3	11	II	6
Fish	Creole Darter	2	3	2	1	3	11	II	6
Fish	Crystal Darter	2	3	2	2	3	12	II	2, 3, 4
Fish	Cypress Minnow	1	3	1	1	3	9	III	2
Fish	Flathead Chub	1	3	1	2	2	9	III	2, 4
Fish	Goldstripe Darter	2	3	2	1	3	11	II	2
Fish	Harlequin Darter	1	3	1	1	3	9	III	2
Fish	Ironcolor Shiner	2	3	1	2	3	11	II	2, 4
Fish	Kiamichi Shiner	2	3	3	1	3	12	II	2, 3, 4, 6
Fish	Least Darter	2	3	2	2	3	12	II	4, 6
Fish	Leopard Darter	3	2	3	3	3	14	I	1, 3, 4, 6
Fish	Longnose Darter	2	3	3	3	3	14	I	2, 3, 4, 6
Fish	Mooneye	1	3	1	1	3	9	III	2
Fish	Mountain Madtom	2	3	1	1	3	10	III	2
Fish	Neosho Madtom	3	2	3	3	3	14	I	1, 3, 4, 6
Fish	Orangebelly Darter	1	3	3	1	3	11	II	6
Fish	Ouachita Mountain Shiner	2	3	3	1	3	12	II	2, 3, 4, 6
Fish	Ozark Cavefish	3	2	3	2	3	13	I	1, 3, 4, 6
Fish	Ozark Minnow	1	3	3	1	3	11	II	6
Fish	Paddlefish	2	1	2	1	3	9	III	3, 4
Fish	Pallid Shiner (Chub)	2	3	2	2	3	12	II	2, 3, 4
Fish	Peppered (Colorless) Shiner	3	3	3	2	3	14	I	2, 3, 4, 6
Fish	Plains Minnow	1	3	2	2	3	11	III	5
Fish	Plains Topminnow	2	3	1	1	3	10	III	2, 3
Fish	Prairie Speckled Chub	3	3	3	1	3	13	I	2, 3
Fish	Red River Pupfish	1	3	3	0	3	10	III	6
Fish	Red River Shiner	1	3	3	0	3	10	III	6
Fish	Redfin Darter	1	3	3	1	3	11	II	6
Fish	Redspot Chub	2	3	3	1	3	12	II	3, 6
Fish	Redspot Darter	1	3	2	1	3	10	III	6
Fish	River Darter	1	3	1	1	3	9	III	2
Fish	Rocky Shiner	2	3	3	1	3	12	II	3, 4, 6
Fish	Scaly Sand Darter	1	3	2	1	3	10	III	3
Fish	Shorthead Redhorse	1	3	1	2	3	10	III	2
Fish	Shovelnose Sturgeon	2	3	2	2	3	12	II	2, 3
Fish	Silverband Shiner	1	3	2	2	3	11	II	3
Fish	Southern Brook Lamprey	1	3	2	2	3	11	II	2
Fish	Spotfin Shiner	1	3	1	1	3	9	III	2
Fish	Sunburst (Stippled) Darter	2	3	3	1	3	12	II	6
Fish	Taillight Shiner	1	3	1	2	3	10	III	2
Fish	Wedgespot Shiner	1	3	3	1	3	11	II	6
Fish	Western Sand Darter	2	3	2	2	3	12	II	3, 4

Group	Species	Score Criterion 1	Score Criterion 2	Score Criterion 3	Score Criterion 4	Score Criterion 5	Total 15 max	Tier	SGCN Selection Criteria
Inver	*Allocapnia jeanae* (stonefly)	3	3	3	1	3	13	I	3, 6
Inver	*Allocapnia peltoides* (stonefly)	2	3	3	1	2	11	II	3
Inver	American Bumble Bee	2	3	1	3	3	12	II	3
Inver	American Burying Beetle	2	2	2	2	3	11	II	1, 3
Inver	*Amerigoniscus centralis* (cave obligate isopod)	3	3	3	1	3	13	I	3, 6
Inver	*Apobaetis futilis* (mayfly)	3	3	2	1	2	11	II	3, 6
Inver	*Arrhopalites jay* (cave springtail)	3	3	3	1	3	13	I	3, 6
Inver	Big Cedar Grasshopper	3	3	2	1	2	11	II	3, 6
Inver	Black Sandshell	1	3	1	2	2	9	III	4
Inve	Bleached Skimmer	2	3	2	2	2	11	II	3,6
Inver	Bowman's Cave Amphipod	3	3	3	1	2	12	II	3, 6
Inver	Butterfly Mussel	2	3	2	2	3	12	II	3, 4
Inver	Byssus Skipper	2	3	2	2	3	12	II	3
Inver	*Caecidotea acuticarpa*	3	3	3	1	3	13	I	3, 6
Inver	*Caecidotea adenta*	3	3	3	2	3	14	I	3, 6
Inver	*Caecidotea ancyla*	2	3	3	1	3	12	II	3
Inver	*Caecidotea antricola*	1	3	3	1	3	11	II	3
Inver	*Caecidotea mackini*	3	3	3	1	3	13	I	3, 6
Inver	*Caecidotea macropropoda*	3	3	3	1	3	13	I	3, 6
Inver	*Caecidotea oculata*	2	3	3	1	3	12	II	3, 6
Inver	*Caecidotea simulator*	3	3	3	1	3	13	I	3, 6
Inver	*Caecidotea stiladactyla*	2	3	3	1	3	12	II	3, 6
Inver	Cave Crayfish	3	3	3	2	3	14	I	3, 4, 6
Inver	Cherokee Needlefly	2	3	3	1	3	12	II	3, 6
Inver	Conchas Crayfish	2	3	3	1	3	12	II	6
Inver	*Crosbyella spinturnix* (cave-obligate harvestman)	2	3	3	1	3	12	II	3, 6
Inver	Crosstimbers Coil	3	3	3	1	2	12	II	6
Inver	Diana Fritillary	2	3	2	2	3	12	II	3
Inver	Dotted Skipper	2	3	1	1	3	10	III	3
Inver	Elktoe	2	3	1	3	2	11	II	4
Inver	*Faxonella blairi*	3	3	3	1	3	13	I	3, 6
Inver	Ghost Tiger Beetle	2	3	1	2	3	11	II	3
Inver	*Hydroptila protera*	3	3	3	1	2	12	II	3, 6
Inver	Iowa Skipper	2	3	1	1	3	10	III	3
Inver	*Islandiana unicornis*	3	3	3	1	3	13	I	3, 6
Inver	Kansas Well Amphipod	2	3	3	1	3	12	II	3, 6
Inver	Kiamichi Crayfish	3	3	3	1	3	13	I	3, 4, 6
Inver	Lidded Oval Snail	3	3	3	1	3	13	I	3, 6
Inver	Linda's Roadside Skipper	3	3	2	1	3	12	II	3
Inver	Little Dubiraphian Riffle Beetle	3	3	3	2	3	14	I	3
Inver	Little Spectaclecase	1	3	2	1	3	10	III	5
Inver	*Lirceus trilobus*	2	3	3	1	2	11	II	3, 6
Inver	Loamy-ground Tiger Beetle	2	3	2	1	3	11	II	3
Inver	Louisiana Fatmucket	2	3	2	1	3	11	II	3, 6
Inver	*Mayatrichia ponta*	2	3	3	1	3	12	II	3, 6
Inver	*Metrichia nigritta* (microcaddisfly)	1	3	1	2	3	10	III	6
Inver	*Miktoniscus oklahomensis*	3	3	3	1	3	13	I	3, 6
Inver	Monkeyface Mussel	2	3	1	1	3	10	III	5
Inver	Neosho Mucket	3	2	3	3	3	14	I	1, 2, 3, 4

Group	Species	Score Criterion 1	Score Criterion 2	Score Criterion 3	Score Criterion 4	Score Criterion 5	Total 15 max	Tier	SGCN Selection Criteria
Inver	*Nixe flowersi* (mayfly)	3	3	2	1	3	12	II	3
Inver	*Ochrotrichia weddleae* (microcaddisfly)	3	3	3	1	3	13	I	3, 6
Inver	Oklahoma Cave Amphipod	3	3	3	1	3	13	I	2, 3, 6
Inver	Oklahoma Cave Crayfish	3	3	3	2	3	14	I	2, 3, 4, 6
Inver	Oklahoma Clubtail	1	3	3	1	3	11	II	6
Inver	Oklahoma Liptooth	3	3	3	1	3	13	1	3, 6
Inver	Oklahoma Spur-throated Grasshopper	2	3	3	1	2	11	II	3, 6
Inver	*Orconectes difficillis*	2	3	2	1	3	11	II	3, 6
Inver	*Orconectes macrus*	2	3	3	1	3	12	II	6
Inver	*Orconectes menae*	2	3	3	1	3	12	II	3, 4, 6
Inver	*Orconectes nana*	2	3	3	1	3	12	II	3, 4, 6
Inver	Oregon Fairy Shrimp	2	3	2	1	3	11	II	3
Inver	Ouachita Creekshell	3	3	2	2	2	12	II	3, 4, 6
Inver	Ouachita Kidneyshell	2	3	3	2	3	13	I	3, 4, 6
Inver	Ouachita Mantleslug	3	3	2	1	3	12	II	3, 6
Inver	Ouachita Rock Pocketbook	3	2	3	3	3	14	I	1, 3, 4
Inver	Ouachita Slitmouth Snail	3	3	3	1	3	13	I	3, 6
Inver	Ouachita Spiketail	3	3	3	1	3	13	I	3, 6
Inver	Outis Skipper	2	3	2	1	3	11	II	3
Inver	Ozark Cave Amphipod	2	3	3	1	3	12	II	3, 6
Inver	Ozark Clubtail	1	3	3	1	3	11	II	6
Inver	Ozark Emerald	2	3	3	1	3	12	II	3, 6
Inver	Ozark Mantleslug	2	3	2	1	3	11	II	3, 6
Inver	Ozark Pigtoe	2	3	3	1	3	12	II	3, 4, 6
Inver	Plain Pocketbook	1	3	2	1	3	10	III	5
Inver	Prairie Mole Cricket	2	3	2	2	3	12	II	3
Inver	*Procambarus tenuis*	2	3	3	1	3	12	II	3, 4, 6
Inver	*Pseudosinella dubia* (cave springtail)	2	3	3	1	2	11	II	3, 6
Inver	Purple Lilliput	3	3	1	2	2	11	II	3, 4
Inver	Pyramid Pigtoe	3	3	1	2	2	11	II	3
Inver	Rabbitsfoot	2	2	2	3	3	12	II	2, 3, 4
Inver	Rattlesnake Master Borer	3	3	2	1	3	12	II	3
Inver	Regal Fritillary	2	3	1	2	3	11	II	3
Inver	Rich Mountain Slitmouth Snail	2	3	3	2	3	13	I	2, 3, 6
Inver	Scaleshell	3	2	2	3	2	12	II	1, 2, 3, 4
Inver	Shinnery Oak Buck Moth	2	3	3	1	3	12	II	3, 6
Inver	Shadow Gloss Snail	2	3	2	1	3	11	II	3
Inver	Slope Ambersnail	2	3	1	1	3	10	III	3, 6
Inver	Smooth-lip Shagreen	2	3	2	1	3	11	II	3, 6
Inver	Southern Hickorynut	3	3	2	2	3	13	I	3, 4
Inver	Southern Plains Bumble Bee	2	3	2	2	3	12	II	3
Inver	Swift Tiger Beetle	2	3	2	2	3	12	II	3
Inver	Texas Lilliput	2	3	1	2	2	10	III	3, 6
Inver	Toothed Stonefly	2	3	3	1	2	11	II	3
Inver	*Tricorythodes curvatus*	3	3	2	1	3	12	II	3
Inver	*Trigenotyla blacki* (cave obligate millipede)	3	3	3	1	3	13	I	3, 6
Inver	*Trigenotyla vaga* (cave obligate millipede)	2	3	3	1	3	12	II	3, 6

Group	Species	Score Criterion 1	Score Criterion 2	Score Criterion 3	Score Criterion 4	Score Criterion 5	Total 15 max	Tier	SGCN Selection Criteria
Inver	Truncate Stonefly	3	3	3	1	2	12	II	3, 6
Inver	Tulsa Whitelip Snail	2	3	3	1	3	12	II	3, 6
Inver	Variable Cuckoo Bumble Bee	3	3	2	2	2	12	II	3
Inver	Wartyback Mussel	2	3	1	2	3	11	II	5
Inver	Washboard	1	3	2	1	3	10	III	5
Inver	Wax Coil Snail	3	3	2	1	3	12	II	6
Inver	Western Fanshell	3	3	2	3	3	14	I	2, 3, 4, 6
Inver	Wichita Mountains Pillsnail	3	3	3	1	3	13	I	3
Inver	Winged Mapleleaf	3	2	2	3	3	13	I	1, 3, 4
Inver	Wyandotte Liptooth	3	3	3	1	3	13	I	3, 6
Mamm	Baird’s Pocket Gopher	1	3	3	1	3	11	II	6
Mamm	Black-tailed Prairie Dog	1	3	2	2	3	11	II	1, 2, 3
Mamm	Brazilian (Mexican) Free-tailed Bat	1	3	2	2	3	11	II	2
Mamm	Colorado Chipmunk	1	3	1	1	3	9	III	6
Mamm	Desert Shrew	1	3	2	2	3	11	II	2
Mamm	Eastern Harvest Mouse	1	3	1	1	3	9	III	2
Mamm	Eastern Small-footed Bat	2	3	1	1	2	9	III	2, 3
Mamm	Eastern Spotted Skunk	1	1	2	3	3	10	III	2, 3
Mamm	Eastern White-throated Woodrat	1	3	1	1	3	9	III	6
Mamm	Golden Mouse	1	3	1	1	3	9	III	2
Mamm	Gray Bat	2	2	2	2	3	11	II	1, 3
Mamm	Hog-nosed Skunk	2	1	1	1	2	7	III	2
Mamm	Indiana Bat	3	2	1	2	2	10	III	1, 3
Mamm	Long-tailed Weasel	1	1	1	2	3	8	III	2
Mamm	Marsh Rice Rat	1	3	2	1	3	10	III	2
Mamm	Meadow Jumping Mouse	1	3	1	2	2	9	III	2
Mamm	Mountain Lion	1	1	1	1	3	7	III	2
Mamm	Northern Long-eared Bat	2	3	2	1	3	11	II	2, 3
Mamm	Northern Rock Mouse	1	3	2	1	3	10	III	6
Mamm	Ozark Big-eared Bat	2	2	3	3	3	13	I	1, 3
Mamm	Rafinesque's Big-eared Bat	2	3	1	2	3	11	II	2, 3
Mamm	Ringtail	1	1	2	1	3	8	III	2
Mamm	Seminole Bat	1	3	1	1	3	9	III	2
Mamm	Southeastern Bat	2	3	2	2	3	12	II	2, 3
Mamm	Swamp Rabbit	1	1	2	2	3	9	III	4
Mamm	Swift Fox	2	1	2	2	3	10	III	2, 3
Mamm	Texas Kangaroo Rat	3	3	1	2	2	11	II	2, 3
Mamm	Tricolored Bat	2	3	2	2	3	12	II	3
Mamm	Western Big-eared Bat	2	3	2	2	3	12	II	2, 3
Mamm	White-ankled Mouse	1	3	1	1	2	8	III	6
Mamm	Yellow-faced Pocket Gopher	1	3	2	1	3	10	III	6
Rept	Alligator Snapping Turtle	2	3	2	3	3	13	I	2, 3
Rept	American Alligator	1	3	1	1	3	9	III	2
Rept	Common Checkered Whiptail	1	3	1	1	3	9	III	2
Rept	Common Lesser Earless Lizard	1	3	2	2	3	11	II	2
Rept	Eastern River Cooter	1	3	2	1	3	10	III	5
Rept	Gulf Crayfish Snake	1	3	2	2	3	11	II	2
Rept	Louisiana Milksnake	2	3	2	2	3	12	II	2
Rept	Midland Smooth Softshell	1	3	2	1	3	10	III	5

Group	Species	Score Criterion 1	Score Criterion 2	Score Criterion 3	Score Criterion 4	Score Criterion 5	Total 15 max	Tier	SGCN Selection Criteria
Rept	Mississippi Map Turtle	1	3	2	1	3	10	III	5
Rept	Northern Map Turtle	1	3	1	1	3	9	III	2
Rept	Northern Scarletsnake	1	3	2	2	3	11	II	2
Rept	Ouachita Map Turtle	1	3	2	1	3	10	III	5
Rept	Razor-backed Musk Turtle	1	3	2	1	3	10	III	6
Rept	Round-tailed Horned Lizard	1	3	1	2	2	9	III	2
Rept	Spiny Softshell Turtle	1	3	2	1	3	10	III	5
Rept	Texas Gartersnake	1	3	3	2	2	11	II	2, 3
Rept	Texas Horned Lizard	2	3	2	3	3	13	I	2
Rept	Texas Long-nosed Snake	1	3	2	2	3	11	II	2
Rept	Western Chicken Turtle	1	3	2	2	3	11	II	2
Rept	Western Diamond-backed Rattlesnake	1	3	2	1	3	10	III	5
Rept	Western Massasauga	2	3	2	1	3	11	II	2, 3
Rept	Western Mudsnake	1	3	2	2	3	11	II	2