Oklahoma's State Wildlife Action Plan

Guiding the management of Oklahoma's rare, declining, threatened, and endangered fish and wildlife.

Lesser prairie-chickens. Photo by Bill Adams.

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Hurter's spadefoot. Photo by ODWC.

Executive Summary

Cardinal shiners. Photo by Brandon Brown/ODWC.

The Oklahoma State Wildlife Action Plan (SWAP), previously known as the Oklahoma Comprehensive Wildlife Conservation Strategy (OCWCS), provides broad, proactive guidance for the conservation of Oklahoma's rare and declining species and meets the requirements of the congressionally authorized State Wildlife Grants Program (SWG). The SWAP is a strategic conservation plan that identifies Oklahoma's Species of Greatest Conservation Need (SGCN), their essential habitats, key conservation issues, and the conservation actions needed to effectively conserve, restore, and improve the statuses of these species and their habitats. Furthermore, the SWAP provides the opportunity to build partnerships which improve the delivery of proactive conservation.

Oklahoma's SWAP is not a research study but instead is a strategic-level conservation plan based upon the best available information and professional judgment provided by more than 190 stakeholders and technical experts representing a wide range of perspectives tied to Oklahoma's ecology, natural history, and land management. Based upon the initial stakeholder input, the SWAP was written to achieve 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 SWG program.
4. The building of partnerships should be encouraged as a means of implementing conservation actions.

The Oklahoma SWAP is integrally connected to the congressional SWG program and is 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, fish and wildlife are public trust resources and states hold the authority and responsibility for managing most of these populations. For decades, state fish and wildlife agencies across our nation have worked successfully with the U.S. Fish and Wildlife Service (USFWS) 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 (e.g. the Wildlife Restoration Program and Sport Fish Restoration Program). In the mid-1970s, Congress established the Cooperative Endangered Species Conservation Fund, to support the conservation and recovery of species that are federally listed under the Endangered Species Act as threatened or endangered. 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

Texas horned lizard. Photo by Jack Chlebanowski.

understood, have specialized ecological needs, and have reached critically low population levels. This realization was one of the impetuses for the creation of the State and Tribal Wildlife Grants Programs (STWG), which aim to address the conservation needs of rare and declining fish and wildlife species before they reach the point at which they are threatened with endangerment or extinction.

As a requirement of the SWG program, Congress directed each state, territory, commonwealth, and the District of Columbia to develop individual conservation plans that identify the species with the greatest need for additional conservation attention and outline actions that could be employed for the benefit of these species. The Oklahoma SWAP is the fulfillment of this congressional requirement for Oklahoma and serves as the guiding document for how the state uses its allocated SWG funding. Beyond these purposes, the broader conservation community can use the SWAP to identify conservation opportunities and priorities in their areas and work to further conserve Oklahoma's SGCN and the habitats on which they depend.

The use of the Oklahoma SWAP 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 SWG funding and was developed as a requirement of that program, the conservation issues and recommended actions within the SWAP are not limited to those for which the ODWC has legal authority or those that can be funded solely through the SWG program. Instead, the SWAP attempts to examine the full range of conservation issues faced by rare and declining species in Oklahoma. The implementation of most of the recommended actions within the SWAP will require voluntary cooperation and funding from private landowners, industries, municipalities, regulatory agencies, conservation organizations, research entities, and the general public.

Because of the SWAP's comprehensive approach and reliance upon partnerships for implementation, a wide range of conservation stakeholders, organizations, and agencies were included in the process during its development. Technical input was sought from over 350 experts and professionals in land management and fish and wildlife conservation from within and outside of state government. The public was invited to participate in the SWAP's initial development and in both the first and second revision processes through public meetings and an online review process. Additionally, guidance provided by Congress, the USFWS, and the Association of Fish and Wildlife Agencies was used to prepare the organizational structure and content of the SWAP.

Statewide Perspective on 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 ecoregions were placed into categories based on their similarity, which included:

1. Land management practices over the past century have altered natural processes such as grazing and burning, and have changed the structure and composition of habitats over large areas (i.e. Modification of Natural Ecosystem Processes);
2. The modification of water flow within streams and rivers brought about by water removal, impoundments and channel modifications has negatively affected many aquatic species (i.e. Modification of Natural Ecosystem Processes);
3. Many wildlife populations across most habitat types have been affected negatively by the fragmentation and conversion of native habitats to other land uses (i.e. Habitat Loss and Fragmentation);
4. Water quality impairment continues to threaten aquatic species in developed landscapes (i.e. Pollution and Sedimentation);
5. Deficiencies in existing data that impede effective conservation planning and implementation (i.e. Information Gaps), and
6. Invasive, non-native plants and animals have altered the structure and composition of many habitats and reduced habitat quality (i.e. Invasive and Problematic Species).

Similarly, there were re-occurring conservation actions that were recommended to lessen the impact of or resolve these larger conservation issues. Many of these actions are

applicable across multiple habitats and benefit large suites of SGCN; therefore, they are viewed as the highest priority conservation actions in the SWAP.

For Terrestrial Habitats

- Conduct landscape-level assessments of habitat conditions and SGCN occupancy to identify the caves and the tracts of tallgrass prairies, shrublands, mesic forests, and bottomland hardwood forests that have the greatest conservation value for SGCN. Implement programs such as long-term or perpetual conservation easements, conservation leases, or willing-seller land acquisitions to place them under conservation management to proactively conserve populations of SGCN.
- Use multiple avenues (cost-share programs, education, large-scale collaboration, funding and equipping prescribed burn associations) to control eastern redcedar in prairie, shrubland, and woodland communities.
- Provide financial support to implement management practices that maintain a balanced landscape of herbaceous vegetation and native shrubs. These might include rotational grazing systems and patch-burn grazing systems with habitat-specific modifications. Monitor the effects of these practices on local populations of SGCN.
- Conduct human dimension studies to measure the existing attitudes, opinions, and needs of rural landowners to determine the best ways to reach them with information and financial incentives for land management that is consistent with SGCN conservation.
- Evaluate the ecological damage done by invasive species and implement preventative control measures that target invasive species before they become established or widespread. Develop early detection surveillance programs for invasive species and promote educational materials to help landowners and sportsmen identify and report potentially invasive species.
- Develop demonstration areas to showcase the economic and ecological benefits that can be achieved by implementing prescribed grazing and fire programs in prairie, shrubland, and oak woodland habitats. These sites can serve as training locations for fire and grazing management workshops for ranchers and other landowners.
- Continue to identify and map the distribution of limestone karst and gypsum caves, with an emphasis on sites that are likely to support SGCN. Develop assistance and incentive programs to help private landowners implement cave management measures such as installing internal cave gates or enhancing habitat conditions surrounding caves.
- Provide long-term funding and support to maintain state and national databases to store and analyze SGCN distribution and ecological data. Make these data available to land managers, conservation agencies, and partners to be incorporated into site-specific, species-specific, and regional conservation plans.
- Develop feasible methods for propagating shinnery oak and develop a cost-share program that encourages landowners to reestablish shinnery oak on retired cropland and pastureland to restore shrubland habitat.
- Evaluate the effectiveness of prescribed burning, mid-story thinning, and selective tree removal or canopy thinning as tools to diversify forest structure and increase the diversity and abundance of understory vegetation.
- Reduce the impediments and constraints that limit the use of prescribed fire as a management tool. These may include providing funding to local burning associations to assist with conducting prescribed burns on private property, developing technical assistance materials for landowners, providing financial assistance or incentives to landowners to encourage woodland restoration, and develop affordable liability insurance that covers landowners conducting prescribed burns.

Texas toad. Photo by ODWC.

For Aquatic Habitats

- 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
- Conduct management-oriented research and pilot studies to determine the pattern and rate of flow needed to meet the ecological needs of the SGCN 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.
- 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. Incorporate ecological flow needs into the permitting process for water withdrawals. 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.
- Develop monitoring programs to measure and track the abundance and geographic ranges of SGCN and the condition of the habitats on which they depend. Where applicable, link monitoring to existing efforts and coordination with other partners to ensure monitoring efficiency and decrease the potential for unhelpful survey duplication.
- Restore, enhance, or create seasonal wetlands/vernal pools to hold storm water and slowly release it to the river to limit development within sensitive floodplains and improve habitat conditions for wildlife SGCN.
- 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.
- Encourage landowners to enroll wetlands, seeps, and vernal pools in conservation programs. 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.
- Fund management-oriented research to determine effective wetland management protocols that will enhance or maintain habitat value for SGCN. Develop a monitoring program to measure the effectiveness of efforts to protect or restore herbaceous wetlands, seeps and vernal pools on populations of SGCN.
- Provide cost-share funding or grants to landowners to restore the structure of herbaceous wetlands, seeps, springs and headwater streams, and the riparian vegetation around them. These actions can include removal of pipes and low dams, or the construction of fencing to limit access by livestock.

American alligator. Photo by Chad Freeny.

The current edition of Oklahoma's SWAP is not an end point, but rather another step towards the extensive and long-term conservation of healthy fish and wildlife populations for present and future generations of Oklahomans. In order for the SWAP to be implemented and serve as more than another forgotten document, it needs to be actively examined, modified, and embraced by conservation-minded partners. The funding base and legal authority to implement many of its recommended actions does not exist within wildlife conservation agencies; therefore, partnerships are crucial for its implementation. It is our desire that through the ongoing communication and coordination among all stakeholders, Oklahoma's SWAP will remain a vital and adaptive template for future fish and wildlife conservation efforts. Conservation partners across the state and region are encouraged to use the SWAP as a guide for their own activities and to share the results of their efforts with all conservation partners.

Introduction and Ecological Framework

Red-headed woodpecker. Photo by Mary Phillips.

Introduction and Purpose

The primary purpose of the Oklahoma State Wildlife Action Plan (SWAP), previously known as the Oklahoma Comprehensive Wildlife Conservation Strategy, is to articulate the conservation strategies necessary to conserve Oklahoma's rare and declining wildlife species and in doing so maintain our rich biological heritage for present and future generations. The Oklahoma SWAP serves as the guiding document for a federal conservation assistance program known as the State Wildlife Grants Program (SWG). In 2000, Congress created the SWG program which required states, territories, commonwealths, and D.C. to develop comprehensive conservation plans that identified at-risk fish and wildlife, essential habitats, key conservation issues, and the conservation actions needed to effectively conserve and restore these species and habitats. Additionally, these strategic plans would serve as the primary guidance for how states would use their portions of SWG funding to advance the conservation of rare and declining species. In 2001, the Tribal Wildlife Grant Program was created by Congress to help Tribal Nations conserve species of conservation and cultural significance. These two programs, collectively known as the State and Tribal Wildlife Grants Programs (STWG), provide critical funding for the management and conservation of fish and wildlife.

This document is the second revision and the third iteration of the SWAP that was originally completed in August 2005. The overarching goal of the Oklahoma SWAP is the conservation of Oklahoma's fish and wildlife species for present and the future generations. To achieve this goal, emphasis is placed on rare and declining species with the assumption that the needs of all species can be met via the successful conservation of species that have more specialized habitat needs and/or a limited geographic range. Throughout the Oklahoma SWAP, these rare and declining species are referred to as "Species of Greatest Conservation Need" — a term based upon the congressional language that created the STWG programs and necessitated the development of this plan. The designation of these Species of Greatest Conservation Need (SGCN) is discussed later in this document, and the range wide status of each species was a substantial consideration in that process. As a result, some species that are rare in Oklahoma but widespread elsewhere in North America were not designated as SGCN, and conversely, a few relatively common species in Oklahoma were designated as SGCN because Oklahoma represents a stronghold for those species. Within the Oklahoma SWAP, SGCN were placed into groups based upon their shared habitat needs, and within each habitat chapter a series of conservation actions were recommended to enhance the long-term persistence of these species within their habitats.

Adaptive management principles were applied to the review and revision process used to produce this edition of the Oklahoma SWAP. The data collected through more than 130 State Wildlife Grants-funded projects between 2003 and 2024 were used to update the list of Oklahoma's

SGCN and to refine, based on that new and/or updated information, the species' status and other ecological aspects of their natural history. Input was sought from technical experts, land managers, 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 this revision, each species, species status, habitat type, conservation issue, and conservation action was reviewed and modified as needed. Beginning with the 2015 list of SGCN, we have removed 52 species and have added 136 for a net change of an additional 85 species. Most removals were species whose statuses and/or population sizes have increased due to increasing population trends or improved and more accurate information about their population sizes or geographic ranges. Most additions were species of grassland birds, shorebirds, and bats whose populations have been trending downward in recent years, or they were range-restricted invertebrates (especially pollinating insects) whose statuses have been assessed for the first time in the past 10 years. The selection criteria for determining which species qualified as SGCN in this SWAP were modified and slightly expanded, but the ranking criteria remained largely the same as the SWAP's 2015 version. All SGCN were re-evaluated and re-ranked based upon new information and insights that have been gained since 2015. Under our current adaptive management protocol, the next comprehensive review and revision of the SWAP will be initiated in 2033 and completed in 2035 to maintain a 10-year interval between reviews.

National Conservation Funding History

In North America, wildlife is a publictrust resource, and most wildlife populations are managed by the individual states for the benefit of their respective citizens. The exceptions to this are migratory birds, diadromous fish, and species that are federally listed as threatened or endangered, where the management authority and public trust responsibility for these species are held by the federal government. For decades, direct conservation of state-managed fish and wildlife populations in Oklahoma, and across the country, has been funded largely by hunters and anglers. 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 USFWS according to set formulas. This system has been very effective for funding the conservation of game species and sport fish, and species like 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 new but much smaller funding source became available for the conservation of America's rarest and most imperiled species through an annual congressional appropriation.

Updates to the 2015 Comprehensive Wildlife Conservation Strategy

SGCN Meeting 2015 Comprehensive Wildlife Conservation Strategy Selection Criteria	313
Species Assessed for the 2025 State Wildlife Action Plan	~2,175
Species that no longer meet the 2025 State Wildlife Action Plan Selection Criteria	52
Species that were not included in the 2015 Comprehensive Wildlife Conservation Strategy but meet 2025 State Wildlife Action Plan Selection Criteria	136
SGCN Meeting 2025 State Wildlife Action Plan Criteria	**397**

These programs have borne the costs for most state-level fish and wildlife conservation because a reliable funding mechanism has not been established to adequately address the remaining species that are not hunted, fished, endangered, nor threatened. These species represent more than 85% 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 species not hunted or fished. In the late 1990s, state wildlife agencies and their partners across the conservation community launched the Teaming With Wildlife (TWW) Initiative. The TWW Initiative created the largest conservation coalition to date, and across the country more than 3,000

Lichen grasshopper. Photo by Alex Harmon.

Royal catchfly. Photo by Carl Lewis/CC BY 2.0.

organizations and businesses lobbied Congress for passage of a dedicated and reliable national funding system for all species of wildlife with an emphasis on those species that are in decline. Funding for these species would be used to increase the public's appreciation and connection with wildlife and to bolster populations of rare and declining species to ensure their survival and the continuation of the ecological services and functions that they provide. The TWW Initiative'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, and often litigious, threatened and endangered species listings.

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 as a subaccount of the Wildlife Restoration Program. Although funds for this Act were appropriated only one time, it identified the elements required to be included in a "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 Programs" that required the states to develop a "Comprehensive Wildlife Conservation Plan" by October 2005 to be eligible to receive STWG funding. All 50 states, the District of Columbia and the U.S. territories of Puerto Rico, U.S. Virgin Islands, American Samoa, Guam, and the Commonwealth of the Northern Marianna Islands developed approved comprehensive wildlife conservation plans.

Oklahoma's SWAP meets the requirements of both federal funding acts and is based upon the best available information contributed over a period of 20 years by more than 200 technical experts representing a wide range of disciplines tied to Oklahoma's ecology, natural history, and land management. The SWAP is a strategic-level conservation plan rather than a work plan. It identifies issues and potential actions that could be taken across the state and is meant to serve as general guidance rather than a plan that commits funds and partners to specific actions. This strategic plan was written for all agencies and organizations in Oklahoma, not just the Oklahoma Department of Wildlife Conservation (ODWC); therefore, many of the potential actions identified in the plan lie beyond the available funding and legal authority of the ODWC. Although the SWAP was written to provide guidance for the use of STWG funding, the recommendations extend beyond that program and include some activities that are important conservation tools but are not eligible for funding under the program.

Connection to State and Tribal Wildlife Grants

The SWAP is the guiding plan for determining which species and activities are eligible for Oklahoma's funding allocation from the state portion of the STWG Programs so that the benefits gained from this investment of conservation dollars are maximized. These programs provide cost-share funding to eligible Tribes and state fish and wildlife agencies for the proactive conservation of SGCN. An SGCN is a rare, uncommon, or declining species whose long-term persistence is in doubt or in jeopardy and most of these species are traditionally classified as "nongame" species. SGCN can include both vertebrates and invertebrates, but the congressional language prohibits the use of STWG funding to address the direct conservation of individual plant species. The funding 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, in most states, plants are the property of the landowner upon whose property they are growing; therefore, states have limited legal authority for plants. Although conservation actions directed and applied toward plants are not eligible for STWG funding, there are substantial conservation concerns for some rare and declining plants. In recognition of those concerns and the important role that plants play in the conservation of Oklahoma's biological diversity, a list of rare and declining plant species was developed for this iteration of the SWAP and is included in the chapter related to Species of Greatest Conservation Need. These Plant Species of Conservation

Need are not formally recognized as SGCN for the purposes of the STWG Programs, but they are included in this document as important biological resources that often occur in the same habitats as SGCN and may benefit from the conservation of those habitats.

The STWG Programs seek 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 (USFWS) 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.

Eight Required Elements

The enabling legislation for the STWG Programs 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 Native American Nations that manage significant land and water areas within Oklahoma or administer programs that significantly affect the conservation of identified species and habitats.
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 SWAP is the result of a process specifically designed to meet the above required elements. Although the SWAP is required in order for Oklahoma to participate in the STWG Programs, 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 SWAP identifies a wide menu of potential actions that can be used by any conservation-minded person or organization for years into the future.

How to Read the Oklahoma State Wildlife Action Plan

This version of Oklahoma's SWAP was reorganized by habitat from a statewide perspective to better align with structure used by most states. It is written as a series of chapters based upon the following broad habitat types: Grasslands, Shrublands, Deciduous Woodlands and Forests, Pine and Mixed-Pine Woodlands and Forests, Caves, Wetlands, Small Rivers and Streams, and Large Rivers. Additionally, there are chapters that address the selection and ranking of SGCN, monitoring, and coordination with

Spiny softshell. Photo by Gene Blackwell.

stakeholders and the general public.
Each of the eight habitat-based chapters was written to be a stand-alone document. Descriptions of the chapter's two to seven most important habitat types for the conservation of Oklahoma's SGCN are followed by a table listing each SGCN that depends upon that broad habitat type, with a brief status statement for each species, the habitats in which it occurs, and the ecoregions within the state where it occurs. Included in the SGCN status table are the species Global Conservation Rank and State Conservation Rank as determined by NatureServe and the Oklahoma Natural Heritage Inventory, respectively. Following the SGCN status table are narrative descriptions of the conservation issues SGCN may experience within that habitat and are written in the order of those that impact the greatest number of SGCN to the least. These narratives are followed by a list of recommended conservation actions, and the chapter ends with a list of recommended monitoring metrics for the actions, the habitats, and the SGCN, as well as a list of conservation lands. A glossary of the terms used in this document can be found in Appendix A.

Ringed salamander. Photo by Peter Paplanus/CC BY 2.0.

Approach and Methods

This document is the second comprehensive revision and third iteration of the Oklahoma SWAP. The development of the 2005 SWAP and the revision that was completed in 2015, are described in detail in the 2015 SWAP, which is publicly available on the Oklahoma Department of Wildlife Conservation's (ODWC) website. The core of the Oklahoma SWAP is the original 2005 plan that was developed over a two-year period by a team of professional conservation planners from Dynamic Solutions Group, LLC, and five biologists from the ODWC. The creation of that document involved coordination with the USFWS, and an Advisory Group comprised of representatives from 35 public agencies and conservation organizations who provided guidance during the SWAP's development. Nearly 150 technical experts in the areas of biology and land management were engaged in the process through a survey and a statewide conference, and they were asked to review two draft versions of the plan before it was completed. Appendix E acknowledges the individuals and organizations that helped develop the original SWAP and its 2015 revision.

The ODWC began the revision process for the 2025 version of the Oklahoma SWAP in July of 2023 and used the 2015 version as the starting document. A comprehensive revision team was assembled that included all six staff associated with the Oklahoma Wildlife Diversity Program. The team began by evaluating the SWAPs of other states; each team member randomly selected three states and reviewed each of their SWAPs looking specifically for the way that each was organized and how the SGCN were selected and ranked (or not ranked). All 18 of the SWAPs that were reviewed from other states were organized by habitat types rather than by ecoregions in the way of the original Oklahoma SWAP. The revision team decided not to create formal technical committees for each taxonomic group, but instead they invited the state's community of biological and conservation technical experts to provide distribution and abundance information, and land management insights relevant to Oklahoma's Species of Greatest Conservation Need (SGCN). 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 management entities including the USFWS, the U.S. Forest Service, The Nature Conservancy, The Samuel Roberts Noble Foundation, Oklahoma State Parks, the Oklahoma Biological Survey, the 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 Nations in Oklahoma.

Next, a list was compiled of 358 technical experts and stakeholders from throughout the state. This list included individuals from academia, Tribal Nations, state and federal government, nongovernmental organizations (NGOs), and businesses in the field of natural resources. A survey was developed and sent to the stakeholders in the fall of 2024 with questions about content, layout, and their use of the Oklahoma SWAP. One outcome of that survey was that most stakeholders are familiar with the state's ecoregions, but most do not organize their work along those boundaries. With this information, the decision was made to restructure the Oklahoma SWAP by statewide habitats, rather than

Kentucky warbler. Photo by Doug Greenberg/CC BY-NC 2.0.

ecoregions, to be consistent with the layout used by most states and all of our neighboring states. The new structure is described in greater detail later in this chapter in the section titled Ecological Framework.

The SWAP revision team then reviewed and updated the criteria that were used to select SGCN in Oklahoma. An objective set of selection criteria were used to determine the species that are included in the list of SGCN, and those selection criteria have been applied to all of the vertebrate species and the invertebrate species that have been evaluated globally by NatureServe and their network of state natural heritage programs. We retained the six selection criteria that were used in the 2005 and 2015 versions (see the chapter dedicated to Species of Greatest Conservation Need for an explanation of these), and we expanded upon the principles of two criteria to create two new criteria. One of these was Selection Criterion 3, which added to the SGCN list any species that was protected in Oklahoma under a year-round, statewide closed season cited in Oklahoma's wildlife regulations (OAC Title 800). The other criterion addition was Selection Criterion 7, which added to the SGCN list any species for which 30% or more of its global geographic range and/or population size fell within the boundaries of Oklahoma, giving Oklahoma an important stewardship responsibility for those species. Selection Criterion 8 was updated to use the most current references, which included the North American Bird Conservation Initiative's assessment of all birds in the continental United States. The SGCN list was then updated and vetted with the assistance of the USFWS Tulsa Field Office, the Oklahoma Natural Heritage Inventory, The Nature Conservancy, and the Sutton Avian Research Center. The Oklahoma Natural Heritage Inventory, working with Oklahoma's community of entomological experts, recommended nearly 200 invertebrates for SGCN consideration, of which 78 were added to the final list. One additional change that was made to the list of SGCN is that no traditional game animals with an annual season were included. Two new practices that ODWC adopted for the third iteration of the Oklahoma SWAP was the inclusion of a list of plants that is somewhat analogous to the SGCN list for animals, and the creation of a tier of SGCN for data deficient species (mostly invertebrates). To develop the plant list, ODWC participated in a regional effort with the other state and territorial members of the Southeastern Association of Fish and Wildlife Agencies (SEAFWA) to identify potential plant species of greatest conservation need. The SEAFWA Wildlife Diversity Committee partnered with NatureServe, the USFWS's Science Applications program, the Atlanta Botanical Garden, and the Southeastern Plant Conservation Alliance, to update the NatureServe global ranks for all plant taxa in the SEAFWA geography and global scores of G1, G2, and G3 to develop recommended plant SGCN. In Oklahoma, 72 species of plants meet these global rank thresholds, and these were selected as Plant Species of Conservation Need in this SWAP. With each successive iteration of the SWAPs, more states are adding invertebrates to their SGCN lists and in greater numbers. Often, invertebrate taxa do not have the same history of ecological research as vertebrate taxa, and the rarest species may be known from only a few dozen specimens with little ecological context to their collection. In response to the data deficiencies inherent in some of the species that warrant SGCN status, many states are adopting a data deficient SGCN category. In the Oklahoma SWAP, we created a tier of SGCN that we labeled Species of Greatest Information Need (SGIN). Species in the SGIN tier are still considered SGCN for the purposes of STWG funding.

Oklahoma's 2025 State Wildlife Action Plan Species of Greatest Conservation Need	
Number of Tier I SGCN	107
Number of Tier II SGCN	208
Number of Species of Greatest Information Need	82
Total Species of Greatest Conservation Need	**397**

Oklahoma's SGCN list was tiered as it had been in the previous two versions; however, one of the ranking criteria was removed and a new Species of Greatest Information Need tier was created. Because game mammals and birds with an annual open season were not considered for the SGCN list, the former Ranking Criterion 2 (Availability of other Federal Assistance Funding) was determined to be

The flathead chub is included in Oklahoma's list of Species of Greatest Conservation Need as a Species of Greatest Information Need. Photo by Sam Stukel/USFWS.

obsolete and was removed. This lowered the range of ranking values from a scale of five to 15 points down to a scale of four to 12 points, and the tiering system was modified so that species which received a total score of 10 to 12 points were placed in Tier I, and species that received a score of nine or lower were placed in Tier II. The third tier was replaced by the SGIN tier; all species for which there was insufficient information to rank them accurately were assigned to the SGIN tier. A complete description of the selection and ranking processes is the basis for the chapter of this document dedicated to Species of Greatest Conservation Need of this document.

After the revision of the SGCN list and the restructuring of the document from an ecoregion-based plan to a habitat-based plan, the conservation issues and recommended actions were reviewed and updated. As in previous versions, the term "conservation issues," is used in place of the term "conservation problems" used by Congress (i.e., Required Element 3). As conservation issues were identified in each habitat type by the revision team and technical experts, they were placed into four to six broad categories with other similar issues (e.g. habitat loss and fragmentation; invasive and problematic species, or modification of natural ecosystem processes). These four to six broad categories were then prioritized within each chapter based upon the number of SGCN 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 interrelatedness 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.

State Overview

Oklahoma is a diverse state, both geologically and ecologically. It stands on the western edge of the vast deciduous forest biome of the eastern United States; at the southern end of all three grassland types within the Great Plains (shortgrass, mixed-grass, and tallgrass prairies); it abuts the eastern edge of the Rocky Mountains at Black Mesa, and extends down to the Gulf Coastal Plain at its southeastern corner. Because of this ecological and geological diversity, it supports rich plant and animal communities. In the 1940s, the Oklahoma Department of Wildlife Conservation developed the first statewide vegetation map, which was used to describe the general habitat types occupied by the state's most

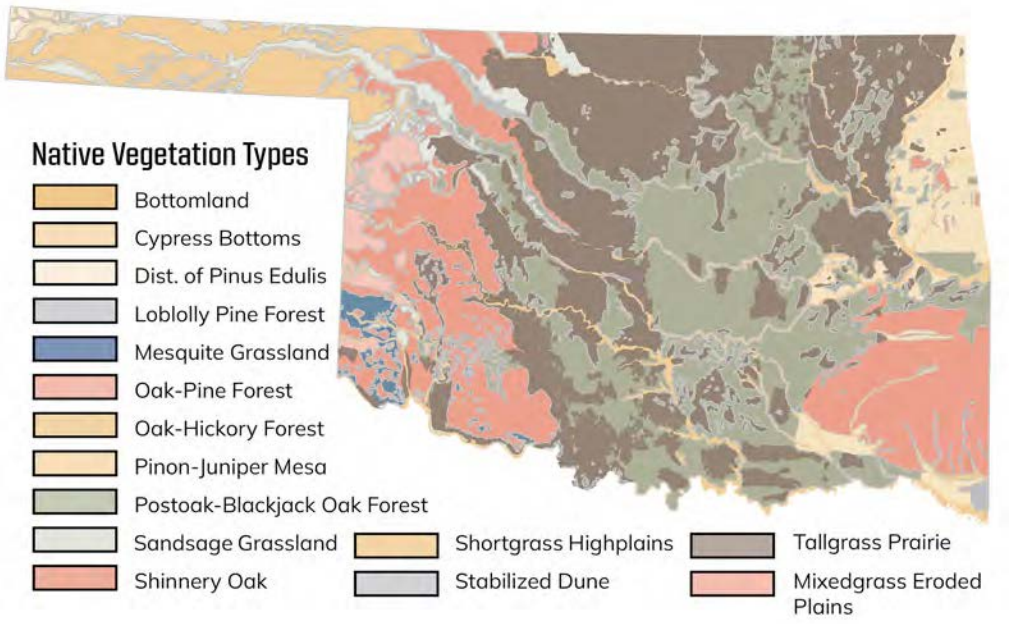


Figure 1. A Game Type Map of Oklahoma (aka Duck and Fletcher Map), Oklahoma Department of Wildlife Conservation, 1943.

important game animals (Figure 1). This historic vegetation map has been used in state conservation planning for almost 75 years. It identifies and maps the geographic extent of 15 important terrestrial plant community types (game habitat types) across Oklahoma.

This diversity of vegetation communities is shaped by the variation in Oklahoma's rainfall, elevation, and soil types as shown in Figures 2, 3, and 4 respectively. Oklahoma's Normal Average Annual Rainfall varies from as little as 16 inches at the western edge of the shortgrass prairie community in the panhandle, to as much as 57 inches in the higher elevation ridges in the Ouachita Mountains in the southeastern corner. Oklahoma's elevation ranges from approximately 300 feet above sea level in the Gulf Coastal Plain in the southeastern corner, to more than 4,900 feet at Black Mesa in the northwestern corner. Soil characteristics combine with rainfall, elevation, and slope/aspect to shape local plant communities. In Oklahoma, forests, woodlands and shrublands frequently occur on alfisols and ultisols, while prairies dominate on deep mollisols and inceptisols.

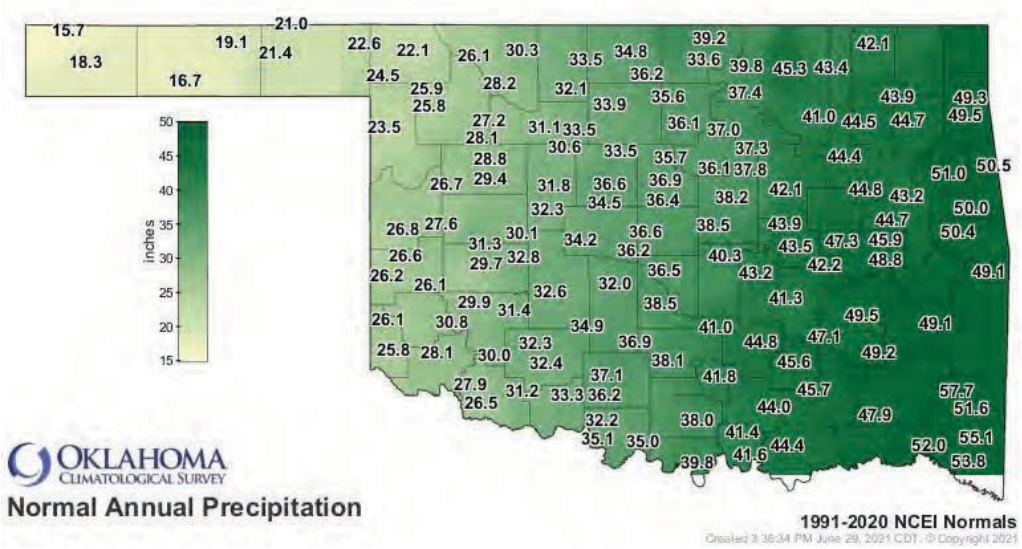


Figure 2. The normal annual precipitation for a 30-year period using observations from the National Weather Service cooperative observer network. Data are quality assured by NOAA's National Centers for Environmental Information (NCEI).

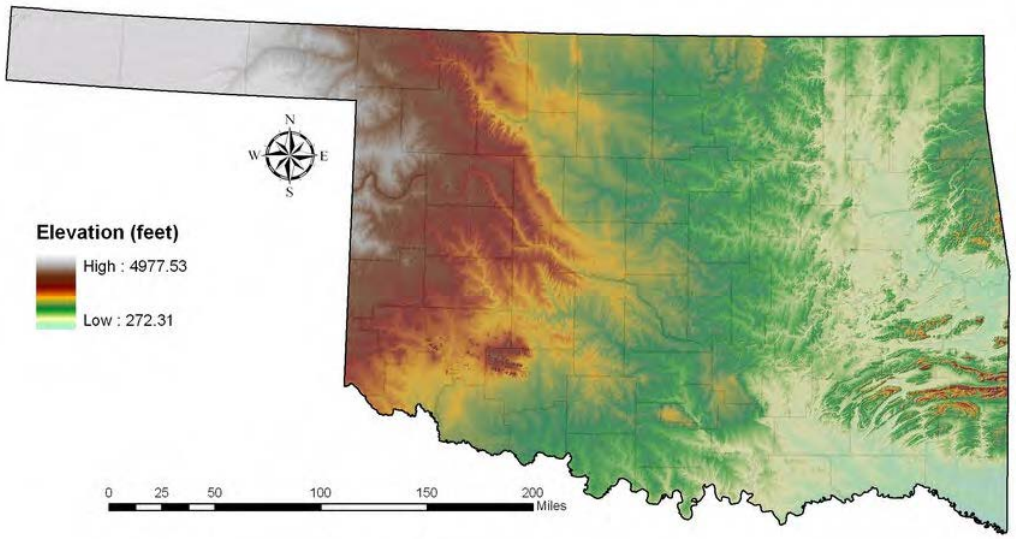


Figure 3. Oklahoma Elevation Gradient from the USGS Digital Elevation Model (DEM).

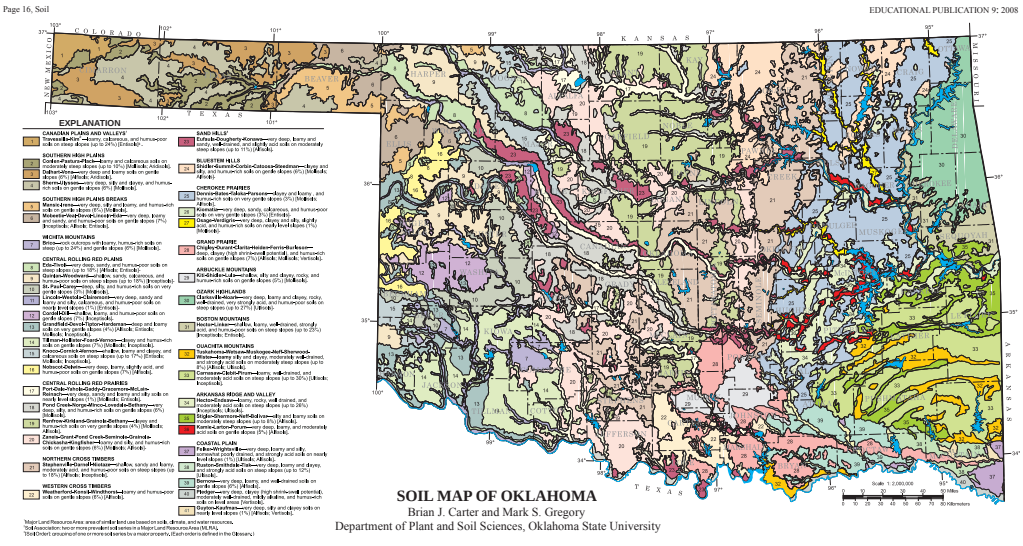


Figure 4. Soil Map of Oklahoma by Brian J. Carter and Mark S. Gregory/Department of Plant and Soil Sciences, Oklahoma State University.

Ecological Framework

Habitats

Oklahoma's terrestrial habitats are based on plant communities, which are shaped primarily by rainfall and soil conditions and secondarily by natural processes such as fire, grazing, drought, and other variations in rainfall. Aquatic habitats also are shaped by rainfall and geology as well as ground water, drought, and flood events. Most of the aquatic habitats used by Oklahoma's SGCN are interconnected and can be classified by stream order. Many of our conservation partners focus their work on specific habitats or recognize sets of habitats that are slightly

different from those of other partners. As examples, the avian habitat joint ventures focus on unique sets of habitats as does The Nature Conservancy and other NGOs. Similarly, other conservation plans define habitats in slightly different ways. As examples, the U.S. Geological Survey's Gap Analysis Project defines habitats in slightly different ways than they are defined by the Department of Defense's Integrated Natural Resources Management Plans for their installations and the USFWS's Comprehensive Conservation Plans for their refuges. We evaluated the habitat delineations used by each of these partners, as well as the habitat frameworks used by the U.S. Department of Agriculture's U.S. Forest Service and the Natural Resources Conservation Service, to develop a set of habitats that encompassed each of these in a biologically meaningful way. The intent was to define habitats in a way that was compatible with the systems used by these partners so that the SWAP could be cross walked with them. For purposes of the Oklahoma SWAP, 25 distinct natural habitats are recognized as important to the conservation of SGCN. The terrestrial habitats are three types of grasslands: Shortgrass Prairie, Mixed-grass Prairie, and Tallgrass Prairie; seven types of shrublands: Pinyon Pine – Juniper Shrubland, Sand Sagebrush – Bluestem Shrubland, Shinnery Oak Shrubland, Canyon Shrubland, Blackjack Oak – Post Oak Shrubland, Mesquite Shrubland, and Juniper Shrubland; three types of deciduous woodland and forest systems: Upland Post Oak – Blackjack Oak – Hickory Woodland and Forest, Bottomland Oak – Hickory Hardwood Forest, and White Oak – Hickory Mesic Forest; three types of pine woodland and forest systems: Shortleaf Pine – Oak – Hickory Woodland and Forest, Shortleaf Pine Open Woodland, and Mesic Loblolly Pine – Oak Forest; and two types of cave systems: Limestone Karst and Gypsum Cave. The aquatic habitats include two types of wetlands: Herbaceous Wetlands and Seeps and Vernal Pools, and three types of flowing systems: Soft-bottom Springs, Streams, and Small Rivers together as a group with their associated Riparian Forests, Hard-bottomed Springs, Streams, and Small Rivers together as a group with their associated Riparian Forests, and Large Rivers with their associated Salt Flat Habitat. Each of these includes some range of variation in their structure and species composition, and these are described in three aquatic-focused chapters: Wetlands, Streams and Small Rivers, and Large Rivers.

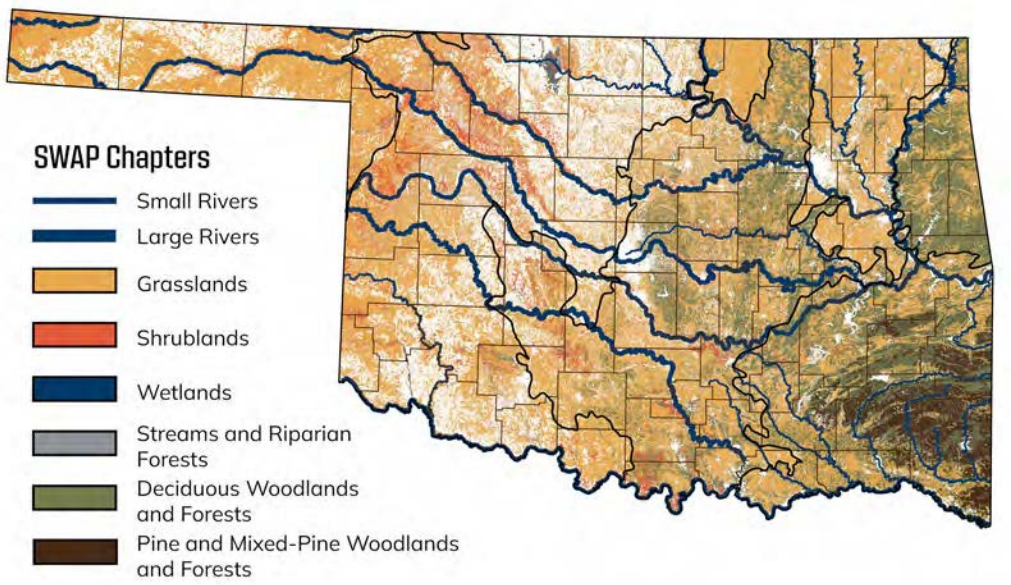


Figure 5. The Oklahoma Ecological Systems Map compiled into eight habitat-based State Wildlife Action Plan chapters.

The Oklahoma Ecological Systems Map depicts the current vegetation cover across the state and was developed between 2013 and 2015 through a partnership between the ODWC, the Missouri Resource Assessment Partnership, the Oklahoma Biological Survey, the USFWS's Science Applications Program, and the Texas Parks and Wildlife Department. Remote imagery was used to identify and map 165 vegetation communities at a scale of 30 by 30 meters. As part of the process, more than 3,000 locations were surveyed on the ground to verify the accuracy of the plant community identifications that were made from the aerial imagery. The process and the final map were modeled after a comparable project that was completed in Texas in 2012 and used the same vegetation terminology so that the habitats in both states were mapped seamlessly across the shared state lines. A link to the Oklahoma Ecological Systems Map and its guidebook can be found here https://www.wildlifedepartment.com/lands-and-minerals/oklahoma-ecological-system-mapping.

The Oklahoma Ecological Systems Map was used to identify and display the distributions and acreages of the 25 habitats that are important for the conservation of Oklahoma's SGCN. One hundred thirty-five of the Oklahoma Ecological Systems Map's vegetation communities were compiled into the 25 habitats identified in the Oklahoma SWAP and further compiled into the SWAP's eight habitat-based chapters (Figure 5).

Ecoregions

Although the 2025 SWAP is no longer organized along ecoregion boundaries, ecoregions are often mentioned in this document because the geographic distributions of many SGCN follow these regional boundaries, especially those that are regionally endemic. In Oklahoma, there are two frequently used hierarchical ecological classification systems: the U.S. Forest Service and its conservation partners developed and use Bailey's ecoregions and subregions of the United States, Puerto Rico, and the U.S. Virgin Islands, while the Environmental Protection

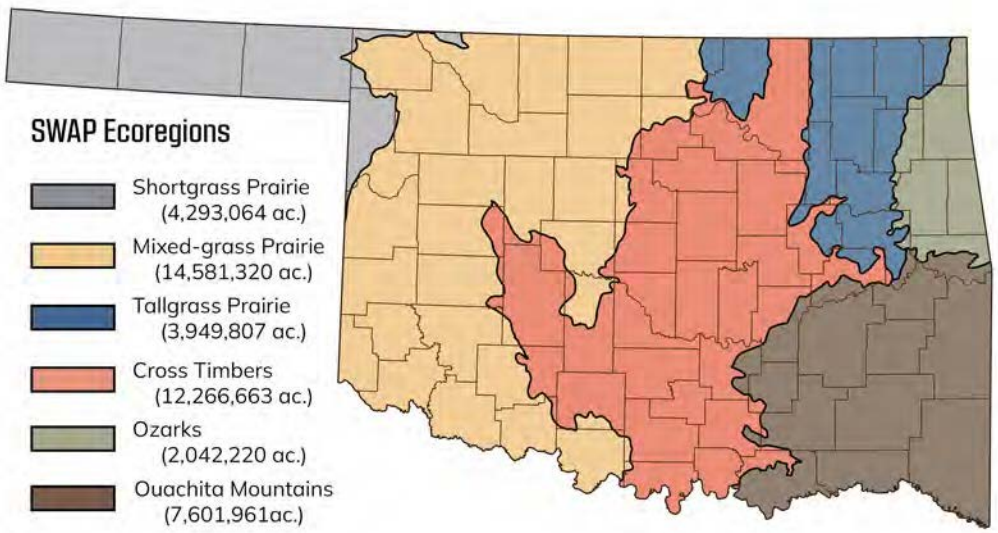


Figure 6. Ecoregion boundaries used when developing Oklahoma's SWAP.

Agency and its partners often use the Omernick Ecoregion Classification System. Both are hierarchical classification systems based on a combination of climate, soils, and dominant vegetation. Additionally, both systems are very similar and have been tested and refined over the past 25 years. For the purposes of the SWAP, the Oklahoma Department of Wildlife Conservation has divided the state into the six broad ecoregions described below that are intended to be compatible with both the Bailey and Omernick classification frameworks (Figure 6).

Shortgrass Prairie Ecoregion

This ecoregion is comprised of the panhandle of Oklahoma and the northwestern corner of the main body of the state. It includes Cimarron, Texas, Beaver, and portions of Harper and Ellis counties. From the perspective of the Omernick (Environmental Protection Agency) Level III Ecoregion Classification System, the Shortgrass Prairie Ecoregion is analogous to the High Plains Ecoregion and the northern portions of the Southwestern Tablelands Ecoregion. From the perspective of Bailey's (U.S. Forest Service) ecoregion classification system, the Shortgrass Prairie Ecoregion is analogous to the Oklahoma portion of the Southern High Plains Section.

Mixed-grass Prairie Ecoregion

In Oklahoma, this region encompasses 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. From the perspective of the Omernick Level III Ecoregion Classification System, the Mixed-grass Prairie Ecoregion used in the Oklahoma SWAP is analogous to the Central Great Plains Ecoregion and the southern portion of the Southwestern Tablelands Ecoregion. From the perspective of Bailey's ecoregion classification system, the Mixed-grass Prairie Ecoregion of the SWAP is equivalent to the South Central Plains and Red Bed Plains Sections.

Tallgrass Prairie Ecoregion

In Oklahoma, this region encompasses all or portions of Osage, Kay, Pawnee, Washington, Nowata, Rogers, Wagoner, Tulsa, Okmulgee, Muskogee, Mayes, Craig, and Ottawa counties. From the perspective of the Omernick Level III Ecoregion Classification System, the Tallgrass Prairie Ecoregion of the SWAP is analogous to the Flint Hills Ecoregion and the Central Irregular Plains Ecoregion. From the perspective of Bailey's ecoregion classification system, the Tallgrass Prairie Ecoregion is the combined Osage Plains Section and Flint Hills Section.

Cross Timbers Ecoregion

This ecoregion 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 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. From the perspective of the Omernick Level III Ecoregion Classification System, the Cross Timbers Ecoregion is analogous to the combined Cross Timbers, East Central Texas Plains, and the western one-half of the South Central Plains ecoregions. From the perspective of Bailey's ecoregion classification system, the Cross Timbers Ecoregion is analogous to the Cross Timbers and Prairies Section plus the northern-most portions of the Blackland Prairie and the Oak Woods and Prairies sections.

Ozark Ecoregion

The counties that comprise the Ozark Ecoregion are Ottawa, Delaware, Mayes, Cherokee, Adair, and Sequoyah counties, as well as small portions of Craig, Muskogee, and Wagoner counties. From the perspective of the Omernick Level III Ecoregion Classification System, the SWAP Ozark Region is analogous to the combined Ozark Highlands and Boston Mountains ecoregions. From the perspective of Bailey's ecoregion classification system, the Ozark Ecoregion is analogous to the combined Ozark Highlands and Boston Mountains sections.

Ouachita Mountains Ecoregion

This is a diverse and complex ecoregion that is comprised of three similar ecoregions – the Ouachita Mountains, Arkansas River Valley, and the Gulf Coastal Plain. Each of these regions is largely dominated by pine communities – loblolly pine in the low-elevation Gulf Coastal Plain and shortleaf pine throughout the rest of the ecoregion. The counties within this ecoregion include Sequoyah, Haskell, Le Flore, Latimer, Pittsburg, Atoka, Pushmataha, Choctaw, and McCurtain counties. From the perspective of the Omernick Level III Ecoregion Classification System, the SWAP Ouachita Mountains Ecoregion is the Ouachita Mountains Ecoregion plus the Arkansas Valley Ecoregion and the eastern one-half of the South-Central Plains Ecoregion. From the perspective of Bailey's ecoregion classification system, the SWAP Ouachita Mountains Ecoregion is analogous to the combined Ouachita Mountain, Arkansas Valley, and Western Mid Coastal Plain sections.

Plains topminnow. Photo by Sam Stukel/USFWS.

Oklahoma: A Regional Perspective

In 2018, the Association of Fish and Wildlife Agencies (AFWA) adopted a resolution on landscape conservation that recognized "the importance of collaboration at landscape scales to help fish and wildlife agencies meet their statutory and regulatory responsibilities to conserve fish and wildlife and their habitats." In response to the resolution, AFWA established a President's Task Force on Shared Science & Landscape Conservation Priorities in 2020, which recommended that SWAPs serve as a framework for regional coordination and collaboration.

The Oklahoma SWAP identifies SGCN and the conservation actions needed to sustain populations, promote the recovery of threatened and endangered species, and prevent the need for additional federal listings under the Endangered Species Act. For Oklahoma to sustain the species that are its responsibility to manage for present and future generations, it must consider its role in and the influences of the larger landscapes surrounding the state.

Many of the issues that impact Oklahoma's SGCN, as well as its more common species, are regional and extend beyond the state's boundaries. Addressing these issues effectively requires aligning conservation strategies across state boundaries. By using consistent regional information, shared by other states, Oklahoma can better address its role in regional conservation priorities and help connect the region's lands and waters.

Oklahoma and the Southeast Conservation Adaptation Strategy (SECAS)

The Southeast Conservation Adaptation Strategy (SECAS) is a regional conservation initiative that spans the Southeastern United States and Caribbean. The SECAS partnership was created by the state wildlife agency directors of the SEAFWA in 2012 to facilitate the sharing of information across state lines and the implementation of multi-state habitat- and species-based conservation initiatives to meet shared goals. Additionally, SECAS brings together diverse partners around an ambitious goal: a 10% or greater improvement in the health, function, and connectivity of Southeastern ecosystems by 2060. The Southeast Conservation Blueprint (v2024) is the primary product of SECAS and is a living, spatial plan that identifies priority areas where conservation action would make the most impact, based on a suite of natural and cultural resource indicators, towards creating a connected networks of lands and waters across the Southeast. More than 1,700 people from more than 500 different organizations, including nearly 30 staff from ODWC, have been involved in developing the Blueprint and achieving a connected network of lands and waters across the region.

The Southeast Conservation Blueprint recognizes nearly 21.4 million acres, or roughly 47% of the state, as a priority for connecting the region's lands and waters. About 10.4 million acres (23%) are rated as highest or high priority, meaning that these are areas where conservation action would make the biggest impact, based on a suite of natural and cultural resource indicators. An additional 8.4 million acres (19%) are rated as medium priority; these are areas where conservation actions would make an above-average impact. An additional 2.6 million acres (6%) are considered a priority connection, or areas that can help facilitate the flow of species and ecological processes within the state while also considering connectivity with the broader region.

The priority acreage in the Blueprint is not distributed equally across Oklahoma's ecoregions, which underscores the importance of some geographic areas based on unique and endemic species, or large tracts of relatively intact habitats. Disproportionally more acreage in the Ouachita Mountains Ecoregion, 82%, falls within the priority landscapes in the Blueprint, while only 37% of the acreage within the Mixed-grass Prairie Ecoregion occurs within priority landscapes. Across the Shortgrass Prairie, Tallgrass Prairie, Cross Timbers, and Ozark ecoregions, between 49% and 54% of the acreages are priorities for conservation.

The Southeast Conservation Blueprint includes a connectivity analysis that identifies corridors that link important areas based on a least-cost path analysis, where hubs provide anchors to link corridors across the shortest distance possible, while also routing through as much Blueprint priority as possible. Hubs are large patches (~5,000-plus acres) of highest priority areas and/or protected lands while corridors connect those hubs within broad areas of established conservation interest for connectivity. About 12.7 million acres (28.5%) within Oklahoma are considered a hub or corridor, providing many conservation opportunities to support species movement and migration, which are important considerations for supporting wildlife adaptation to landscape-level changes. This can help Oklahoma and adjacent states to look across state boundaries and consider how to most effectively align conservation actions within the state to provide the greatest benefit to species with wider ranges and to identify cross-jurisdictional opportunities with neighboring states.

Urbanization trends also were examined by the Southeast Conservation Adaptation Strategy. Currently, approximately 2,550,000 acres in Oklahoma, or about 5.7% of the state's acreage, is classified as urbanized (urban or suburban). As Oklahoma's population grows, the urbanized acreage is expected to grow slowly over the next 75 years to approximately 3,050,000 acres (6.8% of the state's acreage). Most of the growth in urbanized acres is anticipated to occur around the Oklahoma City and Tulsa metropolitan areas, with smaller percentages around Ardmore, Bartlesville, Claremore, Enid, Fort Smith, Muskogee, Shawnee, Stillwater, and the Interstate 35 corridor from Edmond south to the Red River.

Connecting the Region's Lands and Waters

Oklahoma supports a wide diversity of habitats, culturally and historically significant landscapes, and ecosystems that provide benefits to the state as well as the broader Southeast, Midwest, and Western Regions. Oklahoma plays an important role in connecting the lands and waters of these regions, as well as hosting some regionally important ecosystems and habitats like the tallgrass prairie, and many regional and local partners are working with the ODWC to help conserve the state's iconic and important landscapes.

Management of Oklahoma's biological resources requires working beyond the state line on a regular basis because most SGCN, and the habitats on which they depend, range beyond our borders and require partnerships with neighboring states and regions to accomplish the comprehensive conservation actions needed to achieve shared goals. Watersheds and flyways often encompass all or parts of multiple states and require complex coordination among many partners and jurisdictions to improve conditions, regulate harvest, and provide needed habitat. Restoration of declining species that have large ranges requires coordination with partners and agencies with interest and jurisdiction throughout the species' range. The importance of cross-boundary partnerships is underscored by the results of an analysis of the 2015 SWAPs by the Southeast Conservation Adaptation Strategy. It found that Oklahoma shares at least 44 SGCN with every other state in the Southeastern U.S. (average of 69 per state) and shares 105 SGCN with Missouri, 106 SGCN with Texas, and 111 SGCN with Arkansas.

In addition to contributing to the conservation landscape of the Southeast, Oklahoma's lands and waters also benefit the state's economy. The Bureau of Economic Analysis provides Outdoor Recreation Analyses for each state, and in 2023, estimated that the outdoor recreation economy generated $5.5 billion in value for the state's Gross Domestic Product and another $2.4 billion in wages and salaries. In addition to recreational value, natural landscapes can support working lands such as agriculture and timber.

Diana fritillary. Photo by David Arbour.

Working With Partners Across the Region

Wood thrush. Photo by Larry Hubble/CC BY-NC-ND 2.0.

There are multiple regional conservation partnerships that include the state of Oklahoma within their geographic scopes. At the present time, many of these partnerships involve highly mobile species such as birds, but the breadth of taxa involved in multi-state partnerships is expected to increase over time if personnel resources are available. One dimension of these partnerships includes efforts to protect and maintain habitat for migratory species throughout their annual cycles, which is called full life-cycle conservation. To advance full life-cycle conservation of migratory species, the Association of Fish and Wildlife Agencies created the Southern Wings Initiative that helps states and NGO partners direct funds to conservation projects in Latin America where many migratory SGCN birds spend the winter months. Most of Oklahoma's SGCN birds that winter south of the border can be found in Mexico and Central America, and the grasslands of eastern Mexico provide important winter habitat for many of the grassland species including mountain plover, long-billed curlew, burrowing owl, Sprague's pipit, and lark bunting. The tropical forests of Central America provide critical winter habitat for many of the avian SGCN from eastern Oklahoma including the Kentucky warbler, worm-eating warbler, and prothonotary warbler. Commitments to cross-border conservation are vital to the improving the long-term sustainability of these species.

Within the continental United States, there is network of regional bird habitat joint ventures that involve state and federal conservation agencies and a wide range of NGOs. These were originally formed in the 1980s and 1990s to enhance habitat for waterfowl; however, over time they expanded their scopes to include shorebirds, and then later all birds. The geographic boundaries for four of these joint ventures overlap different portions of Oklahoma, and most of Oklahoma's avian SGCN are shared priorities with the joint ventures.

Lower Mississippi Valley Joint Venture

The Lower Mississippi Valley Joint Venture (LMVJV) operates within the geographic regions of the Lower Mississippi Valley, West Gulf Coastal Plain, Arkansas River Valley, and the Ouachita Mountains. This area encompasses all of southeast Oklahoma and extends into adjacent states, collaborating with various organizations to conduct research and analysis that inform conservation initiatives and decision-making processes. Its primary objective is to serve as a collaborative forum for private, state, and federal conservation entities to cultivate a unified approach to bird conservation. The broadened network facilitates enhanced opportunities for cooperation at the landscape scale and across state boundaries. Within its boundaries, the LMVJV has identified bird species that are conservation priorities in the Gulf Coastal Plain and Ouachita Mountains, of which 11 are also SGCN in the Oklahoma SWAP: Bachman's sparrow, brown-headed nuthatch, Kentucky warbler, LeConte's sparrow, prairie warbler, prothonotary warbler, red-cockaded woodpecker, red-headed woodpecker, rusty blackbird, Swainson's warbler, and wood thrush.

Central Hardwoods Joint Venture

The Central Hardwoods Joint Venture (CHJV) encompasses portions of six states and operates within the Ozark Plateau in northeast Oklahoma. The CHJV functions as a collaborative partnership involving private landowners, nongovernmental organizations, and both state and federal agencies, all committed to prioritizing bird habitat and conservation efforts. The CHJV emphasizes the importance of ecosystem conservation and restoration as a critical component in supporting important habitat for priority bird populations, and within the CHJV's list of priority bird species, ten are found on the SWAP's list of SGCN. These are Bachman's sparrow, Bell's vireo, blue-winged warbler, cerulean warbler, Kentucky warbler, loggerhead shrike, red-headed woodpecker, Swainson's warbler, wood thrush, and worm-eating warbler.

Oaks and Prairies Joint Venture

The Oaks and Prairie Joint Venture (OPJV) spans across multiple ecoregions in central Oklahoma and Texas including the Edward's Plateau and the Cross Timbers. Like other joint ventures, the OPJV operates as a self-directed partnership of government and nongovernmental entities, collaborating with stakeholders across administrative

boundaries to deliver landscape conservation planning with a science-based approach. Their efforts prioritize the advancement of bird conservation through activities that focus on advancing bird conservation through outreach, research and monitoring, development of decision support tools, and fund raising aimed at supporting these goals. Sixteen of their conservation priority birds are shared with the SWAP's SGCN list including American golden-plover, Bell's vireo, black-capped vireo, buff-breasted sandpiper, chuck-will's-widow, field sparrow, greater prairie-chicken, Harris's sparrow, Kentucky warbler, LeConte's sparrow, little blue heron, loggerhead shrike, red-headed woodpecker, prothonotary warbler, Smith's longspur, and Sprague's pipit.

LeConte's sparrow. Photo by Howard Patterson/CC BY-NC-SA 2.0.

Playa Lakes Joint Venture

The Playa Lakes Joint Venture (PLJV) operates in portions of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, and Texas, and its boundary encompasses all of the Shortgrass Prairie and Mixed-grass Prairie ecoregions in Oklahoma. Their mission is to conserve the playas, prairies, and landscapes within their geographic footprint through partnership to benefit birds, other wildlife, and people. The PLJV operates through partner-based solutions to facilitate communication and coordination between partners, while providing science-based tools and information to remove conservation roadblocks. In their ongoing monitoring efforts, the PLJV has identified lists of framework species representative of healthy system conditions. Seventeen of these species can also be found on the SWAP's list of SGCN birds: Bell's vireo, burrowing owl, ferruginous hawk, lark bunting, lesser prairie-chicken, loggerhead shrike, long-billed curlew, mountain plover, red-headed woodpecker, snowy plover, Swainson's hawk, and thick-billed longspur.

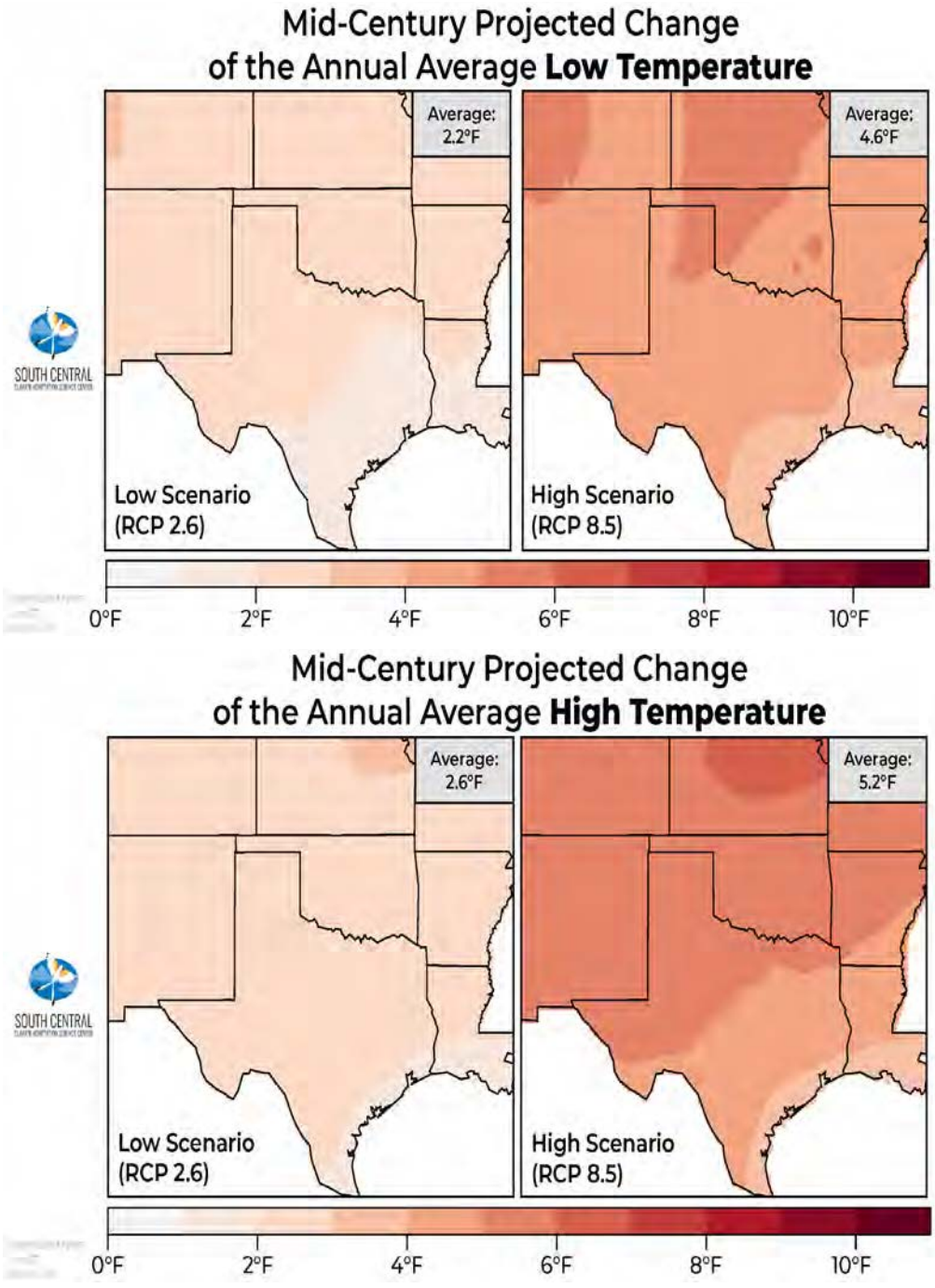
Climate Adaptation

In response to climate legislation passed in the United States House of Representatives in 2009, state fish and wildlife agencies were encouraged to incorporate climate adaption strategies for fish, wildlife, and their habitats into SWAPs. There is nearly universal agreement that the Earth's climate is in a constant state of change, although there is debate regarding the rate of change and the relative contribution of each causative factor driving climate change. This section of the SWAP discusses climate change in general, projections for Oklahoma, and potential strategies to help fish, wildlife, and the habitats on which they depend, adapt to changing conditions. The ongoing discussion of climate change presents an opportunity to consider long-term conservation planning. Traditionally, wildlife managers have developed plans that address relatively short intervals of time (e.g. 10-year; 25-year; and occasionally 50-year time periods). However, it is increasingly apparent that conservation agencies and organizations need to consider planning at longer temporal scales than what has been done traditionally.

Meteorology and climatology are related scientific disciplines that have existed for more than a century, but the magnitude of research in both fields has increased dramatically during the past 40 years. Although these disciplines are linked, there is a fundamental difference between the study of weather and the study of climate. Weather typically refers to the evaluation of meteorological variables, like temperature, rainfall, or wind speed, at a particular time and place. In contrast, climate encompasses these same meteorological variables, but across a larger geographic area and over a longer period of time. Basic meteorological data for sites across Oklahoma are readily available to the public via the Oklahoma Climatological Survey (OCS) (www.ou.edu/ocs) and the Oklahoma Mesonet (www.mesonet.org). Additional information and resources are available through the Southern Climate Impacts Planning Program (SCIPP), a regional partnership between the National Oceanic and Atmospheric Administration (NOAA), Oklahoma Climatological Survey, United States Geological Survey South Central Climate Adaptation Science Center (SC-CASC) and other research partners in neighboring states. The SCIPP partnership is focused on improving regional resilience against the risks and impacts of extreme weather conditions across the south-central United States. Through this partnership, a number of resources have been developed, such as the Historical Climate Trends Tool, which provides temperature and precipitation data that can be examined annually, seasonally, or monthly at a statewide or regional scale within Oklahoma.

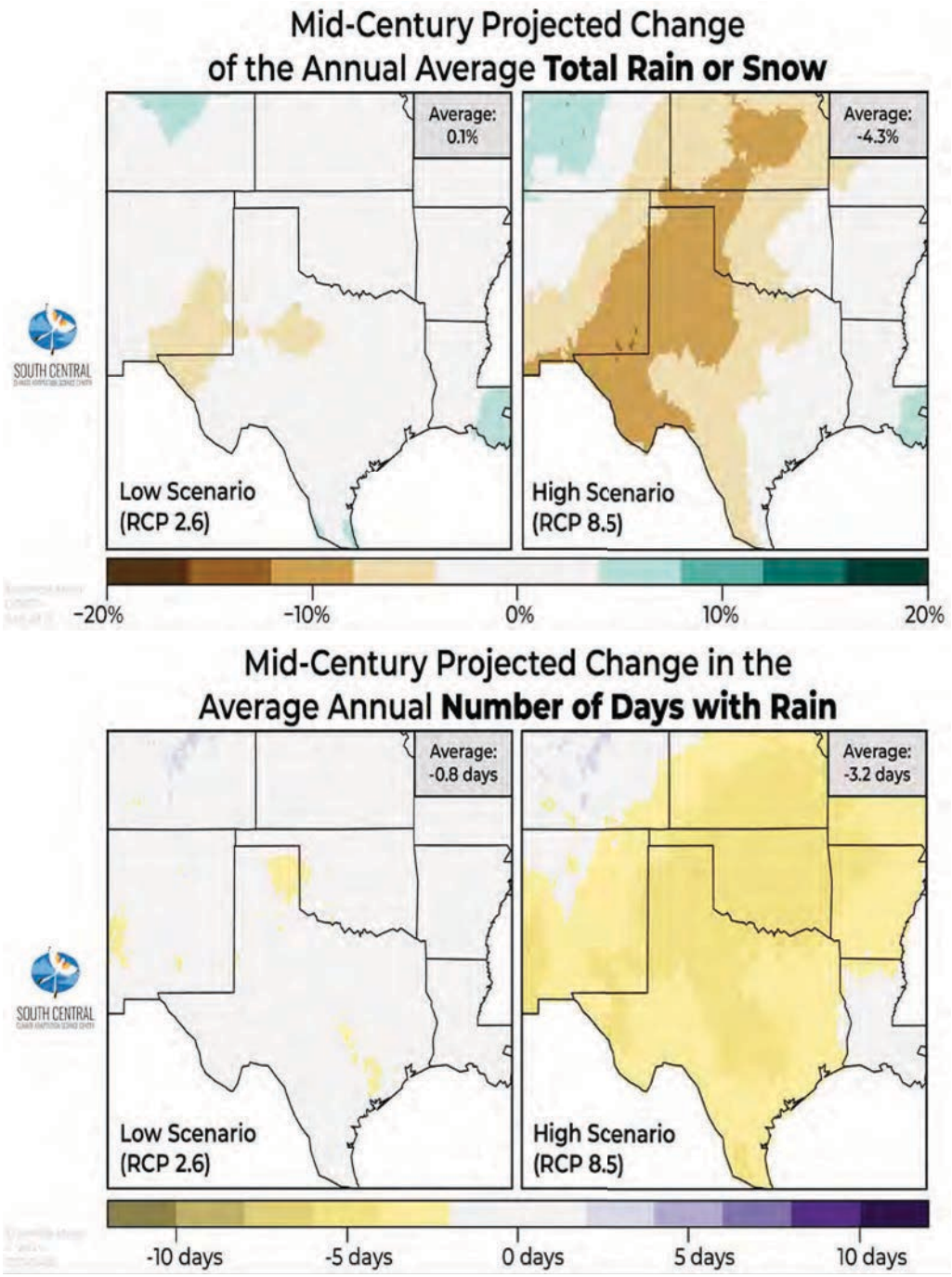
International concern about climate change has increased during the past three decades, in part because of atmospheric increases documented in the concentration of methane, carbon dioxide and other gases, collectively known as 'greenhouse gases.' These greenhouse gases have been demonstrated to absorb the infrared heat radiating from the Earth's surface and retain it in the atmosphere, thus raising the temperature of Earth's surface. This concern has led to the publication of national and international assessments of climate change by the Intergovernmental Panel on Climate Change (IPCC), an organization created in 1988 by the World Meteorological Organization and the United Nations' Environmental Program. Since 1990, the IPCC has prepared six Assessment Reports (ARs), that outline the current state of knowledge regarding climate change, its impacts and potential mitigation tactics. The most recent iteration is the Sixth Assessment Report (AR6), which was published in four parts between 2021 to 2023. Scientists use global climate models (GCMs) to project future climate conditions and assess the direction and magnitude of change over time. More than two dozen of these models have been examined by the IPCC and run through different scenarios that vary in terms of projected human population growth, economic and technological development and greenhouse gas emissions. The AR6 uses two primary sets of scenarios known as representative concentration pathways (RCPs) and shared socioeconomic pathways (SSPs). RCPs focus on how emissions and levels of greenhouse gases in the atmosphere might change over time, while SSPs fill socioeconomic gaps by encompassing potential changes in the rate of human population growth, economic development, and land uses. The combination of these complementary pathways provides a more holistic view of future climate projections. Three RCPs are outlined in the AR6: RCP2.6, RCP4.5 and RCP8.5. Similarly, five SSPs are identified in the AR6: SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0 and SSP5-8.5. The greater the number equates to larger concentrations of greenhouse gases in the atmosphere. These high, intermediate, and low emissions scenarios represent plausible projections of how climate may change over time and are not considered to be definite predictions or forecasts.

Projections for Oklahoma were generated through SC-CASC and the Geophysical Fluid Dynamics Laboratory of NOAA. The historical annual average daytime high of Oklahoma is 72.1°F. Average annual high temperatures for the period from 2036-2065 (mid-century) are projected to increase by about 2°F for the low-end scenario to about 5°F for the high-end scenario above the historical annual average high



Dixon K.W., A.M. Wootten, M.J. Nath, J. Lanzante, D.J. Adams-Smith, C.E. Whitlock, C.F. Gaitán, R.A. McPherson, 2020: South Central Climate Projections Evaluation Project (C-PrEP), South Central Climate Adaptation Science Center, Norman, Oklahoma, USA. DOI: https://doi.org/10.21429/12gk-dh47

temperatures. The projected warming will lead to changes in the average annual number of very hot days (i.e., days with temperatures above 100°F). On average, Oklahoma currently experiences about 11 very hot days on an annual basis and by mid-century, projections indicate there will be at least 15 more very hot days on average per year for Oklahoma. Similar to the average annual high temperature, the average annual low temperatures for the mid-century are projected to increase by about 2°F for the low-end scenario to about 5°F for the high-end scenario in central Oklahoma. As average temperatures increase, winters are expected to become warmer, and Oklahoma may experience less snowfall. In addition to higher temperatures, projections show generally drier soils, fewer days with precipitation, and the potential for more intense precipitation events when they do occur. The historical annual average total precipitation of Oklahoma is 36.7 inches. In central Oklahoma, average annual total precipitation by mid-century is projected to stay about the same in the low-end scenario but decrease by 3-5% in the high-end scenario. Oklahoma currently experiences about 129 days with some level of precipitation and by mid-century, projections show a decrease from about 1-5 fewer days.



Dixon K.W., A.M. Wootten, M.J. Nath, J. Lanzante, D.J. Adams-Smith, C.E. Whitlock, C.F. Gaitán, R.A. McPherson, 2020: South Central Climate Projections Evaluation Project (C-PrEP), South Central Climate Adaptation Science Center, Norman, Oklahoma, USA. DOI: https://doi.org/10.21429/12gk-dh47

Some species may expand or contract their geographic ranges northward in response to temperature shifts or eastward in response to rainfall shifts. These changes are likely to have a disproportionally negative effect on the structure of aquatic and forest habitats, as well as the species that depend upon them. In contrast, these changes may have beneficial effects on grasslands, shrublands, and woodland communities. The magnitude of these changes and the speed at which they will occur are uncertain 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 emergence times by insects, amphibians and reptiles, longer 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 population declines if they are not able to adapt to the temporal shifts of their prey or food base (e.g.

Neotropical migratory birds).

According to the IPCC, adaptation is defined as "In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects." The concept of adjusting natural systems to moderate the harmful effects of changing conditions and to exploit the beneficial opportunities is a fundamental principle 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 next half-century, the increased development pressure brought about by an expanding human population is as likely or more likely to affect Oklahoma's SGCN as changes in climate.

Facilitating the successful adaptation of natural systems (e.g. animal species, aquatic communities, and plant communities) to climatic changes 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 change, resistance is the ability of a species or community to withstand the negative effects of change. Often, management to increase the likelihood of resistance involves growing or maintaining large population sizes or large tracts of contiguous or connected habitat and plant communities to 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, management to increase resilience involves actions that increase structural diversity in a system or genetic diversity within a population. Adaptability (also referred to as adaptive capacity) contains elements of resilience and 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 conservation 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 serve 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 also 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 and 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 metapopulational 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 fire is a management tool used on many Wildlife Management Areas, including Packsaddle WMA. Photo by ODWC.

and implement prescribed burning plans that help maintain habitats in their natural condition, reduce excessive fuel loads, and make habitats more resistant to catastrophic wildfire that can dramatically alter habitat conditions and community composition.

Eastern redcedar can encroach on a variety of upland habitats. Photo by ODWC.

- **Manage invasive and non-native species.** In both aquatic and terrestrial habitats, non-native 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. non-native 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, non-native 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 firewood).
  - » 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 change 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 and restore climax communities.** Climax communities, including tallgrass prairies, oak forests, and pine forests, tend to be stable and maintain a large percentage of their biomass underground in extensive root systems. These roost systems effectively sequester carbon underground and conservation of these plant communities can help to slow the atmospheric accumulation of carbon dioxide.
- **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.
  - » Restoring and conserving riparian forests.
  - » Limiting 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's Landscape Conservation Cooperatives, the USGS's Climate Science Centers, the Southern Climate Impacts Planning Program, Oklahoma Climatological Survey, and other interested parties to:
  - » Assess the vulnerability of each ecoregion and important habitat types to climate changes.
  - » Assess the vulnerability of watersheds that support species of greatest conservation need to climate changes.
  - » Assess species-specific responses to climate change.

Wildlife Health

In 2023, the Association of Fish and Wildlife Agencies launched a wildlife health initiative in response to the Center for Disease Control's One Health program, which is a collaborative, multi-disciplinary approach that recognizes the interconnectedness of human, animal, and environmental health. Each of the four regional wildlife agency associations created a wildlife health position held by a veterinarian who provides technical assistance to the state agencies. One of the products that the regional wildlife health specialists produced was an overview of wildlife health, with optional recommendations for agencies, that could be included in their SWAPs. This section is a summary of that document, and it is included as a resource for developing conservation strategies to maintain healthy and resilient fish and wildlife populations.

Wildlife health is a complex and dynamic topic that can be difficult to define and measure. Wildlife health encompasses more than simply the presence or absence of disease caused by pathogens, parasites, and toxicants (e.g., contaminants or other poisonous substances produced by animals, plants, or people); rather, wildlife health is defined by a population's ability to withstand stressors and challenges, such as habitat loss, the emergence of disease-causing agents, and other environmental, climatic, and anthropogenic threats. The term "resilience" can be used instead of "health" and, as such, health is the result of interacting biological, social, and environmental determinants.

Why Wildlife Health Is Important

A research team from the University of Oklahoma studying Brazilian free-tailed bats used Motus tracking devices to learn more about the species' movements. Photo by ODWC.

The health of wildlife populations determines their ability to persist in the wild at sustainable levels for the long term. Wildlife health is linked to environmental and ecosystem health, as well as the health of humans and domestic animals. Monitoring wildlife health provides important information about population, community, and ecosystem dynamics and can inform the measures needed to protect human and domestic animal health, as well as other wildlife populations. Wildlife health is linked with ecosystem health, and healthy ecosystems provide a plethora of services, from supporting productive agriculture to facilitating the enjoyment of natural areas through recreation to mitigating the effects of severe weather events, among many others. Healthy, resilient wildlife

populations support healthy ecosystems.

How Disease Relates to Wildlife Health

Disease occurs when a host responds to the presence of a pathogen, parasite, or toxicant, and it can be both a determinant of health, as well as a stressor to health. Disease-causing agents can have significant impacts on wildlife populations because diseases can have direct (e.g., causing overt morbidity and mortality) and indirect (e.g., decreased fitness) impacts on populations, both of which can cause or exacerbate population declines. The development of disease depends on factors related to the host organism, the environment, and the disease-causing agent. In healthy wildlife populations, pathogens (e.g., bacteria, fungi, viruses, parasites) and toxicants are present, and the diseases associated with these pathogens and toxicants typically occur at low levels that do not have population-level impacts; however, when the host (i.e., wildlife) population experiences additional stressors or threats, the prevalence of disease may increase.

Cave salamander. Photo by Peter Paplanus/CC BY 2.0.

How Emerging Diseases and Other Health Threats Impact Wildlife Populations

An emerging disease is defined as "one that has recently been discovered; has recently increased in incidence, geography, or host range; or is newly evolved." Two hypotheses can apply to an emerging disease: the novel pathogen hypothesis states that the disease has recently spread into new geographic areas, whereas the endemic pathogen hypothesis suggests that it has been present in the environment but recently has affected new hosts or increased in its ability to cause disease. Diseases pose unique challenges to the conservation of wildlife populations, particularly in species that are already experiencing other stressors. Disease may be the primary cause of population decline, or it may exacerbate a population decline. Although we often lack full comprehension of the impacts of diseases on wildlife populations, the impact of disease is well-documented in certain populations. For example, in North America, chytridiomycosis, caused by the fungus *Batrachochytrium dendrobatidis*, and white-nose syndrome, caused by the fungus *Pseudogymnoascus destructans*, have emerged following pathogen introduction into new geographic areas and have had devastating impacts on amphibian and bat populations, respectively.

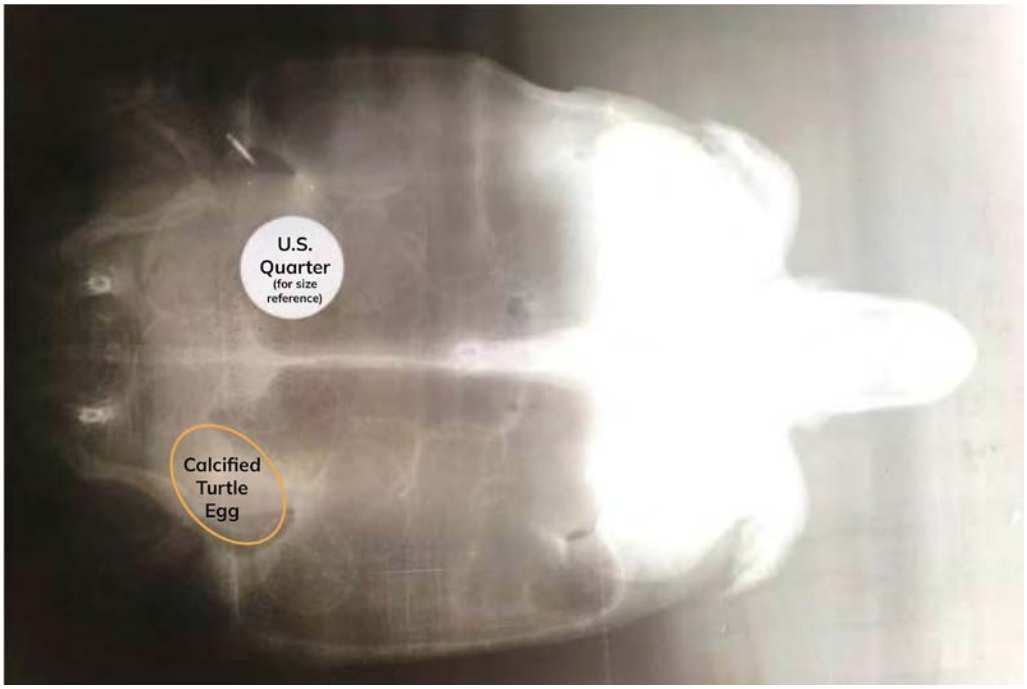
The Role of Wildlife Health in One Health

There are numerous definitions of One Health, but generally, One Health is considered a collaborative approach that recognizes that the health of humans, domestic and wild animals, and the ecosystems/landscapes they inhabit are interconnected. For example, sometimes disease-causing agents/toxicants that impact wildlife health may also threaten human (e.g., zoonotic diseases) or domestic animal health and vice versa. Further, anthropogenic changes to the landscape can also affect wildlife populations. Discussions of wildlife health should consider linkages with humans, domestic animals, and ecosystems through a variety of measures and collaborations.

How Wildlife Health Is Measured

Many different approaches can be used to measure health and evaluate health outcomes in wildlife. In a population of interest, potential health threats should be evaluated, followed by estimating the possible subsequent health outcomes. The health of wildlife populations (i.e., a population's resilience to stressors) is difficult to measure without the presence of an obvious challenge or threat that causes overt mortality. Evaluating potential threats to the health of wildlife populations will inform and guide the best way(s) to measure, evaluate, and subsequently manage health outcomes, which may vary by individual species, population, threat, and scenario.

Factors that may influence the health of populations include genetic variability; population demographics; extreme weather events (e.g., drought, flood, cold); resource availability; habitat continuity/quality; exposure to toxicants, pathogens, or parasites; and other stressors. These factors may directly affect population health or may work in conjunction with other factors to affect populations. For example, anthropogenic transport may alter the geographic



An x-ray of a gravid female chicken turtle to determine the number of eggs and their dimensions. X-rays provided by All Animal Veterinary Hospital in Atoka County.

distribution of a pathogen, leading to exposure of naive wildlife populations, or decreased resource availability or poorer quality and/or quantity of habitat may weaken a population's ability to respond to a pathogen, resulting in more significant impacts.

Factors that may reflect the health of individuals and populations, and thus the resilience of a population, include genetic variability, immune function, reproductive fitness, population parameters, body condition, organ function, active infections, parasite loads, and causes of morbidity and mortality. These lists are not exhaustive but provide good examples of factors to consider when evaluating both potential health threats and measuring / evaluating health outcomes and the health of wildlife populations.

Components of Wildlife Health

Morbidity and Mortality Events

Wildlife morbidity and mortality events often occur unexpectedly and may be highly visible and variable in scale. These events may include a few individuals of one species or many individuals of multiple species or any combination of these. Management agencies must be prepared to respond quickly and efficiently to investigate the cause of such events and to address the media and the public, should there be interest. They should also be prepared to communicate their findings and coordinate their response with other state, regional, and federal partners. The overarching goal of wildlife mortality investigations is to identify the cause(s) of such an event and identify any factors that may have contributed. Successfully investigating wildlife mortality events requires planning, preparation, flexibility, and often cooperation among agencies and other organizations (e.g., diagnostic laboratories).

Emergency Disease Outbreak Preparedness

An agency's ability to appropriately respond to morbidity and mortality events and disease outbreaks largely depends on the agency's emergency disease outbreak preparedness, meaning how well they have planned and prepared for potential future disease outbreak scenarios. Often, disease outbreaks occur rapidly and with minimal to no forewarning. Disease outbreaks may involve endemic or emerging/novel pathogens, parasites, or toxicants and may occur in a variety of scenarios. Emergency disease outbreak preparedness is necessary to respond rapidly and appropriately to these events and can encompass many different elements that are tailored to each specific agency and region's needs. Foundational elements of emergency disease outbreak preparedness and response may include: planned coordination among all involved agencies/organizations, including established contracts with diagnostic laboratories; dedicated funding to enable swift and appropriate responses; predetermined agency response plans and protocols for field investigation of disease outbreaks and morbidity/mortality events; biosecurity protocols; and kits with all necessary field investigation supplies.

Prevention

While many threats to wildlife health cannot be prevented, certain steps can be taken to reduce the risk of them occurring and/or their effects on wildlife populations. For example, avoiding the transport of animals, plants, or environmental substrates (i.e. water and soil) between different areas can help to reduce the risk of moving disease-causing agents or diseased animals to naive areas. Regular inspections of facilities that temporarily house animals may reduce risk. Adhering to biosecurity measures when handling animals or biological material also reduces risk. Such measures may include disinfection of field equipment; cleaning boots; and wearing personal protective equipment such as gloves, masks, and/or disposable aprons or boot covers. Previous knowledge of the potential disease-causing agents in a particular area can also help managers be prepared for outbreaks and prevent their spread.

Surveillance, Monitoring, and Management

It's important to understand the differences between surveillance, monitoring, and management when dealing with wildlife health. Surveillance can be active (intentional, planned collection of specific samples) or passive (opportunistic collection of samples as they are available)

and involves testing for specific pathogens, toxicants, diseases, or other markers. While surveillance is typically aimed at prevention or early detection of health threats, monitoring aims to measure the threat and its impacts once present in the population. Finally, management is the action taken to reduce the risk, spread, or impacts of a health threat. Conducting surveillance for the presence of a threat is not management, but monitoring is necessary to evaluate whether management actions are effective. Strategies for pathogen surveillance have been developed for some herpetofauna populations, but there are few published surveillance strategies for other taxa. Strategies similar to these could be applied to a broad range of species, and wildlife health specialists are an excellent resource to collaborate with to develop species-, state-, and region-specific surveillance and monitoring strategies, as these may vary spatially and by population.

Actions for Integrating Wildlife Health Into State Wildlife Action Plans

- Recognize the importance of wildlife health and its role in supporting resilient wildlife populations and incorporate wildlife health into management plans.
- Work with academic and other partners to address emerging diseases through surveillance and research, including determining causes of death and/or population declines in species of greatest conservation need.
- Develop agency-specific morbidity and mortality event protocols and emergency disease outbreak and response protocols, including appropriate biosecurity measures, to better respond and address morbidity/mortality events and emergency disease outbreaks, as necessary.
- Work collaboratively and cooperatively with adjacent state fish and wildlife agencies, regional fish and wildlife associations, national fish and wildlife associations and agencies, agricultural and public health agencies, and others to address wildlife health issues at regional and national scales.
- Provide opportunities for wildlife biologists, managers, agency personnel, and the public to expand their knowledge of wildlife health and improve wildlife health communication, as necessary.

Arogos skipper at Lexington Wildlife Management Area. Photo by ODWC.

Species of Greatest Conservation Need

Ornate box turtle. Photo by ODWC.

This chapter addresses the selection of the Species of Greatest Conservation Need (SGCN) that are the focus of the Oklahoma State Wildlife Action Plan (SWAP). The term "Species of Greatest Conservation Need" was created by Congressional writers in 2000 specifically for the State and Tribal Wildlife Grants Programs and the Wildlife Conservation and Restoration Program. It is meant to encompass species that are rare, declining, at-risk, of special concern, threatened, or endangered, and in the greatest need of additional conservation effort to maintain long-term, self-sustaining populations. The State and Tribal Wildlife Grants Programs are Congressional appropriations to states and a competitive grants program for Tribes to assist with the conservation of rare and declining fish and wildlife. The program was created as part of the federal fiscal year 2001 Omnibus Bill and has been funded every year from 2001 through 2025. The Wildlife Conservation and Restoration Program was created for the same purpose in the federal fiscal year 2001 Omnibus Bill as a subaccount of the existing Wildlife Restoration Program. It was funded only during fiscal year 2001 but remains a Congressionally authorized program and has been recommended as the funding distribution program for the proposed Recovering America's Wildlife Act.

These federal cost-share programs provide each state with flexibility to decide which species are in greatest need of conservation within their respective boundaries. Oklahoma's geographic position is at an ecological crossroads and many species reach the western, eastern, northern, or southern edge of their range in this state. As a result, species that may be uncommon or rare in Oklahoma may be relatively common regionally or throughout the United States and vice versa. The Oklahoma Department of Wildlife Conservation (ODWC) endeavored to establish an objective evaluation process that considers those species that have experienced the greatest population declines over time and those for which the state of Oklahoma supports a large percentage of the global population and has a relatively high stewardship responsibility. Thus, this process considered the status of each species both within Oklahoma and globally. Eight selection criteria, described below, were identified. If a species met one or more of those criteria, it was recognized as a SGCN in Oklahoma for the purposes of this conservation plan and the State and Tribal Wildlife Grants and Wildlife Conservation and Restoration programs.

The ODWC SWAP revision team used a variety of sources to evaluate all native vertebrate species (approximately 775) and those invertebrates that have been assessed for their global status by NatureServe (nearly 1,400 species). Exceptions were made for those species that are believed to no longer have self-sustaining wild populations in Oklahoma. Known extinct species, including the passenger pigeon (*Ectopistes migratorius*) and Carolina parakeet (*Conuropsis carolinensis*); known extirpated species including the brown bear (*Ursus arctos*) and red wolf (*Canis rufus*), and species such as the American bison (*Bison bison*) that no longer exist as a wild population in Oklahoma were not evaluated for SGCN consideration. Additionally,

evaluations were made for full species rather than subspecies because of the uncertainty associated with subspecific designations and the differential treatment of subspecies among larger taxonomic groups. The exception to this rule occurred when a species was represented by two or more subspecies in Oklahoma and one of those subspecies had a federal listing status as threatened or endangered. Those subspecies were evaluated separately because of their unique legal status. In Oklahoma, the only subspecies evaluated as a SGCN was the federally endangered Ozark big-eared bat (*Corynorhynus townsendii ingens*). There are other federally listed subspecies in Oklahoma including the rabbitsfoot (*Theliderma cylindrica cylindrica*) and eastern black rail (*Laterallus jamaicensis jamaicensis*); however, those subspecies are the sole representatives for their species in this state and there isn't a need to differentiate between subspecies in the Oklahoma SWAP. To provide some continuity with our neighboring state wildlife agencies, we chose to follow NatureServe as our taxonomic source. We realize that NatureServe is an aggregator of taxonomic information and not a formal naming body; however, they track the taxonomic changes that are approved by the organizations that are the taxonomic authorities, and the NatureServe database is used as a taxonomic source by many state wildlife agencies and state natural heritage programs.

Rich Mountain slitmouth. Photo by Wayne Van Devender.

Identification of Species of Greatest Conservation Need

Each species was evaluated against the eight selection criteria listed below. If a species meets at least one of the selection criteria, it was recognized as an SGCN in Oklahoma for the purposes of this conservation plan and the State Wildlife Grants Program. Most of these criteria were developed in cooperation with an advisory group and technical experts for the original 2005 SWAP and they have not been changed. However, Selection Criteria 3 and 7 are new for the 2025 SWAP, and Selection Criterion 8 was updated to reflect more recent assessments and current information. Many species satisfied multiple criteria and were included in the Oklahoma SGCN list for two or more reasons. A summary of the 2025 SGCN and the selection criteria that they met is shown in the SGCN Selection and Ranking Criteria Table beginning on page 33.

Shorthead redhorse. Photo by Sam Stukel/USFWS.

- **Selection Criterion 1** – The species is listed as federal candidate or threatened or endangered species under the Endangered Species Act as of June 1, 2025.
- **Selection Criterion 2** – The species is classified as a state species of special concern or a state-threatened or a state-endangered species in Oklahoma's wildlife regulations (OAC Title 800: Section 25-19-4 & 25-19-5).
- **Selection Criterion 3** – The species is protected under Oklahoma wildlife regulations with a year-round, statewide closed-season

Swift fox. Photo by Scott Smith.

(OAC Title 800: Section 25-7-8 (reptiles), 800: 25-7-9 (amphibians), 800: 25-7-14 (prairie-chickens), and 800: 25-7-61 (furbearers)). Unlike the previous versions of the Oklahoma SWAP, we do not include mammal and bird species that have regulated seasonal harvest.

- **Selection Criterion 4** – The species has been evaluated and assigned a global conservation ranking score of G1, G2, or G3 by NatureServe and the network of state Natural Heritage Inventory programs.
- **Selection Criterion 5** – The species is a reptile, amphibian, fish, or mussel currently subject to legal or illegal commercial harvest in Oklahoma or has been subject to these types of commercial activities in the previous 25 years and there is concern that these activities have had a continued impact at the population level. These species are not eligible for federal cost-share assistance funding under the existing Wildlife Restoration or Sport Fish Restoration programs, and the purpose of this selection criterion is to provide funding assistance for the monitoring of these species that may be impacted by legal or illegal commercial activity. These species include several freshwater mussel species that were harvested for commercial purposes until recently, and several reptile species that can be legally harvested (e.g., some aquatic turtles) or have been illegally harvested (e.g., box turtles) for commercial purposes.
- **Selection Criterion 6** – The species is endemic to an ecological region that occurs in Oklahoma. We define ecological regions as geographic areas that correspond to the EPA Level III ecoregions and/or the USDA Forest Service ecoregions. (Please refer to the Introduction and Ecological Framework for greater detail.)
- **Selection Criterion 7** – At least 30% of the species' population or geographic range occurs within the state and Oklahoma has an elevated stewardship responsibility for the species as state conservation efforts affect a relatively large portion of the species' overall population.
- **Selection Criterion 8** – The species has been identified as a conservation priority through a peer-reviewed assessment of an entire large taxonomic division (e.g., at the order or class level). The following four publications are widely recognized by wildlife conservation professionals and were applied to this criterion:
  - » **The American Fisheries Society's 2008 "Conservation Status of Imperiled North American Freshwater and Diadromous Fishes."** Full species that occur in Oklahoma and were classified as Vulnerable, Threatened, or Endangered were included

Snowy plover. Photo by Jeremiah Zurenda.

Western massasauga. Photo by ODWC.

as SGCN.

» **The American Fisheries Society's 2007 "A Reassessment of the Conservation Status of Crayfishes of the United States and Canada."** Full species that occur in Oklahoma and were classified as Vulnerable, Threatened, or Endangered were included as SGCN.

» **The American Fisheries Society's 1993 "Conservation Status of Freshwater Mussels of the United States and Canada."** There have been several taxonomic changes within the freshwater mussels since 1993, so we applied the current taxonomy to this publication and included on the SGCN list any species occurring in Oklahoma that the AFS classified as Special Concern, Threatened, or Endangered.

» **The North American Bird Conservation Initiative's (NABCI) 2023 conservation assessment for all birds of the continental United States.** In 2023, a NABCI Technical Committee applied the 2016 Partners In Flight (PIF) conservation assessment protocol to more than 700 North American bird species. Each species was evaluated and assigned a Conservation Concern Score between 4 and 20. The Conservation Concern Score, the species' population trend, and the species' population size were used by PIF to assign the most vulnerable species to either a Red Watch List, Orange Watch List, Yellow Watch List, or Tan Watch List (Common Birds in Steep Decline). For the Oklahoma SGCN list, we adopted: a) all birds on the Red and Orange watch lists except for eruptive wintering species and migrating shorebirds that typically over-fly Oklahoma; b) all birds on the Yellow Watch List that breed or winter in Oklahoma as well as migrating species which use the Central Flyway as their sole or primary migration corridor; c) all birds on the Tan Watch List that breed or winter in Oklahoma, have a population of less than 12,000,000 birds, and a Conservation Concern Score of at least 12; and d) all non-watch list species that breed in Oklahoma and have a Conservation Concern Score of 13 or higher.

Ranking of the Species of Greatest Conservation Need and Identification of Species of Greatest Information Need

Conservation funding is not limitless and the total funding available for wildlife conservation has traditionally fallen far short of what is needed to meet current needs. Furthermore, the level of funding provided by Congress through the State and Tribal Wildlife Grants Programs has never equaled the level at which the program was authorized. Due to these resource limitations, the funding that is available to implement the Oklahoma State Wildlife Action Plan is sufficient to address only a small percentage of the conservation issues facing the state's SGCN, and the SGCN list was prioritized into tiers to further identify those species requiring the most immediate conservation attention.

Species identified as SGCN through the selection criteria process were then evaluated to determine their relative degree of conservation need. Four ranking criteria were identified, and each species was scored on a scale of one to three for each criterion. Species that received a total score of 10 or more were placed in Tier I, which is the tier of higher concern. Species that received a total score of nine or fewer were placed in Tier II. However, some species could not be scored due to data deficiencies. These species, although still considered to be SGCN, were categorized as Species of Greatest Information Need (SGIN). A species was placed into the SGIN tier if it met one of the following scenarios: a) NatureServe had not established a global conservation rank for the species; b) the species was potentially extirpated from the state because no records exist in Oklahoma during the previous 60 years; c) there were too few historic and recent records, generally fewer than 20 documented occurrences, for the distribution or population status to be adequately evaluated; or d) there was insufficient life history and ecological information to confidently assign the species to a preferred habitat association. The ranking scores for each SGCN are summarized in the SGCN Selection and Ranking Criteria Table beginning on page 33.

- **Ranking Criterion 1 – Natural Heritage Global Conservation Rank.** NatureServe and its partner network of state Natural Heritage Inventory programs periodically assess the conservation status of many North American animal and plant species. Each species is evaluated at multiple spatial scales with the state-level and global-level being the most widely used.

Rich Mountain salamander. Photo by ODWC.

State-level conservation evaluations are stepped up to the global scale and most species have been assessed a global conservation rank on a scale from G1 through G5, with G1 species being the most imperiled and G5 species being the most secure. Each species' Global Conservation Rank is consistent across its geographic range and is publicly available on NatureServe's website.

- » **3 points:** The species has a Global Heritage Rank of G1 or G2.
- » **2 points:** The species has a Global Heritage Rank of G3 or G4.
- » **1 point:** The species has a Global Heritage Rank of G5.

- **Ranking Criterion 2 – Percent of Population Size or Geographic Range Within Oklahoma.** This criterion assesses the relative importance of Oklahoma to the conservation of each SGCN. A species receives a higher score if it is found primarily in Oklahoma and a few surrounding states, and it receives a lower score if Oklahoma is on the periphery of the species' range or represents a small portion of its overall geographic range.
  - » **3 points:** Oklahoma encompasses >25% of the species' range or population.
  - » **2 points:** Oklahoma encompasses 3 – 25% of the species' range or population.
  - » **1 point:** Oklahoma encompasses <3% of the species' range or population.
- **Ranking Criterion 3 – Trend in Population Size or Geographic Range in the Past 60 Years.** This criterion assesses the population trend for each species; however, it is focused on recent decades because population data are more sparse and less reliable for historic records. Rather than focusing on the past century or the past 140 years since widespread European settlement of Oklahoma, we used the past 60 years to measure population trend because: a) monitoring data and informed population estimates for most species date 60 years or less from the present, and b) the relatively narrow time frame is a better reflection of current trends and habitat conditions. Because of Oklahoma's increasing human population growth and increasing development footprint, we assume that most wildlife populations are experiencing some degree of small population decline due to habitat loss, and hopefully this decline is reduced to some degree by the tendency for most new development to occur in areas that were previously disturbed for agricultural or other uses.
  - » **3 points:** The species has experienced a well-documented and substantial population decline or contraction in its geographic range within Oklahoma during the past 60 years.
  - » **2 points:** The species' overall population appears steady or has declined slowly over the past 60 years and has maintained its geographic range or experienced only a minor range contraction in the past 60 years. This category also includes species for which there is insufficient information to determine its population trend, but it appears to have changed minimally during the past 60 years.
  - » **1 point:** The species appears to have an increasing population trend, or its geographic range has expanded during the past 60 years. This expansion is most likely recolonization of previously lost historic range.
- **Ranking Criterion 4 – Length of Annual Residency in Oklahoma.** This criterion evaluates how much of the species' annual life cycle is spent in Oklahoma and primarily addresses migratory and transient species. Although insects, amphibians, or reptiles may be active for only a portion of the year, those species are considered year-round residents if they occur in the state throughout the year as minimally active eggs or pupae, or in a state of hibernation or brumation.
  - » **3 points:** The species is present throughout the year in Oklahoma or occurs in the state during its breeding or reproductive season. This includes some migratory bird, bat, and insect 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 or more months.
  - » **1 point:** The species is an annual migrant through the state, but most individuals are not present in Oklahoma for more than three to six weeks.

Ranked SGCN were then placed into one of three relative priority tiers.

Tier Ranking of Species of Greatest Conservation Need

- **Tier I:** The species received a combined score of 10 to 12.
- **Tier II:** The species received a combined score of 6 to 9.
- **SGIN:** The species could not be confidently scored due to insufficient information.

Next, each species was assigned to one or more habitat types with which it was most frequently associated and believed to be the species' primary habitat. The intent is to identify the habitat types in which management actions could be implemented most effectively to maintain or improve the species' status. Similarly, the ecoregion or regions in which each species occurs was noted. The geographic range and habitat information for each SGCN Status and Distribution tables beginning on page 56.

SGCN By Taxa	Count
Amphibians	23
Birds	74
Fish	59
Invertebrates	188
Mammals	31
Reptiles	22
Total Oklahoma SGCN	**397**

SGCN By Ecoregion	Count
Shortgrass Prairie	70
Mixed-grass Prairie	125
Tallgrass Prairie	105
Cross Timbers	157
Ozarks	167
Ouachita Mountains	199

SGCN By SWAP Habitat	Count
Shortgrass Prairie	32
Mixed-grass Prairie	60
Tallgrass Prairie	56
Pinyon Pine – Juniper Shrubland	23
Sand Sagebrush – Bluestem Shrubland	23
Shinnery Oak Shrubland	23
Canyon Shrubland	23
Blackjack Oak – Post Oak Shrubland	33
Mesquite Shrubland	20
Juniper Shrubland	9
Upland Post Oak – Blackjack Oak – Hickory Woodlands and Forests	63

SGCN By SWAP Habitat, cont.	Count
Bottomland Oak – Hickory Hardwood Forest	52
White Oak – Hickory Mesic Forest	57
Shortleaf Pine – Oak – Hickory Woodland and Forest	45
Shortleaf Pine Open Woodland	21
Mesic Loblolly Pine – Oak Forest	30
Limestone Karst	41
Gypsum Cave	5
Herbaceous Wetland	57
Seeps and Vernal Pools	8
Soft-bottom Streams, Springs, and Riparian Forests	52
Hard-bottom Streams, Springs, and Riparian Forest	94
Small Rivers	88
Large Rivers	66
Salt Flat	11

Scientific Name	Common Name	NatureServe Global Rank	SGCN Selection Criteria											SGCN Ranking Criteria								
			Federally Listed	State Listed	Closed Season	NatureServe Rank G1 – G3	Subject to Comm. Harvest	Regionally Endemic	Oklahoma Stewardship	Peer Reviewed Assessments: 2008 AFS	Peer Reviewed Assessments: 1993 AFS Mussels	Peer Reviewed Assessments: 2008 AFS Crayfish	Peer Reviewed Assessments: 2023 NABCI	Yes = SGIN: Lacking NS G Rank	Yes = SGIN: Potentially Extirpated	Yes = SGIN: Insufficient Info.	NatureServe Global Rank	% Pop. w/in OK	Trend in Pop. or Range	Length of OK Residency	2025 Total Ranking Score	2025 SGCN Tier
AMPHIBIANS																						
Ambystoma annulatum	Ringed Salamander	4		•	•			•	•								2	3	2	3	10	1
Ambystoma talpoideum	Mole Salamander	5		•	•												1	2	2	3	8	2
Amphiuma tridactylum	Three-toed Amphiuma	5		•	•												1	2	2	3	8	2
Anaxyrus debilis	Chihuahuan Green Toad	5						•									1	2	2	3	8	2
Anaxyrus speciosus	Texas Toad	5						•	•								1	3	2	3	9	2
Desmognathus brimleyorum	Ouachita Dusky Salamander	4		•	•			•	•								2	3	2	3	10	1
Dryophytes avivoca	Bird-voiced Treefrog	5		•													1	2	2	3	8	2
Eurycea lucifuga	Cave Salamander	5			•												1	2	2	3	8	2
Eurycea multiplicata	Many-ribbed Salamander	4						•	•								2	3	2	3	10	1
Eurycea spelaea	Western Grotto Salamander	4		•	•			•	•								2	3	2	3	10	1
Eurycea tynerensis	Oklahoma Salamander	3		•	•	•		•	•								2	3	2	3	10	1
Hemidactylium scutatum	Four-toed Salamander	5		•	•												1	1	2	3	7	2
Lithobates areolatus	Crawfish Frog	4							•								2	3	2	3	10	1
Necturus louisianensis	Red River Mudpuppy	4						•								•						SGIN
Plethodon albagula	Western Slimy Salamander	5			•												1	2	2	3	8	2
Plethodon angusticlavius	Ozark Zigzag Salamander	4			•			•	•								2	3	2	3	10	1

NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated

Scientific Name	Common Name	NatureServe Global Rank	SGCN Selection Criteria											SGCN Ranking Criteria								
			Federally Listed	State Listed	Closed Season	NatureServe Rank G1 – G3	Subject to Comm. Harvest	Regionally Endemic	Oklahoma Stewardship	Peer Reviewed Assessments: 2008 AFS	Peer Reviewed Assessments: 1993 AFS Mussels	Peer Reviewed Assessments: 2008 AFS Crayfish	Peer Reviewed Assessments: 2023 NABCI	Yes = SGIN: Lacking NS G Rank	Yes = SGIN: Potentially Extirpated	Yes = SGIN: Insufficient Info.	NatureServe Global Rank	% Pop. w/in OK	Trend in Pop. or Range	Length of OK Residency	2025 Total Ranking Score	2025 SGCN Tier
Plethodon kiamichi	Kiamichi Slimy Salamander	2			•	•		•	•								3	3	2	3	11	1
Plethodon ouachitae	Rich Mountain Salamander	3		•	•	•		•	•								2	3	2	3	10	1
Plethodon sequoyah	Sequoyah Slimy Salamander	1			•	•		•	•								3	3	2	3	11	1
Plethodon serratus	Southern Red-backed Salamander	5						•	•								1	3	2	3	9	2
Pseudacris streckeri	Strecker's Chorus Frog	5							•								1	3	2	3	9	2
Scaphiopus hurterii	Hurter's Spadefoot	5						•	•								1	3	2	3	9	2
Siren nettingi	Western Siren	5		•													1	2	2	3	8	2
BIRDS																						
Ammospiza leconteii	LeConte's Sparrow	5											•				1	2	3	2	8	2
Anarhynchus montanus	Mountain Plover	3		•		•							•				2	2	3	3	10	1
Anarhynchus nivosus	Snowy Plover	3		•		•							•				2	2	2	3	9	2
Anthus spragueii	Sprague's Pipit	3				•							•				2	3	3	2	10	1
Antrostomus carolinensis	Chuck-will's-widow	5											•				1	2	3	3	9	2
Antrostomus vociferus	Eastern Whip-poor-will	5											•				1	2	3	3	9	2
Aquila chrysaetos	Golden Eagle	5		•													1	1	2	2	6	2
Asio flammeus	Short-eared Owl	5											•				1	1	3	2	7	2
Athene cunicularia	Burrowing Owl	4		•													2	2	2	3	9	2
Auriparus flaviceps	Verdin	5											•				1	1	3	3	8	2

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Scientific Name	Common Name	NatureServe Global Rank	SGCN Selection Criteria											SGCN Ranking Criteria								
			Federally Listed	State Listed	Closed Season	NatureServe Rank G1 – G3	Subject to Comm. Harvest	Regionally Endemic	Oklahoma Stewardship	Peer Reviewed Assessments				Yes = SGIN			NatureServe Global Rank	% Pop. w/in OK	Trend in Pop. or Range	Length of OK Residency	2025 Total Ranking Score	2025 SGCN Tier
										2008 AFS	1993 AFS Mussels	2008 AFS Crayfish	2023 NABCI	Lacking NS G Rank	Potentially Extirpated	Insufficient Info.						
Buteo regalis	Ferruginous Hawk	4		•													2	2	1	3	8	2
Buteo swainsoni	Swainson's Hawk	5		•													1	2	1	3	7	2
Butorides virescens	Green Heron	5											•				1	2	3	3	9	2
Calamospiza melanocorys	Lark Bunting	5											•				1	2	3	3	9	2
Calcarius ornatus	Chestnut-collared Longspur	5											•				1	2	3	2	8	2
Calcarius pictus	Smith's Longspur	4							•								2	3	2	2	9	2
Calidris bairdii	Baird's Sandpiper	5											•				1	3	2	1	7	2
Calidris canutus	Red Knot	4	•														2	1	3	1	7	2
Calidris fuscicollis	White-rumped Sandpiper	5											•				1	2	3	1	7	2
Calidris himantopus	Stilt Sandpiper	5											•				1	2	3	1	7	2
Calidris melanotos	Pectoral Sandpiper	5											•				1	2	3	1	7	2
Calidris pusilla	Semipalmated Sandpiper	5											•				1	2	3	1	7	2
Calidris subruficollis	Buff-breasted Sandpiper	4											•				2	3	3	1	9	2
Centronyx bairdii	Baird's Sparrow	4											•				2	2	3	1	8	2
Centronyx henslowii	Henslow's Sparrow	4											•				2	2	3	3	10	1
Chaetura pelagica	Chimney Swift	4											•				2	2	3	3	10	1
Charadrius melodus	Piping Plover	3	•			•							•				2	1	2	1	6	2
Coturnicops noveboracensis	Yellow Rail	4											•				2	1	2	1	6	2

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			Federally Listed	State Listed	Closed Season	NatureServe Rank G1 – G3	Subject to Comm. Harvest	Regionally Endemic	Oklahoma Stewardship	Peer Reviewed Assessments				Yes = SGIN			NatureServe Global Rank	% Pop. w/in OK	Trend in Pop. or Range	Length of OK Residency	2025 Total Ranking Score	2025 SGCN Tier
										2008 AFS	1993 AFS Mussels	2008 AFS Crayfish	2023 NABCI	Lacking NS G Rank	Potentially Extirpated	Insufficient Info.						
Dolichonyx oryzivorus	Bobolink	5											•				1	2	3	1	7	2
Dryobates borealis	Red-cockaded Woodpecker	3	•			•							•				2	1	3	3	9	2
Egretta caerulea	Little Blue Heron	5											•				1	2	3	3	9	2
Euphagus carolinus	Rusty Blackbird	4											•				2	2	3	2	9	2
Falco mexicanus	Prairie Falcon	5		•													1	1	2	3	7	2
Geothlypis formosa	Kentucky Warbler	5											•				1	2	3	3	9	2
Grus americana	Whooping Crane	1	•			•							•				3	3	2	1	9	2
Gymnorhinus cyanocephalus	Pinyon Jay	3				•							•				2	1	3	3	9	2
Helmitheros vermivorum	Worm-eating Warbler	5											•				1	2	2	3	8	2
Hylocichla mustelina	Wood Thrush	4											•				2	1	3	3	9	2
Lanius ludovicianus	Loggerhead Shrike	4		•													2	2	3	3	10	1
Laterallus jamaicensis	Black Rail	3	•			•							•				2	2	3	1	8	2
Limnodromus griseus	Short-billed Dowitcher	3				•											2	1	3	1	7	2
Limnodromus scolopaceus	Long-billed Dowitcher	5											•				1	2	3	1	7	2
Limnothlypis swainsonii	Swainson's Warbler	4											•				2	2	2	3	9	2
Limosa fedoa	Marbled Godwit	5											•				1	2	2	1	6	2
Limosa haemastica	Hudsonian Godwit	4											•				2	2	3	1	8	2
Melanerpes erythrocephalus	Red-headed Woodpecker	5											•				1	2	3	3	9	2

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										2008 AFS	1993 AFS Mussels	2008 AFS Crayfish	2023 NABCI	Lacking NS G Rank	Potentially Extirpated	Insufficient Info.						
Melanerpes lewis	Lewis's Woodpecker	3				•							•				2	1	2	2	7	2
Numenius americanus	Long-billed Curlew	4		•													2	2	2	3	9	2
Peucaea aestivalis	Bachman's Sparrow	3		•		•							•				2	2	3	3	10	1
Pipilo erythrophthalmus	Eastern Towhee	5											•				1	2	3	2	8	2
Pluvialis dominica	American Golden-Plover	5											•				1	2	3	1	7	2
Pluvialis squatarola	Black-bellied Plover	5											•				1	2	3	1	7	2
Podiceps auritus	Horned Grebe	5											•				1	2	3	2	8	2
Protonotaria citrea	Prothonotary Warbler	5											•				1	2	2	3	8	2
Rallus elegans	King Rail	4											•				2	1	3	3	9	2
Rhynchophanes mccownii	Thick-billed Longspur	4											•				2	2	3	2	9	2
Salpinctes obsoletus	Rock Wren	5											•				1	1	3	3	8	2
Selasphorus rufus	Rufous Hummingbird	4											•				2	1	3	1	7	2
Setophaga cerulea	Cerulean Warbler	4											•				2	1	3	3	9	2
Setophaga discolor	Prairie Warbler	5											•				1	2	3	3	9	2
Sitta pusilla	Brown-headed Nuthatch	4											•				2	2	2	3	9	2
Spizella pusilla	Field Sparrow	5											•				1	2	3	3	9	2
Sternula antillarum	Least Tern	4											•				2	2	2	3	9	2
Tringa flavipes	Lesser Yellowlegs	5											•				1	2	3	1	7	2

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Tringa melanoleuca	Greater Yellowlegs	5											•				1	2	3	1	7	2
Tringa semipalmata	Willet	5											•				1	1	3	1	6	2
Tympanuchus cupido	Greater Prairie-chicken	4			•								•				2	2	3	3	10	1
Tympanuchus pallidicinctus	Lesser Prairie-chicken	3	•		•	•							•				2	2	3	3	10	1
Tyto furcata	American Barn Owl	5		•													1	1	2	3	7	2
Vermivora chrysoptera	Golden-winged Warbler	4											•				2	1	3	1	7	2
Vermivora cyanoptera	Blue-winged Warbler	5											•				1	1	2	3	7	2
Vireo atricapilla	Black-capped Vireo	5							•				•				1	3	3	3	10	1
Vireo bellii	Bell's Vireo	5		•													1	2	2	3	8	2
Zonotrichia querula	Harris's Sparrow	5							•				•				1	3	3	2	9	2
FISH																						
Alburnops bairdi	Red River Shiner	4						•	•								2	3	1	3	9	2
Alburnops chalybaeus	Ironcolor Shiner	4		•						•							2	2	2	3	9	2
Alburnops girardi	Arkansas River Shiner	2	•			•				•							3	3	3	3	12	1
Alburnops potteri	Chub Shiner	4						•	•								2	3	3	3	11	1
Alosa alabamae	Alabama Shad	2		•		•				•					•							SGIN
Ameiurus nebulosus	Brown Bullhead	5		•													1	1	2	3	7	2
Ammocrypta clara	Western Sand Darter	3				•				•							2	2	2	3	9	2

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Ammocrypta vivax	Scaly Sand Darter	5						•									1	2	2	3	8	2
Atractosteus spatula	Alligator Gar	3		•		•				•							2	2	2	3	9	2
Crystallaria asprella	Crystal Darter	3		•		•				•							2	2	2	3	9	2
Cycleptus elongatus	Blue Sucker	3		•		•				•							2	2	2	3	9	2
Cyprinella camura	Bluntface Shiner	5		•													1	3	2	3	9	2
Cyprinella spiloptera	Spotfin Shiner	5		•											•							SGIN
Cyprinodon rubrofluviatilis	Red River Pupfish	5						•	•								1	3	1	3	8	2
Esox niger	Chain Pickerel	5		•													1	1	1	3	6	2
Etheostoma collettei	Creole Darter	4						•	•								2	2	2	3	9	2
Etheostoma cragini	Arkansas Darter	3		•		•				•							2	3	2	3	10	1
Etheostoma cyanorum	Blue River Orangebelly Darter	1						•	•								3	3	2	3	11	1
Etheostoma histrio	Harlequin Darter	5		•													1	2	2	3	8	2
Etheostoma microperca	Least Darter	5						•	•								1	1	2	3	7	2
Etheostoma mihileze	Sunburst Darter	4						•	•								2	3	2	3	10	1
Etheostoma parvipinne	Goldstripe Darter	4		•													2	2	2	3	9	2
Etheostoma radiosum	Orangebelly Darter	4						•	•								2	3	2	3	10	1
Etheostoma whipplei	Redfin Darter	4						•	•								2	2	2	3	9	2
Fundulus blairae	Western Starhead Topminnow	4						•									2	2	2	3	9	2

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Fundulus sciadicus	Plains Topminnow	4		•													2	1	2	3	8	2
Hiodon tergisus	Mooneye	5		•													1	1	2	3	7	2
Hybognathus hayi	Cypress Minnow	4		•													2	1	2	3	8	2
Hybognathus placitus	Plains Minnow	4					•			•							2	2	3	3	10	1
Hybopsis amnis	Pallid Shiner	4		•						•							2	1	2	3	8	2
Ichthyomyzon gagei	Southern Brook Lamprey	5		•													1	2	2	3	8	2
Ictiobus niger	Black Buffalo	5		•													1	1	2	3	7	2
Luxilus cardinalis	Cardinal Shiner	4						•	•								2	3	2	3	10	1
Lythrurus fumeus	Ribbon Shiner	5		•													1	2	2	3	8	2
Lythrurus snelsoni	Ouachita Shiner	3				•		•	•	•							2	3	2	3	10	1
Macrhybopsis australis	Prairie Chub	3				•		•	•	•							2	3	2	3	10	1
Macrhybopsis tetranema	Peppered Chub	1	•	•		•				•					•							SGIN
Micropterus velox	Neosho Bass	NR						•						•								SGIN
Miniellus greenei	Wedgespot Shiner	5						•	•								1	2	2	3	8	2
Miniellus nubilus	Ozark Minnow	5						•	•								1	1	2	3	7	2
Miniellus ortenburgeri	Kiamichi Shiner	3		•		•		•	•	•							2	3	2	3	10	1
Miniellus perpallidus	Peppered Shiner	3		•		•		•	•	•							2	3	3	3	11	1
Moxostoma macrolepidotum	Shorthead Redhorse	5		•													1	1	2	3	7	2

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Nocomis asper	Redspot Chub	4						•	•								2	3	2	3	10	1
Notropis atrocaudalis	Blackspot Shiner	4						•	•								2	3	2	3	10	1
Notropis maculatus	Taillight Shiner	5		•													1	1	2	3	7	2
Notropis suttkusi	Rocky Shiner	3				•		•	•	•							2	3	2	3	10	1
Noturus eleutherus	Mountain Madtom	4		•													2	1	2	3	8	2
Noturus flavus	Stonecat	5		•													1	1	2	3	7	2
Noturus placidus	Neosho Madtom	2	•			•		•	•	•							3	3	3	3	12	1
Percina maculata	Blackside Darter	5		•													1	1	2	3	7	2
Percina nasuta	Longnose Darter	3		•		•		•	•	•							2	3	2	3	10	1
Percina pantherina	Leopard Darter	2	•			•		•	•	•							3	3	3	3	12	1
Percina shumardi	River Darter	5		•													1	1	2	3	7	2
Platygobio gracilis	Flathead Chub	5		•											•							SGIN
Polyodon spathula	Paddlefish	4								•							2	2	1	3	8	2
Pteronotropis hubbsi	Bluehead Shiner	3		•		•		•	•	•							2	2	2	3	9	2
Scaphirhynchus platorynchus	Shovelnose Sturgeon	4		•													2	2	2	3	9	2
Troglichthys rosae	Ozark Cavefish	3	•			•		•	•	•							2	3	2	3	10	1
INVERTEBRATES																						
Alasmidonta marginata	Elktoe	4									•						2	1	3	3	9	2

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Allocapnia jeannae	Osage Snowfly	3				•		•	•								2	3	2	3	10	1
Allocapnia peltoides	Shield Snowfly	3				•		•	•								2	3	2	3	10	1
Allocrangonyx pellucidus	Oklahoma Cave Amphipod	2		•		•		•	•								3	3	2	3	11	1
Amblycheila picolominii	Plateau Giant Tiger Beetle	3				•											2	1	2	3	8	2
Amblyscirtes linda	Linda's Roadside-Skipper	2				•											3	2	2	3	10	1
Amerigoniscus centralis	a cave obligate isopod	1				•		•	•								3	3	2	3	11	1
Andrena arenicola	a miner bee	NR						•						•								SGIN
Andrena beameri	a miner bee	NR						•						•								SGIN
Andrena biscutellata	a miner bee	NR						•						•								SGIN
Andrena brevicornis	a miner bee	NR						•						•		•						SGIN
Andrena bullata	a miner bee	NR						•						•		•						SGIN
Andrena dapsilis	a miner bee	NR						•						•								SGIN
Andrena trapezoidea	a miner bee	NR						•						•								SGIN
Andrena unicostata	a miner bee	NR						•						•								SGIN
Anthidium michenerorum	a wool-carder bee	2				•		•	•								3	1	2	3	9	2
Anthophora fedorica	Fedor Digger Bee	2				•		•	•								3	1	2	3	9	2
Apobaetis futilis	Futile Small Minnow Mayfly	2				•										•						SGIN
Arcidens wheeleri	Ouachita Rock Pocketbook	1	•			•			•		•						3	3	3	3	12	1

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										2008 AFS	1993 AFS Mussels	2008 AFS Crayfish	2023 NABCI	Lacking NS G Rank	Potentially Extirpated	Insufficient Info.						
Arethaea grallator	Stilt-walker Katydid	NR						•						•								SGIN
Argia leonorae	Leonora's Dancer	3				•											2	1	2	3	8	2
Atrytone arogos	Arogos Skipper	2				•											3	2	2	3	10	1
Bactrurus hubrichti	Kansas Well Amphipod	4						•	•								2	2	2	3	9	2
Bombus fraternus	Southern Plains Bumble bee	3				•											2	2	2	3	9	2
Bombus morrisoni	Morrison's Bumble bee	3				•										•						SGIN
Bombus pensylvanicus	American Bumble bee	3				•											2	2	2	3	9	2
Bombus variabilis	Variable Cuckoo Bumble bee	1				•									•	•						SGIN
Caecidotea acuticarpa	a cave obligate isopod	2				•		•	•								3	3	2	3	11	1
Caecidotea adenta	a cave obligate isopod	1				•		•	•								3	3	2	3	11	1
Caecidotea ancyla	a cave obligate isopod	3				•		•									2	2	2	3	9	2
Caecidotea antricola	a cave obligate isopod	5						•									1	2	2	3	8	2
Caecidotea mackini	a cave obligate isopod	NR						•	•					•		•						SGIN
Caecidotea macropropoda	Bat Cave Isopod	3				•		•	•								2	3	2	3	10	1
Caecidotea oculata	Water Slater	1				•		•	•								3	3	2	3	11	1
Caecidotea simulator	Springfield Plain Groundwater Isopod	3				•		•	•								2	3	2	3	10	1
Caecidotea steevesi	Steeve's Cave Isopod	3				•		•								•						SGIN
Caecidotea stiladactyla	Slender-fingered Cave Isopod	3				•		•	•								2	3	2	3	10	1

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Calephelis borealis	Northern Metalmark	3				•											2	2	2	3	9	2
Calephelis muticum	Swamp Metalmark	3				•											2	1	2	3	8	2
Callophrys irus	Frosted Elfin	3				•											2	2	2	3	9	2
Cambarus subterraneus	Delaware County Cave Crayfish	1				•		•	•			•					3	3	2	3	11	1
Cambarus tartarus	Oklahoma Cave Crayfish	1		•		•		•	•			•					3	3	2	3	11	1
Catocala consors	Consort Underwing	3				•											2	2	2	3	9	2
Catocala frederici	an underwing moth	3				•		•								•						SGIN
Catocala herodias	Herodias Underwing	3				•											2	2	2	3	9	2
Catocala nuptialis	Married Underwing	3				•											2	2	2	3	9	2
Cernotina oklahoma	a caddisfly	3				•		•									2	2	2	3	9	2
Cheumatopsyche comis	Flint's Net-spinning Caddisfly	3				•										•						SGIN
Cogia outis	Outis Skipper	3				•											2	2	2	3	9	2
Colletes inuncantipedis	a cellophane bee	NR						•						•		•						SGIN
Cordulegaster talaria	Ouachita Spiketail	1				•		•	•								3	2	2	3	10	1
Cotalpa subcribrata	a goldsmith beetle	NR						•						•								SGIN
Crosbyella spinturnix	a cave obligate harvestman	NR						•	•					•								SGIN
Cyprogenia aberti	Western Fanshell	1	•	•		•		•	•		•						3	2	3	3	11	1
Daedalochila deltoidea	Oklahoma Liptooth	2				•		•	•								3	3	2	3	11	1

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Daedalochila jacksoni	Ozark Liptooth	3				•											2	2	2	3	9	2
Daedalochila lithica	Stone Liptooth	3				•											2	3	2	3	10	1
Daedalochila simpsoni	Wyandotte Liptooth	2				•		•	•								3	3	2	3	11	1
Danaus plexippus	Monarch	4	•														3	1	3	3	10	1
Dendrocoelopsis americana	a cave obligate planarian	3				•										•						SGIN
Dromochorus belfragei	Loamy-ground Tiger Beetle	NR						•						•								SGIN
Dubiraphia parva	Little Dubiraphian Riffle Beetle	2				•											3	2	2	3	10	1
Ellipsaria lineolata	Butterfly Mussel	4					•				•						2	1	2	3	8	2
Ellipsoptera lepida	Ghost Tiger Beetle	3				•											2	2	2	3	9	2
Erynnis martialis	Mottled Duskywing	3				•											2	1	2	3	8	2
Eubranchipus oregonus	Oregon Fairy Shrimp	3				•											2	1	2	3	8	2
Euchemotrema imperforatum	Ouachita Pillsnail	NR						•	•					•								SGIN
Euchemotrema wichitorum	Wichita Mountains Pillsnail	2				•		•	•								3	3	1	3	10	1
Fallicambarus tenuis	Ouachita Mountains Crayfish	3				•		•	•			•					2	3	2	3	10	1
Faxonella blairi	Blair's Fencing Crayfish	4						•									2	2	1	3	8	2
Faxonius deanae	Conchas Crayfish	4						•	•			•					2	2	2	3	9	2
Faxonius difficillis	Painted Crayfish	3				•		•	•								2	2	2	3	9	2
Faxonius macrus	Neosho Midget Crayfish	4						•	•			•					2	3	2	3	10	1

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Faxonius meeki	Meek's Crayfish	4						•	•			•					2	2	2	3	9	2
Faxonius menae	Mena Crayfish	3				•		•	•			•					2	3	2	3	10	1
Faxonius nana	Midget Crayfish	3				•		•	•			•					2	2	2	3	9	2
Faxonius saxatilis	Kiamichi Crayfish	1				•		•	•			•					3	3	2	3	11	1
Gastrocopta ruidosensis	Ruidoso Snaggletooth	1				•											3	2	2	3	10	1
Gastrocopta sterkiana	a snaggletooth snail	3				•											2	2	2	3	9	2
Gomphurus ozarkensis	Ozark Clubtail	4						•	•								2	2	2	3	9	2
Gryllotalpa major	Prairie Mole Cricket	3		•		•			•								2	3	3	3	11	1
Helicodiscus nummus	Wax Coil Snail	1				•		•								•						SGIN
Helicodiscus tridens	Crosstimbers Coil	2				•		•	•							•						SGIN
Helopicus nalatus	Ozark Springfly	3				•											2	2	2	3	9	2
Hemileuca slosseri	Slosser's Buckmoth	3				•		•	•								2	2	2	3	9	2
Hesperia attalus	Dotted Skipper	3				•											2	2	2	3	9	2
Hesperia ottoe	Ottoe Skipper	3				•											2	1	2	3	8	2
Hydroptila melia	a purse casemaker caddisfly	2				•		•									3	2	2	3	10	1
Hydroptila protera	a purse casemaker caddisfly	1				•		•	•								3	3	2	3	11	1
Hylogomphus apomyius	Banner Clubtail	3				•											2	1	2	3	8	2
Inflectarius edentatus	Smooth-lip Shagreen	2				•		•	•								3	1	2	3	9	2

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Inscudderia taxodii	Bald Cypress Katydid	NR						•						•		•						SGIN
Islandiana unicornis	a cave obligate spider	2				•		•	•							•						SGIN
Isoperla ouachita	Ouachita Stripetail	3				•		•									2	2	2	3	9	2
Lampsilis cardium	Plain Pocketbook	5					•				•						1	1	2	3	7	2
Lampsilis rafinesqueana	Neosho Mucket	1	•			•			•		•						3	3	3	3	12	1
Lasioglossum danforthi	a sweat bee	NR						•						•		•						SGIN
Lepidostoma ozarkense	a lepidostomatid caddisfly	1				•		•								•						SGIN
Ligumia recta	Black Sandshell	4									•				•							SGIN
Lintneria eremitoides	Sage Sphinx	2				•										•						SGIN
Lirceus trilobus	an isopod	NR						•	•					•		•						SGIN
Mayatrichia ponta	a microcaddisfly	3				•											2	3	2	3	10	1
Mediappendix wandae	Slope Ambersnail	3				•										•						SGIN
Megachile amica	a leafcutter bee	2				•		•								•						SGIN
Megachile deflexa	a leafcutter bee	2				•										•						SGIN
Megachile fortis	Robust Sunflower Leafcutter Bee	2				•											3	1	2	3	9	2
Megachile oenotherae	a leafcutter bee	2				•									•	•						SGIN
Megachile parksi	a leafcutter bee	2				•										•						SGIN
Megalonaias nervosa	Washboard	5					•										1	2	3	3	9	2

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										2008 AFS	1993 AFS Mussels	2008 AFS Crayfish	2023 NABCI	Lacking NS G Rank	Potentially Extirpated	Insufficient Info.						
Megapallifera ragsdalei	Ozark Mantleslug	3				•		•	•								2	2	2	3	9	2
Melanoplus cohni	Cohn's Spur-throat grasshopper	NR						•						•								SGIN
Melanoplus decurvus	a spur-throat grasshopper	NR						•						•								SGIN
Melanoplus oklahomae	Oklahoma Spur-throated Grasshopper	2				•		•	•								3	3	2	3	11	1
Melissodes intortus	a callirhoe bee	NR						•						•		•						SGIN
Miktoniscus oklahomensis	Racovitza's Cave Isopod	1				•		•	•								3	3	2	3	11	1
Neohelix lioderma	Tulsa Whitelip	1				•		•	•								3	3	2	3	11	1
Neoperla falayah	Curved Stonefly	3				•										•						SGIN
Neoperla osage	Osage Stonefly	3				•		•								•						SGIN
Neotrichia riegeli	a microcaddisfly	3				•										•						SGIN
Nicrophorus americanus	American Burying Beetle	3	•			•											2	3	2	3	10	1
Nixe flowersi	a flat-headed mayfly	2				•										•						SGIN
Nomia universitatis	University Nomia	3				•		•									2	1	2	3	8	2
Obovaria arkansasensis	Southern Hickorynut	3				•			•		•						2	3	2	3	10	1
Ochrotrichia capitana	a purse casemaker caddisfly	3				•								•			3	2	2	3	10	1
Ochrotrichia weddleae	a purse casemaker caddisfly	1				•		•	•						•	•						SGIN
Oecetis ouachita	a longhorned caddisfly	2				•		•								•						SGIN
Onthophagus cavernicollis	a cave-dwelling dung beetle	NR						•						•		•						SGIN

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Pallifera marmorea	Marbled Mantleslug	3				•											2	2	2	3	9	2
Pallifera tournescalis	Ouachita Mantleslug	1				•		•	•								3	3	2	3	11	1
Papaipema eryngii	Rattlesnake Master Borer	2				•											3	2	2	3	10	1
Papaipema limpida	Vernonia Borer Moth	3				•										•						SGIN
Paravitrea significans	Domed Supercoil	3				•											2	3	2	3	10	1
Parvindela celeripes	Swift Tiger Beetle	3				•			•								2	3	2	3	10	1
Patera binneyana	Half-lidded Oval	2				•		•									3	3	2	3	11	1
Patera indianorum	Lidded Oval	2				•		•	•								3	3	2	3	11	1
Patera kiowaensis	Drywoods Oval	2				•		•	•								3	3	2	3	11	1
Patera roemeri	Texas Oval	3				•			•								2	1	2	3	8	2
Perdita jonesi	a fairy bee	NR						•						•								SGIN
Perlesta baumanni	Darkwing Stonefly	2				•		•									3	3	2	3	11	1
Perlesta bolukta	Truncate Stonefly	2				•		•	•								3	1	2	3	9	2
Perlesta browni	Toothed Stonefly	3				•											2	1	2	3	8	2
Perlesta fusca	Tinted Stonefly	3				•										•						SGIN
Photinus dimissus	Two-step Flasher Firefly	3				•										•						SGIN
Plauditus texanus	a small minnow mayfly	2				•										•						SGIN
Pleurobema cordatum	Ohio Pigtoe	3				•	•				•						2	2	3	3	10	1

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Scientific Name	Common Name	NatureServe Global Rank	SGCN Selection Criteria											SGCN Ranking Criteria								
			Federally Listed	State Listed	Closed Season	NatureServe Rank G1 – G3	Subject to Comm. Harvest	Regionally Endemic	Oklahoma Stewardship	Peer Reviewed Assessments				Yes = SGIN			NatureServe Global Rank	% Pop. w/in OK	Trend in Pop. or Range	Length of OK Residency	2025 Total Ranking Score	2025 SGCN Tier
										2008 AFS	1993 AFS Mussels	2008 AFS Crayfish	2023 NABCI	Lacking NS G Rank	Potentially Extirpated	Insufficient Info.						
Pleurobema riddellii	Louisiana Pigtoe	1	•			•					•						3	1	2	3	9	2
Potamilus leptodon	Scaleshell	1	•			•					•				•							SGIN
Proserpinus gaurae	Proud Sphinx	NR							•					•		•						SGIN
Prostoia ozarkensis	Ozark Forestfly	3				•											2	2	2	3	9	2
Protandrena kansensis	a miner bee	NR						•						•								SGIN
Pseudosinella dubia	a cave obligate springtail	3				•											2	2	2	3	9	2
Ptychobranchus occidentalis	Ouachita Kidneyshell	3				•		•	•		•						2	3	2	3	10	1
Pupoides inornatus	Rocky Mountain Dagger	2				•										•						SGIN
Pustulosa nodulata	Wartyback	4					•										3	2	2	3	10	1
Pygmarrhopalites jay	a cave obligate springtail	2				•		•	•								3	3	2	3	11	1
Quadrula fragosa	Winged Mapleleaf	1	•			•			•		•						3	2	2	3	10	1
Rhyacophila kiamichi	a rhyacophilid caddisfly	3				•		•								•						SGIN
Scaphinotus parisiana	Ozark Snail-eating Beetle	NR						•						•		•						SGIN
Setodes oxapius	a leptocerid caddisfly	3				•		•								•						SGIN
Siphlonurus minnoi	a primitive minnow mayfly	3				•		•								•						SGIN
Somatochlora margarita	Texas Emerald	2				•		•									3	1	2	3	9	2
Somatochlora ozarkensis	Ozark Emerald	3				•		•	•								2	3	2	3	10	1
Speyeria diana	Diana Fritillary	2				•											3	2	2	3	10	1

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			Federally Listed	State Listed	Closed Season	NatureServe Rank G1 – G3	Subject to Comm. Harvest	Regionally Endemic	Oklahoma Stewardship	Peer Reviewed Assessments				Yes = SGIN			NatureServe Global Rank	% Pop. w/in OK	Trend in Pop. or Range	Length of OK Residency	2025 Total Ranking Score	2025 SGCN Tier
										2008 AFS	1993 AFS Mussels	2008 AFS Crayfish	2023 NABCI	Lacking NS G Rank	Potentially Extirpated	Insufficient Info.						
Speyeria idalia	Regal Fritillary	3		•		•											2	1	2	3	8	2
Sphecodosoma pratti	a shortface sweat bee	NR						•						•								SGIN
Stenotrema labrosum	Ozark Slitmouth	3				•			•								2	2	2	3	9	2
Stenotrema pilsbryi	Rich Mountain Slitmouth	2		•		•		•	•								3	3	2	3	11	1
Stenotrema uncifernum	Ouachita Slitmouth	3				•		•	•								2	3	2	3	10	1
Strophopteryx cucullata	Kiamichi Willowfly	3				•											2	3	2	3	10	1
Stygobromus bowmani	Bowman's Cave Amphipod	1		•		•		•	•								3	3	2	3	11	1
Stygobromus onondagaensis	Onondaga Cave Amphipod	3				•											2	1	2	3	8	2
Stygobromus ozarkensis	Ozark Cave Amphipod	4						•									2	3	2	3	10	1
Tetraloniella paenalbata	a long-horned bee	NR						•						•								SGIN
Theliderma cylindrica	Rabbitsfoot	3	•			•					•						2	2	2	3	9	2
Theliderma metanevra	Monkeyface Mussel	NR					•							•								SGIN
Toxolasma lividum	Purple Lilliput	3				•					•				•	•						SGIN
Toxolasma texasiense	Texas Lilliput	4						•								•						SGIN
Triaenodes helo	Marsh Triaenode Caddisfly	3				•										•						SGIN
Triaenodes tridontus	Three-toothed Triaenodes Caddisfly	2				•		•							•	•						SGIN
Trigenotyla blacki	Black's Cave Millipede	1				•		•	•							•						SGIN
Trigenotyla seminole	a cave millipede	1				•										•						SGIN

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			Federally Listed	State Listed	Closed Season	NatureServe Rank G1 – G3	Subject to Comm. Harvest	Regionally Endemic	Oklahoma Stewardship	Peer Reviewed Assessments				Yes = SGIN			NatureServe Global Rank	% Pop. w/in OK	Trend in Pop. or Range	Length of OK Residency	2025 Total Ranking Score	2025 SGCN Tier
										2008 AFS	1993 AFS Mussels	2008 AFS Crayfish	2023 NABCI	Lacking NS G Rank	Potentially Extirpated	Insufficient Info.						
Trigenotyla vaga	a cave millipede	NR						•	•					•								SGIN
Trimerotropis saxatilis	Lichen Grasshopper	3				•											2	2	2	3	9	2
Triodopsis neglecta	Ozark Threetooth	3				•		•									2	2	2	3	9	2
Ventridens brittsi	Western Dome	3				•		•									2	2	2	2	8	2
Wormaldia strota	a caddisfly	2				•		•									3	2	2	3	10	1
Zealeuctra cherokee	Cherokee Needlefly	3				•		•									2	2	2	3	9	2
Zealeuctra warreni	Early Needlefly	3				•											2	2	2	3	9	2
MAMMALS																						
Bassariscus astutus	Ringtail	5		•	•												1	1	2	3	7	2
Conepatus leuconotus	American Hog-nosed Skunk	4		•													2	1	3	3	9	2
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	3		•		•											2	2	2	3	9	2
Corynorhinus townsendii	Townsend's Big-eared Bat	4		•													2	2	3	3	10	1
Corynorhinus townsendii ingens	Ozark Big-eared Bat	1	•			•		•	•								3	3	3	3	12	1
Cratogeomys castanops	Yellow-faced Pocket Gopher	5						•	•								1	2	2	3	8	2
Cynomys ludovicianus	Black-tailed Prairie Dog	4		•													2	2	3	3	10	1
Dipodomys elator	Texas Kangaroo Rat	2		•		•									•							SGIN
Geomys breviceps	Baird's Pocket Gopher	5						•	•								1	3	2	3	9	2
Lasiurus cinereus	Northern Hoary Bat	3				•											2	1	3	3	9	2

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										Peer Reviewed Assessments				Yes = SGIN								
			Federally Listed	State Listed	Closed Season	NatureServe Rank G1 – G3	Subject to Comm. Harvest	Regionally Endemic	Oklahoma Stewardship	2008 AFS	1993 AFS Mussels	2008 AFS Crayfish	2023 NABCI	Lacking NS G Rank	Potentially Extirpated	Insufficient Info.	NatureServe Global Rank	% Pop. w/in OK	Trend in Pop. or Range	Length of OK Residency	2025 Total Ranking Score	2025 SGCN Tier
Lasiurus seminolus	Seminole Bat	5		•													1	1	2	3	7	2
Marmota monax	Woodchuck	5		•													1	1	1	3	6	2
Myotis austroriparius	Southeastern Myotis	4		•													2	2	2	3	9	2
Myotis grisescens	Gray Myotis	3	•			•											2	2	2	3	9	2
Myotis leibii	Eastern Small-footed Myotis	4		•													2	1	2	3	8	2
Myotis lucifugus	Little Brown Myotis	3				•											2	1	3	2	8	2
Myotis septentrionalis	Northern Long-eared Myotis	2	•			•											3	2	3	3	11	1
Myotis sodalis	Indiana Myotis	2	•			•											3	1	2	2	8	2
Myotis velifer	Cave Myotis	4							•								2	3	2	3	10	1
Neotoma leucodon	White-toothed Woodrat	5						•	•								1	1	2	3	7	2
Notiosorex crawfordi	Crawford's Desert Shrew	4		•													2	2	2	3	9	2
Ochrotomys nuttalli	Golden Mouse	5		•													1	1	2	3	7	2
Oryzomys texensis	Texas Marsh Rice Rat	NR		•										•								SGIN
Perimyotis subflavus	Tricolored Bat	3	•			•											2	2	3	3	10	1
Peromyscus laceianus	Lacey's White-ankled Mouse	5						•									1	2	2	3	8	2
Peromyscus nasutus	Northern Rock Deermouse	5						•	•								1	2	2	3	8	2
Reithrodontomys humulis	Eastern Harvest Mouse	5		•													1	1	2	3	7	2
Spilogale interrupta	Plains Spotted Skunk	3			•	•											2	3	3	3	11	1

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			Federally Listed	State Listed	Closed Season	NatureServe Rank G1 – G3	Subject to Comm. Harvest	Regionally Endemic	Oklahoma Stewardship	Peer Reviewed Assessments				Yes = SGIN			NatureServe Global Rank	% Pop. w/in OK	Trend in Pop. or Range	Length of OK Residency	2025 Total Ranking Score	2025 SGCN Tier
										2008 AFS	1993 AFS Mussels	2008 AFS Crayfish	2023 NABCI	Lacking NS G Rank	Potentially Extirpated	Insufficient Info.						
Tadarida brasiliensis	Brazilian Free-tailed Bat	5		•													1	2	2	3	8	2
Vulpes velox	Swift Fox	3		•	•	•											2	2	2	3	9	2
Zapus hudsonius	Meadow Jumping Mouse	5		•											•							SGIN
REPTILES																						
Alligator mississippiensis	American Alligator	5			•												1	1	1	3	6	2
Apalone mutica	Smooth Softshell	5					•										1	2	2	3	8	2
Apalone spinifera	Spiny Softshell	5					•										1	1	2	3	7	2
Aspidoscelis tesselata	Common Checkered Whiptail	5			•												1	2	2	3	8	2
Cemophora coccinea	Common Scarletsnake	5		•													1	2	2	3	8	2
Crotalus atrox	Western Diamond-backed Rattlesnake	5					•										1	2	2	3	8	2
Deirochelys reticularia	Chicken Turtle	5			•												1	2	3	3	9	2
Farancia abacura	Red-bellied Mudsnake	5		•	•												1	1	2	3	7	2
Graptemys geographica	Northern Map Turtle	4		•	•												2	1	2	3	8	2
Holbrookia maculata	Common Lesser Earless Lizard	5		•	•												1	2	3	3	9	2
Liodytes rigida	Glossy Swampsnake	5		•	•												1	1	2	3	7	2
Macrochelys temminckii	Western Alligator Snapping Turtle	3	•	•	•	•											2	2	3	3	10	1
Phrynosoma cornutum	Texas Horned Lizard	4		•	•												2	3	3	3	11	1
Phrynosoma modestum	Round-tailed Horned Lizard	5		•	•											•						SGIN

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Scientific Name	Common Name	NatureServe Global Rank	SGCN Selection Criteria											SGCN Ranking Criteria							2025 Total Ranking Score	2025 SGCN Tier
			Federally Listed	State Listed	Closed Season	NatureServe Rank G1 – G3	Subject to Comm. Harvest	Regionally Endemic	Oklahoma Stewardship	Peer Reviewed Assessments				Yes = SGIN			NatureServe Global Rank	% Pop. w/in OK	Trend in Pop. or Range	Length of OK Residency		
										2008 AFS	1993 AFS Mussels	2008 AFS Crayfish	2023 NABCI	Lacking NS G Rank	Potentially Extirpated	Insufficient Info.						
Pseudemys concinna	River Cooter	5					•										1	2	2	3	8	2
Rhinocheilus lecontei	Long-nosed Snake	5		•													1	2	2	3	8	2
Sistrurus tergeminus	Western Massasauga	3		•		•											2	2	2	3	9	2
Sternotherus carinatus	Razor-backed Musk Turtle	5						•									1	2	2	3	8	2
Terrapene ornata	Ornate Box Turtle	4					•										2	2	2	3	9	2
Terrapene triunguis	Three-toed Box Turtle	NR					•							•								SGIN
Thamnophis elegans	Terrestrial Gartersnake	5			•										•							SGIN
Uta stansburiana	Common Side-blotched Lizard	5			•										•							SGIN

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Scientific Name	Common Name	NatureServe Global Rank	OK Heritage Rank	Ecoregion: Shortgrass Prairie	Ecoregion: Mixed-grass Prairie	Ecoregion: Tallgrass Prairie	Ecoregion: Cross Timbers	Ecoregion: Ozarks	Ecoregion: Ouachita Mountains	2025 SWAP Habitats: Grasslands: Shortgrass Prairie	Grasslands: Mixed-grass Prairie	Grasslands: Tallgrass Prairie	Shrublands: Pinyon Pine-Juniper Shrubland	Shrublands: Sand Sagebrush-Bluestem Shrubland	Shrublands: Shinnery Oak Shrubland	Shrublands: Canyon Shrubland	Shrublands: Blackjack Oak-Post Oak Shrubland	Shrublands: Mesquite Shrubland	Shrublands: Juniper Shrubland	Deciduous Woodland and Forest: Upland Post Oak-Blackjack Oak-Hickory Woodlands and Forests	Deciduous Woodland and Forest: Bottomland Oak-Hickory Hardwood Forest	Deciduous Woodland and Forest: White Oak-Hickory Mesic Forest	Pine-Mixed Pine Woodland and Forest: Shortleaf Pine-Oak-Hickory Woodland and Forest	Pine-Mixed Pine Woodland and Forest: Shortleaf Pine Open Woodland	Pine-Mixed Pine Woodland and Forest: Mesic Loblolly Pine-Oak Forest	Caves: Limestone Karst	Caves: Gypsum Cave	Wetlands: Herbaceous Wetland	Wetlands: Seeps and Vernal Pools	Small Rivers and Streams: Soft-bottom Streams, Springs, and Riparian Forests	Small Rivers and Streams: Hard-bottom Streams, Springs, and Riparian Forest	Small Rivers and Streams: Small Rivers	Large Rivers: Large Rivers	Large Rivers: Salt Flats
AMPHIBIANS																																		
Ambystoma annulatum	Ringed Salamander	4	2					●	●											●	●	●	●					●		●				
Ambystoma talpoideum	Mole Salamander	5	1						●												●				●			●	●					
Amphiuma tridactylum	Three-toed Amphiuma	5	1						●												●							●		●		●		
Anaxyrus debilis	Chihuahuan Green Toad	5	3	●	●								●			●	●	●	●									●		●				
Anaxyrus speciosus	Texas Toad	5	3		●						●							●										●						
Desmognathus brimleyorum	Ouachita Dusky Salamander	4	3						●													●						●		●				
Dryophytes avivoca	Bird-voiced Treefrog	5	2						●												●							●						
Eurycea lucifuga	Cave Salamander	5	3					●												●		●				●				●				
Eurycea multiplicata	Many-ribbed Salamander	4	4						●												●	●	●		●			●		●				
Eurycea spelaea	Western Grotto Salamander	4	3					●																		●				●				
Eurycea tynerensis	Oklahoma Salamander	3	3					●													●	●								●	●			
Hemidactylium scutatum	Four-toed Salamander	5	1						●													●							●					
Lithobates areolatus	Crawfish Frog	4	4			●	●	●	●			●									●							●						
Necturus louisianensis	Red River Mudpuppy	4	NR					●	●																				●	●	●	●		

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Plethodon albagula	Western Slimy Salamander	5	NR					●	●											●	●	●				●					●			
Plethodon angusticlavius	Ozark Zigzag Salamander	4	2					●												●	●	●				●					●			
Plethodon kiamichi	Kiamichi Slimy Salamander	2	2						●												●	●	●								●			
Plethodon ouachitae	Rich Mountain Salamander	3	2						●													●												
Plethodon sequoyah	Sequoyah Slimy Salamander	1	2						●												●	●	●		●						●			
Plethodon serratus	Southern Red-backed Salamander	5	3						●													●	●	●	●									
Pseudacris streckeri	Strecker's Chorus Frog	5	NR		●	●	●				●	●					●			●								●		●				
Scaphiopus hurterii	Hurter's Spadefoot	5	2				●		●											●	●													
Siren nettingi	Western Siren	5	NR						●												●							●			●		●		
BIRDS																																		
Ammospiza leconteii	LeConte's Sparrow	5	4	●	●	●	●	●	●		●	●			●													●						
Anarhynchus montanus	Mountain Plover	3	2	●						●																								
Anarhynchus nivosus	Snowy Plover	3	3		●		●																										●	●
Anthus spragueii	Sprague's Pipit	3	3	●	●	●	●		●		●	●																						

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										Grasslands			Shrublands								Deciduous Woodland and Forest			Pine-Mixed Pine Woodland and Forest			Caves		Wet-lands		Small Rivers and Streams			Large Rivers	
				Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozarks	Ouachita Mountains	Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Pinyon Pine-Juniper Shrubland	Sand Sagebrush-Bluestem Shrubland	Shinnery Oak Shrubland	Canyon Shrubland	Blackjack Oak-Post Oak Shrubland	Mesquite Shrubland	Juniper Shrubland	Upland Post Oak-Blackjack Oak-Hickory Woodlands and Forests	Bottomland Oak-Hickory Hardwood Forest	White Oak-Hickory Mesic Forest	Shortleaf Pine-Oak-Hickory Woodland and Forest	Shortleaf Pine Open Woodland	Mesic Loblolly Pine-Oak Forest	Limestone Karst	Gypsum Cave	Herbaceous Wetland	Seeps and Vernal Pools	Soft-bottom Streams, Springs, and Riparian Forests	Hard-bottom Streams, Springs, and Riparian Forest	Small Rivers	Large Rivers	Salt Flats
Antrostomus carolinensis	Chuck-will's-widow	5	NR		●	●	●	●	●								●			●	●	●	●	●	●									
Antrostomus vociferus	Eastern Whip-poor-will	5	2					●	●											●		●		●	●									
Aquila chrysaetos	Golden Eagle	5	2	●	●					●	●		●																					
Asio flammeus	Short-eared Owl	5	3	●	●	●	●	●	●	●	●	●																	●					
Athene cunicularia	Burrowing Owl	4	2	●	●					●	●			●				●																
Auriparus flaviceps	Verdin	5	1		●													●																
Buteo regalis	Ferruginous Hawk	4	NR	●	●					●	●		●	●																				
Buteo swainsoni	Swainson's Hawk	5	3	●	●	●	●			●	●	●		●	●																			
Butorides virescens	Green Heron	5	2		●	●	●	●	●																				●		●	●	●	●	
Calamospiza melanocorys	Lark Bunting	5	1	●	●					●	●																							
Calcarius ornatus	Chestnut-collared Longspur	5	NR	●	●					●	●																							
Calcarius pictus	Smith's Longspur	4	NR		●	●	●	●	●		●	●																						
Calidris bairdii	Baird's Sandpiper	5	NR	●	●	●	●																						●				●	●
Calidris canutus	Red Knot	4	1		●	●																							●				●	●
Calidris fuscicollis	White-rumped Sandpiper	5	3		●	●	●	●	●																				●				●	●
Calidris himantopus	Stilt Sandpiper	5	3		●	●	●		●																				●				●	●

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										Grasslands			Shrublands								Deciduous Woodland and Forest			Pine-Mixed Pine Woodland and Forest			Caves		Wet-lands		Small Rivers and Streams			Large Rivers	
				Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozarks	Ouachita Mountains	Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Pinyon Pine-Juniper Shrubland	Sand Sagebrush-Bluestem Shrubland	Shinnery Oak Shrubland	Canyon Shrubland	Blackjack Oak-Post Oak Shrubland	Mesquite Shrubland	Juniper Shrubland	Upland Post Oak-Blackjack Oak-Hickory Woodlands and Forests	Bottomland Oak-Hickory Hardwood Forest	White Oak-Hickory Mesic Forest	Shortleaf Pine-Oak-Hickory Woodland and Forest	Shortleaf Pine Open Woodland	Mesic Loblolly Pine-Oak Forest	Limestone Karst	Gypsum Cave	Herbaceous Wetland	Seeps and Vernal Pools	Soft-bottom Streams, Springs, and Riparian Forests	Hard-bottom Streams, Springs, and Riparian Forest	Small Rivers	Large Rivers	Salt Flats
Calidris melanotos	Pectoral Sandpiper	5	NR		●	●	●	●	●																			●					●	●
Calidris pusilla	Semipalmated Sandpiper	5	NR	●	●	●	●	●	●																			●					●	●
Calidris subruficollis	Buff-breasted Sandpiper	4	3		●	●	●		●		●	●																●					●	
Centronyx bairdii	Baird's Sparrow	4	3	●	●					●	●																								
Centronyx henslowii	Henslow's Sparrow	4	2			●	●	●	●			●																							
Chaetura pelagica	Chimney Swift	4	NR		●	●	●	●	●												●	●	●	●	●	●									
Charadrius melodus	Piping Plover	3	NR		●	●	●		●																			●					●	●
Coturnicops noveboracensis	Yellow Rail	4	NR			●		●	●			●																●						
Dolichonyx oryzivorus	Bobolink	5	2		●	●	●	●	●			●																●						
Dryobates borealis	Red-cockaded Woodpecker	3	1						●																●									
Egretta caerulea	Little Blue Heron	5	NR		●	●	●	●	●													●						●		●	●	●	●	
Euphagus carolinus	Rusty Blackbird	4	3			●	●	●	●													●						●						
Falco mexicanus	Prairie Falcon	5	3	●	●	●	●			●	●	●	●	●	●	●																		
Geothlypis formosa	Kentucky Warbler	5	NR			●	●	●	●												●	●	●	●		●								
Grus americana	Whooping Crane	1	1	●	●		●																					●					●	

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Gymnorhinus cyanocephalus	Pinyon Jay	3	2	●									●																					
Helmitheros vermivorum	Worm-eating Warbler	5	1					●	●													●												
Hylocichla mustelina	Wood Thrush	4	2			●	●	●	●												●	●												
Lanius ludovicianus	Loggerhead Shrike	4	NR	●	●	●	●	●	●	●	●	●	●	●	●	●		●																
Laterallus jamaicensis	Black Rail	3	1	●	●		●		●																					●				●
Limnodromus griseus	Short-billed Dowitcher	3	1			●	●		●																					●			●	
Limnodromus scolopaceus	Long-billed Dowitcher	5	NR	●	●	●	●	●	●																					●			●	
Limnothlypis swainsonii	Swainson's Warbler	4	1				●	●	●													●				●					●			
Limosa fedoa	Marbled Godwit	5	2	●	●	●	●																							●			●	
Limosa haemastica	Hudsonian Godwit	4	2		●	●	●	●	●																					●			●	
Melanerpes erythrocephalus	Red-headed Woodpecker	5	4	●	●	●	●	●	●								●				●	●		●	●						●			
Melanerpes lewis	Lewis's Woodpecker	3	2	●									●																					
Numenius americanus	Long-billed Curlew	4	2	●	●					●	●																			●				
Peucaea aestivalis	Bachman's Sparrow	3	2			●	●	●	●												●			●	●								
Pipilo erythrophthalmus	Eastern Towhee	5	4				●	●	●												●		●	●		●							
Pluvialis dominica	American Golden-Plover	5	2	●	●	●	●	●	●		●	●																		●			●	

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Pluvialis squatarola	Black-bellied Plover	5	2	●	●	●	●		●																			●					●	●
Podiceps auritus	Horned Grebe	5	2		●	●	●	●	●																								●	
Protonotaria citrea	Prothonotary Warbler	5	NR		●	●	●	●	●													●								●	●	●		
Rallus elegans	King Rail	4	1		●	●	●		●																			●					●	
Rhynchophanes mccownii	Thick-billed Longspur	4	2	●	●					●	●																							
Salpinctes obsoletus	Rock Wren	5	NR	●	●					●			●			●																		
Selasphorus rufus	Rufous Hummingbird	4	NR	●	●							●				●	●																	
Setophaga cerulea	Cerulean Warbler	4	2					●	●													●	●											
Setophaga discolor	Prairie Warbler	5	3					●	●											●				●	●	●								
Sitta pusilla	Brown-headed Nuthatch	4	1						●															●	●	●								
Spizella pusilla	Field Sparrow	5	NR		●	●	●	●	●		●	●			●		●		●	●													
Sternula antillarum	Least Tern	4	2		●	●	●	●	●																			●					●	●
Tringa flavipes	Lesser Yellowlegs	5	NR	●	●	●	●	●	●																			●				●	●	
Tringa melanoleuca	Greater Yellowlegs	5	NR	●	●	●	●	●	●																			●				●	●	
Tringa semipalmata	Willet	5	3	●	●	●	●	●	●																			●					●	
Tympanuchus cupido	Greater Prairie-chicken	4	3			●						●								●													

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Tympanuchus pallidicinctus	Lesser Prairie-chicken	3	1	●	●					●	●			●	●																			
Tyto furcata	American Barn Owl	5	3	●	●	●	●		●	●	●	●		●		●		●	●								●		●					
Vermivora chrysoptera	Golden-winged Warbler	4	3					●	●											●		●												
Vermivora cyanoptera	Blue-winged Warbler	5	1					●	●											●														
Vireo atricapilla	Black-capped Vireo	5	1		●		●									●	●																	
Vireo bellii	Bell's Vireo	5	3	●	●	●	●	●	●		●	●		●	●		●														●		●	
Zonotrichia querula	Harris's Sparrow	5	NR	●	●	●	●		●		●	●		●	●		●	●	●	●				●										
FISH																																		
Alburnops bairdi	Red River Shiner	4	3		●		●		●																						●	●		
Alburnops chalybaeus	Ironcolor Shiner	4	1						●																						●			
Alburnops girardi	Arkansas River Shiner	2	1		●		●																									●		
Alburnops potteri	Chub Shiner	4	NR		●		●		●																							●		
Alosa alabamae	Alabama Shad	2	2					●	●																						●	●		
Ameiurus nebulosus	Brown Bullhead	5	5						●																						●			
Ammocrypta clara	Western Sand Darter	3	2				●		●																					●		●	●	
Ammocrypta vivax	Scaly Sand Darter	5	2				●		●																							●		
Atractosteus spatula	Alligator Gar	3	1				●		●																						●	●		

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Crystallaria asprella	Crystal Darter	3	1				●		●																							●		
Cycleptus elongatus	Blue Sucker	3	2				●	●	●																							●	●	
Cyprinella camura	Bluntface Shiner	5	1			●	●	●																						●	●	●	●	
Cyprinella spiloptera	Spotfin Shiner	5	1					●																								●		
Cyprinodon rubrofluviatilis	Red River Pupfish	5	4		●		●																							●		●	●	
Esox niger	Chain Pickerel	5	NR																													●	●	
Etheostoma collettei	Creole Darter	4	3						●																					●		●		
Etheostoma cragini	Arkansas Darter	3	1	●	●	●		●																						●	●		●	
Etheostoma cyanorum	Blue River Orangebelly Darter	1	1				●	●																							●	●		
Etheostoma histrio	Harlequin Darter	5	3						●																						●	●		
Etheostoma microperca	Least Darter	5	3				●	●																							●	●		
Etheostoma mihileze	Sunburst Darter	4	3					●																							●			
Etheostoma parvipinne	Goldstripe Darter	4	NR						●																							●			
Etheostoma radiosum	Orangebelly Darter	4	4				●		●																							●	●		
Etheostoma whipplei	Redfin Darter	4	4			●		●	●																							●	●		
Fundulus blairae	Western Starhead Topminnow	4	2						●																							●			

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Fundulus sciadicus	Plains Topminnow	4	1					●																						●						
Hiodon tergisus	Mooneye	5	2						●																							●					
Hybognathus hayi	Cypress Minnow	4	1						●																					●		●					
Hybognathus placitus	Plains Minnow	4	3	●	●	●	●																							●		●	●				
Hybopsis amnis	Pallid Shiner	4	1				●	●	●																					●		●	●				
Ichthyomyzon gagei	Southern Brook Lamprey	5	2					●																							●	●					
Ictiobus niger	Black Buffalo	5	NR			●	●	●	●																							●	●				
Luxilus cardinalis	Cardinal Shiner	4	4			●		●																						●	●					
Lythrurus fumeus	Ribbon Shiner	5	3				●	●	●																							●	●	●			
Lythrurus snelsoni	Ouachita Shiner	3	2						●																							●					
Macrhybopsis australis	Prairie Chub	3	2		●		●																										●	●			
Macrhybopsis tetranema	Peppered Chub	1	NR		●																													●			
Micropterus velox	Neosho Bass	NR	NR					●																								●	●				
Miniellus greenei	Wedgespot Shiner	5	2					●																									●				
Miniellus nubilus	Ozark Minnow	5	4					●																								●					
Miniellus ortenburgeri	Kiamichi Shiner	3	3			●	●		●																					●	●	●				
Miniellus perpallidus	Peppered Shiner	3	2						●																								●	●			

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Moxostoma macrolepidotum	Shorthead Redhorse	5	2					●																							●	●	●		
Nocomis asper	Redspot Chub	4	4				●	●																							●	●			
Notropis atrocaudalis	Blackspot Shiner	4	1				●		●																					●		●			
Notropis maculatus	Taillight Shiner	5	1						●																					●		●			
Notropis suttkusi	Rocky Shiner	3	3				●		●																						●	●			
Noturus eleutherus	Mountain Madtom	4	2						●																							●			
Noturus flavus	Stonecat	5	2			●		●																						●	●	●			
Noturus placidus	Neosho Madtom	2	1					●																									●		
Percina maculata	Blackside Darter	5	2					●	●																						●	●			
Percina nasuta	Longnose Darter	3	1					●	●																						●	●			
Percina pantherina	Leopard Darter	2	1						●																							●			
Percina shumardi	River Darter	5	3					●																							●	●	●		
Platygobio gracilis	Flathead Chub	5	2	●																													●		
Polyodon spathula	Paddlefish	4	2			●	●	●	●																							●	●		
Pteronotropis hubbsi	Bluehead Shiner	3	1						●																							●			
Scaphirhynchus platorynchus	Shovelnose Sturgeon	4	1			●	●	●	●																							●	●		

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Troglichthys rosae	Ozark Cavefish	3	1					●																		●								
INVERTEBRATES																																			
Alasmidonta marginata	Elktoe	4	1					●																									●		
Allocapnia jeannae	Osage Snowfly	3	4					●																								●	●		
Allocapnia peltoides	Shield Snowfly	3	4						●																							●			
Allocrangonyx pellucidus	Oklahoma Cave Amphipod	2	3				●																			●						●			
Amblycheila picolominii	Plateau Giant Tiger Beetle	3	NR		●											●																			
Amblyscirtes linda	Linda's Roadside-Skipper	2	2			●		●	●													●	●	●		●					●	●			
Amerigoniscus centralis	a cave obligate isopod	1	1				●																			●									
Andrena arenicola	a miner bee	NR	NR		●		●																							●		●			
Andrena beameri	a miner bee	NR	NR			●						●																							
Andrena biscutellata	a miner bee	NR	NR	●			●				●	●																							
Andrena brevicornis	a miner bee	NR	NR		●						●					●		●																	
Andrena bullata	a miner bee	NR	NR		●		●								●		●				●														
Andrena dapsilis	a miner bee	NR	NR		●						●																								
Andrena trapezoidea	a miner bee	NR	NR		●						●																								

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Andrena unicostata	a miner bee	NR	NR				●																									●				
Anthidium michenerorum	a wool-carder bee	2	1		●					●	●	●				●		●																	
Anthophora fedorica	Fedor Digger Bee	2	NR	●	●		●			●																										
Apobaetis futilis	Futile Small Minnow Mayfly	2	NR						●																								●			
Arcidens wheeleri	Ouachita Rock Pocketbook	1	1						●																									●		
Arethaea grallator	Stilt-walker Katydid	NR	NR				●													●																
Argia leonorae	Leonora's Dancer	3	5		●																									●		●				
Atrytone arogos	Arogos Skipper	2	3		●	●	●	●			●	●			●		●			●																
Bactrurus hubrichti	Kansas Well Amphipod	4	1			●		●																								●	●			
Bombus fraternus	Southern Plains Bumble bee	3	2	●	●	●	●		●	●	●	●					●																		
Bombus morrisoni	Morrison's Bumble bee	3	3	●									●																							
Bombus pensylvanicus	American Bumble bee	3	5	●	●	●	●	●	●	●	●	●		●	●	●	●			●			●	●	●				●						
Bombus variabilis	Variable Cuckoo Bumble bee	1	H		●		●				●	●					●																		
Caecidotea acuticarpa	a cave obligate isopod	2	1				●																				●					●			
Caecidotea adenta	a cave obligate isopod	1	1		●																						●								

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Caecidotea ancyla	a cave obligate isopod	3	2					●																			●									
Caecidotea antricola	a cave obligate isopod	5	1					●																			●									
Caecidotea mackini	a cave obligate isopod	NR	1					●																			●									
Caecidotea macropropoda	Bat Cave Isopod	3	1					●																			●						●			
Caecidotea oculata	Water Slater	1	1						●																								●			
Caecidotea simulator	Springfield Plain Groundwater Isopod	3	2					●																			●						●			
Caecidotea steevesi	Steeve's Cave Isopod	3	1					●																			●									
Caecidotea stiladactyla	Slender-fingered Cave Isopod	3	2					●																			●						●			
Calephelis borealis	Northern Metalmark	3	2					●	●												●		●													
Calephelis muticum	Swamp Metalmark	3	1					●																						●						
Callophrys irus	Frosted Elfin	3	1				●		●								●				●			●	●	●									
Cambarus subterraneus	Delaware County Cave Crayfish	1	1					●																			●									
Cambarus tartarus	Oklahoma Cave Crayfish	1	1					●																			●									
Catocala consors	Consort Underwing	3	NR			●	●	●	●																							●			●	
Catocala frederici	an underwing moth	3	NR		●						●					●	●																			

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Catocala herodias	Herodias Underwing	3	NR		●											●	●			●														
Catocala nuptialis	Married Underwing	3	NR		●	●	●					●								●														
Cernotina oklahoma	a caddisfly	3	NR				●																								●			
Cheumatopsyche comis	Flint's Net-spinning Caddisfly	3	NR		●																										●			
Cogia outis	Outis Skipper	3	2		●		●	●			●	●			●		●																	
Colletes inuncantipedis	a cellophane bee	NR	NR				●										●				●													
Cordulegaster talaria	Ouachita Spiketail	1	1						●																					●				
Cotalpa subcribrata	a goldsmith beetle	NR	NR				●														●													
Crosbyella spinturnix	a cave obligate harvestman	NR	1					●																			●							
Cyprogenia aberti	Western Fanshell	1	NR			●																											●	
Daedalochila deltoidea	Oklahoma Liptooth	2	NR					●	●												●		●											
Daedalochila jacksoni	Ozark Liptooth	3	NR					●	●												●			●										
Daedalochila lithica	Stone Liptooth	3	NR					●	●												●		●											
Daedalochila simpsoni	Wyandotte Liptooth	2	NR				●	●	●												●		●											
Danaus plexippus	Monarch	4	NR		●	●	●	●	●		X	X			X	X	X				●			●	●	●			●					
Dendrocoelopsis americana	a cave obligate planarian	3	2					●																			●							

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Dromochorus belfragei	Loamy-ground Tiger Beetle	NR	NR		●		●				●	●																							
Dubiraphia parva	Little Dubiraphian Riffle Beetle	2	1				●																									●			
Ellipsaria lineolata	Butterfly Mussel	4	2			●			●																								●		
Ellipsoptera lepida	Ghost Tiger Beetle	3	4	●	●	●	●							●																			●	
Erynnis martialis	Mottled Duskywing	3	3				●	●	●												●		●	●	●	●								
Eubranchipus oregonus	Oregon Fairy Shrimp	3	4				●																						●					
Euchemotrema imperforatum	Ouachita Pillsnail	NR	NR						●													●	●	●		●								
Euchemotrema wichitorum	Wichita Mountains Pillsnail	2	NR		●												●				●													
Fallicambarus tenuis	Ouachita Mountains Crayfish	3	1						●																							●		
Faxonella blairi	Blair's Fencing Crayfish	4	1						●																								●	
Faxonius deanae	Conchas Crayfish	4	3		●	●	●	●																									●	
Faxonius difficillis	Painted Crayfish	3	3				●		●																						●	●	●		
Faxonius macrus	Neosho Midget Crayfish	4	2					●																								●		
Faxonius meeki	Meek's Crayfish	4	2					●																									●	
Faxonius menae	Mena Crayfish	3	2						●																							●		

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Faxonius nana	Midget Crayfish	3	3					●																								●		
Faxonius saxatilis	Kiamichi Crayfish	1	1						●																						●			
Gastrocopta ruidosensis	Ruidoso Snaggletooth	1	NR	●						●			●						●															
Gastrocopta sterkiana	a snaggletooth snail	3	NR	●	●	●	●			●	●	●	●																					
Gomphurus ozarkensis	Ozark Clubtail	4	3			●		●	●																						●			
Gryllotalpa major	Prairie Mole Cricket	3	2			●	●					●																						
Helicodiscus nummus	Wax Coil Snail	1	NR		●	●	●				●	●																						
Helicodiscus tridens	Crosstimbers Coil	2	NR				●	●																								●		
Helopicus nalatus	Ozark Springfly	3	NR					●																							●			
Hemileuca slosseri	Slosser's Buckmoth	3	NR		●										●																			
Hesperia attalus	Dotted Skipper	3	3		●	●	●				●	●					●			●														
Hesperia ottoe	Ottoe Skipper	3	2		●	●	●	●			●	●																						
Hydroptila melia	a purse casemaker caddisfly	2	NR				●																								●			
Hydroptila protera	a purse casemaker caddisfly	1	NR				●																								●			
Hylogomphus apomyius	Banner Clubtail	3	2						●																						●			
Inflectarius edentatus	Smooth-lip Shagreen	2	NR					●													●		●	●										

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Inscudderia taxodii	Bald Cypress Katydid	NR	NR						●												●													
Islandiana unicornis	a cave obligate spider	2	1					●																			●							
Isoperla ouachita	Ouachita Stripetail	3	NR					●	●																						●			
Lampsilis cardium	Plain Pocketbook	5	NR					●	●																							●	●	
Lampsilis rafinesqueana	Neosho Mucket	1	1					●																								●	●	
Lasioglossum danforthi	a sweat bee	NR	NR		●		●								●		●				●													
Lepidostoma ozarkense	a lepidostomatid caddisfly	1	NR						●																						●			
Ligumia recta	Black Sandshell	4	1					●																			●					●	●	
Lintneria eremitoides	Sage Sphinx	2	NR		●						●			●	●																			
Lirceus trilobus	an isopod	NR	1					●																						●				
Mayatrichia ponta	a microcaddisfly	3	NR				●																							●				
Mediappendix wandae	Slope Ambersnail	3	NR			●	●														●													
Megachile amica	a leafcutter bee	2	NR		●						●																							
Megachile deflexa	a leafcutter bee	2	NR				●														●													
Megachile fortis	Robust Sunflower Leafcutter Bee	2	NR		●	●	●				●	●			●		●																	
Megachile oenotherae	a leafcutter bee	2	NR		●		●				●	●																						

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Megachile parksi	a leafcutter bee	2	NR		●									●																					
Megalonaias nervosa	Washboard	5	2					●	●																								●	●	
Megapallifera ragsdalei	Ozark Mantleslug	3	NR					●														●					●								
Melanoplus cohni	Cohn's Spur-throat grasshopper	NR	NR						●			●												●	●										
Melanoplus decurvus	a spur-throat grasshopper	NR	NR				●					●								●															
Melanoplus oklahomae	Oklahoma Spur-throated Grasshopper	2	4				●		●			●								●				●	●										
Melissodes intortus	a callirhoe bee	NR	NR		●		●				●	●																							
Miktoniscus oklahomensis	Racovitza's Cave Isopod	1	1				●																				●								
Neohelix lioderma	Tulsa Whitelip	1	NR			●	●													●							●								
Neoperla falayah	Curved Stonefly	3	NR					●																									●		
Neoperla osage	Osage Stonefly	3	NR					●	●																								●		
Neotrichia riegeli	a microcaddisfly	3	NR					●																									●		
Nicrophorus americanus	American Burying Beetle	3	1			●	●	●	●			●								●		●	●	●	●										
Nixe flowersi	a flat-headed mayfly	2	4					●																									●		
Nomia universitatis	University Nomia	3	NR	●						●																									

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Obovaria arkansasensis	Southern Hickorynut	3	2						●																							●		
Ochrotrichia capitana	a purse casemaker caddisfly	3	NR				●																								●			
Ochrotrichia weddleae	a purse casemaker caddisfly	1	NR						●																						●			
Oecetis ouachita	a longhorned caddisfly	2	NR						●																						●			
Onthophagus cavernicollis	a cave-dwelling dung beetle	NR	NR					●																			●							
Pallifera marmorea	Marbled Mantleslug	3	NR				●	●	●											●		●	●											
Pallifera tournescalis	Ouachita Mantleslug	1	NR						●												●	●												
Papaipema eryngii	Rattlesnake Master Borer	2	1			●			●			●												●										
Papaipema limpida	Vernonia Borer Moth	3	NR			●	●					●																						
Paravitrea significans	Domed Supercoil	3	NR					●	●												●	●					●							
Parvindela celeripes	Swift Tiger Beetle	3	4		●						●					●																		
Patera binneyana	Half-lidded Oval	2	NR						●												●	●	●		●									
Patera indianorum	Lidded Oval	2	NR				●		●												●	●	●											
Patera kiowaensis	Drywoods Oval	2	NR						●											●		●	●											
Patera roemeri	Texas Oval	3	NR				●													●	●													

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Perdita jonesi	a fairy bee	NR	NR				●					●																							
Perlesta baumanni	Darkwing Stonefly	2	NR						●																							●			
Perlesta bolukta	Truncate Stonefly	2	4					●	●																							●			
Perlesta browni	Toothed Stonefly	3	4						●																							●			
Perlesta fusca	Tinted Stonefly	3	NR				●																									●			
Photinus dimissus	Two-step Flasher Firefly	3	NR				●		●																						●		●	●	
Plauditus texanus	a small minnow mayfly	2	NR		●																											●			
Pleurobema cordatum	Ohio Pigtoe	3	2			●		●	●																								●		
Pleurobema riddellii	Louisiana Pigtoe	1	NR						●																								●		
Potamilus leptodon	Scaleshell	1	1						●																								●		
Proserpinus gaurae	Proud Sphinx	NR	NR		●		●				●	●																							
Prostoia ozarkensis	Ozark Forestfly	3	NR					●																								●			
Protandrena kansensis	a miner bee	NR	NR			●	●					●																							
Pseudosinella dubia	a cave obligate springtail	3	1					●																				●							
Ptychobranchus occidentalis	Ouachita Kidneyshell	3	2			●	●	●	●																							●	●		
Pupoides inornatus	Rocky Mountain Dagger	2	NR	●									●																						

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Scientific Name	Common Name	NatureServe Global Rank	OK Heritage Rank	Ecoregion						2025 SWAP Habitats																									
										Grasslands			Shrublands								Deciduous Woodland and Forest			Pine-Mixed Pine Woodland and Forest			Caves		Wet-lands		Small Rivers and Streams			Large Rivers	
				Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozarks	Ouachita Mountains	Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Pinyon Pine-Juniper Shrubland	Sand Sagebrush-Bluestem Shrubland	Shinnery Oak Shrubland	Canyon Shrubland	Blackjack Oak-Post Oak Shrubland	Mesquite Shrubland	Juniper Shrubland	Upland Post Oak-Blackjack Oak-Hickory Woodlands and Forests	Bottomland Oak-Hickory Hardwood Forest	White Oak-Hickory Mesic Forest	Shortleaf Pine-Oak-Hickory Woodland and Forest	Shortleaf Pine Open Woodland	Mesic Loblolly Pine-Oak Forest	Limestone Karst	Gypsum Cave	Herbaceous Wetland	Seeps and Vernal Pools	Soft-bottom Streams, Springs, and Riparian Forests	Hard-bottom Streams, Springs, and Riparian Forest	Small Rivers	Large Rivers	Salt Flats
Pustulosa nodulata	Wartyback	4	1			●	●																									●		
Pygmarrhopalites jay	a cave obligate springtail	2	1					●																		●								
Quadrula fragosa	Winged Mapleleaf	1	1						●																							●		
Rhyacophila kiamichi	a rhyacophilid caddisfly	3	NR						●																							●		
Scaphinotus parisiana	Ozark Snail-eating Beetle	NR	NR					●												●		●												
Setodes oxapius	a leptocerid caddisfly	3	NR					●																								●		
Siphlonurus minnoi	a primitive minnow mayfly	3	NR					●																								●	●	
Somatochlora margarita	Texas Emerald	2	NR						●																						●		●		
Somatochlora ozarkensis	Ozark Emerald	3	1					●	●																							●	●	
Speyeria diana	Diana Fritillary	2	2				●	●	●												●	●	●		●									
Speyeria idalia	Regal Fritillary	3	1			●						●																						
Sphecodosoma pratti	a shortface sweat bee	NR	NR		●						●																							
Stenotrema labrosum	Ozark Slitmouth	3	NR					●	●												●		●	●			●							
Stenotrema pilsbryi	Rich Mountain Slitmouth	2	2						●														●	●										
Stenotrema uncifernum	Ouachita Slitmouth	3	NR						●														●	●										
Strophopteryx cucullata	Kiamichi Willowfly	3	NR					●	●																							●		

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Stygobromus bowmani	Bowman's Cave Amphipod	1	1					●																		●					●					
Stygobromus onondagaensis	Onondaga Cave Amphipod	3	2					●																		●										
Stygobromus ozarkensis	Ozark Cave Amphipod	4	3					●																		●										
Tetraloniella paenalbata	a long-horned bee	NR	NR	●	●					●	●							●																		
Theliderma cylindrica	Rabbitsfoot	3	1			●		●	●																								●			
Theliderma metanevra	Monkeyface Mussel	NR	NR					●																									●	●		
Toxolasma lividum	Purple Lilliput	3	NR					●	●																								●			
Toxolasma texasiense	Texas Lilliput	4	1						●																								●			
Triaenodes helo	Marsh Triaenode Caddisfly	3	NR		●																										●					
Triaenodes tridontus	Three-toothed Triaenodes Caddisfly	2	NR						●																						●					
Trigenotyla blacki	Black's Cave Millipede	1	1					●																		●										
Trigenotyla seminole	a cave millipede	1	1				●																			●										
Trigenotyla vaga	a cave millipede	NR	1				●		●															●		●										
Trimerotropis saxatilis	Lichen Grasshopper	3	NR		●	●	●	●	●			●				●	●																			
Triodopsis neglecta	Ozark Threetooth	3	NR					●													●																

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Ventridens brittsi	Western Dome	3	NR					●	●											●		●	●										
Wormaldia strota	a caddisfly	2	NR						●																						●			
Zealeuctra cherokee	Cherokee Needlefly	3	4						●																						●			
Zealeuctra warreni	Early Needlefly	3	NR					●	●																						●			
MAMMALS																																		
Bassariscus astutus	Ringtail	5	3	●	●		●						●			●	●		●															
Conepatus leuconotus	American Hog-nosed Skunk	4	1	●									●																					
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	3	3						●													●	●		●								
Corynorhinus townsendii	Townsend's Big-eared Bat	4	3	●	●								●			●											●			●			
Corynorhinus townsendii ingens	Ozark Big-eared Bat	1	1					●														●				●							
Cratogeomys castanops	Yellow-faced Pocket Gopher	5	2	●						●	●																							
Cynomys ludovicianus	Black-tailed Prairie Dog	4	3	●	●					●	●			●				●																
Dipodomys elator	Texas Kangaroo Rat	2	1		●													●																
Geomys breviceps	Baird's Pocket Gopher	5	4			●	●	●	●			●																						
Lasiurus cinereus	Northern Hoary Bat	3	NR		●	●	●	●	●								●				●	●	●	●	●									

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Lasiurus seminolus	Seminole Bat	5	3						●																●									
Marmota monax	Woodchuck	5	3			●		●				●								●														
Myotis austroriparius	Southeastern Myotis	4	1						●												●	●			●			●		●		●		
Myotis grisescens	Gray Myotis	3	1					●													●	●				●					●			
Myotis leibii	Eastern Small-footed Myotis	4	1						●													●	●											
Myotis lucifugus	Little Brown Myotis	3	1					●	●											●	●	●	●		●	●								
Myotis septentrionalis	Northern Long-eared Myotis	2	2			●		●	●											●	●	●	●	●	●	●		●		●	●	●		
Myotis sodalis	Indiana Myotis	2	1					●	●												●	●			●	●								
Myotis velifer	Cave Myotis	4	3	●	●																						●							
Neotoma leucodon	White-toothed Woodrat	5	3	●									●	●																				
Notiosorex crawfordi	Crawford's Desert Shrew	4	3	●	●					●	●		●	●	●	●		●	●															
Ochrotomys nuttalli	Golden Mouse	5	2						●												●	●			●									
Oryzomys texensis	Texas Marsh Rice Rat	NR	3				●		●												●							●		●				
Perimyotis subflavus	Tricolored Bat	3	3	●	●	●	●	●	●											●	●	●	●		●	●	●							
Peromyscus laceianus	Lacey's White-ankled Mouse	5	NR				●										●			●														

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Peromyscus nasutus	Northern Rock Deermouse	5	3	●									●																					
Reithrodontomys humulis	Eastern Harvest Mouse	5	2			●	●		●			●								●									●				
Spilogale interrupta	Plains Spotted Skunk	3	2		●	●	●	●	●								●			●	●	●	●										
Tadarida brasiliensis	Brazilian Free-tailed Bat	5	3		●																						●						
Vulpes velox	Swift Fox	3	1	●						●	●																						
Zapus hudsonius	Meadow Jumping Mouse	5	1			●	●																								●		
REPTILES																																	
Alligator mississippiensis	American Alligator	5	4						●												●								●		●	●	
Apalone mutica	Smooth Softshell	5	5		●	●	●		●												●								●		●	●	
Apalone spinifera	Spiny Softshell	5	5	●	●	●	●	●	●																				●		●		
Aspidoscelis tesselata	Common Checkered Whiptail	5	1	●									●																				
Cemophora coccinea	Common Scarletsnake	5	2				●		●											●	●	●	●		●								
Crotalus atrox	Western Diamond-backed Rattlesnake	5	4		●		●	●	●		●					●	●	●	●				●	●									
Deirochelys reticularia	Chicken Turtle	5	2				●		●												●								●	●			
Farancia abacura	Red-bellied Mudsnake	5	1						●												●								●				

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Graptemys geographica	Northern Map Turtle	4	1					●																							●				
Holbrookia maculata	Common Lesser Earless Lizard	5	4	●	●					●	●			●				●																	
Liodytes rigida	Glossy Swampsnake	5	1						●												●								●						
Macrochelys temminckii	Western Alligator Snapping Turtle	3	2			●	●	●	●																				●		●	●	●	●	
Phrynosoma cornutum	Texas Horned Lizard	4	2	●	●	●	●			●	●	●	●	●	●		●	●		●															
Phrynosoma modestum	Round-tailed Horned Lizard	5	1	●									●																							
Pseudemys concinna	River Cooter	5	4			●	●	●	●													●									●	●	●	●	
Rhinocheilus lecontei	Long-nosed Snake	5	3	●	●					●	●			●	●			●																	
Sistrurus tergeminus	Western Massasauga	3	NR	●	●	●				●	●	●		●	●			●																	
Sternotherus carinatus	Razor-backed Musk Turtle	5	4				●		●												●										●	●	●		
Terrapene ornata	Ornate Box Turtle	4	NR	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●											●					
Terrapene triunguis	Three-toed Box Turtle	NR	NR		●	●	●	●	●		●	●					●			●	●	●	●	●	●			●	●						
Thamnophis elegans	Terrestrial Gartersnake	5	1	●									●	●		●													●						
Uta stansburiana	Common Side-blotched Lizard	5	1		●									●	●	●		●																	

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Identification of Plant Species of Conservation Need

Southern lady's-slipper. Photo by Tom Potterfield/CC BY-NC-SA 2.0

With more than 2,600 species in Oklahoma, plants are important components of our biological diversity and natural heritage. Although plant species are not eligible for funding assistance through the State and Tribal Wildlife Grants Programs, the ODWC is highlighting rare and at-risk plant species in the Oklahoma SWAP to link the conservation of these plants with the animal SGCN that share their same habitats. Between 2022 and 2024, the ODWC participated in a regional effort to evaluate native plants and identify those species that were in greatest need of additional conservation effort. This partnership involved the Southeastern Association of Fish and Wildlife Agencies' Wildlife Diversity Committee, the U.S. Fish and Wildlife Service's Science Applications Program, the Atlanta Botanical Garden, NatureServe, the Southeastern Plant Conservation Alliance, and the state Natural Heritage Inventory programs across the southeastern U.S. This team identified approximately 11,000 plant taxa that are native to the southeastern U.S. and evaluated these species using updated natural heritage global conservation ranks. Nearly 1,800 plant taxa across the Southeast have a global conservation rank of G1, G2, or G3, and the evaluation team recommended that states consider these for inclusion in their SWAPs. With the assistance of botanists from the Oklahoma Natural Heritage Program and the Oklahoma Biological Survey, the list of potential species was reviewed and vetted, which resulted in the current list of 72 plant species of conservation need for Oklahoma. Where sufficient information exists, we have identified within the Oklahoma SWAP the habitat types in which each of these species is found to raise their profile and to underscore the importance of these habitats to the plant and animal species in need of conservation attention. This list of plant species is analogous to the animal SGCN list; however, because direct plant conservation activities are not eligible for State and Tribal Wildlife Grants funding, we chose to call these species Plants Species of Conservation Need (PSCN) to reduce confusion and create a small distinction between the plant and animal lists. For the list of PSCN, we also followed the taxonomy that is recognized by NatureServe. To be consistent with the animal SGCN list, we recognized plants at the full species level and did not recognize individual subspecies or varieties.

Tinytim. Photo by Lisa Miller.

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Abdra aprica	Open-ground Whitlowgrass	3	1					●	●											●													
Agalinis auriculata	Earleaf False Foxglove	3	H			●	●		●		●	●																	●				
Agalinis densiflora	Osage Plains False Foxglove	3	2		●	●	●	●			●	●																					
Alnus maritima	Seaside Alder	3	2				●																								●			
Amorpha laevigata	Smooth Indigobush	3	2			●	●		●			●								●									●	●				
Amorpha ouachitensis	Ouachita Leadplant	3	2						●												●	●	●							●				
Amorpha paniculata	Panicled Indigobush	3	1						●																	●		●		●				
Amsonia hubrichtii	Hubricht's Slimpod	3	2						●												●									●				
Asclepias uncialis	Greene milkweed	2	H	●						●			●																					
Calamovilfa arcuata	Rivergrass	2	2						●																						●			
Callirhoe bushii	Bush's Poppymallow	3	2			●		●	●			●									●										●			
Calopogon oklahomensis	Oklahoma Grasspink	2	2			●		●	●			●																						
Carex decomposita	Cypress-knee Sedge	3	1						●																				●					
Carex latebracteata	Waterfall's Sedge	3	3						●											●		●	●											
Carex shinnersii	Shinner's Sedge	3	1		●	●	●		●																				●	●				

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Castanea ozarkensis	Ozark Chinquapin	NR	2					●	●													●	●										
Cuscuta attenuata	Tapertip Dodder	2	2		●		●		●																				●					
Cypripedium kentuckiense	Southern Lady's-slipper	3	1						●																							●		
Dalea cylindriceps	Sandsage Prairie-clover	3	H	●										●																				
Desmodium tweedyi	Tweedy's Tick-trefoil	3	2		●		●										●			●													
Echinacea atrorubens	Topeka Purple coneflower	3	3			●	●		●			●																					
Echinacea paradoxa	Bush's Purple Coneflower	3	1				●					●																					
Elymus churchii	Church's Wild Rye	3	1						●											●				●	●								
Ephedra antisyphilitica	Mormon-tea	3	2		●											●		●															
Eriocaulon koernickianum	Small-headed Pipewort	2	1					●	●											●			●							●			
Euphorbia carunculata	Sand-dune Broomspurge	3	H		●						●																						
Euphorbia longicruris	Wedgeleaf Spurge	3	2		●		●				●	●					●			●													
Euphorbia ouachitana	Ouachita Spurge	3	2						●											●		●	●										
Euthamia oklahomensis	Oklahoma Goldentop	1	1						●																				●	●	●			
Festuca versuta	Texas Fescue	3	1		●		●		●								●			●		●											
Geocarpon minimum	Tinytim	2	2			●	●		●			●								●													

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Scientific Name	Common Name	NatureServe Global Rank	OK Heritage Rank	Ecoregion						2025 SWAP Habitats																											
										Grasslands			Shrublands								Deciduous Woodland and Forest			Pine-Mixed Pine Woodland and Forest			Caves		Wet-lands		Small Rivers and Streams			Large Rivers				
				Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozarks	Ouachita Mountains	Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Pinyon Pine-Juniper Shrubland	Sand Sagebrush-Bluestem Shrubland	Shinnery Oak Shrubland	Canyon Shrubland	Blackjack Oak-Post Oak Shrubland	Mesquite Shrubland	Juniper Shrubland	Upland Post Oak-Blackjack Oak-Hickory Woodlands and Forests	Bottomland Oak-Hickory Hardwood Forest	White Oak-Hickory Mesic Forest	Shortleaf Pine-Oak-Hickory Woodland and Forest	Shortleaf Pine Open Woodland	Mesic Loblolly Pine-Oak Forest	Limestone Karst	Gypsum Cave	Herbaceous Wetland	Seeps and Vernal Pools	Soft-bottom Streams, Springs, and Riparian Forests	Hard-bottom Streams, Springs, and Riparian Forest	Small Rivers	Large Rivers	Salt Flats
Houstonia ouachitana	Ouachita Bluet	3	3						●														●	●												
Ipomoea shumardiana	Narrowleaf Morning-glory	2	2		●		●				●																									
Krigia wrightii	Wright's Dwarfdandelion	3	1				●		●			●									●			●	●											
Leavenworthia aurea	Golden Gladecress	2	2						●			●																								
Liatris aestivalis	Summer Blazing Star	3	1				●		●			●																								
Matelea baldwyniana	Baldwin's Milkvine	3	2					●	●												●			●												
Nemastylis nuttallii	Nuttall's Pleatleaf	3	1			●	●	●	●			●																								
Nolina greenei	Woodland Bear-grass	2	1	●						●			●																								
Oenothera triangulata	Prairie Beeblossom	3	2		●	●	●				●	●					●				●															
Panax quinquefolius	American Ginseng	3	1				●	●	●												●		●	●												
Parnassia grandifolia	Largeleaf Grass-of-Parnassus	3	1						●																					●	●					
Pediomelum reverchonii	Rock Indian Breadroot	3	2				●				●	●					●				●															
Penstemon oklahomensis	Oklahoma Beardtongue	3	3		●	●	●		●			●					●				●															
Phemeranthus rugospermus	Prairie Fameflower	3	1						●															●												
Phlox longipilosa	Long-hair Phlox	1	1		●						●						●																			

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Scientific Name	Common Name	NatureServe Global Rank	OK Heritage Rank	Ecoregion						2025 SWAP Habitats																											
										Grasslands			Shrublands								Deciduous Woodland and Forest			Pine-Mixed Pine Woodland and Forest			Caves		Wet-lands		Small Rivers and Streams			Large Rivers				
				Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozarks	Ouachita Mountains	Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Pinyon Pine-Juniper Shrubland	Sand Sagebrush-Bluestem Shrubland	Shinnery Oak Shrubland	Canyon Shrubland	Blackjack Oak-Post Oak Shrubland	Mesquite Shrubland	Juniper Shrubland	Upland Post Oak-Blackjack Oak-Hickory Woodlands and Forests	Bottomland Oak-Hickory Hardwood Forest	White Oak-Hickory Mesic Forest	Shortleaf Pine-Oak-Hickory Woodland and Forest	Shortleaf Pine Open Woodland	Mesic Loblolly Pine-Oak Forest	Limestone Karst	Gypsum Cave	Herbaceous Wetland	Seeps and Vernal Pools	Soft-bottom Streams, Springs, and Riparian Forests	Hard-bottom Streams, Springs, and Riparian Forest	Small Rivers	Large Rivers	Salt Flats
Phlox oklahomensis	Oklahoma Phlox	3	2		●						●																									
Physalis missouriensis	Missouri Groundcherry	2	1			●	●	●				●								●																
Physaria angustifolia	Threadleaf Bladderpod	3	2						●			●																								
Platanthera leucophaea	Eastern Prairie White-fringed Orchid	2	H						●			●																	●							
Platanthera praeclara	Western Prairie White-fringed Orchid	3	H			●						●																	●							
Prenanthes barbata	Barbed Rattlesnake-root	3	1						●			●								●	●	●	●	●	●					●						
Pseudoclappia arenaria	Trans Pecos False Clappia	3	H		●						●																			●						
Ptilimnium nodosum	Harperella	2	1						●																							●	●			
Sabatia formosa	Stately Rose Gentian	2	H				●				●	●					●			●																
Sagittaria ambigua	Kansas Arrowhead	2	2		●	●	●	●	●																				●		●	●				
Schoenoplectiella hallii	Hall's Bulrush	3	1		●		●																						●							
Silene regia	Royal Catchfly	3	1					●				●								●		●														
Solidago ouachitensis	Ouachita Mountain Goldenrod	3	2						●													●														
Spiranthes magnicamporum	Great Plains Ladies' Tresses	3	3		●	●	●	●	●		●	●																		●						
Stachys iltisii	Ozark Hedge-nettle	3	2						●													●	●													

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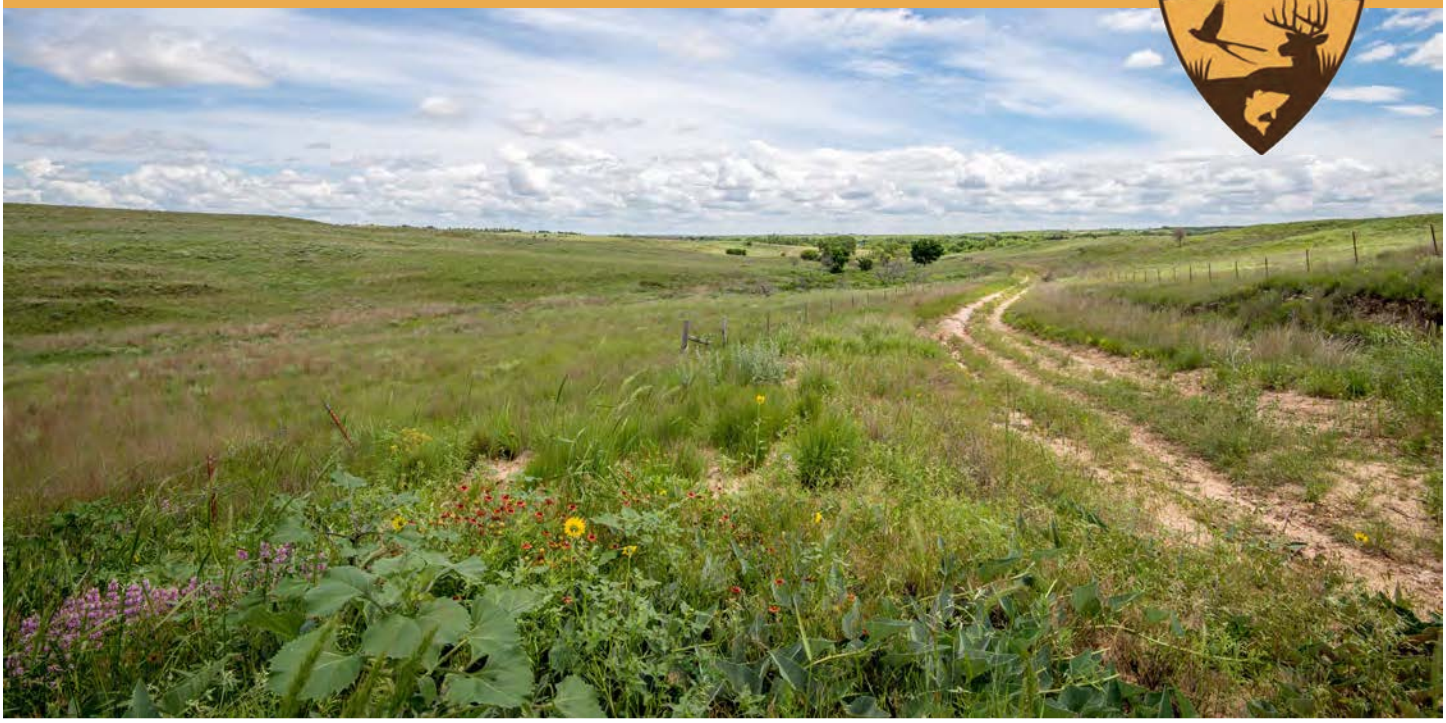
Scientific Name	Common Name	NatureServe Global Rank	OK Heritage Rank	Ecoregion						2025 SWAP Habitats																								
										Grasslands			Shrublands							Deciduous Woodland and Forest			Pine-Mixed Pine Woodland and Forest			Caves		Wet-lands		Small Rivers and Streams			Large Rivers	
				Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozarks	Ouachita Mountains	Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Pinyon Pine-Juniper Shrubland	Sand Sagebrush-Bluestem Shrubland	Shinnery Oak Shrubland	Canyon Shrubland	Blackjack Oak-Post Oak Shrubland	Mesquite Shrubland	Juniper Shrubland	Upland Post Oak-Blackjack Oak-Hickory Woodlands and Forests	Bottomland Oak-Hickory Hardwood Forest	White Oak-Hickory Mesic Forest	Shortleaf Pine-Oak-Hickory Woodland and Forest	Shortleaf Pine Open Woodland	Mesic Loblolly Pine-Oak Forest	Limestone Karst	Gypsum Cave	Herbaceous Wetland	Seeps and Vernal Pools	Soft-bottom Streams, Springs, and Riparian Forests	Hard-bottom Streams, Springs, and Riparian Forest	Small Rivers	Large Rivers	Salt Flats
Streptanthus maculatus	Clasping Twistflower	3	2					●	●											●		●	●		●								
Streptanthus squamiformis	Pine-oak Jewelflower	2	2						●														●	●									
Thalictrum arkansanum	Arkansas Meadowrue	2	2						●												●				●						●		
Tradescantia ernestiana	Ernest's Spiderwort	3	3					●	●											●			●								●		
Tradescantia ozarkana	Ozark Spiderwort	3	2					●	●											●		●	●										
Trifolium reflexum	Buffalo Clover	3	3		●		●	●	●		●	●								●			●										
Valerianella nuttallii	Nuttall's Cornsalad	3	2					●	●			●																					
Valerianella ozarkana	Ozark Cornsalad	3	H					●												●		●	●										
Valerianella palmeri	Palmer's Cornsalad	3	2						●											●		●	●										
Vernonia lettermannii	Narrowleaf Ironweed	3	3						●																						●		
Vitis rupestris	Rock Grape	3	2		●		●	●	●											●		●							●	●			

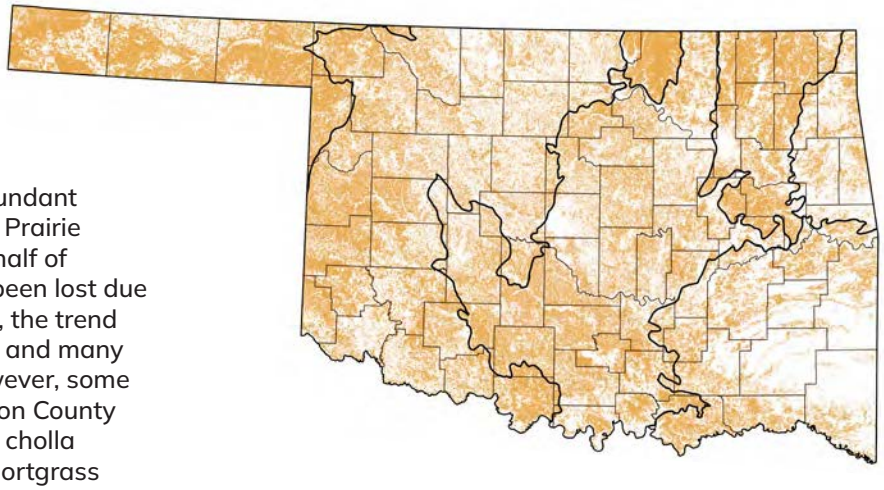
NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated

Grasslands



Ellis County Wildlife Management Area. Photo by Kelly Adams/ODWC.

Within Oklahoma, three types of grassland habitats exist: Shortgrass Prairie, Mixed-grass Prairie, and Tallgrass Prairie habitats.

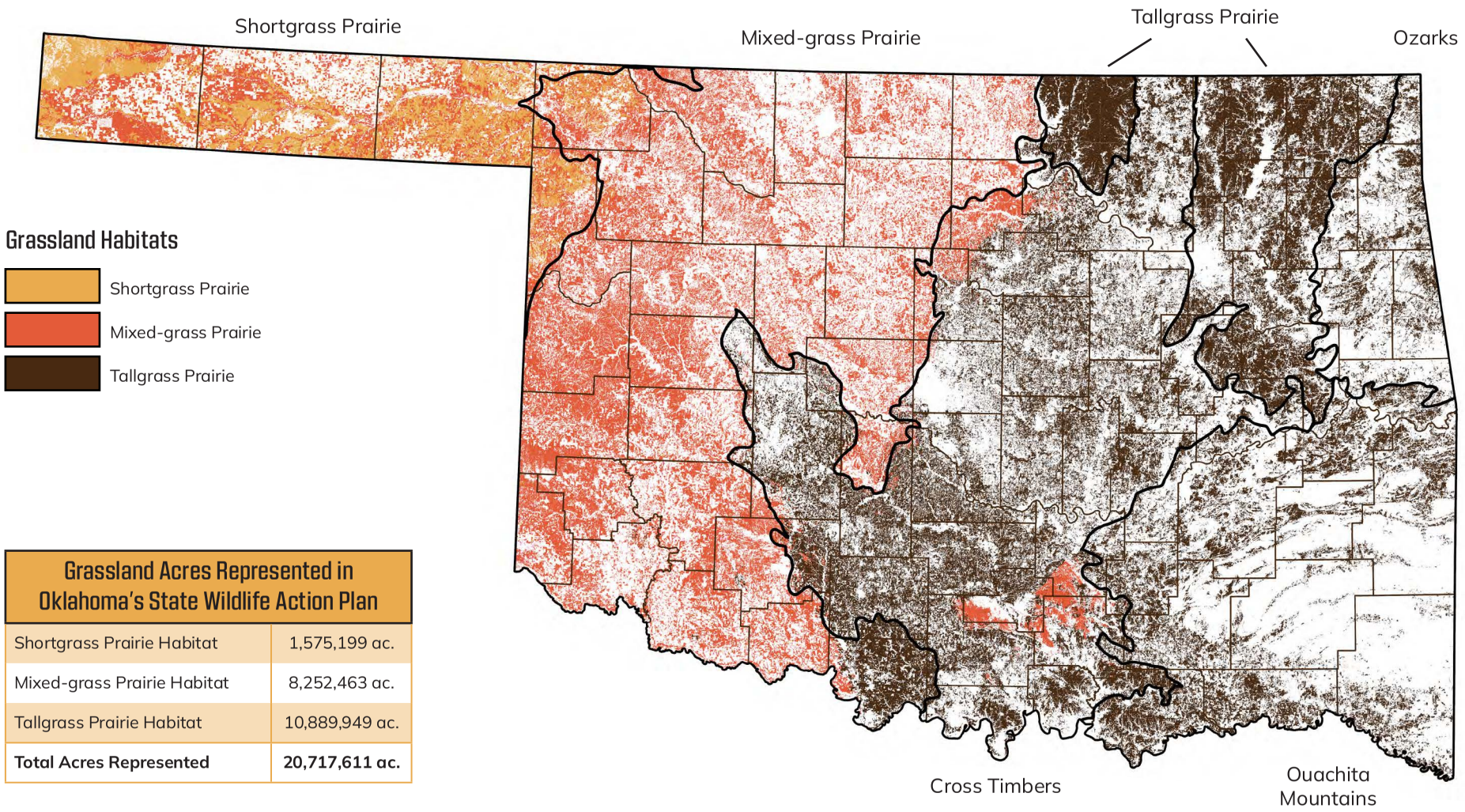


Grasslands occur in all Oklahoma ecoregions. Please note that many of the acres shaded above may be dominated by non-native pasture grasses.

Shortgrass Prairie Habitat

The Shortgrass Prairie Habitat is the most abundant habitat type found throughout the Shortgrass Prairie Ecoregion. Despite its abundance, more than half of Oklahoma's historic shortgrass prairies have been lost due to conversion into agricultural fields. Currently, the trend in the acreage of habitat appears to be stable and many shortgrass prairies are in good condition. However, some modification is occurring in portions of Cimarron County as a result of an increasing abundance of tree cholla (*Cylindropuntia imbricata*). Nearly all of the Shortgrass Prairie Habitat in Oklahoma is found within the Shortgrass Prairie Ecoregion, where it is widespread and often occurs in a matrix with other habitat types.

Shortgrass Prairie habitats are comprised of several herbaceous plant associations including sideoats grama (*Bouteloua curtipendula*), blue grama (*Bouteloua gracilis*), and buffalograss (*Bouteloua dactyloides*) on well drained soils or rocky slopes, blue grama and hairy grama (*Bouteloua hirsuta*) on loamy or sandy soils, and blue grama and buffalograss on clay soils. Other grasses and forbs include scarlet globemallow (*Sphaeralcea coccinea*), blackfoot daisy (*Melampodium leucanthum*), Rocky Mountain zinnia (*Zinnia grandiflora*), ring muhly (*Muhlenbergia torreyi*), prickly pear cactus (*Opuntia spp.*), and yucca (*Yucca spp.*). Vine mesquite (*Panicum obtusum*) and western wheatgrass (*Pascopyrum smithii*) grow in more mesic sites such as the margins of playas. During the past 30 years, many crop fields have been enrolled in the Conservation Reserve Program (CRP) because of the potential for soil loss due to wind erosion. However, most of these acreages have been planted to non-native grasses such as yellow bluestem (*Bothriochloa ischaemum*) or mixed-grass prairie species such as little bluestem (*Schizachyrium scoparium*), instead of to native shortgrass



Grassland Acres Represented in Oklahoma's State Wildlife Action Plan	
Shortgrass Prairie Habitat	1,575,199 ac.
Mixed-grass Prairie Habitat	8,252,463 ac.
Tallgrass Prairie Habitat	10,889,949 ac.
Total Acres Represented	**20,717,611 ac.**

**Please note that many of the acres shaded above may be dominated by non-native pasture grasses.*

Shortgrass Prairie Habitat in Cimarron County. Photo by ODWC.

prairie species.

Recognized Shortgrass Prairie Habitat Vegetation Associations

- 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

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Mixed-grass Prairie Habitat

Mixed-grass Prairie Habitat can be found in three broad Oklahoma Ecoregions: Shortgrass Prairie, Mixed-grass Prairie, and Cross Timbers ecoregions. In each ecoregion, these prairies are dominated by little bluestem and grama grasses.

Within the Shortgrass Prairie Ecoregion, mixed-grass prairies are most often found in rich soils and bottomlands. In addition to little bluestem, sites often have sideoats grama and blue grama. Silver beardgrass (*Bothriochloa laguroides*) and prairie threeawn (*Aristida oligantha*) occur in disturbed sites. Other common grasses and forbs include sneezeweed (*Helenium amarum*), white heath aster (*Symphyotrichum ericoides*), roundleaf bladderpod (*Physaria ovalifolia*), and foxtail barley (*Hordeum jubatum*). This habitat type appears to be more common today than it was historically in the ecoregion because a large acreage of former cropland has been enrolled into the CRP and planted to perennial grasses. These fields resemble mixed-grass prairies in structure, but most of these acreages are dominated by non-native grasses such as yellow bluestem, and many have been planted in areas that were historically vegetated by shortgrass prairies.

The Mixed-grass Prairie Habitat is one of the largest grassland types present in the Mixed-grass Prairie Ecoregion. Here, these prairies can have a diverse composition, but plant communities are often dominated by little bluestem and sideoats grama. These prairies typically include little bluestem, Indiangrass (*Sorghastrum nutans*), blue grama, big bluestem (*Andropogon gerardii*), and switchgrass (*Panicum virgatum*). Silver beardgrass and prairie threeawn often occur on disturbed sites.

Mixed-grass Prairie Habitat at the Wichita Mountains Wildlife Refuge. Photo by Seth Schubert.

Mixed-grass Prairie Habitat at The Nature Conservancy's Four Canyon Preserve. Photo by ODWC.

Other common grasses and forbs include sneezeweed, prairie sunflower (*Helianthus petiolaris*), white heath aster, roundleaf bladderpod, western ragweed (*Ambrosia psilostachya*), Texas croton (*Croton texensis*), narrowleaf purple coneflower (*Echinacea angustifolia*), leadplant (*Amorpha canescens*), Heller's rosette grass (*Dichanthelium oligosanthes*), and foxtail barley. The regionally endemic Oklahoma phlox (*Phlox oklahomensis*) is found in a limited number of mixed-grass prairies in the western sandstone hills and cimarron gypsum hills of northwestern Oklahoma and is one of Oklahoma's Plant Species of Conservation Need. Much of the historic mixed-grass prairie in this region has been converted to other land uses, especially cropland and introduced pasture. Nearly 4,000,000 acres of Mixed-grass Prairie Habitat is thought to remain in the Mixed-grass Prairie Ecoregion, but this is less than 40% of the historic acreage. Mixed-grass prairies have been altered by several factors including fire suppression and heavy year-round grazing. These modifications have facilitated the invasion of prairies by introduced grasses and forbs, and the expansion of the native eastern redcedar (*Juniperus virginiana*).

Most of the Mixed-grass Prairie Habitat found in the Cross Timbers Ecoregion occur locally on upland sites with relatively thin and drought-prone clay soil and are scattered along the region's western edge and southern Arbuckle Uplift. This habitat type is maintained by a combination of soil conditions and periodic fire. Here, the prairies are again dominated by little bluestem and sideoats grama. Other grasses that may be common include big bluestem and blue grama. Forbs are often abundant and include purple poppymallow (*Callirhoe involucrata*), white heath aster, and dotted blazing star (*Liatris punctata*). Despite the limited distribution of mixed-grass prairies within the Cross Timbers Ecoregion, the acreage comprised of has changed little during the past decade.

Recognized Mixed-grass Prairie Habitat Vegetation Associations

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

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Tallgrass Prairie Habitat

Tallgrass prairies were historically the most common grassland type in Oklahoma, and they still occur in five of Oklahoma's ecoregions: the Tallgrass Prairie, Mixed-grass Prairie, Cross Timbers, Ozark and Ouachita Mountains ecoregions. Tallgrass Prairie Habitat is known for having a rich diversity of herbaceous plants and more than 700 species of grasses, forbs, and other plants occur within these communities. It's common for as many as 100 species to occur in a single acre of well-managed tallgrass prairie. Wherever they occur in the state, tallgrass prairies are dominated by four characteristic grass species: big bluestem, Indiangrass, switchgrass, and little bluestem, alongside dozens of other grasses and forbs or wildflowers. In general terms, the tallgrass prairie occupies the transition zone between the vast deciduous forests of the eastern United States, and the prairies of the Great Plains. To the east and south, the tallgrass prairies of Oklahoma merge into oak woodlands, while to the west they transition into mixed-grass prairies. Tallgrass prairies typically develop on sites that have deep, dark-colored, fine-textured, clayey soils derived from shale and limestone, while oak-dominated woodlands and forests occur on sites where the soils are light-colored, course-textured, and derived from reddish or yellowish sandstones. Small tracts of tallgrass prairies also occur locally in western Oklahoma in silty and sandy alluvial soils in the floodplains of rivers and ancient dunes.

Although tallgrass prairie communities may seem uniform at first glance, ecologists and soil scientists recognize many unique variations. One of these is the blackland prairie which is comprised of a few pockets of dark, alkaline clayey soils in southeastern Oklahoma. In parts of eastern Oklahoma, including the Arkansas River Valley, there are unique tallgrass prairies locally referred to as pimpled prairies. These prairies have typical tallgrass prairie plant communities, but they contain regularly spaced, short, raised mounds of soil that give them an unusual

appearance. These mounds are typically composed of sandy loam soil overlying a small, subterranean patch of clay. Another unique variation of the tallgrass prairie community occurs in scattered locations within the Ozark Plateau and the Arbuckle Mountains on sites with thin, seasonally dry soils that overlie sandstone or limestone rock. These areas are known as glades and function as small tracts of rocky prairie, often surrounded by forest cover.

Historically, tallgrass prairies spanned portions of fourteen states and nearly 150,000,000 acres. In the present day, however, large, unbroken tracts of tallgrass prairie are rare and the largest now exist in the Flint Hills of Oklahoma and Kansas. Historically, tallgrass prairies were distributed across the eastern two-thirds of Oklahoma and covered as much as 9,000,000 acres, approximately 20% of the state. Tallgrass prairies were most abundant and widespread in the north-central and northeastern portions of the state in the area known as the Tallgrass Prairie Ecoregion, where they were the predominant plant community. Tallgrass prairies occurred in the Ozark Ecoregion as well, on sites with deep soils on the level portions of the Springfield Plateau. These prairies were the first sites that were settled and towns like Tahlequah, Stillwell, Jay, and Grove were developed on these prairies. The broad, deep-soiled valleys that separate the ridges of the Ouachita Mountains and the sandstone formations of the Arkansas River Valley also supported extensive tallgrass prairies. Additional tracts of these prairies were distributed in a scattered pattern through the Cross Timbers Ecoregion with the largest tracts over the limestone formations of the Arbuckle Uplift and the Grand Prairies in south-central Oklahoma. While Tallgrass Prairie Habitat may never again sustain huge herds of free roaming American bison (*Bison bison*), and the historic grazing and fire patterns may no longer function on the same massive scale that they once did, the remaining tracts of prairie still function as ecological habitats for many native species.

In addition to the four dominant tallgrass prairie grasses, other plants found in these prairies include purpletop tridens (*Tridens flavus*), composite dropseed (*Sporobolus compositus*), sideoats grama, eastern gamagrass (*Tripsacum dactyloides*), wholeleaf rosinweed (*Silphium integrifolium*), compassplant (*Silphium laciniatum*), leadplant, slimflower scurfpea (*Psoralidium tenuiflorum*), Illinois bundleflower (*Desmanthus illinoensis*), purple prairie clover (*Dalea purpurea*), prairie blazing star (*Liatris pycnostachya*), several species of goldenrods (*Solidago spp.*), roundhead lespedeza (*Lespedeza capitata*), tall lespedeza (*Lespedeza stuevei*), sessileleaf ticktrefoil (*Desmodium sessilifolium*), scarlet Indian paintbrush (*Castilleja coccinea*), ashy sunflower (*Helianthus mollis*), and Maximillian sunflower (*Helianthus maximiliani*). In the eastern quarter of Oklahoma, where annual rainfall is higher, the tallgrass prairie communities include are greater diversity of plants including longspike tridens (*Tridens strictus*), rattlesnake master (*Eryngium yuccifolium*), narrowleaf false dragonhead (*Physostegia angustifolia*), narrowleaf mountainmint (*Pycnanthemum tenuifolium*), Arkansas ironweed (*Vernonia arkansana*), sawtooth sunflower (*Helianthus grosseserratus*), and winecup (*Callirhoe digitata*), rough coneflower (*Rudbeckia grandiflora*), tall blazing star (*Liatris aspera*), pinkscale blazing star (*Liatris elegans*), and white wild indigo (*Baptisia alba*).

Thirty-one Plant Species of Conservation Need (PSCN) occur in tallgrass prairie habitats in some part of the state. This is nearly half of Oklahoma's plant species considered to be of conservation need. Two federally threatened orchid species, the western prairie white-fringed orchid (*Platanthera praeclara*) and eastern prairie white-fringed orchid (*Platanthera leucophaea*), were thought to occur in the wet prairies of eastern Oklahoma but are now presumed to be extirpated from the state. In portions of Choctaw and southern McCurtain counties, there is a narrow band of prairie growing in shallow soil over limestone bedrock that contains pockets of glade-like communities that support two specialized, spring-blooming plants – the golden gladecress (*Leavenworthia aurea*), which is found nowhere else, and the threadleaf bladderpod (*Physaria angustifolia*) that occurs only in Oklahoma and Texas. This limestone-derived band of prairies is noticeable in the spring due to the presence of blooming yellow wild indigo (*Baptisia sphaerocarpa*) plants, which commonly grow in this soil type. Another plant species that is nearly endemic to Oklahoma is the

Tallgrass Prairie Habitat at Deep Fork Wildlife Management Area. Photo by ODWC.

Tallgrass Prairie Habitat in McCurtain County. Photo by ODWC.

Oklahoma beardtongue (*Penstemon oklahomensis*), which is widespread in prairies and open oak woodlands across the Cross Timbers Ecoregion. Other PSCN include Osage Plains false foxglove (*Agalinis densiflora*), earleaf false foxglove (*Agalinis auriculata*), Oklahoma grasspink (*Calopogon oklahomensis*), open-ground whitlowgrass (*Abdra aprica*), Topeka purple coneflower (*Echinacea atrorubens*), Bush's purple coneflower (*Echinacea paradoxa*), wedgeleaf spurge (*Euphorbia longicruris*), prairie beeblossom (*Oenothera triangulata*), tinytim (*Geocarpon minimum*), Wright's dwarfdandelion (*Krigia wrightii*), summer blazing star (*Liatris aestivalis*), Baldwin's milkvine (*Matelea baldwyniana*), Nuttall's pleatleaf (*Nemastylis nuttallii*), rock Indian breadroot (*Pediomelum reverchonii*), prairie flameflower (*Phemeranthus rugospermus*), Missouri groundcherry (*Physalis missouriensis*), stately rose gentian (*Sabatia formosa*), royal catchfly (*Silene regia*), Great Plains ladies' tresses (*Spiranthes magnicamporum*), and buffalo clover (*Trifolium reflexum*).

The distribution and acreage of Oklahoma's remaining tallgrass prairies is poorly known, and current remote sensing technology is limited in its ability to distinguish native grassland from non-native pasturelands. Most tracts of native prairie appear to be small, but often they exist as scattered clusters each of which shares a similar land use history, soil type, and topography. The largest tracks of unplowed tallgrass prairies occur in the Flint Hills region where the shallow, rocky soils are unsuitable for conversion to crop agriculture, and ranching remains the most common land use. The Flint Hills is the only area where tallgrass prairies occur at a scale where they dominate the landscape, but relatively large tracts of prairie remain on ranches in the northeastern and south-central parts of the state. Elsewhere, small prairie tracts remain on conservation lands and in road and utility line rights-of-way, or they exist as hay meadows.

Recognized Tallgrass Prairie Habitat Vegetation Associations

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

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Grasslands
Species of Greatest Conservation Need

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat		
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie
AMPHIBIANS										
Texas Toad *Anaxyrus speciosus*	**Global Status: G5; State Status: S3.** Endemic to the southwestern Great Plains. Locally common in the vicinity of breeding ponds and seasonally flooded wetlands within mixed-grass prairies and mesquite shrublands of southwestern Oklahoma. Typically associated with sandy soils.		•						•	
Crawfish Frog *Lithobates areolatus*	**Global Status: G4; State Status: S4.** Locally common in level, clay-soil prairies and transition zones between bottomland forests and open, grassy habitats in the eastern one-third of Oklahoma. Fossorial throughout most of the year and often tied to crayfish or small mammal burrows. Rarely seen above ground except during the spring breeding season when adults move to seasonally flooded wetlands and breeding ponds.			•	•	•	•			•
Strecker's Chorus Frog *Pseudacris streckeri*	**Global Status: G4; State Status: NR.** Restricted to the south-central United States. Typically tied to sandy areas in tallgrass and mixed-grass prairies across the central one-third of Oklahoma. Uses temporary pools during the spring breeding season and burrows when inactive.		•	•	•				•	•
BIRDS										
LeConte's Sparrow *Ammospiza leconteii*	**Global Status: G5; State Status: S4.** Uncommon and secretive winter resident in tallgrass and mixed-grass prairies. Typically found in tracts with tall standing grass and sparse shrubs. More common in the southern half of the state.	•	•	•	•	•	•		•	•
Mountain Plover *Anarhynchus montanus*	**Global Status: G3; State Status: S2.** Rare summer resident that is restricted to shortgrass prairies and cropfields in the western one-half of the panhandle. During the nesting season it is found in areas with level, clay soils in Cimarron and northwest Texas counties, and often nests in fallow crop fields, winter wheat, and grazed prairies, and prairie dog colonies.	•						•		
Sprague's Pipit *Anthus spragueii*	**Global Status: G3; State Status S3.** Uncommon and secretive spring and fall migrant throughout western and central Oklahoma. During migration, it is solitary or occurs in small flocks and is found most often in heavily grazed or disturbed mixed-grass and tallgrass prairies.	•	•	•	•		•		•	•
Golden Eagle *Aquila chrysaetos*	**Global Status: G5; State Status: S2.** Rare winter resident in grasslands across the state, and more common in western Oklahoma than eastern Oklahoma. A few breeding birds from eastern Canada spend the winter in the Ozark Mountains, and there is small nesting population that resides year-round in the western half of the panhandle.	•	•					•	•	
Short-eared Owl *Asio flammeus*	**Global Status: G5; State Status: S3.** Uncommon winter resident and rare summer resident in shortgrass, mixed-grass, and tallgrass prairies. Occurs locally at sites with tall or dense vegetation.	•	•	•	•	•	•	•	•	•

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		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie
Burrowing Owl *Athene cunicularia*	**Global Status: G4; State Status: S2.** Uncommon summer resident and rare winter resident in shortgrass and mixed-grass prairies. Typically associated with prairie dog colonies, which serve as nesting and roosting sites.	•	•					•	•	
Ferruginous Hawk *Buteo regalis*	**Global Status: G4; State Status: NR.** Uncommon year-round resident and breeding species in the shortgrass prairies of the panhandle counties, and an uncommon winter resident in open grasslands throughout the rest of the western half of the state.	•	•					•	•	
Swainson's Hawk *Buteo swainsoni*	**Global Status: G5; State Status: S3.** Widespread summer resident in shortgrass, mixed-grass, and tallgrass prairies across central and western Oklahoma. Occurs in low densities in relatively flat, open landscapes with sparse tree cover.	•	•	•	•			•	•	•
Lark Bunting *Calamospiza melanocorys*	**Global Status: G5; State Status: S1.** Uncommon summer resident in the panhandle where it nests in tracts of mixed-grass prairie. Often, many individuals will nest in close proximity to each other in what seems like a loose colony. During the spring and fall, it migrates through the western one-quarter of the state and some spend the winter in southwestern Oklahoma.	•	•					•	•	
Chestnut-collared Longspur *Calcarius ornatus*	**Global Status: G5; State Status: NR.** Uncommon winter resident in large tracts of shortgrass and mixed-grass prairies. Prefers open prairie with sufficient standing grass cover.	•	•					•	•	
Smith's Longspur *Calcarius pictus*	**Global Status: G4; State Status: NR.** Uncommon and secretive winter resident in mixed-grass and tallgrass prairies. Occurs primarily in disturbed prairie sites and early succession grasslands.		•	•	•	•	•		•	•
Buff-breasted Sandpiper *Calidris subruficollis*	**Global Status: G4; State Status: S3.** Rare spring and fall migrant through mixed-grass and tallgrass prairies. Uses seasonally flooded, burned or grazed prairies as stop-over foraging habitat.		•	•	•		•		•	•
Baird's Sparrow *Centronyx bairdii*	**Global Status: G4; State Status: S3.** Very rare spring and fall migrant in shortgrass and mixed-grass prairies. Documented only twice in Oklahoma in the last 60 years. Presumably occupies stands of relatively tall, dense grass.	•	•					•	•	
Henslow's Sparrow *Centronyx henslowii*	**Global Status: G5; State Status: S2.** Rare summer resident in tallgrass prairies in north-central and northeastern Oklahoma. Small numbers nest in scattered tracts of tallgrass prairie where tall or dense, standing dead vegetation exists in the spring. Migrates through the eastern one-third of the state.			•	•	•	•			•
Yellow Rail *Coturnicops noveboracensis*	**Global Status: G4; State Status: NR.** Rare spring and fall migrant throughout the eastern one-half of the state. Uses damp prairies and shallow, emergent wetlands with dense vegetation as stop-over habitat during migration. Rare winter resident in the West Gulf Costal Plain of extreme southeastern Oklahoma. Overwintering population appears to be dependent on the availability of damp, densely vegetated, tallgrass prairies dominated by grasses and sedges with shallow (<1.5 in) to no standing water.			•		•	•			•
Bobolink *Dolichonyx oryzivourus*	**Global Status: G5; State Status: S2.** Bobolinks occur in Oklahoma only during their spring and fall migrations when the use marshes, haymeadows, and tallgrass and mixed-grass prairies in the eastern four-fifths of the state as stopover habitats.		•	•	•	•	•			•

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		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie
Prairie Falcon *Falco mexicanus*	**Global Status: G5; State Status: S3.** A small (< 15 birds) year-round resident population nests in the western panhandle in the Black Mesa area. During the winter, prairie falcons are widespread but occur in very low densities in prairies and grasslands across western and central Oklahoma.	•	•	•	•			•	•	•
Loggerhead Shrike *Lanius ludovicianus*	**Global Status: G4; State Status: NR.** Occurs in scattered, year-round resident populations in landscapes dominated by prairies and agricultural land where scattered trees provide nesting and perching sites. Found in low densities in open grassland habitats almost statewide except for the Ouachita Mountains. Additional birds migrate to Oklahoma during the winter from more northerly states, and some of our summer residents may migrate southward.	•	•	•	•	•	•	•	•	•
Long-billed Curlew *Numenius americanus*	**Global Status: G4; State Status: S2.** Uncommon summer resident in the western one-half of the panhandle where it nests in shortgrass prairies, playa depressions, and sometimes wheat fields. Long-billed curlews migrate through the western one-half of the state and use herbaceous wetlands and shorelines as stopover habitats.	•	•					•	•	
American Golden-Plover *Pluvialis dominica*	**Global Status: G5; State Status: S2.** Uncommon spring and fall migrant that passes through the eastern three-fourths of Oklahoma. It uses prairies and herbaceous wetlands with short vegetation due to burning, mowing, or grazing as foraging and stopover habitats.	•	•	•	•	•	•		•	•
Thick-billed Longspur *Rhynchophanes mccownii*	**Global Status: G4; State Status: S2.** Uncommon winter resident in the western one-third of the state. It occurs in large, grazed shortgrass and mixed-grass prairies and in areas where tracts of prairie are mixed with winter wheat fields.	•	•					•	•	
Rock Wren *Salpinctes obsoletus*	**Global Status: G5; State Status: NR.** Uncommon year-round resident in sparsely vegetated, rocky shortgrass prairies in the western one-third of the state. A small number of migrant birds spend the winter in quarries and gravel pits in the central one-third of Oklahoma.	•	•					•		
Rufous Hummingbird *Selasphorus rufus*	**Global Status: G5; State Status: NR.** Rare fall migrant that moves quickly through the state. Occasionally observed in the western half of the Oklahoma in tallgrass prarires where woody cover and fall blooming plants are available.		•							•
Field Sparrow *Spizella pusilla*	**Global Status: G5; State Status: NR.** Year-round residents in tallgrass prairies across Oklahoma except for the panhandle. They are most common in shrublands and edges between woodlands and tallgrass prairies.		•	•	•	•	•		•	•
Greater Prairie-chicken *Tympanuchus cupido*	**Global Status: G4; State Status: S3.** Uncommon and locally occurring year-round resident in large tracts of tallgrass prairie in a few counties in north-central Oklahoma. Most of Oklahoma's population occurs in Tallgrass Prairie Habitat in and adjacent to the Flint Hills region.			•						•
Lesser Prairie-chicken *Tympanuchus pallidicinctus*	**Global Status: G3; State Status: S1.** Uncommon and locally occurring year-round resident that is found in sideoats grama – little bluestem prairies in northwestern Oklahoma, primarily in Beaver, Ellis, and Harper counties.	•	•					•	•	

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		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie
American Barn Owl *Tyto furcata*	**Global Status: G5; State Status: S3.** Uncommon year-round resident in prairies and agricultural landscapes where barns, buildings, gypsum caves or rock outcrops provide nesting and roosting sites. Found primarily in the western one-third of Oklahoma, but small populations occur in prairie habitats almost statewide.	•	•	•	•		•	•	•	•
Bell's Vireo *Vireo bellii*	**Global Status: G5; State Status: S3.** Uncommon summer resident in mixed-grass and tallgrass prairies in the main body of the state. Nests in sand plum and roughleaf dogwood thickets that provide low, dense shrub cover.		•	•	•	•	•		•	•
Harris's Sparrow *Zonotrichia querula*	**Global Status: G5; State Status: NR.** Common winter resident in mixed-grass and tallgrass prairies in central and western Oklahoma. Rare winter resident in the eastern one-quarter of the state and the panhandle.	•	•	•	•		•		•	•
INVERTEBRATES										
a miner bee *Andrena beameri*	**Global Status: GNR; State Status: NR.** Rare and poorly documented miner bee known to occur in Oklahoma, Arkansas, Kansas, and Missouri. It is found in tallgrass prairies in the northeastern corner of the state. This solitary, ground-nesting bee is primarily associated with early-blooming species of tickseeds (*Coreopsis*) and coneflowers (*Echinacea*). It has only been documented twice in Oklahoma, both in Ottawa County.			•						•
a miner bee *Andrena biscutellata*	**Global Status: GNR; State Status: NR.** Rare and poorly documented miner bee known to occur in Oklahoma, Kansas, and Texas. Only two records exist for this species in Oklahoma, one from the tallgrass prairies of the Arbuckle Mountains in Murray County and one from the mixed-grass prairies of the panhandle in Texas County. The individuals were documented on Engelmann's daisy and yellow plainsman respectively. Typically associated with blanketflowers (*Gaillardia*).	•			•				•	•
a miner bee *Andrena brevicornis*	**Global Status: GNR; State Status: NR.** Rare spring-season miner bee that occurs in mixed-grass prairies. Plant associations are not fully understood, but species has been recorded on plants in the mustard family (*Brassicaceae*), pea family (*Fabaceae*), poppy family (*Papaveraceae*), and sumac family (*Anacardiaceae*). This species is not in NatureServe, but was recently documented in Oklahoma and is known to occur in Texas.		•						•	
a miner bee *Andrena dapsilis*	**Global Status: GNR; State Status: NR.** Rare, early spring miner bee that is known from mixed-grass prairies in the southwestern quarter of the state. Typically associated with plants in the mustard family, such as pepperweeds (*Lepidium*) and bladderpods (*Physaria*).		•						•	
a miner bee *Andrena trapezoidea*	**Global Status: GNR; State Status: NR.** Rare miner bee found in mixed-grass prairies in the western one-third of the state. It is only active in the early spring, typically in association with plants in the mustard family, such as bladderpods.		•						•	
a wool-carder bee *Anthidium michenerorum*	**Global Status: G2; State Status: S1.** Rare bee species that is restricted to prairie habitats. This bee has very few records in the state, all of which occurred in Blaine County of west-central Oklahoma. Associated with plants in the pea family (*Fabaceae*), such as milkvetch (*Astragalus*) and breadroots (*Pediomelum*).		•						•	

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		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie
Fedor Digger Bee *Anthophora fedorica*	**Global Status: G2; State Status: NR.** Uncommon and poorly documented bee found in the Southern Great Plains. Oklahoma's occurences are in Texas, Love, Carter, and Comanche counties. This bee has been reported on various plants including prickly pears (*Opuntia*), evening primroses (*Oenothera*), larkspurs (*Delphinium*), and specifically on curvepod fumewort (*Corydalis curvisiliqua*) in Oklahoma.	•	•		•			•	•	•
Arogos Skipper *Atrytone arogos*	**Global Status: G2; State Status: S3.** Uncommon and easily overlooked butterfly that occurs locally in relatively undisturbed mixed-grass and tallgrass prairies throughout the main body of the state except for the southeast. Appears to favor big bluestem as its larval host plant.		•	•	•	•			•	•
Southern Plains Bumble Bee *Bombus fraternus*	**Global Status: G3; State Status: S2.** Uncommon, but widespread bumble bee with records in shortgrass, mixed-grass and tallgrass prairies across most of the state. Associated with milkweeds (*Asclepias*), prairie clovers (*Dalea*), blazing stars (*Liatris*), sweetclovers (*Melilotus*), prairie coneflowers (*Ratibida*), and goldenrods (*Solidago*).	•	•	•	•			•	•	•
American Bumble Bee *Bombus pensylvanicus*	**Global Status: G3; State Status: S5.** Common and widespread bumble bee found statewide in wide range of habitats including shortgrass, mixed-grass and tallgrass prairies. Appears to be in decline in the northern parts of its range outside of Oklahoma. Associated with a variety of plants such as milkvetchs, thistles (*Cirsium*), dogwoods (*Cornus*), prairie clovers, coneflowers, sunflowers (*Helianthus*), blazing stars, rosinweeds (*Silphium*), nightshades (*Solanum*), trefoils (*Trifolium*), and vetches (*Vicia*).	•	•	•	•	•	•	•	•	•
Variable Cuckoo Bumble Bee *Bombus variabilis*	**Global Status: G1; State Status: SH.** Extremely rare bumble bee that is possibly extirpated from Oklahoma. It has not been seen in the state since 1975 and its current distribution is unknown. This is an obligate nest parasite that lays its eggs in nests of other bumble bee species. Associated with coneflowers, sunflowers, trefoils, and hyssops (*Agastache*).		•		•				•	•
an underwing moth *Catocala frederici*	**Global Status: G3; State Status: NR.** Uncommon moth that reaches the northeastern limit of its range in southwestern Oklahoma. It appears to be associated with mixed-grass prairies, but its habitat needs are incompletely known. Larva are believed to feed on various on oaks (*Quercus*).		•						•	
Married Underwing *Catocala nuptialis*	**Global Status: G3; State Status: NR.** Widespread moth found primarily in high-quality tallgrass prairies in the Midwest. Oklahoma is on the southwestern edge of its range. Known to occur in association with false indigos (*Amorpha*), including leadplant as larval host plants.		•	•	•					•
Outis Skipper *Cogia outis*	**Global Status: G3; State Status: S2.** Uncommon and locally occurring butterfly that appears to be dependent upon prairie acacia (*Acaciella angustissima*) as its larval food plant. Oklahoma records are in tallgrass and mixed-grass prairies in the southwestern, central, and northeastern parts of the state. Adults are active in the spring through mid-summer.		•		•	•			•	•
Monarch *Danaus plexippus*	**Global Status: G4; State Status: NR.** Widespread, migratory butterfly that occupies a wide range of habitats including mixed-grass and tallgrass prairies. Monarchs are uncommon in Oklahoma during the spring and summer, but large numbers migrate through the state in the fall. Uses several milkweeds as larval host plants, especially green milkweed (*Asclepias viridis*).		•	•	•	•	•		•	•

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		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie
Loamy-ground Tiger Beetle *Dromochorus belfragei*	**Global Status: GNR; State Status: NR.** Tiger beetle that can be locally common in tallgrass and mixed-grass prairies with clayey soils and sparse vegetation in central and western Oklahoma. Endemic to the Southern Great Plains, but its distribution is incompletely documented.		•		•				•	•
Ruidoso Snaggletooth *Gastrocopta ruidosensis*	**Global Status: G1; State Status: NR.** Microsnail with only two Oklahoma records in shortgrass prairies around Black Mesa. State is poorly sampled for microsnails.	•						•		
a snaggletooth snail *Gastrocopta sterkiana*	**Global Status: G2; State Status: NR.** Microsnail with very few records in Oklahoma. Thought to occur in xeric prairies with exposed bedrock, such as the Flint Hills in the northeastern corner of the state. Appears to be common and widespread in Texas, where sampling has been more extensive. Lacking information on species habitat associations.	•	•	•	•			•	•	•
Prairie Mole Cricket *Gryllotalpa major*	**Global Status: G3; State Status: S2.** Uncommon cricket that occurs in scattered, local populations within intact tallgrass prairie habitat in central and northeastern Oklahoma. Most common in the Flint Hills, but its full geographic range is incompletely known.			•	•	•				•
Wax Coil Snail *Helicodiscus nummus*	**Global Status: GNR; State Status: NR.** Microsnail with few records scattered throughout Oklahoma. Common species in Texas, where it has an S4 state rank. Species is possibly extirpated in Arkansas, where it has an SH state rank.		•	•	•				•	•
Dotted Skipper *Hesperia attalus*	**Global Status: G3; State Status: S3.** Uncommon and locally occurring butterfly found in tallgrass and mixed-grass prairies of central and western Oklahoma. Appears to use fall witchgrass (*Digitaria cognata*) and sideoats grama as primary larval host plants. Adults will use various nectar plants including milkweeds and thistles.		•	•	•				•	•
Ottoe Skipper *Hesperia ottoe*	**Global Status: G3; State Status: S2.** Widespread, but uncommon butterfly in the Great Plains where it occurs in mixed-grass and tallgrass prairies. Oklahoma lies at the southern edge of its range and it is found in the north-central and northwestern parts of the state. Prairie specialist that uses fall witchgrass, little bluestem, and big bluestem as larval host plants. Adults will actively nectar on various plants including prickly pears, milkweeds, blazing stars, coneflowers, thistles and sunflowers.		•	•	•	•			•	•
Sage Sphinx *Lintneria eremitoides*	**Global Status: G2; State Status: NR.** Rare moth known from Kansas, Missouri, Oklahoma and Texas. Appears to occur in sandy, mixed-grass prairies where sages (*Salvia*) are present. Catepillars consume sage leaves and adults will nectar on a variety of deep-throated flowers. Believed to have two broods per year: one in the spring and one in late summer.		•						•	
a leafcutter bee *Megachile amica*	**Global Status: G2; State Status: NR.** Rare leafcutter bee endemic to the Southern Great Plains. It reaches the northern limit of its range in the mixed-grass prairies of western Oklahoma. Species is possibly extirpated from its historic range in Texas and Kansas, as the only 21st century records are from Oklahoma. It is active in the spring and early summer and presumed to be associated with prickly pears. Its biology is poorly known.		•						•	

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Robust Sunflower Leafcutter Bee *Megachile fortis*	**Global Status: G2; State Status: NR.** Rare, but widespread leafcutter bee that occurs across the Great Plains and much of central North America including central and western Oklahoma. Species has also been recorded in Rogers County in northeastern Oklahoma, which is the easternmost observation in the state. Primarily a prairie species associated with sunflowers.		•	•	•				•	•
a leafcutter bee *Megachile oenotherae*	**Global Status: G2; State Status: NR.** Rare leafcutter bee of grasslands in the southeastern United States. This species is active in early through mid-summer and typically found in association with evening primroses, but may also visit ceanothus (*Ceanothus*) and beardtongues (*Penstemon*). Only known from threes occurrences in Oklahoma in Pottawatomie, Cleveland, and Canadian counties.		•		•				•	•
Cohn's Spur-throated grasshopper *Melanoplus cohni*	**Global Status: GNR; State Status: NR.** Endemic to the Ouachita Mountains of southeastern Oklahoma. Uncommon short-horned grasshopper that occurs in tallgrass prairies. Species has been documented in Latimer, Le Flore, McCurtain, and Pushmataha counties.						•			•
a spur-throated grasshopper *Melanoplus decurvus*	**Global Status: GNR; State Status: NR.** Rare short-horned grasshopper only known to occur in Atoka and Bryan counties of southeastern Oklahoma. Appears to be associated with tallgrass prairies.				•					•
Oklahoma Spur-throat Grasshopper *Melanoplus oklahomae*	**Global Status: G2; State Status: S4.** Endemic to the Ouachita Mountains and the adjacent portion of the Cross Timbers Ecoregion. Locally common short-horned grasshopper found in tallgrass prairies in southern Oklahoma.				•		•			•
a callirhoe bee *Melissodes intortus*	**Global Status: GNR; State Status: NR.** Rare bee found in tallgrass and mixed-grass prairies in central and western Oklahoma. It appears to be active from May through July and is found in association with poppymallows (*Callirhoe*).		•		•				•	•
American Burying Beetle *Nicrophorus americanus*	**Global Status: G3; State Status: S1.** Federally listed threatened. Uncommon to rare beetle, but widespread in the eastern one-half of Oklahoma. Occurs in tallgrass prairies, but is absent from areas with shallow or rocky soils. More common in the northern two-thirds of the state and less common in the southern one-third.			•	•					•
University Nomia *Nomia universitatis*	**Global Status: G3; State Status: NR.** Uncommon bee found in shortgrass and mixed-grass prairies in the Northern Great Plains. Only recently documented in Oklahoma, where the species is at the southern edge of its range. Appears to be associated with plants in the pea family, such as milkvetches and scurfpeas (*Psoralidium*).	•						•		
Rattlesnake Master Borer Moth *Papaipema eryngii*	**Global Status: G2; State Status: S1.** Uncommon moth that is dependent upon rattlesnake master, the host plant for its larvae which bore into the stems and roots. Presumed to occur in moist tallgrass prairies where its host plant is common. Adults are nocturnal, short-lived and difficult to document. Adult feeding habits of this species are unknown.			•			•			•

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Vernonia Borer Moth *Papaipema limpida*	**Global Status: G3; State Status: NR.** Uncommon moth that is restricted to moist tallgrass prairies in the northeastern corner of the state. This species appears to be dependent upon ironweeds (*Vernonia*), especially giant ironweed (*Vernonia gigantea*), Missouri ironweed (*Vernonia missurica*), and Baldwin's ironweed (*Vernonia baldwinii*). Larvae will feed within the stems and roots. This species is difficult to document as adults are nocturnal and short-lived. The only known records in Oklahoma are from Osage, Payne, and Washington counties.			•	•					•
a fairy bee *Perdita jonesi*	**Global Status: GNR; State Status: NR.** Rare fairy bee that was only recently documented in Oklahoma. It is thought to be associated with tallgrass prairies in the Cross Timbers Ecoregion. Very little is known about its biology, but it is active in early summer and is likely a pollen specialist on beebalms (*Monarda*).				•					•
Swift Tiger Beetle *Parvindela celeripes*	**Global Status: G3; State Status: S4.** Small tiger beetle that can be locally common, but its distribution is incompletely known. Often associated with dry, sparsely vegetated mixed-grass prairies and tight gypsum or clayey soils.		•						•	
Proud Sphinx *Proserpinus gaurae*	**Global Status: GNR; State Status: NR.** Very rare sphinx moth that depends upon evening primroses as its larval food plant. All recent records for this species have been documented in grasslands in south-central Oklahoma.		•		•				•	•
a miner bee *Protandrena kansensis*	**Global Status: GNR; State Status: NR.** Species not profiled in NatureServe. Rare miner bee known primarily from tallgrass prairie habitats in the Flint Hills region of Kansas. Species range in Oklahoma is largely unknown, with the only record occurring in Cleveland County. Little is known about its plant associations, but it has been documented on broomweeds (*Amphiachyris*).			•	•					•
Regal Fritillary *Speyeria idalia*	**Global Status: G3; State Status: S1.** Uncommon butterfly found in tallgrass prairies and is only known to occur at a few locations along the Kansas border in the north-central part of the state. It uses several species of violets (*Viola*) as larval food plants, but primarily prairie violet (*Viola pedatifida*) which is rare in Oklahoma. The state sits at the southern edge of its wide distribution.			•						•
a shortface sweat bee *Sphecodosoma pratti*	**Global Status: GNR; State Status: NR.** Rare bee endemic to the southern High Plains of Texas and Mexico. It has been documented in Caddo County in southwestern Oklahoma, which is the northernmost limit of its range, and is known to occur in a few dry, sandy mixed-grass prairie sites. Species is associated with bristly nama (*Nama hispidum*), but has also been observed on bladderpods.		•						•	
A long-horned bee *Tetraloniella paenalbata*	**Global Status: GNR; State Status: NR.** Uncommon, but widespread through the High Plains. It has been documented in Cleveland and Woodward counties in Oklahoma. Species appears to be a specialist on nineanther prairie clover (*Dalea enneandra*), but may utilize other prairie clovers species in the vicinity of *D. enneandra*.	•	•					•	•	
Lichen Grasshopper *Trimerotropis saxatilis*	**Global Status: G3; State Status: NR.** Well-camouflaged grasshopper that occurs in prairie habitats where glades or exposed rock is present, usually among lichens. In Oklahoma, it is typically associated with eastern mountain glades in the Ozarks and Ouachitas, the Wichita Mountains, and the Arbuckles.		•	•	•	•	•			•

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MAMMALS										
Yellow-faced Pocket Gopher *Cratogeomys castanops*	**Global Status: G5; State Status: S2.** Uncommon and found primarily in Cimarron County in the Oklahoma panhandle. Very few records exist from Beaver and Texas counties. Typically associated with shortgrass and mixed-grass prairies, but will also use agricultural land and roadside ditches. Fossorial species that prefers sandy, silty soils and tends to avoid areas with rocky substrates that are not as suitable for burrowing.	•						•	•	
Black-tailed Prairie Dog *Cynomys ludovicianus*	**Global Status: G4; State Status: S3.** Locally occurring in scattered populations across the western half of Oklahoma. Species prefers open, shortgrass and mixed-grass prairies with sparse vegetation and does well in landscapes grazed by cattle.	•	•					•	•	
Baird's Pocket Gopher *Geomys breviceps*	**Global Status: G5; State Status: S4.** Uncommon and locally occurring in the eastern half of Oklahoma with exception to the extreme northeastern corner of the state. Cryptic, fossorial species that occurs in Tallgrass Prairie habitats where sandy, loamy soils are present.			•	•	•	•			•
Woodchuck *Marmota monax*	**Global Status: G5; State Status: S3.** Uncommon but increasing in tallgrass prairies in the Ozark Plateau and north-central Oklahoma. Slowly expanding its range westward and southward into southern Oklahoma.			•		•				•
Crawford's Desert Shrew *Notiosorex crawfordi*	**Global Status: G4; State Status: S3.** Rare and infrequently documented shrew of the southwestern United States and Mexico. Oklahoma lies at the northeastern edge of its range. It is found in xeric shortgrass and mixed-grass prairies in western Oklahoma and is often associated with active and abandoned woodrat (*Neotoma*) nests.	•	•					•	•	
Eastern Harvest Mouse *Reithrodontomys humulis*	**Global Status: G5; State Status: S2.** Uncommon and locally occurring species that has been documented in tallgrass prairie habitats at scattered locations across the eastern half of the state.			•			•			•
Swift Fox *Vulpes velox*	**Global Status: G3; State Status: S1.** Uncommon, but widespread at low density across the Shortgrass Prairie Ecoregion in the Oklahoma panhandle, with most records from Cimarron County. Occurs in open, shortgrass and mixed-grass prairies dominated by grazed grasslands and non-irrigated wheat fields. Species has also been reported in Harper, Ellis, and Roger Mills counties, but their distribution in these counties is unknown.	•						•	•	
REPTILES										
Western Diamond-backed Rattlesnake *Crotalus atrox*	**Global Status: G5; State Status: S4.** Locally common in arid, mixed-grass prairies, including some forest areas in the Arbuckle Mountains. Its distribution is disjointed and tied to rocky, upland sites with sparse or open woody overstory vegetation.				•				•	
Common Lesser Earless Lizard *Holbrookia maculata*	**Global Status: G5; State Status: S4.** Uncommon and locally occurring at scattered locations in the western half of the state. Occurs in tracts of shortgrass and mixed-grass prairie with sparse vegetation and sandy soils.	•	•					•	•	

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat		
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie
Texas Horned Lizard *Phrynosoma cornutum*	**Global Status: G4; State Status: S2.** Locally common within shortgrass, mixed-grass, and tallgrass prairie habitats in the western one-third of Oklahoma. Predominantly occurring in tracts of native grassland with sparse vegetation, sandy soils and bare ground. Historically found across the western two-thirds of the state, but have seen declines in the central and eastern portions of their range. Populations are uncommon, but persist in pockets of quality habitat in these parts of their range in Oklahoma.	•	•	•	•			•	•	•
Long-nosed Snake *Rhinocheilus lecontei*	**Global Status: G5; State Status: S3.** Uncommon, nocturnal and secretive. Fossorial species that is uncommonly encountered, therefore its range in Oklahoma is incompletely documented. Primarily known to occur in shortgrass and mixed-grass prairies in the panhandle and western edge of the state. Typically associated with sandy or gravelly soils that are suitable for burrowing.	•	•					•	•	
Western Massasauga *Sistrurus tergeminus*	**Global Status: G3; State Status: NR.** Uncommon, but widespread in scattered localities across the eastern one-third of the Shortgrass Prairie Ecoregion, the western two-thirds of the Mixed-grass Prairie Ecoregion, and along the Kansas state line in the northernmost portions of Oklahoma. Locally occurring in Shortgrass Prairie, Mixed-grass Prairie, and Tallgrass Prairie habitats, often near water or rocky areas.	•	•	•				•	•	•
Ornate Box Turtle *Terrapene ornata*	**Global Status: G4; State Status: NR.** Widespread terrestrial turtle found almost statewide, with the exception to the extreme southeastern corner of Oklahoma. Common in Shortgrass Prairie, Mixed-grass Prairie, and Tallgrass Prairie habitats, especially where sandy soils are present.	•	•	•	•	•	•	•	•	•
Three-toed Box Turtle *Terrapene triunguis*	**Global Status: GNR; State Status: NR.** Recently elevated from a subspecies to a full species. Common and widespread terrestrial turtle in the eastern half of Oklahoma. Typically associated with forested habitats, but will also use prairies adjacent to wooded areas.		•	•	•	•	•		•	•

Grasslands Conservation Issues and Actions

Four overarching conservation issues have been identified for grassland habitats in Oklahoma: habitat conversion and fragmentation, information gaps, invasive and problematic species, and natural system management and modification.

Wind farm in Woodward County. Photo by ODWC.

Conservation Issue: Habitat Loss and Fragmentation

A large percentage of the state's native Shortgrass Prairie, Mixed-grass Prairie, and Tallgrass Prairie habitats have been lost through the conversion of native grasslands to cropland and non-native grasses, urban expansion, and energy development and production. These land uses directly cause habitat loss and fragmentation, as remaining tracts of prairie are left smaller in size and disconnected from one another. Many prairie-dependent species occur in low densities or have poor dispersal capabilities, often requiring large acreages of habitat to support sustainable populations. As the size of a prairie tract decreases, its quality and suitability for many wildlife species decreases. Cumulatively, these issues reduce the quality and quantity of the habitat and create dispersal or movement barriers for many Species of Greatest Conservation Need (SGCN).

The conversion of native prairie to crop fields and non-native grasslands, such as bermudagrass (*Cynodon dactylon*), decreases connectivity and reduces the quantity and quality of remaining prairie tracts. Reduced size and increased isolation of habitat tracts disproportionately affect SGCN that require large, contiguous acreages of habitat for their home ranges or territories, including the lesser prairie-chicken (*Tympanuchus pallidicinctus*), or those that have limited dispersal and long-distance movement abilities, such as the Texas horned lizard (*Phrynosoma cornutum*) and prairie mole cricket (*Gryllotalpa major*). Conversion of native grasslands may be a less obvious form of habitat change to some but biologically, this practice has greatly reduced species diversity and may help in the dispersal and spread of non-native and invasive plant species.

In areas with relatively level topography and fertile soils, conversion to cropland and domestic pasture grasses has occurred at a scale that is sufficient to alter entire landscapes. These soil conditions are attractive to agricultural land uses such as row crop production, pastureland, and hay fields. The use of center-pivot irrigation has facilitated the conversion of additional acres of prairie habitat. Conversion 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. Through the CRP, more than 250,000 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; however, most fields have been planted to taller grasses that have mixed-grass prairie structural characteristics such as yellow bluestem and little bluestem. This has resulted in the continued fragmentation of native prairie habitats by stands of ungrazed prairie that are not beneficial or suitable to all wildlife.

Prairies may be fragmented by smaller-scale conversions of land with an increasing trend in individuals owning smaller tracts of property. These conversions may include the construction of fences, rural homes, roads, overhead utility lines, utility line rights-of-ways, shelter belts, windmills, and pipelines. Urban and suburban development can cause fragmentation around existing towns with the expansion of such infrastructure. Fences, windbreaks, and tree planting can create a collision hazard for ground-nesting birds like lesser prairie-chicken, serve as pathways for the movement of predators or species that do not commonly inhabit prairies, create linear changes in vegetation structure, and provide locations where eastern redcedars can become established. Additionally, wildlife may disperse tree and

A pump jack in Beaver County. Photo by ODWC.

shrub seeds along fences, creating corridors where woody vegetation can encroach upon remaining prairie habitats. Herbicide use in right-of-way management may reduce the abundance and diversity of native forbs and grasses that are food and habitat for some prairie SGCN. Fragmentation can also be facilitated by changes in landownership. Some inheritance laws make it economically difficult to pass large, intact tracts of land to succeeding generations and directly encourage heirs to divide or sell ranches to entities that may use purchased properties for non-wildlife-friendly purposes. Landowners also have split surface and mineral ownership, resulting in conflicts and the limited ability of surface owners to negotiate the locations of energy development and access roads.

Energy exploration and development further fragment prairie habitats through the construction of access roads, oil and gas wells, wind turbines, surface structures, electric transmission lines, and development pads. This type of fragmentation reduces the quality of habitat for SGCN by creating obstacles for the movement of wildlife across the landscape and triggering avoidance behavior in some species due to the presence of anthropogenic structures or noise generated by these developments. Construction of utility-scale wind energy farms have also created landscape-scale fragmentation across grassland prairies. These turbines and transmission lines may cause direct bird and bat mortalities due to collisions and may also trigger avoidance behavior from species such as the lesser prairie-chicken.

Conservation Actions

- Continue to work with conservation organizations such as the Natural Resources Conservation Service and other land management and technical assistance agencies to promote and prioritize native prairie establishment that address multiple conservation benefits.
- Promote an environmentally sensitive ethic in the ranching community that celebrates working with nature.
  - » Educate landowners on environmentally conscious practices and the benefits of reducing undesirable plants and increasing native grasses and forbs.
- Support the continuation of CRP policies that provide a higher score to lands under new contracts which are planted to native grasses and forbs, and that advocate for increasing the over-seeding of native species in existing and re-enrolled lands.
- Conduct research to facilitate effective methods in restoring grasslands with low forb diversity and prairie habitats that have been planted to introduced species and converted to cropland, pastureland, or enrolled in the CRP.
  - » Research related to the planting and management techniques that help native grasses and forbs compete with established yellow bluestem may also be beneficial.
- Encourage the development of and funding increases for perpetual easement programs, leases, or fee-title land acquisitions from willing sellers, which can place higher quality tracts of prairie under conservation management to proactively conserve populations of rare and declining species.
  - » Expansion of the CRP and State Acres for Wildlife Enhancement (SAFE) Initiative in the Farm Bill and increased funding from this legislation may also help.
  - » Prioritize large, intact and biologically important tracts of prairie habitats for these programs.
  - » Tax incentives and tax relief may motivate landowners to maintain quality prairie that meet the needs of SGCN.
- Modify agricultural loan and cost-share programs that directly or indirectly encourage the conversion of native prairie to crop production or non-native pasture.
  - » Similarly, cost-share programs that encourage the construction of excessive fencing or the planting of shelter belts that could fragment prairies could be modified or eliminated.
- Develop regional landowner organizations that facilitate partnerships between ranchers and conservationists to address issues that threaten both the ranching culture and the natural resource heritage on privately owned landscapes.
  - » Partnerships could be modeled after the Tallgrass Legacy Alliance of the Kansas Flint Hills.
- Develop prairie restoration technical guidance for landowners that enhance the quality and suitability of existing landscapes and benefit SGCN.

  - » 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 privately owned, native prairies and the enhancement of species diversity on degraded grasslands.
- Prioritize crop and pastureland when employing habitat restoration techniques, especially in areas where landowners will expand on an existing tract of prairie or connect two or more fragmented parcels.
- Continue to fund research that evaluates the economic and nutritional advantages of managing native grasses and forbs in ranching operations instead of non-native 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.
- Cooperate with the agricultural community and other conservation-minded partners to develop demonstration areas where landowners can see the results of sustainable grazing practices and successful native prairie restoration techniques that are beneficial for SGCN.
- Conduct research to determine which grazing practices are most sustainable and best balance economic benefits with the maintenance of healthy native prairie habitats.
  - » Recommendations generated by these studies can be published and distributed to landowners.
  - » Additionally, the economic value of nature-based tourism in an intact and complete prairie landscape can be emphasized to landowners and encourage the involvement in the Great Plains Trail, a road-based wildlife-viewing trail that provides travelers with recommended destinations for quality opportunities.
- Develop Best Management Practices for agricultural development, grazing management, erosion control, and herbicide application and provide cost-share funding to encourage landowners to convert cropland to native grassland prairies or implement practices that maintain or improve existing prairie habitat.
- Support legislation that enables large ranches to remain in single-family ownership and be passed down from one generation to the next.
  - » Additionally, encourage land acquisitions and the purchase of conservation easements by nongovernmental organizations (NGOs), like land trusts and The Nature Conservancy to conserve important tracts of prairie habitat.
  - » With that, support increased funding for the grassland conservation component of the Agricultural Conservation Easements Program.
- Coordinate with other agencies and research institutions to develop Best Management Practices to minimize disturbance and the ecological footprint left by road, pipeline, utility line construction, and right-of-way maintenance activities such as herbicide use and mowing.
- Encourage and provide funding for landowners to remove unneeded or abandoned fences and to utilize alternative grazing practices that use patch burning and mineral blocks to control the movement of cattle rather than using fencing.
- Encourage the use of new, sustainable urban development techniques, such as cluster development, that minimize impacts and integrate and protect open space.
  - » Additionally, provide information on SGCN and priority habitats to local, city, and county planners to encourage ecological sustainability.
- Conduct field studies to better understand the impacts of wind and solar farms and oil and gas development on SGCN.
- Encourage the placement of wind farms and oil or gas pads outside of intact, native prairies by modifying tax credits and other incentives. Impact fees and tax disincentives for practices that cause habitat community fragmentation also may be assessed.
- Cooperate with appropriate entities such as energy companies, federal and state agencies, and individual landowners to site energy developments in an intentional manner that will minimize fragmentation of native habitats and have less impact on SGCN.
  - » In the reclamation of surface drilling sites, encourage the use of native grasses and forbs.
  - » Additionally, require on-site or off-site mitigation

A private landowner plants native grass and forb seed in Osage County. Photo by ODWC.

for unavoidable energy development impacts on native prairie habitats.
- Conduct human dimension studies to measure the existing attitudes, opinions and knowledge gaps of landowners, as well as the best ways to reach them with information and advise or incentivize for land management consistent with wildlife conservation.

Crawfish frog. Photo by Owen Edwards.

Conservation Issue: Information Gaps

Existing data are incomplete for some SGCN with respect to their current distributions, ecological needs, and population trends. These deficiencies impede the development and implementation of effective conservation strategies and make it difficult to identify conservation focus areas. Additionally, baseline knowledge regarding the historic and current structural condition, distribution, and community composition of prairie habitats are incomplete. This includes our understanding of where the remaining tracts of shortgrass, mixed-grass, and tallgrass prairies occur in the various ecoregions. To establish effective conservation actions, more complete data and thorough evaluations are needed to determine the factors that limit population sizes or are responsible for apparent population declines.

Conservation Actions

- Continue to review existing literature, reports, and museum records, along with interviews of technical experts to compile historic and recent distributional and ecological information for SGCN.
- Continue surveys and research that establish baseline data on the current distribution, abundance, habitat affinities, and that identify factors that may limit distribution, abundance, and possible population declines of SGCN.
  - » These assessments can be utilized to develop monitoring programs for SGCN to measure abundance, geographic range, and the condition of the habitats on which they depend.
- Create a long-term habitat monitoring program based upon photographic documentation of habitat structure and condition.
  - » Where feasible, locate existing historic photographs and their exact location and use those sites as long-term photo sites for habitat monitoring.
- Identify, prioritize, and map remaining tracts of grassland prairies, areas that have the greatest conservation value, corridors, and habitat conditions to determine where conservation efforts should be directed to increase connectivity and provide the greatest benefit to SGCN.
  - » Maintain and expand large, contiguous tracts of prairies that are of greatest conservation value and identify adjacent areas to protect and restore.
  - » Additionally, conduct inventories to better understand the biological communities these tracts support.
  - » Where appropriate, conservation practices can be identified that could enhance the habitat value of these tracts.
- Identify conservation opportunity areas and develop conservation practices for prairie management, enhancement, and restoration to enhance populations of SGCN through improved habitat conditions or enhanced juvenile recruitment.
- Evaluate and develop biologically meaningful ecological site descriptions with the Natural Resources Conservation Service for the range of grassland prairie communities. Descriptions should include the condition of high-quality prairie grassland habitats and serve as the range of target conditions for prairie restoration, enhancement, and maintenance efforts.
- Provide long-term funding to maintain databases to store and analyze species distributional and ecological data.
- Disseminate the results of published ecological studies to land managers, conservation and natural resource government agencies, municipalities, and NGO partners so that they can be incorporated into site-specific, species-specific, and regional conservation plans, including future revisions of the Oklahoma State Wildlife Action Plan (SWAP).

Conservation Issue: Invasive and Problematic Species

Due to changes in historic burning and grazing regimes, as well as other factors, invasive and non-native species have become widely established prairie habitats. These species have displaced more beneficial native vegetation

and lowered diversity. In the past, invasives may have been promoted by conservation agencies and organizations to control erosion, improve livestock forage and wildlife habitat, and to be used in beautification programs. Invasive species can be difficult to manage and some practices like herbicide application may have detrimental impacts to the non-target plants if not carried out with caution. Introduced grasses and forbs such as yellow bluestem, Johnsongrass (*Sorghum halepense*), perennial ryegrass (*Lolium perenne*), prickly Russian thistle (*Salsola tragus*), sweetclover (*Melilotus officinalis*), sericea lespedeza (*Lespedeza cuneata*), and several species of Asiatic bromes (*Bromus spp.*) have become widespread across prairie habitats. These species have displaced more beneficial, native vegetation and have altered the structural components of these landscapes. Some species, including prickly Russian thistle and yellow bluestem, have spread into prairies from neighboring disturbed agricultural fields. Many of the lands enrolled in the CRP have been planted to non-native grasses, primarily yellow bluestem, which has also facilitated their expansion. These introduced pastures are often overutilized during times of prolonged drought or are chronically overgrazed, creating an additional avenue for expansion. Additionally, some species have expanded from disturbed roadsides, abandoned cropland, and pipeline rights-of-ways.

Similarly, invasive woody vegetation including native eastern redcedar, winged elm (*Ulmus alata*), honey locust (*Gleditsia triacanthos*), and black locust (*Robinia pseudoacacia*), and non-native Siberian elm (*Ulmus pumila*), Callery pear (*Pyrus calleryana*), and Chinese privet (*Ligustrum sinense*) have become widely established in prairie landscapes. In areas where prescribed fire is absent, they can easily displace and shade native prairie grasses and forbs, thus creating a form of habitat conversion at a localized scale. The presence of these taller, woody plants can substantially alter the structure of grasslands and reduce the habitat's quality for SGCN, such as grassland-dependent birds and mammals. Beyond invasive plants, invasive and non-native animals have been allowed to further invade native prairies. Livestock grazing may enhance local populations of brown-headed cowbirds (*Molothrus ater*), a native bird that parasitizes the nests of other birds. The potential impact of established non-native ring-necked pheasants (*Phasianus colchicus*), as a competitor of native birds is unknown but may also pose as a threat. Songbird SGCN that may be affected include the prairie warbler (*Setophaga discolor*), Bell's vireo (*Vireo bellii*), and Bachman's sparrow (*Peucaea aestivalis*).

Conservation Actions

- 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.
  - » Develop early detection surveillance programs for invasive species and work with the Oklahoma Invasive Plant Council and Oklahoma State University Extension Service to develop and promote educational materials to help landowners and sportsmen identify and report potentially invasive species.
  - » Improve coordination between wildlife biologists, conservation agencies, and agricultural organizations to facilitate information sharing about the negative impacts of non-native and invasive plants.
- Provide funding for research on improving the success rates of native prairie establishment and to determine the most effective methods in eliminating and controlling yellow bluestem and sericea lespedeza.
  - » Remove federal funding from research that develops strains or hybrids of non-native plants that may become invasive, including bermudagrass and turf from other countries.
  - » Support congressional or regulatory action to reclassify these plants as noxious species in the Southern Tallgrass Prairie Region of the United States, where they are the greatest invasive and non-native threat to native rangelands.
- Modify erosion control and CRP guidance by the Natural Resources Conservation Service, Oklahoma State University Cooperative Extension Service and their county offices to eliminate the planting of undesirable, non-native species and increase desirable forbs and grasses.
  - » Support policies and specifications that prohibit the use of yellow bluestem and weeping lovegrass and that require the use of only

Sericea lespedeza. Photo by Dendroica cerulea/CC BY-NC-SA 2.0.

Ring-necked pheasant. Photo by Zachary Handke.

native grasses and forbs in new enrollments.
  - » Landowner outreach, including information about identification and control of invasive species and recommendations for modifying grazing, plowing, and mowing practices, can help prevent the spread or establishment of non-native invasive species.
  - » Furthermore, develop financial incentives for landowners willing to eliminate of yellow bluestem and replant existing program acreage to native grasses such as grama grasses and buffalograss.
- Conduct pilot studies to determine successful management and eradication strategies for non-native and invasive species.
  - » With these data, develop and implement management plans outlining methods for controlling or eliminating invasive and non-native plant species on all public conservation lands.
  - » These areas can be used as demonstration sites that showcase the results of management activities and their economic and ecological benefits to wildlife and ranchers and encourage the implementation of invasive species control.
  - » Along with this, provide technical guidance and recommended practices to landowners for invasive species management and use of techniques beyond herbicide.
- Provide financial assistance and cost-share funding to landowners who work to control invasive species and are willing to convert cropland, expired CRP fields, and pastureland back to native prairie vegetation.
  - » Develop tax incentives for landowners who maintain high quality native prairie.
  - » Support and encourage the enrollment in incentive programs such as the Oaks and Prairies Joint Venture (OPJV) Grassland Restoration Incentive Program (GRIP) which provides funding to landowners to implement approved management practices that improve grassland bird habitat in tallgrass prairies.
- Develop alternatives to broadcast and aerial spraying as a control measure for non-native plants.
  - » Drone technology may be beneficial in helping facilitate aerial spot treatment.
- Continue to support the use of prescribed burning as a means for controlling the abundance of eastern redcedar in grassland prairie habitats.
  - » Financial and logistical support could be provided to existing prescribed burn associations and to commercial burn teams to make prescribed fire more accessible to landowners.
- Require right-of-way revegetation with native species following the construction of roads, pipelines, and other forms of urban expansion, to discourage the spread of invasive plants.
- Discourage the unintentional dispersal of seeds from non-native grasses and undesirable weeds through the development and promotion of certified hay programs that change the way in which hay is graded and encourage native hay.

Conservation Issue: Modification of Natural Ecosystem Processes

Oklahoma's prairie communities are shaped by the combination of rainfall, periodic fire and seasonal grazing. Rainfall is a relatively fixed variable, and while the amount of rainfall varies from year to year, the long-term annual average is somewhat stable and predictable. Periodic fire and seasonal grazing are much more dynamic natural processes that can and have changed substantially within the past century. The shortgrass prairie communities are characterized by low rainfall (average < 21 inches per year) and their structures are heavily influenced by grazing and less influenced by periodic fire. On the other end of the spectrum, the tallgrass prairies are characterized by relatively high average annual rainfall (> 30 inches), and their structures are much more influenced by periodic fire than by grazing. Mixed-grass prairie communities receive intermediate amounts of rainfall and are influenced more substantially by grazing on the lower end of the rainfall spectrum and by fire on the upper end of the rainfall spectrum.

The periodic burning of prairies as a result of naturally occurring fires is an important and necessary natural process to control the abundance of trees and shrubs. Fires also help maintain the diversity of grasses and forbs by reducing the over-shading of the lower-stature forbs and

grasses by a few tall or aggressive grasses. These fires happen during both the growing season in late summer, and the dormant season in the late fall and winter. In the tallgrass prairies of central and eastern Oklahoma, most acres probably burned at a frequency of every three to five years and fires carried easily in tall dry or dormant grass during droughts and shorter dry periods in the late summer, fall, and winter. Mixed-grass and shortgrass prairies burned less frequently because lower rainfall and higher grazing pressure produced a lower fuel load to carry fires. Historically, mixed-grass prairies probably burned at an average frequency of five to eight years, and shortgrass prairies probably burned every seven to ten years. All prairie species, both plants and animals, have adaptations to periodic fires, but each species responds differently to the timing, frequency, and spatial scale of prescribed burns, and our understanding of these responses is incomplete.

The historic, natural fire regime has been disrupted or nearly eliminated across most of the remaining native prairie tracts. Widespread fire suppression has greatly extended the interval between fires. This reduction in regular burning has fostered an increase in the abundance and dominance of eastern redcedar, winged elm, and other prolific woody plants on many prairies and has facilitated an increase in the fuel load such that the risk of wildfires has increased. Fire suppression and the resulting reduction in the frequency of fires is a widespread concern in mixed-grass and tallgrass prairie communities throughout the main body of the state. Prescribed burns are fires that are intentionally set and controlled to replicate the benefits of natural fires. However, several limitations discourage landowners from using prescribed burning as a land management tool, including limited financial and personnel capacity to conduct prescribed burns, landowner liability issues, air quality concerns, and limited training and technical assistance for conducting burns. While fires are less frequent than they were historically across most of the state, the tallgrass prairies in the Fint Hills are experiencing the opposite pattern. Many landowners set fires almost annually in the Flint Hills during the late winter and early spring as a method for controlling forbs and encouraging a flush of new grass each growing season for the rearing of stocker cattle. This frequency affects forb abundance and diversity as well as the cover available for wintering birds and early spring nesters.

Prairie communities also are shaped by grazing, but current grazing patterns are very different than they were prior to European settlement. Pre-settlement, grazing was seasonal and accomplished by nomadic or migrating herds of bison and pronghorn (*Antilocapra americana*). Today, nearly all grazing is accomplished by domestic cattle and horses, and grazing occurs year-round. Many ranchers use a rotational grazing system that mimics the historic grazing pattern, but others graze their rangeland tracts continuously. Where grazing systems have been altered and the prairies experience continuous grazing, decreases have occurred in the abundance of grazing-sensitive plant species such as big bluestem, eastern gamagrass, leadplant, slimflower scurfpea, and compassplant, while grazing-tolerant grasses and forbs such as purpletop tridens, prairie broomweed (*Amphiachyris dracunculoides*), and sneezeweed now comprise a larger percentage of the plant community. These changes have subtle effects on the food resources and cover available for wildlife in these grasslands. Added to the change of grazing practices, frequent and unpredictable droughts increase the complexity and difficulty that landowners face when making decisions about stocking rates and the management of their livestock's grazing. Vegetation that is produced by many years of careful grazing management can be set back dramatically by just a few years of severe drought, which often results in the overutilization of grasses and forbs.

Some ecologists believe that tallgrass prairies were historically more abundant and widespread in the areas around the Arbuckle Mountains and in a transition zone between the Tallgrass Prairie and Mixed-grass Prairie ecoregions. They hypothesize that more than a century of altered grazing conditions with continuous and heavier grazing may have reduced the average standing biomass of the grasses to the extent that it has diminished the root mass needed to support blade growth and reduced the organic material in the soil. This can reduce soil productivity, the ability of the soil to hold moisture, and the ability of the soil to infiltrate rainwater, which in turn can facilitate the transition of these former tallgrass prairies into little bluestem-dominated prairies that are more tolerant of poorer and drier soil conditions.

Prescribed grazing is a common practice in grassland habitats. Photo by ODWC.

A marked fence in Mixed-grass Prairie Habitat. Photo by ODWC.

Fences often come with the practice of grazing and can create collision obstacles for prairie-dependent species like lesser prairie-chickens. Land use changes and control measures have reduced the number and sizes of black-tailed prairie dog (*Cynomys ludovicianus*) colonies and have isolated many of the remaining colonies. Further, broadleaf herbicide treatments have reduced the abundance of native forbs, and thus reduce the food resources available for insects, birds, reptiles, and small mammals.

Broadleaf herbicides are increasingly available to landowners and are used frequently to control weedy species and native species perceived to be weedy or competitors with grasses. These applications reduce the abundance and diversity of native forbs in each prairie community, including species not traditionally considered to be weeds. This has many subtle ripple effects on the ecology of these prairies including a lower production of the seeds and insects on which wildlife populations depend. The results of these herbicide applications are prairie tracts are less diverse and dominated by a few species of native grasses and are therefore less valuable as wildlife habitat. The aerial spraying of broadleaf herbicides is widely practiced across the tallgrass and mixed-grass prairie regions and often is not used strategically or discriminatingly to target problematic species because some landowners do not have the training or the tools that they need to distinguish those forbs that are highly palatable and beneficial from those that are not. The result is that beneficial and palatable forbs are lost or greatly diminished in abundance, which affects both the livestock and wildlife. With a similar motivation, chemical controls have been used on insects and mammals that are potential competitors with livestock. Insecticides have been applied on a broad scale to control grasshopper pests, and poisons have been applied to black-tailed prairie dog colonies to eradicate or control them. These chemical control measures can have community-level effects over a large area and the loss and fragmentation of prairie dog colony complexes can have a detrimental effect on several SGCN including the burrowing owl (*Athene cunicularia*), mountain plover (*Anarhynchus montanus*), ferruginous hawk (*Buteo regalis*), golden eagle (*Aquila chrysaetos*), and swift fox (*Vulpes velox*).

Conservation Actions

- Short-term grazing leases can be purchased to temporarily remove livestock or reduce the stocking rates on over-utilized rangeland in a manner that still provides income to landowners as their rangeland quality improves.
- Develop technical and financial assistance programs for landowners to encourage grazing practices that minimize fencing and increase the structural diversity of rangelands.
- Develop a conservation easement program to work with landowners to maintain high quality examples of grassland prairie habitat.
- Provide funding for burn schools to train members of local prescribed fire cooperatives.
  - » Work with experienced prescribed burning organizations and contractors to develop informational materials that increase landowner awareness and use of prescribed burning.
- Develop demonstration areas to showcase the economic and ecological benefits that can be achieved by implementing prescribed grazing and fire programs. These sites can serve as training locations for fire and grazing management workshops for ranchers and landowners.
  - » Demonstration sites should be developed regionally and tailored to specific regions and prairie communities with different seasonal rainfall and humidity patterns to better benefit local SGCN.
  - » Along with this, develop technical guidance and recommended practices for grazing management and the use of prescribed fire.
  - » Encourage the participation in existing workshops held by organizations like the OPJV.
- Promote the enrollment in conservation programs such as GRIP, which provides funding to landowners to implement management practices that improve grassland bird habitat in tallgrass prairies.
  - » In Oklahoma, the most common practices utilized by landowners in this program are prescribed grazing, fire and brush management.
- Promote or expand other conservation programs providing economic incentives to continue conservation efforts for black-tailed prairie dogs and other SGCN.

- Develop economic incentives and programs to provide payments to landowners in return for maintaining or restoring black-tailed prairie dog colonies.
  - » As part of this development, the distribution of black-tailed prairie dog colonies should be identified, and core areas can be prioritized to enhance complex development and better conserved prairie dogs and their associated SGCN.
- Conduct research into holistic grazing systems, such as adaptive grazing, that aim to mimic historic grazing patterns, retain biodiversity, and improve ecosystem condition and function on remaining tracts of prairies. Evaluate the use of mowing, brush-hogging, or late-season haying in developed areas as alternatives to conducting prescribed burns in order to maintain prairies.
- Evaluate the use of mowing, brush-hogging, or late-season haying in developed areas as alternatives to conducting prescribed burns in order to maintain prairies.
- Develop fire-grazing management programs that promote landscape heterogeneity such as patch-burning, rather than the currently used practices that promote uniformity and thus low natural diversity.
- Eliminate cost-sharing programs that encourage the non-selective use of herbicides that lower plant diversity.
  - » Instead, educate landowners and right-of-way managers about the negative consequences of herbicides and how to apply these in a targeted way to control invasive plants and problem plants.
- Develop and distribute information to landowners about native plant identification and the benefits and value of native plants to ranching operations.
- Promote and encourage landowners to attend the pesticide spraying education programs available through the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State University Extension Service.
- Establish grazing lease or conservation easement programs that target the protection of large, intact tallgrass prairie tracts.
- Support ranch diversification that will allow ranchers to lower stocking rates and grazing pressure and offset that loss of income with new sources of income from lease hunting, fishing access, and nature-based tourism.
- Promote market-based approaches to add value to products grown or raised using ecologically sustaining tactics.
- Conduct research to evaluate the economic and nutritional benefits compared to losses of using herbicides in the management of grasslands.
  - » Similar comparisons could be made between the economic and nutritional effects of retaining native for diversity in rangelands.
- Provide financial, technical, and equipment support for the development and operation of prescribed burning and fire management associations.
- Encourage private for-profit fire management contractors to increase the capacity for burning in landscapes where fire is lacking.

Potential Indicators for Monitoring the Effectiveness of the Conservation Actions

- Acres conserved through fee-title purchase, conservation easements, conservation ownership or enrolled in other conservation programs
- Number of landowners and total acreage engaged in conservation programs
- Distribution and connectivity of the remaining prairie tracts
- Changes in connectivity of prairie tracts
- Condition and quantity of prairie habitats across the state
- Changes in the relative condition and quality of prairie habitats, such as the diversity of native grasses and forbs, presence of rare or uncommon plant species, and percentage cover by woody plant species
- Changes in the acreage of native, intact or high-quality prairie
- Changes in acreage of non-native or invasive vegetation
- Changes in acreage affected by invasive vegetation
- Number of acres of native plant communities restored, enhanced or converted from non-native to native grasses
- Acres of shortgrass, mixed-grass, and tallgrass prairies restored from former cropland and pasture
- Index of habitat

Prescribed fire conducted at The Nature Conservancy's Joseph H. Williams Tallgrass Prairie Preserve. Photo by ODWC.

fragmentation and isolation of prairie tracts
- Degree of habitat fragmentation based upon an analysis of aerial imagery
- Population sizes, trends and distributions of grassland-dependent SGCN, such as black-tailed prairie dogs and key indicator species like mountain plover, burrowing owl, long-billed curlew (*Numenius americanus*), swift fox, and Texas horned lizard
- Changes in population sizes and trends of SGCN
- Avian point counts with greater diversity and abundance of prairie-dependent birds
- Native plant diversity and number of prairie-dependent plants in prairie tracts
- Changes in plant diversity within tracts of prairie habitat
- Acres of prairie that have undergone prescribed burns
- Acres burned periodically to maintain prairie structure
- Acres periodically burned and under a conservation management plan
- Annual changes in the number of prairie acres burned
- Acres of removed invasive woody vegetation, such as eastern redcedar
- Wildlife and vegetation response to management practices such as prescribed burning, fence removal, and rotational grazing
- Acres of habitat occupied or impacted by utility-scale energy development (e.g. wind and solar farms), large private industry facilities (e.g. factories and data centers), and fossil fuel oil or gas development.
- Changes in the acreage of grassland habitat that is subjected to aerial spraying

Mixed-grass Prairie Habitat at Cimarron Bluff Wildlife Management Area. Photo by ODWC.

Representative Conservation Areas Supporting Grasslands

- Atoka Wildlife Management Area (ODWC)
- Beaver River Wildlife Management Area (ODWC)
- Black Kettle National Grassland (U.S. Forest Service)
- Bluestem Lake and Pahuska Lake (City of Pawhuska)
- Camp Gruber (Department of Defense)
- Chouteau Wildlife Management Area (ODWC and ACOE)
- Cimarron Bluff Wildlife Management Area (ODWC)
- Cimarron Hills Wildlife Management Area (ODWC)
- Copan Reservoir and Wildlife Management Area (ODWC and ACOE)
- Cross Timbers Range Research Station (Oklahoma State University)
- Ellis County Wildlife Management Area (ODWC)
- Fort Gibson Wildlife Management Area (ODWC and ACOE)
- Fort Sill Military Reservation (Department of Defense)
- Four Canyons Preserve (The Nature Conservancy)
- Grady County Wildlife Management Area (ODWC)
- Hackberry Flat Wildlife Management Area (ODWC)
- Hal and Fern Cooper Wildlife Management Area (ODWC)
- Hulah Reservoir and Wildlife Management Area (ODWC and ACOE)
- James Collins Wildlife Management Area (ODWC)
- Kaw Reservoir and Wildlife Management Area (ODWC and ACOE)
- Klemme Range Research Station (Oklahoma State University)
- Lexington Wildlife Management Area (ODWC)
- McAlester Army Ammunition Plant (U.S. Department of Defense)
- J.T. Nickel Family Wildlife Preserve (The Nature Conservancy)
- Oka'Yanahli Preserve (The Nature Conservancy)
- Okmulgee Wildlife Management Area (ODWC)
- Oologah Reservoir and Wildlife Management Area (ODWC and ACOE)
- Osage Wildlife Management Area (ODWC)
- Packsaddle Wildlife Management Area (ODWC)
- Pearl Jackson Cross Timbers Preserve (The Nature Conservancy)
- Pontotoc Ridge Preserve (The Nature Conservancy)
- Rita Blanca National Grassland (U.S. Forest Service)
- Salt Plains National Wildlife Refuge (USFWS)
- Sandhills Wildlife Management Area (ODWC)
- Sandy Sanders Wildlife Management Area (ODWC)
- Skiatook Wildlife Management Area (ODWC, ACOE)
- Spavinaw Hills Wildlife Management Area (ODWC)
- Tallgrass Prairie Preserve (The Nature Conservancy)
- Washita National Wildlife Refuge (USFWS)
- Waurika Wildlife Management Area (ODWC and ACOE)
- White Oak Prairie Preserve (The Nature Conservancy)
- Wichita Mountains Wildlife Refuge (USFWS)
- Woolaroc Nature Preserve (Phillips Foundation)

Shrublands

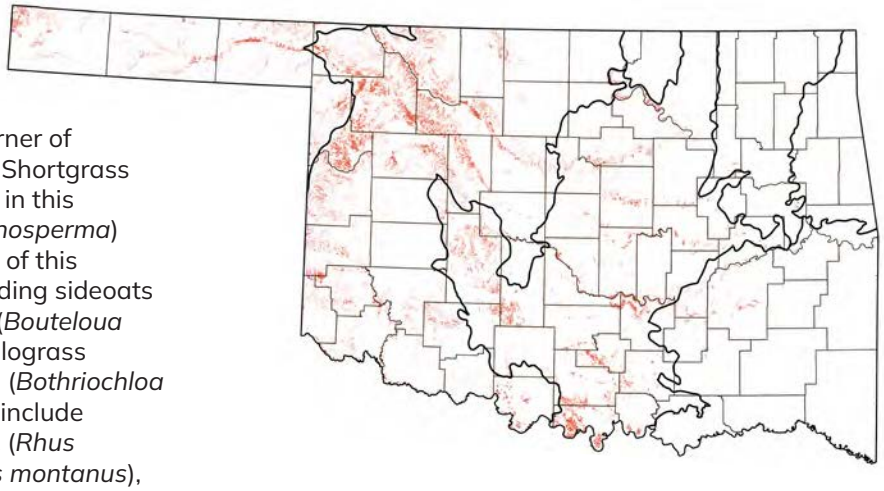
Shinnery Oak Shrubland Habitat at Packsaddle Wildlife Management Area. Photo by ODWC.

Pinyon Pine – Juniper Shrubland Habitat

In Oklahoma, Pinyon Pine – Juniper Shrubland Habitat is found on rocky soils in the Black Mesa area in the northwestern corner of the Oklahoma Panhandle and is unique to the Shortgrass Prairie Ecoregion. The dominant woody plants in this community are oneseed juniper (*Juniperus monosperma*) and pinyon pine (*Pinus edulis*). The understory of this shrubland is dominated by short grasses including sideoats grama (*Bouteloua curtipendula*), hairy grama (*Bouteloua hirsuta*), blue grama (*Bouteloua gracilis*), buffalograss (*Bouteloua dactyloides*), and silver beardgrass (*Bothriochloa laguroides*). Other less common woody plants include clump-forming shrubs such as fragrant sumac (*Rhus aromatica*), mountain mahogany (*Cercocarpus montanus*), Gamble oak (*Quercus gambelii*), and several cacti including tree cholla (*Cylindropuntia imbricata*) and prickly pears (*Opuntia spp.*). Ponderosa pine (*Pinus ponderosa*) occurs in a few canyons. The rare Greene milkweed (*Asclepias uncialis*) and the woodland beargrass (*Nolina greenei*) are Plant Species of Conservation Need that are unique to this habitat. Much of the Pinyon Pine – Juniper Shrubland Habitat is in good to fair condition and the number of acres in this community has been stable in recent decades.

Recognized Pinyon Pine – Juniper Shrubland Habitat Vegetation Associations

- Oneseed Juniper – Pinyon Pine-Grama Woodland



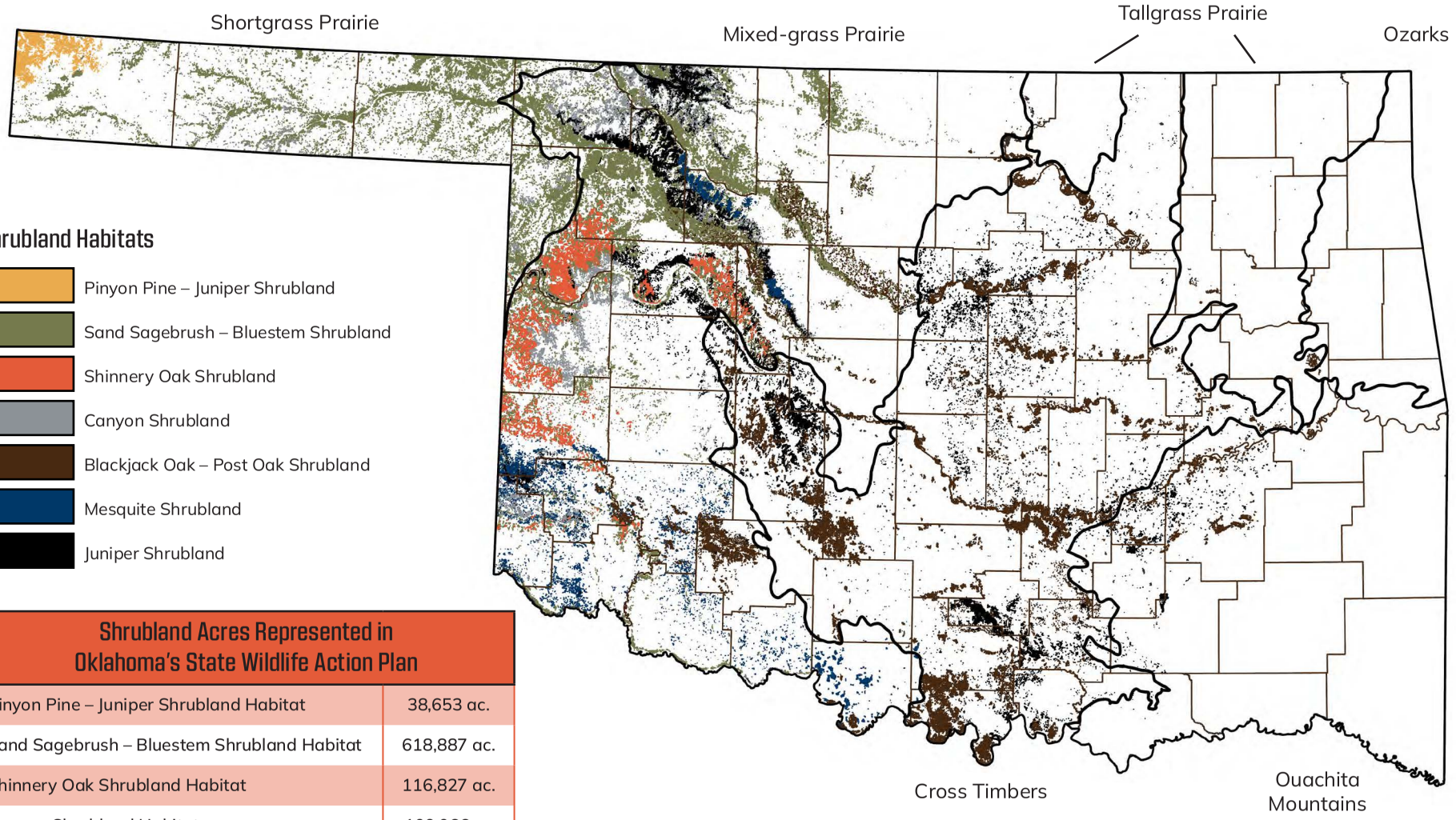
Shrublands occur in Oklahoma's Shortgrass Prairie, Mixed-grass Prairie, and Cross Timbers ecoregions.

- Oneseed Juniper – Grama Woodland
- Ponderosa Pine-Grama – Little Bluestem Woodland

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Sand Sagebrush – Bluestem Shrubland Habitat

Sand Sagebrush – Bluestem Shrubland Habitat can be found in two broad Oklahoma ecoregions, equally divided between the Shortgrass Prairie and Mixed-grass Prairie



Shrubland Habitats

- Pinyon Pine – Juniper Shrubland
- Sand Sagebrush – Bluestem Shrubland
- Shinnery Oak Shrubland
- Canyon Shrubland
- Blackjack Oak – Post Oak Shrubland
- Mesquite Shrubland
- Juniper Shrubland

Shrubland Acres Represented in Oklahoma's State Wildlife Action Plan	
Pinyon Pine – Juniper Shrubland Habitat	38,653 ac.
Sand Sagebrush – Bluestem Shrubland Habitat	618,887 ac.
Shinnery Oak Shrubland Habitat	116,827 ac.
Canyon Shrubland Habitat	109,066 ac
Blackjack Oak – Post Oak Shrubland Habitat	593,740 ac.
Mesquite Shrubland Habitat	78,993 ac.
Juniper Shrubland Habitat	200,968 ac.
Total Acres Represented	**1,757,134 ac.**

Black Mesa State Park. Photo by ODWC.

ecoregions. Within the Shortgrass Prairie Ecoregion, Sand Sagebrush – Bluestem Shrubland Habitat is found in scattered locations, but is most common in the eastern one-third of the ecoregion and is restricted to sites with deep sandy soils and stabilized dunes, primarily in the vicinity of the Beaver, North Canadian, and Cimarron rivers. Here, sand sagebrush (*Artemisia filifolia*) is typically associated with sand dropseed (*Sporobolus cryptandrus*) and little bluestem (*Schizachyrium scoparium*). In these plant communities, sand sagebrush may comprise 5-40% 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 increase grass coverage and decrease sagebrush. Other grasses and forbs found in this community include sand bluestem (*Andropogon hallii*), sideoats grama, prairie sandreed (*Calamovilfa gigantea*), sand lovegrass (*Eragrostis trichodes*), yellow sand paspalum (*Paspalum setaceum var. stramineum*), prairie sunflower (*Helianthus petiolaris*), mentzelia (*Mentzelia sp.*), hoary false goldenaster (*Heterotheca canescens*), yellow sundrops (*Oenothera serrulatus*), annual buckwheat (*Eriogonum annuum*), Indian blanket (*Gaillardia pulchella*), prairie spiderwort (*Tradescantia occidentalis*), and soapweed yucca (*Yucca glauca*). The uncommon sandsage prairie-clover (*Dalea cylindriceps*) is a Plant Species of Conservation Need that is unique to this habitat. Most of the Sand Sagebrush – Bluestem Shrubland Habitat appears to be in fair to good condition and the acreage occupied by this habitat has been stable for the past few decades.

In the Shortgrass Prairie Ecoregion's stabilized dune systems with the greatest magnitude of dune height, shrublands are dominated by fragrant sumac 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 ecoregion 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 and netleaf hackberry (*Celtis reticulata*). Common grasses and forbs include little bluestem, Indian blanket, sideoats grama, and switchgrass (*Panicum virgatum*). The historic and current acreages for the fragrant sumac shrub community type have not been measured but are unlikely to exceed more than 50,000 acres.

In the Mixed-grass Prairie Ecoregion, this habitat type is found locally in the northwestern portion of region and occurs on deep sandy soils and stabilized dunes in the vicinity of the Cimarron, North Canadian, and Canadian rivers. Plant communities closely resemble those found in

Sand Sagebrush – Bluestem Shrubland Habitat at Cimarron Hills Wildlife Management Area. Photo by ODWC.

the Shortgrass Prairie Ecoregion. Similarly, fragrant sumac thickets dominate some of the taller, lower-elevation dunes near river floodplains in this ecoregion. Many tracts of this shrubland habitat in the Mixed-grass Prairie Ecoregion are in fair to good condition and the abundance of this habitat appears to have a stable trend.

Recognized Sand Sagebrush – Bluestem Shrubland Habitat Vegetation Associations

- Sand Sagebrush-Sand Dropseed – Little Bluestem Shrubland
- Sand Plum – Little Bluestem Shrubland
- Fragrant Sumac Shrubland
- Sand Bluestem – Giant Sandreed Grassland

Shinnery Oak Shrubland Habitat at Packsaddle Wildlife Management Area. Photo by ODWC.

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Shinnery Oak Shrubland Habitat

In Oklahoma, the Shinnery Oak Shrubland Habitat is unique to the Mixed-grass Prairie Ecoregion and occurs locally on sandy soils and stabilized dunes in portions of Harmon, Beckham, Roger Mills, Ellis, Dewey, and Woodward counties. The 1944 Duck and Fletcher habitat map estimated that nearly 750,000 acres of Shinnery Oak Shrubland Habitat occurred historically in Oklahoma. A 2015 land cover mapping and analysis estimated approximately 116,000 acres (15.5%) are remaining. Shinnery Oak Shrubland Habitat is a late-succession plant community in which shrubs and grasses are codominant. Shinnery oak (*Quercus havardii*), also known as Havard oak, is the dominant shrub, though sand sagebrush, sand plum, and netleaf hackberry are also common. Sand dropseed and little bluestem are dominant grasses in this habitat, but sand bluestem, switchgrass, sideoats grama, and sand lovegrass are also common.

Sandy Sanders Wildlife Management Area. Photo by ODWC.

Shinnery oak is a low shrub usually less than seven foot tall that develops a massive system of underground stems and a deep root system. A single shinnery oak may have over 100 aboveground stems, each appearing to be a single small shrub and spreading 10-50-foot in diameter. Shinnery oak hybridizes with other oak species. Much of the Shinnery Oak Shrubland Habitat in Oklahoma contain scattered groves or mottes of oaks up to 15-foot tall that are hybrids between shinnery oak and post oak (*Quercus stellata*). Like pure shinnery 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.

Blackjack Oak – Post Oak Shrubland Habitat at Cross Timbers Wildlife Management Area. Photo by ODWC.

Recognized Shinnery Oak Shrubland Habitat Vegetation Associations

- Shinnery Oak – Sand Dropseed – Little Bluestem Shrubland

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Canyon Shrubland Habitat

Rugged Canyon Shrubland habitats occur in three discreet portions of the Mixed-grass Prairie Ecoregion and are tied to gypsum formations. The largest expanse of this habitat occurs over the Blaine Gypsum formation in the northcentral portion of the region extending through portions of Blaine, Major, Woods, and Woodward counties. Other gypsum formations occur 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.

These shrublands are largely intact because their rough topography and dry, rocky, infertile soils are not conducive to agricultural development. Only a small portion of the Canyon Shrubland Habitat has been converted to other land uses, primarily gypsum quarries, but the structure of the vegetation community has been affected by eastern redcedar encroachment and erosion. This 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, hairy grama, dotted blazing star (*Liatris punctata*), Gordon's bladderpod (*Physaria gordonii*), and stemmy four-nerve daisy (*Tetraneuris scaposa*). Years of erosion have carved out canyons, buttes, and mesas.

Recognized Canyon Shrubland Habitat Vegetation Associations

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

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Blackjack Oak – Post Oak Shrubland Habitat

Blackjack Oak – Post Oak Shrubland habitats occur broadly in the Mixed-grass Prairie and Cross Timbers ecoregions. Within the Mixed-grass Prairie Ecoregion, these shrublands occur locally on the rocky slopes of the Wichita Mountains, in areas where the soil is thin, rocky and underlain by sandstone in the canyons of Caddo and Blaine counties, in areas of thin, rocky soil in the Arbuckle Mountains, and in the bands of sandy soils and stabilized dunes that follow the Canadian, North Canadian, and Cimarron rivers in western and central Oklahoma. These shrublands are often a structural mosaic of open, stunted oak woodlands, thickets of scrubby oaks, and patches of tallgrass or mixed-grass prairie. Historically, the structure of this mosaic habitat was maintained by periodic fires and drought.

The dominant shrub-like trees in this community are blackjack oak (*Quercus marilandica*) and post oak. Blackjack oaks tend to be more dominant in the shrublands that grow on stabilized dunes and other sandy sites, while post oaks tend to be dominant on rocky slopes and canyons. Other widespread woody plants include chittamwood (*Sideroxylon lanuginosum*), eastern redcedar (*Juniperus virginiana*) eastern redbud (*Cercis canadensis*), roughleaf dogwood (*Cornus drummondii*), Oklahoma plum (*Prunus gracilis*), and winged sumac (*Rhus copallinum*). In a few sheltered sites within the Wichita Mountains, small stands of sugar maple (*Acer saccharum*), Shumard oak (*Quercus shumardii*), and little walnut (*Juglans microcarpa*) may be found growing in association with the blackjack and post oaks. Dominant grasses include common tallgrass prairie species like little bluestem, switchgrass, 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 largest remaining nesting populations of the once-endangered black-capped vireo in Oklahoma. In the extreme western end of the Wichita Mountains, in the vicinity of Quartz

Mountain, the scrubby oak community includes one of the few populations of Texas live oak (*Quercus fusiformis*) in Oklahoma.

Most of the Blackjack Oak – Post Oak Shrubland Habitat is in relatively poor condition and has declined in abundance over the past century as a result of conversion to agricultural uses and fire suppression in the remaining tracts. Decades of fire suppression have altered the structure of this community throughout the state by facilitating an increase in the abundance of and dominance of eastern redcedars, and in some areas fire suppression also has fostered an increased height and density of oaks.

Sandy Sanders Wildlife Management Area. Photo by ODWC.

Recognized Blackjack Oak – Post Oak Shrubland Habitat Vegetation Associations

- 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

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Mesquite Shrubland Habitat

Mesquite Shrubland Habitat occurs widely in roughly the southern one-third of the Mixed-grass Prairie Ecoregion, particularly on sites with clay soils. This community is sometimes treated as a variation of the mixed-grass prairie community with the addition of a honey mesquite (*Prosopis glandulosa*) overstory. The historic abundance of mesquite within this community is poorly understood and heavily debated. Despite the range of opinions regarding its historic abundance, most biologists agree 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, buffalograss, sideoats grama, little bluestem, vine mesquite (*Panicum obtusum*), prickly pear cactus, soapweed yucca, and sneezeweed (*Helenium amarum*).

Recognized Mesquite Shrubland Habitat Vegetation Associations

- Honey Mesquite – Blue Grama – Buffalograss Shrubland
- Honey Mesquite – Lotebush Shrubland

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Juniper Shrubland Habitat

The status and distribution of Juniper Shrubland Habitat is complex and dynamic. In addition to the pinyon pine-juniper woodlands discussed earlier in this chapter, there are three other Juniper Shrubland Habitat communities in western and central Oklahoma. Juniper Shrubland Habitat dominated by eastern redcedar are widespread in canyons and former prairies in western and central Oklahoma, shrublands dominated by redberry juniper (*Juniperus pinchotii*) occurs on rocky buttes and in canyons in the southwestern corner of Oklahoma, and a shrubland community dominated by Ashe juniper (*Juniperus ashei*) occurs in the Arbuckle Mountains on sites with dry, shallow soils over limestone rock.

Historically, eastern redcedars were 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 is now common and distributed throughout central Oklahoma and many of the grasslands of western Oklahoma. This native juniper has shown a dramatic increase in abundance across the region in 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 prairie habitats have developed into Juniper Shrublands. The increase in juniper

abundance also has affected the structure of other habitat types in western Oklahoma, including Sand Sagebrush – Bluestem Shrublands and Blackjack Oak – Post Oak Shrublands.

Redberry juniper, also known as Pinchot juniper, is much less common and more restricted in its range. These shrublands 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 these shrublands do not appear to have spread beyond their historic range and remain localized in canyons and "badlands" on thin soils derived from gypsum or shale.

Sandy Sanders Wildlife Management Area. Photo by Tell Judkins/ODWC.

Ashe juniper forms a shrubland community on sites with thin, rocky soil in the Arbuckle Mountains, where it co-occurs with short-lobed oak (*Quercus sinuata*), cedar elm (*Ulmus crassifolia*), netleaf hackberry, and post oak. Similar to the Redberry Juniper Shrublands, the Ashe Juniper Shrublands do not appear to be spreading beyond their historic range and remain localized in Murray and Carter counties. However, as a result of reduced fire frequency, the abundance of Ashe junipers within these shrublands has increased and eastern redcedar has encroached into this habitat type and become common.

Recognized Juniper Shrubland Habitat Vegetation Associations

- Redberry Juniper – Grama (Sideoats, Hairy) Woodland
- Eastern Redcedar – Little Bluestem Woodland
- Little Bluestem – Eastern Redcedar Prairie

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Shrublands
Species of Greatest Conservation Need

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat							
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Pinyon Pine – Juniper	Sand Sagebrush – Bluestem	Shinnery Oak	Canyon	Blackjack Oak – Post Oak	Mesquite	Juniper
AMPHIBIANS														
Green Toad *Anaxyrus debilis*	**Global Status: G5; State Status: S3.** Locally common in rocky canyons and hillsides in the far southwest of the state, Black Mesa, and the Arbuckles.	•	•					•			•	•	•	•
Texas Toad *Anaxyrus speciosus*	**Global Status: G5; State Status: S3.** Endemic to the southwestern Great Plains. Locally common in the vicinity of breeding ponds and seasonally flooded wetlands within Mesquite Shrublands of southwestern Oklahoma. Typically associated with sandy soils.		•										•	
Strecker's Chorus Frog *Pseudacris streckeri*	**Global Status: G4; State Status: NR.** Associated with prairies and sandy soils with temporary pools across the central one-third of the state. Adults are active in the spring (early March – late May).		•		•							•		
BIRDS														
LeConte's Sparrow *Ammospiza leconteii*	**Global Status: G5; State Status: S4.** Uncommon and secretive winter resident in Tallgrass Prairie and Mixed-grass Prairie habitats. Typically found in tracts with tall standing grass and sparse shrubs, but also occurs in shinnery oak shrublands. More common in the southern half of the state.		•							•				
Chuck-will's-widow *Antrostomus carolinensis*	**Global Status: G5; State Status: NR.** Uncommon spring and summer resident in Blackjack Oak – Post Oak Shrublands in the Wichita Mountains as well as riparian woodlands in the western part of the state. More common in woodlands in the central and eastern part of the state.		•		•							•		
Golden Eagle *Aquila chrysaetos*	**Global Status: G5; State Status: S2.** Small nesting population resides year-round in Pinyon Pine Shrublands around the Black Mesa area. During the winter, golden eagles migrate into Oklahoma from regions outside of the state to the north and west and are rare, low-density winter residents in grasslands across the state.	•						•						
Burrowing Owl *Athene cunicularia*	**Global Status: G4; State Status: S2.** Uncommon summer resident and rare winter resident in Sand Sagebrush – Bluestem Shrubland and Mesquite Shrubland habitats. Typically associated with prairie dog colonies, which serve as nesting and roosting sites.	•	•						•				•	

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat							
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Pinyon Pine – Juniper	Sand Sagebrush – Bluestem	Shinnery Oak	Canyon	Blackjack Oak – Post Oak	Mesquite	Juniper	
Verdin *Auriparus flaviceps*	**Global Status: G5; State Status: S1.** Resident with small range in Oklahoma limited to a few canyons along the bluffs of the Red River in the far southwest of the state.		•										•		
Ferruginous Hawk *Buteo regalis*	**Global Status: G4; State Status: NR.** Uncommon year-round resident and breeding species in the shrublands of the panhandle counties and an uncommon winter resident in open grasslands throughout the rest of the western half of the state.	•	•					•	•						
Swainson's Hawk *Buteo swainsoni*	**Global Status: G5; State Status: S3.** Widespread summer resident that occurs in low densities throughout several shrubland habitat types and throughout most of Oklahoma besides the southeast quarter and the far northeast of the state.	•	•						•	•					
Prairie Falcon *Falco mexicanus*	**Global Status: G5; State Status: S3.** Small (< 15 birds) year-round resident population nests in the Black Mesa area of the western panhandle. During the winter, prairie falcons are widespread but occur in very low densities in prairies and grasslands across western and central Oklahoma.	•	•					•	•	•	•				
Pinyon Jay *Gymnorhinus cyanocephalus*	**Global Status: G3; State Status: S2.** Rare year-round resident in the Pinyon Pine – Juniper Shrubland Habitat around the Black Mesa area.	•						•							
Loggerhead Shrike *Lanius ludovicianus*	**Global Status: G4; State Status: NR.** Occurs in scattered, year-round resident populations in landscapes dominated by prairies, sparse shrublands, and agricultural land where scattered trees provide nesting and perching sites. Found in low densities in open grassland habitats almost statewide. Additional birds migrate to Oklahoma during the winter from more northerly states, and some summer residents may migrate southward.	•	•					•	•	•	•		•		
Red-headed Woodpecker *Melanerpes erythrocephalus*	**Global Status: G5; State Status: S4.** Uncommon year-round resident throughout Blackjack Oak – Post Oak Shrublands, but usually in areas with many standing dead trees where trees have been killed by fire or flooding. In winter, birds may move into oak forests and bottomland forests in search of acorns which comprise most of their winter diet.		•		•							•			
Lewis's Woodpecker *Melanerpes lewis*	**Global Status: G4; State Status: S2.** Uncommon year-round resident of Pinyon Pine – Juniper Shrublands in the Black Mesa region.	•						•							
Rock Wren *Salpinctes obsoletus*	**Global Status: G5; State Status: NR.** Bird of rocky canyon habitats. Some small resident populations in the western one-third of the state with occasional migrants seen in other parts of the state.	•	•					•			•				

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		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Pinyon Pine – Juniper	Sand Sagebrush – Bluestem	Shinnery Oak	Canyon	Blackjack Oak – Post Oak	Mesquite	Juniper
Rufous Hummingbird *Selasphorus rufus*	**Global Status: G5; State Status: NR.** Migrant occasionally observed in the western half of the state in any habitat with woody cover and fall blooming plants. Moves through the state quickly.	•	•								•	•		
Field Sparrow *Spizella pusilla*	**Global Status: G5; State Status: NR.** Year-round resident of shrubland habitats with sufficient trees for perching. Also found across the main body of the state in tallgrass prairies, oak woodlands, and forest edges.		•		•					•		•		•
Lesser Prairie-chicken *Tympanuchus pallidicinctus*	**Global Status: G3; State Status: S1.** Uncommon year-round resident restricted to areas open prairie or Sand Sagebrush or Shinnery Oak shrublands with low shrub density and low-statured shrubs. Found in the eastern panhandle and far northwest corner of the state, primarily Beaver, Ellis, Harper counties.	•	•						•	•				
American Barn Owl *Tyto furcata*	**Global Status: G5; State Status: S3.** Uncommon year-round resident in many shrubland habitats where barns, buildings, gypsum caves, or rock outcrops provide nesting and roosting sites. Found primarily in the western one-third of Oklahoma, but small populations occur in prairie habitats almost statewide.	•	•						•		•		•	•
Black-capped Vireo *Vireo atricapilla*	**Global Status: G5; State Status: S1.** Rare and locally occurring summer resident. Nesting populations occur in the Wichita Mountains and canyons in northern Blaine County. Historically occurred as an uncommon breeding species in shrublands associated with the Cross Timbers, but are likely to be currently extirpated from the ecoregion.		•		•						•	•		
Bell's Vireo *Vireo bellii*	**Global Status: G5; State Status: S3.** Uncommon summer resident in shrublands that host sand plum thickets, oak mottes, or fragrant sumac thickets.	•	•		•				•	•		•		
Harris's Sparrow *Zonotrichia querula*	**Global Status: G5; State Status: NR.** Common and widespread winter resident in many shrublands habitats, tallgrass prairies, and oak woodlands nearly statewide. Rare in the eastern quarter of the state and the panhandle.	•	•						•	•		•	•	•
INVERTEBRATES														
Plateau Giant Tiger Beetle *Amblycheila picolominii*	**Global Status: G3; State Status: NR.** Rare and large southwestern species of tiger beetle that reaches the northeastern limit of its known range in the canyonlands of southwestern Oklahoma.		•								•			

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A miner bee *Andrena brevicornis*	**Global Status: GNR; State Status: NR.** Rare and poorly documented bee species found in some shrubland habitats, but little is known about its ecology, range or habitat associations. This species was recently documented in Oklahoma and is known to occur in Texas. Plant associations in Texas include various shrubland species, such as acacias (*Acacia*), sumacs (*Rhus*) and mesquites (*Prosopis*).		•								•		•		
A miner bee *Andrena bullata*	**Global Status: GNR; State Status: NR.** Rare miner bee that may be endemic to the southern plains. Only recently documented in Oklahoma in Cleveland and Tulsa counties in the Cross Timbers. Species may be tied to riverine habitats with sandy soils. Appears to be associated with plants in the aster family (*Asteraceae*), specifically false goldenasters (*Heterotheca*) and true asters (*Aster*).		•		•					•		•			
A wool-carder bee *Anthidium michenerorum*	**Global Status: G2; State Status: S1.** Rare bee species found in the Southern Great Plains of Kansas, Oklahoma, and Texas. It has few records in the state, all of which occurred in Blaine County in western Oklahoma. Associated with plants in the pea family (*Fabaceae*), such as milkvetch (*Astragalus*) and breadroots (*Pediomelum*).		•								•		•		
Arogos Skipper *Atrytone arogos*	**Global Status: G2; State Status: S3.** Uncommon and easily overlooked butterfly that occurs locally in oak woodlands, shrublands, and prairies that support their larval host plant throughout the main body of the state, except for the southeast. Appears to favor big bluestem as its larval host plant.		•		•					•		•			
Southern Plains Bumble Bee *Bombus fraternus*	**Global Status: G3; State Status: S2.** Uncommon and locally occurring in Blackjack Oak – Post Oak Shrublands. Distribution is incompletely documented in Oklahoma.				•							•			
Morrison's Bumble Bee *Bombus morrisoni*	**Global Status: G3; State Status: S3.** Rare, but widespread bumble bee primarily found in arid habitats across the western United States. Occasionally observed in the Black Mesa region of Cimarron County in the Oklahoma panhandle.	•						•							
American Bumble Bee *Bombus pensylvanicus*	**Global Status: G3; State Status: S5.** Large, common, and widespread bumble bee found in wide range of habitats including prairies, shrublands, oak woodlands, and forest edges statewide. Appears to be in decline in the northern parts of its range outside of Oklahoma.		•		•				•	•	•	•			
Variable Cuckoo Bumble Bee *Bombus variabilis*	**Global Status: G1; State Status: SH.** May be extirpated from the state. May occur in very low densities in Blackjack Oak – Post Oak shrublands. Lays its eggs in the nests of other bee species.		•		•							•			

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Frosted Elfin *Callophrys irus*	**Global Status: G3; State Status: S1.** Butterfly of pine barrens, found in the Arbuckles and Ouachitas, typically associated with wild indigo and wild blue lupine (*Lupinus perennis*).				•							•		
an underwing moth *Catocala frederici*	**Global Status: G3; State Status: NR.** Moth found in southwest part of the state, including Wichita Mountains. Life history is poorly understood.		•								•	•		
Herodias Underwing *Catocala herodias*	**Global Status: G3; State Status: NR.** Rare moth that feeds on oaks. Primarily found in Wichita Mountains.		•								•	•		
Outis Skipper *Cogia outis*	**Global Status: G3; State Status: S2.** Uncommon butterfly in Shinnery Oak Shrublands. Appears to be dependent upon prairie acacia (*Acaciella angustissima*) as its larval food plant. Adults active in the spring through mid-summer. Range is poorly delineated.		•		•					•		•		
a cellophane bee *Colletes inuncantipedis*	**Global Status: GNR; State Status: NR.** Rare cellophane bee only recently documented in Oklahoma from Cleveland and Muskogee counties. Appears to be associated with bully trees (*Sideroxylon*), specifically chittamwood trees (*Sideroxylon lanuginosum*) and sandy soils or river dunes.				•							•		
Monarch *Danaus plexippus*	**Global Status:G4; State Status: NR.** Widespread butterfly associated with multiple shrubland habitats. Associated with milkweeds.		•		•					•	•	•		
Ghost Tiger Beetle *Ellipsoptera lepida*	**Global Status: G3; State Status: S4.** Uncommon and patchily distributed in the western half of Oklahoma. Narrow habitat requirements include dune crests, slopes, and interdunal bowls and requires deep, loose, well-drained, and sparsely vegetated sandy soils, within which larvae burrow 6.5 to 10 feet. Can be found in sand dune habitats within Sand Sagebrush – Bluestem Shrublands. Has scattered populations that are incompletely documented in the state.	•	•						•					
Wichita Mountains Pillsnail *Euchemotrema wichitorum*	**Global Status: G2; State Status: NR.** Locally common in low densities in post oak woodlands in the Wichita Mountains, riparian woodlands that drain the Wichitas, and other post oak woodlands as far northeast as Anadarko.		•									•		
Ruidoso Snaggletooth *Gastrocopta ruidosensis*	**Global Status: G1; State Status: NR.** Microsnail with only two Oklahoma records. State is poorly sampled for microsnails.	•						•						•

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a snaggletooth snail *Gastrocopta sterkiana*	**Global Status: G2; State Status: NR.** Microsnail with few Oklahoma records. Lacking in clear habitat associations, although it is thought to occur in Pinyon Pine – juniper Shrublands in the Oklahoma panhandle. Appears to be common and widespread in Texas, where sampling has been more extensive.	•						•						
Slosser's Buckmoth *Hemileuca slosseri*	**Global Status: G3; State Status: NR.** Endemic to the Shinnery Oak Shrubland Habitat where it is fairly common. Shinnery oak is the primary food plant for its larvae, and a single generation is produced each year. Larvae active in spring and summer and adults active in the fall.		•							•				
Dotted Skipper *Hesperia attalus*	**Global Status: G3; State Status: S3.** Rare and locally occurring butterfly found in open oak woodlands and shrublands along the western edge of the Cross Timbers Ecoregion. It appears to favor fall witchgrass as its larval host plant.		•		•							•		
a sweat bee *Lasioglossum danforthi*	**Global Status: GNR; State Status: NR.** Extremely rare bee with very few Oklahoma records, associated with evening primrose and sandy substrates.		•		•					•		•		
Sage Sphinx *Lintneria eremitoides*	**Global Status: G2; State Status: NR.** Rare moth found in Texas and Kansas, but with no Oklahoma records. Occurs on sandy prairies, larval host plant is Salvia.		•						•	•				
Robust Sunflower Leafcutter Bee *Megachile fortis*	**Global Status: G2; State Status: NR.** Rare and widespread leafcutter bee with few records in the state, but observed in much of the Great Plains. It is a sunflower specialist that has been found in western and central Oklahoma.		•		•					•		•		
a leafcutter bee *Megachile parksi*	**Global Status: G2; State Status: NR.** Extremely rare leafcutter bee only recently documented in Oklahoma after being considered possibly extinct. Two females were found at Little Sahara State Park in Woods County. It is most likely dependent on exposed, sandy soils for nesting. Appears to be associated with plants in the pea family (*Fabaceae*) and aster family (*Asteraceae*).		•						•					
Swift Tiger Beetle *Parvindela celeripes*	**Global Status: G3; State Status: S4.** Small tiger beetle associated with sparsely vegetated sites with tight gypsum or clayey soils. Distribution disjunct and often associated with gypsum outcrops and canyons. Can be locally common and its distribution is incompletely known.		•								•			

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Rocky Mountain Dagger *Pupoides inornatus*	**Global Status: G2; State Status: NR.** Snail with only two records in the state, both in the Black Mesa region. Both records are in close proximity to streams and individuals may have been transported via flood. Any definitive habitat association in the state would be contingent on additional records and study.	•						•						
A long-horned bee *Tetraloniella paenalbata*	**Global Status: GNR; State Status: NR.** Recent state record. Found throughout high plains, where it is a specialist of nine-anther prairie clover.	•	•										•	
Lichen Grasshopper *Trimerotropis saxatilis*	**Global Status: G3; State Status: NR.** Grasshopper associated with glades or other rocky habitat that supports lichens. In Oklahoma, it is typically associated with eastern mountain glades, the Wichita Mountains, and the Arbuckles.		•		•						•	•		
MAMMALS														
Ringtail *Bassariscus astutus*	**Global Status: G5; State Status: S3.** Rare and secretive species that prefers rocky sites, hilly areas, and canyons in many shrubland habitats. Rarely encountered, but most records are from the southwest quarter of the state.	•	•		•			•			•	•		•
American Hog-nosed Skunk *Conepatus leuconotus*	**Global Status: G4; State Status: S1.** Very rare species in Oklahoma with only a handful of records from Cimarron county, with most being within the vicinity of Black Mesa.	•						•						
Townsend's Big-eared Bat *Corynorhinus townsendii*	**Global Status: G4; State Status: S3.** Rare and secretive resident; reported from only a few rocky canyons and buttes around Black Mesa.	•	•					•			•			
Black-tailed Prairie Dog *Cynomys ludovicianus*	**Global Status: G4; State Status: S3.** Locally occurring in scattered populations across the western half of Oklahoma. Can be found in Sand Sagebrush – Bluestem and Mesquite Shrublands with low shrub density. Species does well in landscapes grazed by cattle.	•	•						•				•	
Texas Kangaroo Rat *Dipodomys elator*	**Global Status: G2; State Status: S1.** Very rare and possibly extirpated. Historically occurred in Mesquite Shrublands in parts of Comanche and Cotton counties.		•										•	
Northern Hoary Bat *Lasiurus cinereus*	**Global Status: G3; State Status: NR.** Bat that migrates all over the country and occurs in many habitat types with trees large enough to roost in.		•		•							•		

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White-throated Woodrat *Neotoma leucodon*	**Global Status G5; State Status: S3.** Uncommon resident found in the Black Mesa area, where it is typically associated with mesa tops and slopes with pinyon pine and juniper.	•						•	•					
Crawford's Desert Shrew *Notiosorex crawfordi*	**Global Status: G4; State Status: S3.** Rare and rarely documented shrew of the southwestern United States and Mexico. Oklahoma lies at the northeastern edge of its range. In Oklahoma, it is uncommon to rare in many shrubland habitats in the western one-quarter of the state and is associated with active and abandoned woodrat (*Neotoma*) nests.	•	•					•	•	•	•		•	•
Lacey's White-ankled Deermouse *Peromyscus laceianus*	**Global Status G5; State Status: NR.** Rare rodent that prefers rocky habitat and whose core range is Texas. Oklahoma records from one site in southern Love County close to the state line.				•							•		
Northern Rock Deermouse *Peromyscus nasutus*	**Global Status: G5; State Status: S3.** Rodent found in Black Mesa region, where it prefers rocky habitat devoid of vegetation or lower slopes dominated by pinyon pine and juniper.	•						•						
Plains Spotted Skunk *Spilogale interrupta*	**Global Status: G3; State Status: S2.** Rare, secretive and partially arboreal. Its status is poorly known and most records within the past 30 years are from the eastern one-third of the state in rocky, oak forest habitats, particularly in the Ouachita and Boston mountains.		•		•							•		
REPTILES														
Common Checkered Whiptail *Aspidoscelis tesselatus*	**Global Status: G5; State Status: S1.** Uncommon and locally occurring in sparsely vegetated rocky slopes and canyons in the Black Mesa region.	•						•						
Western Diamond-backed Rattlesnake *Crotalus atrox*	**Global Status: G5; State Status: S4.** Locally common in arid gypsum canyons and rocky shrublands. Its distribution is disjointed and tied to rocky, upland sites with sparse or open woody overstory vegetation, including some forested areas in the Arbuckle and Ouachita mountains.		•		•						•	•	•	•
Common Lesser Earless Lizard *Holbrookia maculata*	**Global Status: G5; State Status: S4.** Uncommon and locally occurring at scattered locations in the western one-third of the state. Occurs in tracts of shrublands, dunes, and shortgrass and mixed-grass prairie with sparse vegetation and sandy soils.	•	•						•				•	

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Texas Horned Lizard *Phrynosoma cornutum*	**Global Status: G4; State Status: S2.** Locally common within shrublands with low shrub density in the western one-third of Oklahoma. Predominantly occurring in tracts with sparse vegetation, sandy soils, and bare ground. Historically found across the western two-thirds of the state, but have seen declines in the central and eastern portions of their range. Populations are uncommon, but persist in pockets of quality habitat in these parts of their range in Oklahoma.	•	•		•			•	•	•		•	•	
Round-tailed Horned Lizard *Phrynsoma modestum*	**Global Status: G5; State Status: S1.** Rare reptile in Oklahoma whose records are primarily from the Black Mesa area. There was a gap of verified records from 1990 until 2023, highlighting the rarity of this species considering the relatively high number of herptile-seeking visitors Black Mesa receives.	•						•						
Long-nosed Snake *Rhinocheilus lecontei*	**Global Status: G5; State Status: S3.** Uncommon, nocturnal, and secretive. Fossorial species that is uncommonly encountered, therefore its range in Oklahoma is incompletely documented. Primarily known to occur in shrublands in the panhandle and the western edge of the state. Typically associated with sandy or gravelly soils that are suitable for burrowing.	•	•						•	•			•	
Western Massasauga *Sistrurus tergeminus*	**Global Status: G3; State Status: NR.** Uncommon but widespread in scattered localities across the eastern one-third of the Shortgrass Prairie Ecoregion, the Mixed-grass Prairie Ecoregion, and in north-central Oklahoma. Locally occurring in shrublands often near water and areas that are either sandy or rocky.	•	•						•	•			•	
Ornate Box Turtle *Terrapene ornata*	**Global Status: G4; State Status: NR.** Widespread through the state except for the far southeast. Found in all shrubland and prairie habitat types in the state.	•	•		•			•	•	•	•	•	•	•
Three-toed Box Turtle *Terrapene triunguis*	**Global Status: GNR; State Status: NR.** Recently elevated to species status. Common and widespread throughout eastern half of state.		•		•							•		
Terrestrial Gartersnake *Thamnophis elegans*	**Global Status: G5; State Status: S1.** Possibly extirpated from the state. Would only be found in western panhandle.	•						•	•		•			
Common Side-blotched Lizard *Uta stansburiana*	**Global Status: G5; State Status: S1.** Possibly extirpated from the state. Only occurrence records are from Mesquite Shrubland Habitat in western Harmon County.		•						•	•	•		•	

Shrublands Conservation Issues and Actions

Conservation Issue: Information Gaps

Existing data are often incomplete for species of greatest conservation need (SGCN) with respect to their distributions, ecological needs, and population trends. In order to establish effective conservation actions, more complete data are needed, and more thorough evaluations are needed to determine the factors that limit population sizes or are responsible for apparent population declines. Similarly, our knowledge of both the historic and current distributions, structural conditions, and community compositions of Oklahoma's shrubland habitats are incomplete.

Wichita Mountains pillsnail. Photo by Wayne Van Devender.

Conservation Actions

- Conduct reviews of existing literature, reports, museum records, and interview technical experts to compile historic and recent distributional and ecological information for all SGCN.
- Conduct surveys and research to assess the current distribution, abundance, and habitat affinities for SGCN. Maintain databases to store and analyze these distributional and ecological data. Then use these data to identify the geographic areas and habitat conditions where conservation efforts should be directed to provide the greatest benefit.
- 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 SGCN. As part of this mapping effort, identify and prioritize core areas of habitat and, where needed, corridors to increase habitat connectivity.
- 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

Black-capped vireo. Photo by Dave McGowen.

conservation plans.

- Conduct research into the population responses of SGCN 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).
- Conduct research to identify the factors that limit the distributions and abundances of SGCN and examine the possible causes of any suspected population declines. Then develop management recommendations to enhance these populations.
- Develop monitoring programs for high priority SGCN to measure their abundance, geographic range, and the condition of the habitats on which they depend.
- Research the historic condition of each shrubland 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.

Eastern redcedar management at the Arcadia Conservation Education Area. Photo by Steve Webber.

Conservation Issue: Modification of Natural Ecosystem Processes

Widespread fire suppression has impacted all shrubland habitats in the state. While some effects vary between habitat types, the most pervasive result is the extreme spread of eastern redcedar and, to a lesser extent, other juniper species. Eastern redcedar is highly combustible and can act as a ladder fuel, complicating prescribed fire operations and increasing the risk to habitat-altering wildfire. Eastern redcedar also outcompetes many other native plants for water resources, shades out herbaceous and desired woody plants, and reduces habitat quality and use by many SGCN. Fire suppression has also led to an overabundance and reduced structural quality in the primary woody species of most shrubland habitat types, reducing the native grass and forb components that are the much larger component of the floral diversity of shrubland habitats and on which many SGCN species depend.

Heavy grazing pressure can greatly reduce herbaceous vegetation, which can reduce the efficacy of fire to limit woody encroachment and maintain a healthy habitat structure. Many shrublands habitats receive little rainfall and experience frequent drought, which greatly reduces the forage capacity of the landscape and can lead to the loss of native forbs and grasses, increased erosion, and the spread of invasive species when stocking rates are not appropriately reduced.

Aerial application of herbicides is frequently used in shrublands to remove woody species and release grasses. This method of vegetation control has the potential to negatively impact the native floral diversity of these habitats and may harm the wildlife subject to spraying because it is non-selective and applied quickly over large areas. Aerial herbicide applications are particularly damaging to Shinnery Oak Shrubland Habitat because of the very low recolonization rates of shinnery oak. In most situations, prescribed fire is the far more ecologically desirable management approach because the shrubs remain viable, although set back for several years, after the burn is completed.

Conservation Actions

- Purchase conservation easements, short-term grazing leases, or fee-title from willing sellers to conserve especially valuable tracts of shrubland habitat.
- Develop demonstration areas on public lands to show how the management of healthy shrubland habitat can be compatible with profitable grazing. Along with the demonstration areas, develop and distribute technical assistance information to landowners on economic benefits of adjustments to stocking rates, prescribed fire, along with patch-burn grazing techniques, conservation cost-share programs, and invasive species management.
- Fund research on prescribed burning and grazing techniques to provide management recommendations such as timing and stocking rates of livestock and maintaining a balanced landscape of herbaceous vegetation and native shrub. Additional research could be focused on the effects of prescribed burning

on SGCN like Texas horned lizards and lesser prairie-chickens, especially regarding seasonal timing, tract size, and frequency, that minimize negative impacts and maximize carrying capacity. Research the efficacy of a patch-burn grazing system in various shrubland habitats. If this is demonstrated to be a beneficial technique, then develop a technical and financial assistance program to help landowners implement patch-burn grazing.

- Continue cost-share programs that facilitate prescribed burning and prescribed grazing practices as well as mechanical brush management practices for eastern redcedar management.
- Research management techniques that can promote the recruitment of native shrub species in order to sustain or enhance populations of shrub-dependent wildlife species.
- Encourage the use of prescribed fire as an alternative to herbicide application for controlling the abundance of native shrubs on sites where historic or current grazing practices and fire suppression have resulted in an overabundance of native shrubs or eastern redcedar.
- Encourage and promote alternative grazing practices that use patch burning, mineral blocks, and placement of watering facilities to control the movement of cattle rather than relying entirely on fencing.
- 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.
- Increase awareness of the erosion risks that occur when native shrubs are removed from stabilized sand dunes.
- Provide cost-share funding for the hand-cutting and burning of eastern redcedars for areas that are hard to access with heavy equipment and burn effectively.
- Develop revegetation recommendations that are specific to gypsum soils and promote the establishment of native plants that are adapted to dry calcareous soils. Provide cost-share programs to encourage replanting of eroded sites with native grasses and forbs.
- Conduct field studies to evaluate the potential effects of wind power development on sensitive SGCN. Coordinate with local governments, landowners, and wind energy developers on site selection for wind energy developments to minimize their impact on SGCN. Additionally, consider the requirement of off-sets or mitigation for habitat and wildlife impacts that cannot be avoided.
- 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 broad-leaved plants.
- Support ranch diversification in order to lower stocking rates and grazing pressure by offsetting the lost revenue with lease hunting and ecotourism revenue.
- 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.

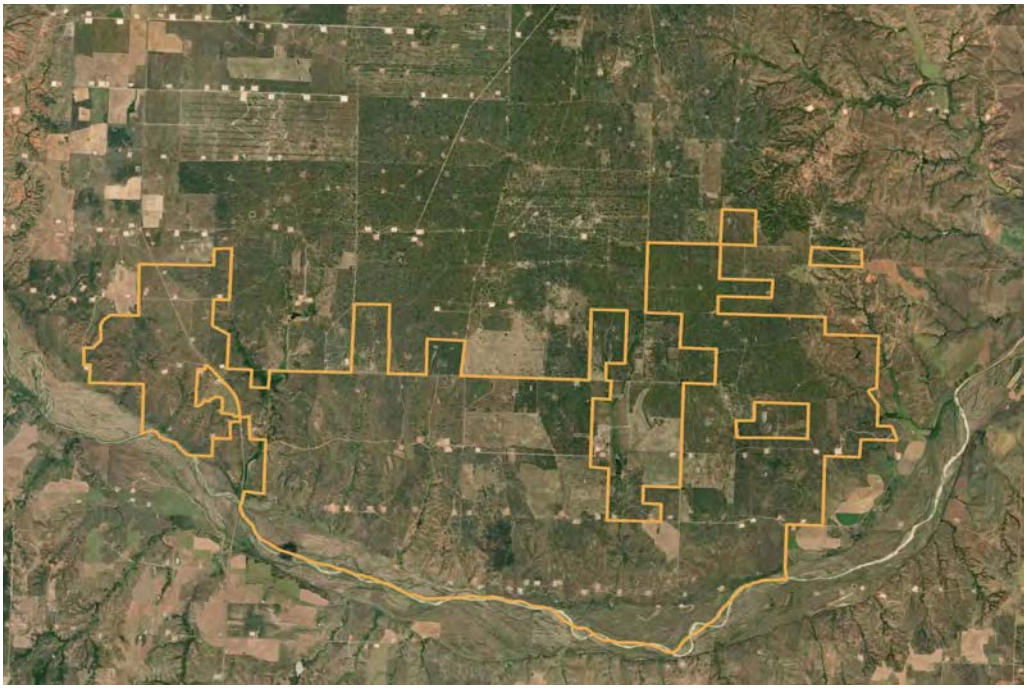
Conservation Issue: Habitat Loss and Fragmentation

Much of the state's historic shrubland habitat has been converted to agricultural use. As more stands are converted into cropland and pasture, remaining tracts become more fragmented and isolated, which can negatively affect area-sensitive SGCN. Retirement of working lands has often been in the form of enrollment in CRP with plantings of non-native grasses, which have far less utility for SGCN species than native floral communities. Ranches are often inherited as subdivided properties, which increases the potential for the land to be used for purposes that do not favor the retention of shrublands and their associated SGCN. Subdivision of large tracts of land also increased the amount of fencing and access roads, which can serve as ingress corridors for invasive species and can provide increased perches and travel corridors for predators of SGCN species. Shinnery Oak Shrubland Habitat is the most reduced shrubland habitat in the state and faces the additional challenge of shinnery oak being a poor recolonizer on disturbed soils, making future recovery of converted lands a much more challenging prospect.

Shrubland tracts are fragmented by continuing energy development. Oil, gas, and wind energy require more developed infrastructure, larger roads, and increase traffic in these habitats, which may disturb some wildlife species. The large structure of wind turbines and

Prescribed grazing in a shrubland. Photo by ODWC.

the noise produced from oil and gas infrastructure may decrease habitat use of some SGCN species. Wind turbines are also a collision hazard for many bird and bat species. Gypsum mining has an even larger local infrastructure footprint and converts tracts of habitat into quarries that may be unusable by some wildlife species.



An aerial view of Packsaddle Wildlife Management Area showing the scope of oil and gas development in the Shinnery Oak Shrubland Habitat.

Conservation Actions

- Identify and 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.
- Encourage and support changes in inheritance legislation to make it easier to pass large intact tracts of land to succeeding generations.
- 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 shrubland habitats.
- 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. If a propagation method is feasible, develop a cost-share program that encourages landowners to reestablish shinnery oak on retired crop and pastureland.
- Work with the NRCS technical committees to promote the incorporation of shrubs such as shinnery oak, sand sagebrush, and sand plum in CRP fields to restore shrublands, and modify the CRP planting standards to increase the abundance and diversity of forbs to benefit pollinator SGCN.
- Expand the Agricultural Conservation Easement Program (ACEP) to include shrublands, particularly Shinnery Oak and Sand Sagebrush Shrubland habitats because these usually occur on working ranching lands.
- Encourage road right-of-way management that conserves and maintains stands of shinnery oak.
- Site access roads in such a way as to minimize the disturbance to stands of oaks and fragmentation of these shrublands.
- Develop a landowner incentives program or easement program to pay landowners to maintain Shinnery Oak Shrubland and Blackjack Oak – Post Oak Shrubland habitats and help landowners restore stands or improve upon the quality of existing stands. 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 shrubland restoration techniques to determine the most cost-effective and successful methods. Use restoration sites on public lands as demonstration areas to encourage the adoption of these practices on private lands.
- 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.
- Encourage the replanting of retired cropland and bermudagrass pastures to mixed-grass prairie grasses and forbs with a sparse mesquite component.
- Encourage the development of a statewide mitigation plan for shrubland and grassland losses due to renewable energy development.

Conservation Issue: Invasive and Problematic Species

The quality and quantity of many of the state's native shrubland habitats has been reduced by invasive species, chief among them eastern redcedar. Non-native grasses like yellow bluestems and Japanese brome and forbs like Russian thistle and sericea lespedeza impact the ground cover or understory components of shrublands. Invasive trees of moderate to high impact include in some shrubland habitats Siberian elm and black locust. Heavy grazing and fire suppression have promoted conditions that allow some invasives to spread and can create habitat structure that increases population and therefore nest parasitism rates of brown-headed cowbirds. Further, much of the Conservation Reserve Program within or adjacent to shrubland habitats has been planted with non-native and invasive species

Eastern redcedars can be a volatile fuel in prescribed fires as well as wildfires. Photo by Jeremiah Zurenda.

such as yellow bluestems and weeping lovegrass. While policy has changed in recent years, many old tracts of these invasive grasses remain on the landscape.

Conservation Actions

- Encourage the use of rotational prescribed burning efforts to maintain these shrubland habitats and manage invasive junipers, elms, and locusts.
- Develop and implement an Invasive Species Management Plan on all public conservation lands to address the control of non-native and invasive species. Then use these areas as demonstration sites to encourage neighboring landowners to implement invasive species controls and share updated Best Management Practices for managing native species.
- Continue to provide cost-share funding or economic incentives to landowners to encourage them to implement invasive species control methods, including prescribed burning and mechanical brush management of eastern redcedar and other problematic species.
- 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 SGCN.
- Where feasible, remove non-native grasses from CRP fields and replant fields with native grasses and forbs. Include native shrubs as part of the planting mix in new and reenrolling CRP contracts.
- Provide cost-share funding to remove invasive species, especially black locust, from shelterbelts and windbreaks where they have the potential to invade shrublands.
- 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.

Potential Indicators for Monitoring the Effectiveness of the Conservation Actions

- Acres of eastern redcedar removed from the landscape through conservation programs and management
- Acres conserved through fee-title purchase, conservation easements, conservation ownership, or enrolled in other conservation programs
- Number of landowners and total acreage engaged in conservation programs
- Increases in acres of shrubland periodically burned
- Changes in acreage dominated by juniper savannahs and woodlands
- Changes in density of junipers or proportion of juniper-dominated habitat that is in an open savannah condition as opposed to a dense juniper woodland condition
- Number of technical assistance visits provided and the number of acres on which recommendations were implemented
- Changes in acreage covered or impacted by invasive vegetation
- Number of fire crews that are trained and conducting prescribed fires
- Number of active prescribed burn associations, their membership numbers, and number of burns they conduct in shrublands
- Response by specific plant species or by overall vegetation structure to different management treatments such as prescribed burning or grazing rotations
- Number of acres CRP land that is converted into native shrubland
- Changes in the population sizes and trends of representative SGCN that serve as indicators of shrubland habitat quality
- Successful propagation efforts for shinnery oak and the number of acres planted through propagation efforts
- Increase in the acres of working shrublands that are maintained on grazing rotations
- Number of acres placed into prescribed burning management programs and the changes in understory vegetation structure and diversity on those acres.

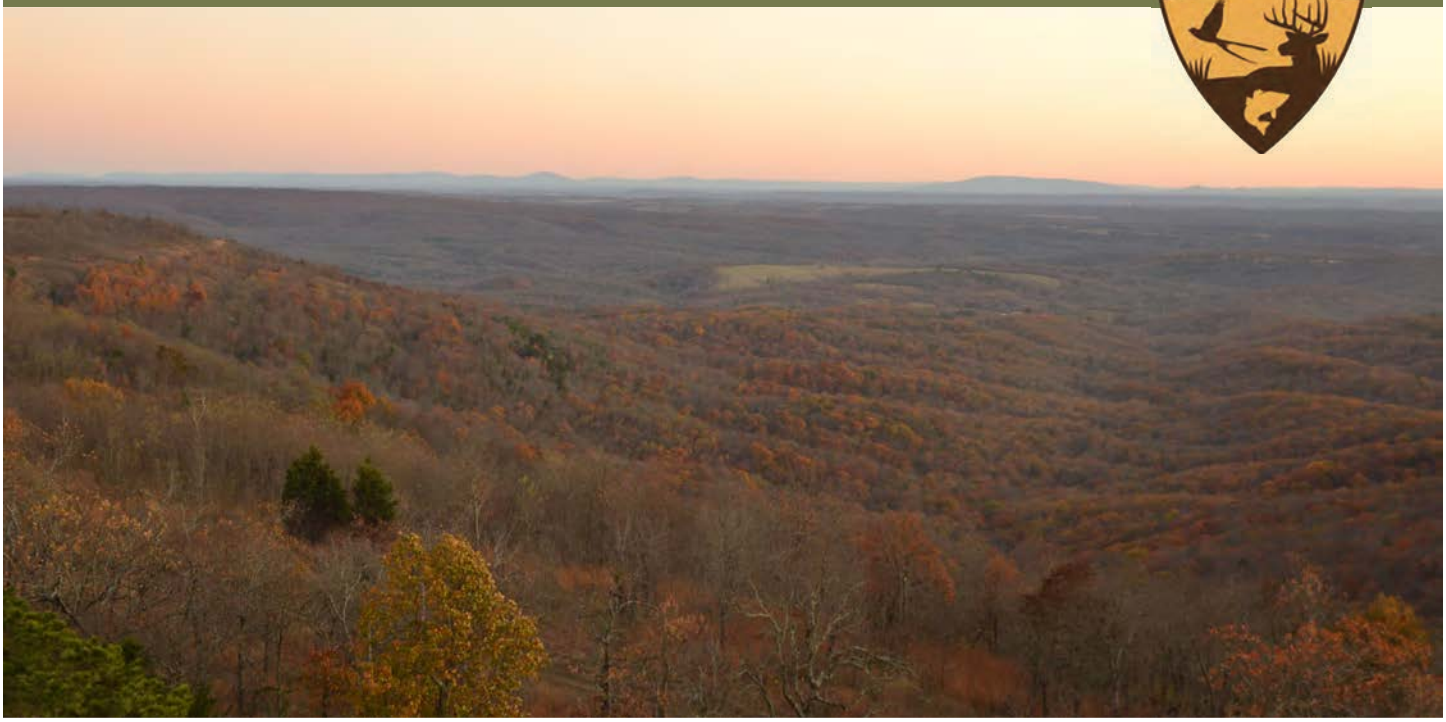
- Distribution and connectivity of the remaining shrubland tracts
- Condition and quantity of shrubland habitats across the state
- Changes in the relative condition and quality of shrubland habitats, such as the diversity of native grasses and forbs, presence of rare or uncommon plant species, and percentage cover by desirable woody plant species
- Number of acres of native plant communities restored, enhanced, or converted from non-native grasslands or juniper shrublands to desired native shrublands
- Index of habitat fragmentation and isolation of shrubland tracts
- Degree of habitat fragmentation based upon an analysis of aerial imagery
- Avian point counts with greater diversity and abundance of shrubland-dependent birds
- Wildlife and vegetation response to management practices such as prescribed burning, fence removal, and rotational grazing
- Acres of habitat occupied or impacted by wind energy, solar plants, and oil or gas development
- Changes in the acreage of shrubland habitat that is subjected to aerial herbicide spraying

Beaver River Wildlife Management Area. Photo by ODWC.

Representative Conservation Areas Supporting Shrublands

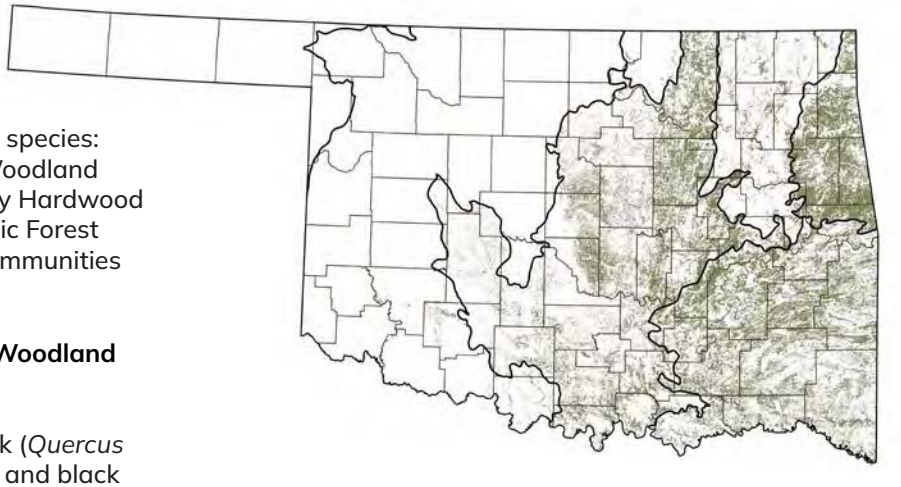
- American Horse Lake (ODWC)
- Arbuckle Springs Wildlife Management Area (ODWC)
- Alabaster Caverns State Park (Oklahoma State Parks Division)
- Beaver River Wildlife Management Area (ODWC)
- Beaver Dunes State Park (Oklahoma State Parks Division)
- Black Kettle National Grassland (U.S. Forest Service)
- Black Mesa State Park and Preserve (Oklahoma State Parks Division)
- Camp Canyon (United Methodist Church)
- Camp Classen (YMCA)
- Camp Simpson (Scouting America)
- Canton Wildlife Management Area (ODWC and ACOE)
- Chickasaw National Recreation Area (National Park Service)
- Cimarron Bluff Wildlife Management Area (ODWC)
- Cimarron Hills Wildlife Management Area (ODWC)
- Ellis County Wildlife Management Area (ODWC)
- Fort Sill Military Reservation (Department of Defense)
- Four Canyons Preserve (The Nature Conservancy)
- Gloss Mountain State Park (Oklahoma State Parks Division)
- Guyman Game Reserve and Sunset Lake (City of Guyman)
- Hal and Fern Cooper Wildlife Management Area (ODWC)
- Lake Louis Burtschi (ODWC)
- Lake Hall (ODWC)
- Little Sahara State Park (Oklahoma State Parks Division)
- Major County Wildlife Management Area (ODWC)
- Mountain Park Wildlife Management Area (ODWC and U.S. Bureau of Reclamation)
- Optima Wildlife Management Area and National Wildlife Refuge (ODWC, USFWS, ACOE)
- Packsaddle Wildlife Management Area (ODWC)
- Pontotoc Ridge Preserve (The Nature Conservancy)
- Quartz Mountain State Park (Oklahoma State Parks Division)
- Roman Nose State Park (Oklahoma State Parks Division)
- Sandhills Wildlife Management Area (ODWC)
- Sandy Sanders Wildlife Management Area (ODWC)
- Selman Bat Cave Wildlife Management Area (ODWC)
- Waurika Wildlife Management Area (ODWC)
- Wichita Mountains Wildlife Refuge (USFWS)

Deciduous Woodlands and Forests



Cookson Wildlife Management Area. Photo by ODWC.

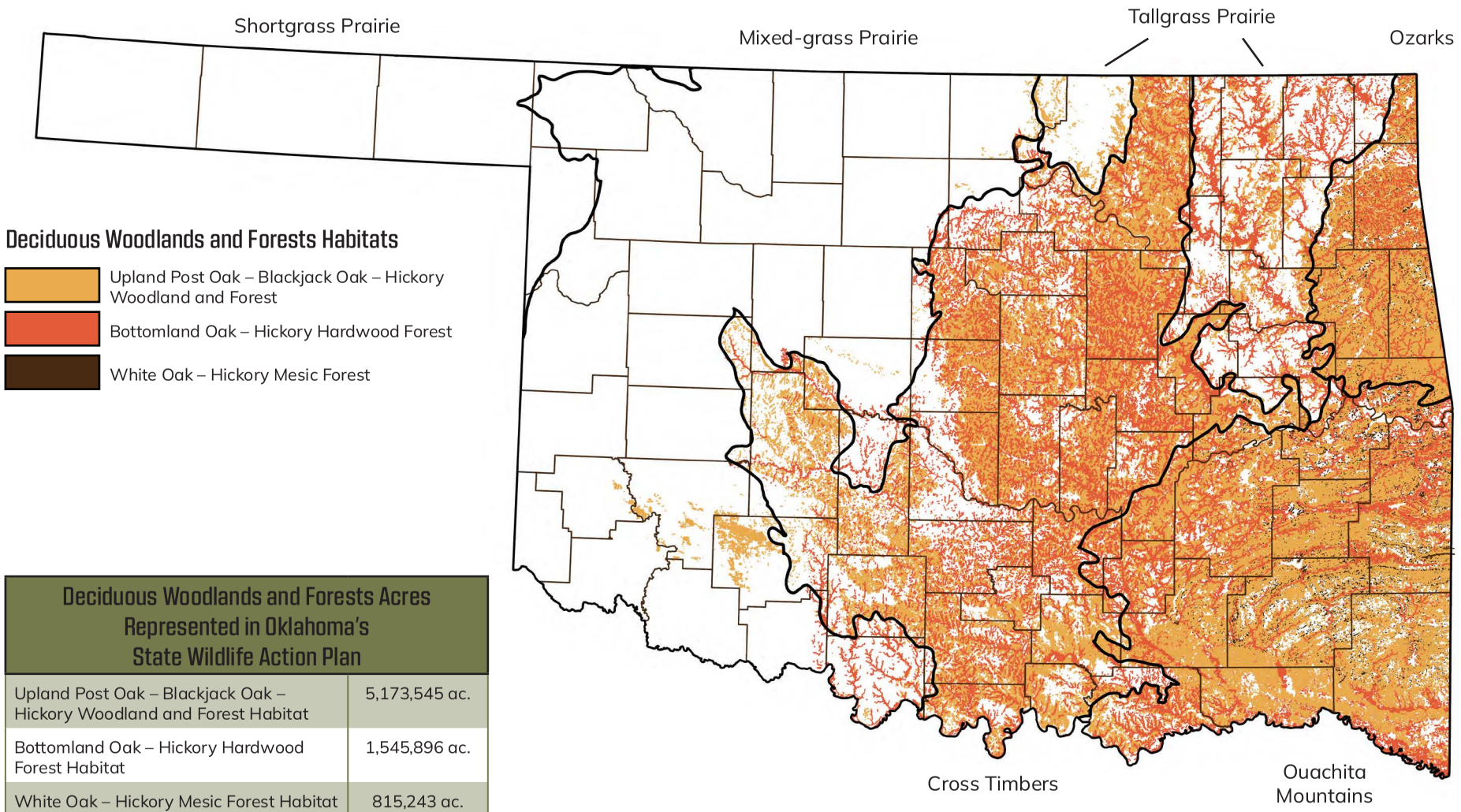
Landscapes that contain oak-dominated woodlands and forests occur across much of central and eastern Oklahoma. These woodlands and forests can be delineated into three broad types based on the dominant species: Upland Post Oak – Blackjack Oak – Hickory Woodland and Forest habitats, Bottomland Oak – Hickory Hardwood Forest habitats, and White Oak – Hickory Mesic Forest habitats. Collectively, these oak-dominated communities total more than 7,500,000 acres in the state.



Deciduous Woodlands and Forests occur in four Oklahoma ecoregions: the Ozark, Ouachita Mountains, Cross Timbers, and Tallgrass Prairie ecoregions.

Upland Post Oak – Blackjack Oak – Hickory Woodland and Forest Habitat

Woodlands and forests dominated by post oak (*Quercus stellata*), blackjack oak (*Quercus marilandica*), and black hickory (*Carya texana*) are widespread in central and eastern Oklahoma and represent the state's largest woodland and forest community by acreage at more than 5,100,000 acres. In Oklahoma and Texas, these woodlands and forests are commonly known as Cross Timbers woodlands and the Cross Timbers Ecoregion that spans central Oklahoma and Texas is named after this plant community. Upland Post Oak – Blackjack Oak – Hickory Woodland and Forest Habitat occurs in a wide range of upland sites and soil conditions as a complex mosaic of forest, woodland, and savannah stands that vary geographically depending upon soil, rainfall, and fire history. In central Oklahoma, this community typically occurs on rocky sandstone ridges and on sandy or coarse soils often derived from underlying sandstone. On sites that are drier and more prone to frequent fire during the late summer, fall, or winter, this community typically exists in a woodland condition with trees that are more widely spaced and have more open and rounded canopies with an average canopy closure of 30-70%. These woodland stands tend to have fewer black hickories and other tree species and often are strongly dominated by the more fire-resistant blackjack and post oaks. Due to greater historic fire frequency, an open woodland condition probably characterized most of the Upland Post Oak –



Deciduous Woodlands and Forests Acres Represented in Oklahoma's State Wildlife Action Plan	
Upland Post Oak – Blackjack Oak – Hickory Woodland and Forest Habitat	5,173,545 ac.
Bottomland Oak – Hickory Hardwood Forest Habitat	1,545,896 ac.
White Oak – Hickory Mesic Forest Habitat	815,243 ac.
Total Acres Represented	**7,534,684 ac.**

Upland Post Oak – Blackjack Oak – Hickory Woodland and Forest Habitat at Cookson Wildlife Management Area. Photo by Whitney Jenkins/ODWC.

Blackjack Oak – Hickory Woodland and Forest Habitat in central Oklahoma prior to 1900. Stands growing on mesic sites, sites with high topographic variability, and sites on north- and east-facing slopes, tend to experience fire less frequently and are often found in a forest condition with the trees having overlapping canopies and the average canopy closure exceeding 70%. In eastern Oklahoma, this community occurs on a wide range of upland sites including upper slopes, ridges, bluffs escarpments, and slopes with a southern or western exposure. Due to greater rainfall, most stands occur in a forest condition with greater than 70% canopy closure, however, woodland stands are typical on sites with thin soils and sites at the interface with prairie habitats, which are more prone to frequent fires.

In addition to the three dominant tree species, the Upland Post Oak – Blackjack Oak – Hickory Woodland and Forest Habitat contains other woody canopy species including bur oak (*Quercus macrocarpa*), black oak (*Quercus velutina*), chinquapin oak (*Quercus muehlenbergii*), chittamwood (*Sideroxylon lanuginosum*), sugarberry (*Celtis laevigata*), red mulberry (*Morus rubra*), winged elm (*Ulmus alata*) and eastern redcedar (*Juniperus virginiana*). In the most mesic sites, Shumard oak (*Quercus shumardii*) and bitternut hickory (*Carya cordiformis*) are prominent components of the canopy. In general, black hickory, black oak, and winged elm are more common in the eastern part of the state where average rainfall is greater than 38 inches. Prominent understory plants include eastern redbud (*Cercis canadensis*), roughleaf dogwood (*Cornus drummondii*), Mexican plum (*Prunus mexicana*), and rusty blackhaw (*Viburnum rufidulum*), while Texas buckeye (*Aesculus glabra*) and common pricklyash (*Zanthoxylum americanum*) are widespread in the region but much less common. Farkleberry (*Vaccinium arboreum*) is a common understory species in forest stands growing on rocky sites in the eastern one-third of the state. Woodland sites that are drier and have a higher frequency of fire, typically have grass-dominated herbaceous understory comprised of little bluestem (*Schizachyrium scoparium*), Indiangrass (*Sorghastrum nutans*), big bluestem (*Andropogon gerardii*), and Heller's rosette grass (*Dichanthelium oligosanthes*).

A unique variation of the Upland Post Oak – Blackjack Oak – Hickory Woodland and Forest Habitat exists in the Arbuckle Mountains where the dominate trees are joined by several species that are adapted to the area's rocky, limestone-derived soils. These species include the Buckley oak (*Quercus buckleyi*), short-lobed oak (*Quercus sinuata*), Ashe juniper (*Juniperus ashei*), Texas ash (*Fraxinus*

Upland Post Oak – Blackjack Oak – Hickory Woodland and Forest Habitat at Lexington Wildlife Management Area. Photo by Kelly Adams/ODWC.

texensis), and a small number of Texas mulberry (*Morus microphylla*). Each of these species is widespread in Texas and reaches the northern limits of its range in the Arbuckle Mountains of Oklahoma.

Plant Species of Conservation Need in this community include open ground whitlowgrass (*Abdra aprica*), smooth indigobush (*Amorpha laevigata*), Tweedy's tick-trefoil (*Desmodium tweedyi*), wedgeleaf spurge (*Euphorbia longicruris*), Wright's dwarfdandelion (*Krigia wrightii*), Baldwin's milkvine (*Matelea baldwyniana*), Oklahoma beardtongue (*Penstemon oklahomensis*), Missouri groundcherry (*Physalis missouriensis*), stately rose gentian (*Sabatia formosa*), and Ernest's spiderwort (*Tradescantia ernestiana*).

This woodland and forest community remains widespread in the eastern one-half of the state; however, many acres have been cleared and converted to rangeland or non-native pasture grasses and to residential and second home developments. Forest fragmentation by road, utility, and pipeline rights-of-way are another compounding habitat threat. The remaining tracts of Oklahoma's oak woodlands and forests face substantial structural changes resulting from reduced fire frequencies. Currently, eastern redcedar and winged elm occur in greater abundance than they did historically, and most oak-dominated stands exist in a more closed-canopy forest condition and relatively little remains in open woodlands.

Recognized Upland Post Oak – Blackjack Oak – Hickory Woodland and Forest Habitat Vegetation Associations

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

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Bottomland Oak – Hickory Hardwood Forest Habitat

Bottomland Oak – Hickory Hardwood Forest Habitat is found on relatively level, seasonally flooded sites within the floodplains of rivers and large streams across the eastern one-half of the state. Historically, bottomland hardwood forests were widespread, but between the late 1880s and the mid-1900s, more than half of these forests were cut and converted to agricultural uses including crop fields, pecan (*Carya illinoensis*) orchards, and introduced fescue pastureland, or were permanently inundated by the construction of large federal reservoirs. Approximately 1,500,000 acres of bottomland forest habitat are likely to remain with the largest tracts occurring within the floodplains of the Muddy Boggy, Kiamichi, and Little rivers within the Red River watershed, and the Deep Fork, Verdigris, and Poteau rivers, and Gaines Creek within the Arkansas River watershed.

Bottomland hardwood forests are diverse plant communities, and the species composition of each stand varies with soil conditions, flooding frequency, and flooding duration. Most bottomland hardwood forests are dominated by oaks and a few species of hickories. Shumard oak, bur oak, chinquapin oak, pecan, bitternut hickory, and black walnut (*Juglans nigra*) are the most widespread of the dominant oaks and hickories and can be found in most bottomland forest stands across eastern Oklahoma along with sugarberry, slippery elm (*Ulmus rubra*), and sycamore (*Platanus occidentalis*). Common and widespread understory species include green hawthorn (*Crataegus viridis*), deciduous holly (*Ilex decidua*), sassafras (*Sassafras albidum*), roughleaf dogwood, spicebush (*Lindera benzoin*) and red mulberry (*Morus rubra*). Two other noteworthy understory plants in Oklahoma's bottomland forests are river cane (*Arundinaria gigantea*) and swamp privet (*Forestiera acuminata*). River cane, Oklahoma's only native species of bamboo, is a culturally significant plant to Native American Nations and once formed large, dense thickets, known as canebrakes, that were the preferred habitat for the Swainson's warbler (*Limnothlypis swainsonii*) and the

Bottomland Oak – Hickory Hardwood Forest Habitat at Osage Wildlife Management Area – Western Wall Unit. Photo by ODWC.

Bottomland Oak – Hickory Hardwood Forest Habitat at Little River National Wildlife Refuge. Photo by ODWC.

now extinct Bachman's warbler (*Vermivora bachmanii*). Swamp privet, not to be confused with the non-native privets in the genus *Ligustrum*, form thickets in seasonally flooded wetlands within the bottomland forest community in widely scattered locations within both the Arkansas River and Red River watersheds.

In northeastern Oklahoma, pin oak (*Quercus palustris*) is a common component of the bottomland forest community, especially along the Arkansas, Verdigris, and Neosho rivers. In southeastern Oklahoma, water oak (*Quercus nigra*), willow oak (*Quercus phellos*), and nutmeg hickory (*Carya myristiciformis*) are widespread components of the bottomland forest community, and within the seasonally flooded portions of the Gulf Coastal Plain Ecoregion in the southeastern corner of the state there are local populations of overcup oak (*Quercus lyrata*), cherrybark oak (*Quercus pagoda*), Nuttall oak (*Quercus texana*), and water hickory (*Carya aquatica*). Other common overstory trees in the bottomland forests of southeastern Oklahoma include black gum (*Nyssa sylvatica*), sweetgum (*Liquidambar styraciflua*), and red maple (*Acer rubrum*), with common understory vegetation including American hornbeam (*Carpinus caroliniana*), parsley hawthorn (*Crataegus marshallii*), and American holly (*Ilex opaca*). Oklahoma's only palm, the dwarf palmetto (*Sabal minor*), grows in the understory of bottomland forests at a few sites in the Gulf Coastal Plain portion of southern McCurtain County. Oklahoma's diverse bottomland forest communities also include bald cypress (*Taxodium distichum*) stands within semi-permanently flooded portions of the Little River floodplain. Plant Species of Conservation Need in Oklahoma's Bottomland Oak – Hickory Hardwood Forest Habitat include Hubricht's bluestar (*Amsonia hubrichtii*), Bush's poppy-mallow (*Callirhoe bushii*), and Arkansas Meadowrue (*Thalictrum arkansanum*).

Recognized Bottomland Oak – Hickory Hardwood Forest Habitat Vegetation Associations

- Bald Cypress Semi-Permanently Flooded Forest
- Overcup Oak – Water Hickory Seasonally Flooded Forest
- Red Maple – Sweetgum Seasonally Flooded Forest
- Sweetgum – Water Oak – American Hornbeam Seasonally Flooded Forest
- Sweetgum – Willow Oak – American Hornbeam Seasonally Flooded Forest
- Black Gum – Red Maple Temporarily Flooded Forest
- Black Gum – Sweetgum Temporarily Flooded Forest
- Water Oak – Red Elm – Sweetgum – American Hornbeam Temporarily Flooded Forest
- Water Oak – Red Elm – Shumard Oak Temporarily

Cookson Wildlife Management Area. Photo by Steve Webber.

Flooded Forest
- Water Oak – Willow Oak – American Hornbeam Temporarily Flooded Forest
- Willow Oak – Black Gum – American Hornbeam Temporarily Flooded Forest
- Bur Oak – Shumard Oak – Bitternut Hickory Temporarily Flooded Forest
- Pin Oak – Pecan/Deciduous Holly Temporarily Flooded Forest
- Pecan – Sugarberry Temporarily Flooded Forest

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

White Oak – Hickory Mesic Forest Habitat

The White Oak – Hickory Mesic Forest Habitat occurs in the Ozark Plateau and the Ouachita Mountains in the eastern one-fifth of the state. These forests often occur in long, linear forest bands along the north-facing and east-facing slopes of mountains and ridges, and as smaller stands of forest within ravines, hollows, and small valleys where the soil remains moist for most of the year. Because mesic forests are restricted to sites with certain physical features with favorable moisture and soil conditions, they can be managed or restored only in specific areas and rarely occur as large contiguous landscapes. Mesic forests have experienced lower rates of conversion to other land uses because of they often occur on steep slopes; however, the total extent of these forests is only about 815,000 acres. Mesic forests have a relatively high diversity of tree species and a complex vegetative structure with well-developed canopy, mid-story, and understory layers. In both the Ozark and Ouachita Mountain ecoregions, these forests are typically dominated by white oak (*Quercus alba*), northern red oak (*Quercus rubra*), mockernut hickory (*Carya tomentosa*), bitternut hickory, black gum, sugar maple (*Acer saccharum*), black cherry (*Prunus serotina*), and white ash (*Fraxinus americana*). Sugar maple and black gum often are associated with the most mesic sites and those that experience infrequent fire. Other common mesic forest trees include Shumard oak, chinquapin oak, black walnut, shagbark hickory (*Carya ovata*), pignut hickory (*Carya glabra*) and American basswood (*Tilia americana*). The habitat's moist soil conditions often allow the development of abundant understory vegetation. Common understory trees and shrubs include flowering dogwood (*Cornus florida*), rusty blackhaw, downy serviceberry (*Amelanchier arborea*), cockspur hawthorn (*Crataegus crus-galli*), Carolina buckthorn (*Frangula caroliniana*), eastern hop hornbeam (*Ostrya virginiana*), American bladderpod (*Staphylea trifolia*), northern spicebush (*Lindera benzoin*), strawberry bush (*Euonymous atropurpureus*), and pawpaw (*Asimina triloba*). In the mesic forests of the Ouachita Mountain, the understory also contains American beautyberry (*Callicarpa americana*), littlehip hawthorn (*Crataegus spathulata*), American fringetree (*Chionanthus virginicus*), and American holly (*Ilex opaca*). Within mesic forests on a few north-facing mountain slopes in Le Flore County, the American beech (*Fagus grandifolia*) is present as an overstory species, and these forests also support Oklahoma's only known populations of cucumber magnolia (*Magnolia acuminata*) and umbrella magnolia (*Magnolia tripetala*).

This forest habitat is considered a late-succession forest type and is maintained by infrequent, small-scale disturbances like wind events, ice storms, and fires. The extent of mesic forests in Oklahoma is poorly known due in part to sparse historical information and to the difficulty in visually delineating mesic forest from adjacent closed-canopy, drier oak and hickory forests. It is likely that the extent of these forests varied prior to European settlement, depending on the intensity of anthropogenic fire disturbance. Unregulated timbering in the late 1800s and early 1900s resulted in the loss of most of the old-growth mesic forests in Oklahoma, but the acquisition of a large block of cut-over land in the Ouachita Mountains in the mid-1930s, now part of the Ouachita National Forest, coupled with fire suppression and grazing policies have allowed some degraded areas to recover.

White Oak – Hickory Mesic Forest Habitat at Spavinaw Wildlife Management Area. Photo by Smokey Solis/ODWC.

Several Plant Species of Conservation Need are found primarily within mesic forest communities. Scattered populations of the rare Ozark chinquapin (*Castanea ozarkensis*), American ginseng (*Panax quinquefolius*), and the Ozark spiderwort (*Tradescantia*

ozarkana) have been found across both the Ozark and Ouachita Mountains ecoregions. Oklahoma's only populations of royal catchfly (*Selene regia*) and Ozark cornsalad (*Valerianella ozarkana*) are found in mesic forests in the Ozark Plateau. Several regionally endemic species are found in the mesic forests of the Ouachita Mountains including Ouachita leadplant (*Amorpha ouachitensis*), Ouachita bluet (Houstonia ouachitana), Ozark hedge-nettle (*Stachys iltisii*), Ouachita Mountain goldenrod (*Solidago ouachitensis*), Ouachita spurge (*Euphorbia ouachitana*), and Waterfall's sedge (*Carex latebracteata*).

Recognized White Oak – Hickory Mesic Forest Habitat Vegetation Associations

- White Oak – Mockernut Hickory – American Basswood Forest
- American Beech – White Oak – American Holly Forest
- Northern Red Oak – Shumard Oak Forest
- Southern Red Oak – Mockernut Hickory Forest
- Chinquapin Oak – Shumard Oak Forest
- Chinquapin Oak – Sugar Maple Forest
- Sugar Maple – White Oak – Mockernut Hickory Forest
- Sugar Maple – Northern Red Oak – Bitternut Hickory Forest
- Sugar Maple – Chinquapin Oak Forest

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Deciduous Woodlands and Forests
Species of Greatest Conservation Need

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat		
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Upland Post Oak – Blackjack Oak – Hickory Woodland and Forest	Bottomland Oak – Hickory Hardwood Forest	White Oak – Hickory Mesic Forest
AMPHIBIANS										
Ringed Salamander *Ambystoma annulatum*	**Global Status: G4; State Status: S2.** Locally common but patchily distributed in upland deciduous and pine-oak forests in the Ozark Plateau and in the Le Flore and McCurtain county portions of the Ouachita Mountains. Populations are tied to breeding pools. A secretive, burrowing and nocturnal salamander that breeds in small ponds and vernal pools in the fall.					•	•	•	•	•
Mole Salamander *Ambystoma talpoideum*	**Global Status: G4; State Status: S1.** Rare, secretive, burrowing species of salamander that is known only from a few bottomland and mesic pine-oak forests sites in the Gulf Coastal Plain portion of McCurtain County.						•		•	
Three-toed Amphiuma *Amphiuma tridactylum*	**Global Status: G5; State Status: S1.** Rare and secretive salamander found in sloughs, swamps and low-gradient streams in bottomland hardwood forests and the flood plains of the Red and Little rivers in the Gulf Coastal Plain.						•		•	
Ouachita Dusky Salamander *Desmognathus brimleyorum*	**Global Status: G4; State Status: S3.** Mostly aquatic and locally occurring, but can be common in springs and small streams on hillsides in the Ouachita Mountains above roughly 800-feet in elevation.						•			•
Bird-voiced Treefrog *Dryophytes avivoca*	**Global Status: G5; State Status: S2.** Uncommon and locally occurring in bottomland hardwood forests and flood plain wetlands in the Gulf Coastal Plain portion of the Little River watershed.						•		•	
Oklahoma Salamander *Eurycea tynerensis*	**Global Status: G3; State Status: S3.** Common in mesic and riparian forests near streams and springs that provide habitat for breeding and larval development.					•			•	•
Cave Salamander *Eurycea lucifuga*	**Global Status: G5; State Status: S3.** Locally common salamander of caves and mesic forests in limestone karst landscapes throughout the Ozark Plateau in Oklahoma.					•		•		•
Many-ribbed Salamander *Eurycea multiplicata*	**Global Status: G4; State Status: S4.** A common stream-breeding salamander found in riparian forests, bottomland forests, and mesic forests throughout the Ouachita Mountains.						•		•	•

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Four-toed Salamander *Hemidactylium scutatum*	**Global Status: G5; State Status: S1.** In Oklahoma, this is a rare species that has been found around seeps and bogs at a few high-elevation forest stands in the Ouachita Mountains.						•			•
Crawfish Frog *Lithobates aerolatus*	**Global Status: G5; State Status: S4.** Locally common species that is found in level, clay-soil prairies in the eastern one-third of Oklahoma. Rarely seen above ground except during the relatively short early spring breeding season when they move into seasonal wetlands and vegetated ponds for breeding ponds. Sometimes found in the transition between bottomland forests and open, grassy habitats.			•	•	•	•		•	
Western Slimy Salamander *Plethodon albagula*	**Global Status: G5; State Status: NR.** Common in mature deciduous forests throughout the Ozark Plateau and the western one-half of the Ouachita Mountains.					•	•	•	•	•
Ozark Zigzag Salamander *Plethodon angusticlavius*	**Global Status: G4; State Status: S2.** Locally common in moist, mesic forests in the Ozark Plateau of Adair, Cherokee, and Delaware counties.					•		•	•	•
Kiamichi Slimy Salamander *Plethodon kiamichi*	**Global Status: G2; State Status: S2.** Locally common but restricted to moist, mature forests along the Kiamichi Mountain ridge and the upper Kiamichi River watershed in Le Flore and Pushmataha counties.						•		•	•
Rich Mountain Salamander *Plethodon ouachitae*	**Global Status: G3; State Status: S2.** Locally common but restricted to high-elevation forests on Winding Stair, Kiamichi, and Rich Mountains.						•			•
Sequoyah Slimy Salamander *Plethodon sequoyah*	**Global Status: G1; State Status: S2.** Uncommon and restricted to forested habitats along the southern edge of the Ouachita Mountains in McCurtain County						•		•	•
Southern Red-backed Salamander *Plethodon serratus*	**Global Status: G5; State Status: S3.** Locally common in mature forests but limited to the eastern half of the Ouachita Mountains Ecoregion in Le Flore and McCurtain counties.						•			•
Strecker's Chorus Frog *Pseudacris streckeri*	**Global Status: G4; State Status: NR.** Endemic to the south-central United States, but widespread in the central one-third of Oklahoma. Can be found in open oak woodlands.			•	•			•		
Hurter's Spadefoot *Scaphiopus hurterii*	**Global Status: G5; State Status: S2.** Locally common in the vicinity of its breeding ponds and vernal pools, but nocturnal, secretive, and uncommonly found above ground. Most common in oak forests and bottomland forests in the eastern one-half of the Cross Timbers Ecoregion and southeastern Oklahoma.				•		•	•	•	

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Western Siren *Siren nettingi*	**Global Status: G5; State Status: NR.** Uncommon, aquatic salamander whose Oklahoma range is limited to streams, sloughs, wetlands, and swamps within forested bottomlands throughout the Gulf Coastal Plain.						•		•	
BIRDS										
Chuck-will's-widow *Antrostomus carolinensis*	**Global Status: G5; State Status: NR.** Common but declining summer resident that nests in all types of upland deciduous forests throughout central and eastern Oklahoma.			•	•	•	•	•	•	•
Eastern Whip-poor-will *Antrostomus vociferus*	**Global Status: G5; State Status: S2.** Uncommon and locally occurring summer resident that nests in the Ozark Plateau and the eastern Ouachita Mountains. Recent research indicates a preference for woodland habitats with open canopies or close proximity to forest edges.					•	•	•		•
Chimney Swift *Chaetura pelagica*	**Global Status: G4; State Status: NR.** Uncommon but widespread summer resident throughout the main body of Oklahoma and occurs where suitable nesting sites exist, particularly in urban areas. They adapted to man-made structures such as uncapped chimneys, and expanded their population size and range in the 1800s and 1900s. But, as the availability of uncapped chimneys declines, their populations are experiencing steep declines and more of the birds are using historic nesting sites such as hollow trees in forested habitats.			•	•	•	•	•	•	•
Little Blue Heron *Egretta caerulea*	**Global Status: G5; State Status: NR.** Uncommon summer resident in the eastern three-quarters of Oklahoma. Nests in colonies, often with other herons and egrets, near rivers and reservoirs. Forages in all clear, shallow-water habitats including wetlands and sloughs within bottomland forests.		•	•	•	•	•		•	
Rusty Blackbird *Euphagus carolinus*	**Global Status: G4; State Status: S3.** Uncommon winter resident in bottomland forests, and forested wetlands across the eastern one-half of the state.			•	•	•	•		•	
Kentucky Warbler *Geothlypis formosa*	**Global Status: G5; State Status: NR.** Summer resident in deciduous forests across the eastern one-half of Oklahoma. This is a ground-nesting species that establishes breeding territories in mature forest stands with an abundance of woody understory vegetation. They are common in mesic forests, and uncommon in the other forest types.			•	•	•	•	•	•	•
Worm-eating Warbler *Helmitheros vermivorum*	**Global Status: G4; State Status: S1.** Rare summer resident in mature mesic forests with abundant tall understory shrubs and small trees. Most frequently found on north-facing hillsides and high-elevation sites, but absent from bottomland forests.					•	•			•
Wood Thrush *Hylocichla mustelina*	**Global Status: G4; State Status: S2.** Rare summer resident in the eastern one-quarter of Oklahoma where it nests in mature, mesic deciduous forest. Often nests in mesic forest stands that have abundant understory trees and are adjacent to mature bottomland forests.			•	•	•	•		•	•

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Swainson's Warbler *Limnothlypis swainsonii*	**Global Status: G4; State Status: S1.** Rare and locally occurring summer resident in scattered bottomland forest tracts along small rivers in the eastern one-third of Oklahoma. Nests primarily in large, mature bottomland hardwood forest and mesic pine-oak forest with thick understory shrubs or giant cane (*Arundinaria gigantea*) thickets.				•	•	•		•	
Red-headed Woodpecker *Melanerpes erythrocephalus*	**Global Status: G5; State Status: S4.** Uncommon and locally occurring, year-round resident in open woodlands and forests statewide, but usually in areas with many standing dead trees where trees have been killed by fire or by flooding caused by beaver activity. In winter, birds may move into oak forests and bottomland forests in search of acorns which comprise much of their winter diet.		•	•	•	•	•	•	•	
Bachman's Sparrow *Peucaea aestivalis*	**Global Status: G3; State Status: S2.** Rare and locally occurring summer resident. Small numbers nest in open oak woodlands with a grassy understory in the Arkansas Valley and southern Cross Timbers ecoregions.			•	•	•	•	•		
Eastern Towhee *Pipilo erythrophthalmus*	**Global Status: G5; State Status: S4.** Winter resident in deciduous and mixed hardwood woodlands and forests across the eastern one-half of Oklahoma, and a rare year-round resident that breeds in oak woodlands on the Ozark Plateau.				•	•	•	•		•
Prothonotary Warbler *Protonotaria citrea*	**Global Status: G5; State Status: NR.** Uncommon summer resident that nests in mature bottomland hardwood forests and riparian forests along streams and small rivers across the eastern one-half of Oklahoma.			•	•	•	•		•	
Cerulean Warbler *Setophaga cerulea*	**Global Status: G4; State Status: S2.** Very rare summer resident that nests in a few large mesic deciduous forest tracts in the Ozark Plateau and on north-facing slopes in the Ouachita Mountains. In recent years, nesting has been documented only around Kiamichi Mountain in southern Le Flore County. Due to its rarity, it's distribution in Oklahoma is poorly known.					•	•		•	•
Prairie Warbler *Setophaga discolor*	**Global Status: G5; State Status: S3.** Summer resident in the eastern one-quarter of Oklahoma that nests in large brushy openings and clear-cuts within forested landscapes, as well as in open oak or mixed hardwood woodlands. Can be common locally within the Ouachita Mountains, but is rare elsewhere in the state.					•	•	•		
Field Sparrow *Spizella pusilla*	**Global Status: G5; State Status: NR.** Year-round residents in shrublands, tallgrass prairies, open oak woodlands and oak savannahs across the main body of Oklahoma. They are most common in shrublands and edges between woodlands and tallgrass prairies.			•	•	•	•	•		
Greater Prairie-chicken *Tympanuchus cupido*	**Global Status: G4; State Status: S3.** Rare and locally occurring year-round resident in tallgrass prairies in north-central Oklahoma, and may move into open oak woodlands and savannahs during the winter months.			•				•		

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Golden-winged Warbler *Vermivora chrysoptera*	**Global Status: G4; State Status: S3.** Rare spring and early fall migrant through the eastern one-quarter of Oklahoma. Uses mesic and bottomland forests as stopover habitat.					•	•	•		•
Blue-winged Warbler *Vermivora cyanoptera*	**Global Status: G5; State Status: S1.** Rare summer resident and breeder in the Ozark Region. It nests in large, brushy openings and woodland edges within forested landscapes.					•		•		
Harris's Sparrow *Zonotrichia querula*	**Global Status: G5; State Status: NR.** Common winter resident in open oak woodlands and savannahs in central Oklahoma's Cross Timbers and Tallgrass Prairie ecoregions.		•	•	•	•		•		
INVERTEBRATES										
Linda's Roadside-Skipper *Amblyscirtes linda*	**Global Status: G2; State Status: S2.** Uncommon butterfly that is active in the spring (April-June) and found in mature mesic and bottomland forests with a grassy understory that includes its larval host plant Indian woodoats (*Chasmanthium latifolium*). In Oklahoma, it occurs in the eastern one-quarter of the state and appears to have one generation per year.			•		•	•		•	•
a miner bee *Andrena bullata*	**Global Status: GNR; State Status: NR.** Rare miner bee that appears to be active only in the fall (September-November). Found only in the southern Great Plains and found in association with sandy sites including riverine dunes, prairies and oak woodlands in central and western Oklahoma.				•			•		
Stilt-walker Katydid *Arethaea grallator*	**Global Status: GNR; State Status: NR.** Long-legged katydid that is endemic to the oak forests of the Cross Timbers Ecoregion of Oklahoma and Texas. Uncommon but present in south-central Oklahoma.				•			•		
Diana Fritillary *Speyeria diana*	**Global Status: G2; State Status: S2.** Uncommon butterfly found in mature mesic forests with abundant herbaceous vegetation including violets (*Viola*), which serve as its larval host plant. Found in the eastern one-third of Oklahoma.					•	•		•	•
Arogos Skipper *Atrytone arogos*	**Global Status: G2; State Status: S3.** Uncommon and easily overlooked butterfly that occurs locally in oak woodlands, savannahs and prairie edges throughout the main body of the state. Appears to favor big bluestem as its larval host plant.		•	•	•			•		
American Bumble Bee *Bombus pensylvanicus*	**Global Status: G3; State Status: S5.** Common and widespread large bumble bee that is found in oak woodlands and forest edges statewide. Its population is declining in the northern part of its range outside of Oklahoma.			•	•	•		•		
Northern Metalmark *Calephelis borealis*	**Global Status: G3; State Status: S2.** Small butterfly found in moist deciduous forests in the eastern one-fifth of Oklahoma. The adults are active during the summer months and use roundleaf ragwort (*Packera obovata*) as the host plant for its larvae.					•	•	•		•

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Frosted Elfin *Callophrys irus*	**Global Status: G3; State Status: S1.** Uncommon, tiny butterfly that is active only in the early spring (March – early May). Found in south-central and southeastern Oklahoma in oak and mixed oak woodlands and in prairies where its host plants yellow wild indigo and Nuttall's wild indigo (*Baptisia sphaerocarpa* and *B. nuttalliana*) grow.				•		•	•		
Herodias Underwing *Catocala herodias*	**Global Status: G3; State Status: NR.** Uncommon species of moth that feeds on oak leaves and is restricted to southwestern Oklahoma and western Texas. Its Oklahoma distribution is centered around the Wichita Mountains.		•					•		
Married Underwing Moth *Catocala nuptialis*	**Global Status: G3; State Status: NR.** Widespread moth of high-quality tallgrass prairies in the Midwest and Oklahoma lies on the southwestern edge of its range. Found in tallgrass prairies and open oak woodlands where it uses leadplant (*Amorpha canescens*) as the host plant for its larvae.		•	•	•			•		
a cellophane bee *Colletes inuncantipedis*	**Global Status: GNR; State Status: NR.** A rare cellophane bee that is endemic to the Southern Great Plains and associated with chittamwood trees (*Sideroxylon lanuginosum*). In Oklahoma, this species has been documented in open oak woodlands growing on sandy soils in the central one-third of the state.				•			•		
a goldsmith beetle *Cotalpa subcribrata*	**Global Status: GNR; State Status: NR.** Scarab beetle endemic to the Cross Timbers Ecoregion of Kansas, Oklahoma, and Texas. Found in oak woodlands and its larvae are presumed to feed on oak tree roots.				•			•		
Oklahoma Liptooth *Daedalochila deltoidea*	**Global Status: G2; State Status: NR.** Uncommon land snail that is endemic to the Ozark and Ouachitas and found in rocky, upland oak and hickory forests.					•	•	•		•
Ozark Liptooth *Daedalochila jacksoni*	**Global Status: G3; State Status: NR.** Fairly common and widespread land snail, but restricted to the Ozark Plateau. Found in upland oak woodlands and glades. The type locality for the species is near Fort Gibson, Oklahoma.					•	•	•		
Stone Liptooth *Daedalochila lithica*	**Global Status: G3; State Status: NR.** Uncommon land snail found in rocky, upland oak forests in a narrow range along the Oklahoma-Arkansas stateline in the Springfield Plateau.					•	•	•		•
Wyandotte Liptooth *Daedalochila simpsoni*	**Global Status: G2; State Status: NR.** Its taxonomy is uncertain and it may be a form of Ozark liptooth. Restricted to a small area of rocky, upland oak forests along the Oklahoma-Arkansas stateline with the Oklahoma records in Ottawa County.				•	•		•		•
Monarch *Danaus plexippus*	**Global Status: G4; State Status: NR.** Widespread, migratory butterfly that occupies a wide range of habitats including open woodlands, suburban areas, shrublands, herbaceous wetlands, and prairies. Monarchs are uncommon in Oklahoma during the spring and summer, but large numbers migrate through the state in the fall. It uses several milkweeds as larval host plants including the green antelopehorn (*Asclepias viridis*).			•	•	•	•	•		

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Mottled Duskywing *Erynnis martialis*	**Global Status: G3; State Status: S3.** Uncommon butterfly whose adults are active in the early spring. Found in open oak woodlands and forest edges in the eastern one-third of Oklahoma where it uses New Jersey tea (*Ceanothus americanus*) as the host plant for its larvae.				•	•	•	•		•
Ouachita Pillsnail *Euchemotrema imperforatum*	**Global Status: GNR; State Status: NR.** Recently elevated to species status. It is endemic to the rocky forests of the Ouachita Mountains, where it can be locally common.						•		•	•
Wichita Mountains Pillsnail *Euchemotrema wichitorum*	**Global Status: G2; State Status: NR.** Locally common land snail found in oak forests and riparian forests in and around the Wichita Mountains in southwestern Oklahoma.		•					•		
Dotted Skipper *Hesperia attalus*	**Global Status: G3; State Status: S3.** Rare and locally occurring butterfly found in prairies in western Oklahoma and open oak woodlands along the in the western edge of the Cross Timbers Ecoregion. It appears to favor fall witchgrass (*Digitaria cognata*) and switchgrass (*Panicum virgatum*) as its larval host plants.		•	•	•			•		
Smooth-lip Shagreen *Inflectarius edentatus*	**Global Status: G2; State Status: NR.** Ozark endemic land snail with very few Oklahoma records, all from Boston Mountains in eastern Adair and Sequoyah counties less than five miles from state line. Found in moist, forested, rocky hillsides, and ravines.					•		•		•
Bald Cypress Katydid *Inscudderia taxodii*	**Global Status: GNR; State Status: NR.** Uncommon katydid that lives and feeds primarily on the leaves of bald cypress (*Taxodium distichum*), and is found only in the southeastern corner of the state. Occurs in the cypress canopy and often over water so it is rarely encountered close to the ground.						•		•	
a sweat bee *Lassioglossum danforthi*	**Global Status: GNR; State Status: NR.** Very rare sweat bee that appears to be an evening primrose specialist. In Oklahoma, it has been found in only a few sandy oak woodland sites along the Canadian River in the Mixed-grass Prairie and western Cross Timbers ecoregions.		•		•			•		
Slope Ambersnail *Mediappendix wandae*	**Global Status: G3; State Status: NR.** Rare, but widespread in the central United States where it occurs locally in rocky woodlands. Its range is poorly known but has been documented in Oklahoma in the northern Cross Timbers Ecoregion.			•	•			•		
a leafcutter bee *Megachile deflexa*	**Global Status: G2; State Status: NR.** Rare leafcutter bee found in open oak woodlands in the southern portion of the Cross Timbers Ecoregion.				•			•		
Ozark Mantleslug *Megapallifera ragsdalei*	**Global Status: G3; State Status: NR.** Locally common and widespread, Ozark-endemic slug. Very distinctive color pattern and found in a variety of moist habitats. Presumed to feed mainly on lichens.					•				•

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a spur-throated grasshopper *Melanoplus decurvus*	**Global Status: GNR; State Status: NR.** Rare short-horned grasshopper that has been found only in tallgrass prairies and open oak woodlands in Atoka and Bryan counties in southeastern Oklahoma.				•			•		
Oklahoma Spur-throated Grasshopper *Melanoplus oklahomae*	**Global Status: G2; State Status: S4.** Endemic to the Ouachita Mountains and the adjacent portion of the Cross Timbers Ecoregion in southern Oklahoma. Locally common short-horned grasshopper found in tallgrass prairies and open woodlands.				•		•	•		
Tulsa Whitelip *Neohelix lioderma*	**Global Status: G1; State Status: NR.** Uncommon and locally occurring land snail typically associated with forested limestone outcrops in a small portion of the northern Cross Timbers Ecoregion in northeast Oklahoma.			•	•			•		
American Burying Beetle *Nicrophorus americanus*	**Global Status: G3; State Status: S1.** Federally listed as threatened. Uncommon to rare, but widespread in the eastern oen-half of Oklahoma. Occurs in open oak woodlands, forest edges, savannahs, and tallgrass prairies, but absent from areas with shallow or rocky soils. More common in the northern two-thirds of the state and less common in the southern one-third.			•	•	•	•	•		•
Marbled Mantleslug *Pallifera marmorea*	**Global Status: G3; State Status: NR.** Uncommon and widespread mantleslug, but easily overlooked. Found in rocky, upland forests across the eastern one-third of Oklahoma including the Ozark Plateau, Ouachita Mountains, and the eastern portion of the Cross Timbers Ecoregion.				•	•	•	•		•
Ouachita Mantleslug *Pallifera tournescalis*	**Global Status: G1; State Status: NR.** An apparently rare and poorly documented mantleslug that is known only from its type locality in mesic forest on Winding Stair Mountain in Le Flore County, Oklahoma.						•		•	•
Domed Supercoil *Paravitrea significans*	**Global Status: G3; State Status: NR.** Uncommon land snail found in mesic oak-hickory forests and bottomland hardwood forests in the Ozark Plateau and Ouachita Mountains.					•	•		•	•
Half-lidded Oval *Patera binneyana*	**Global Status: G2; State Status: NR.** Locally common land snail found in a wide range of forest types but in Oklahoma it is restricted to the eastern Ouachita Mountains in Le Flore and McCurtain counties.						•		•	•
Lidded Oval *Patera indianorum*	**Global Status: G2; State Status: NR.** A rare land snail found in rocky, upland oak, and mixed hardwood forests and known from only a few locations in the eastern Cross Timbers and western Ouachita Mountains ecoregions.				•		•		•	•
Drywoods Oval *Patera kiowaensis*	**Global Status: G2; State Status: NR.** Uncommon snail found in upland oak and mixed hardwood forests and endemic to the Ouachita Mountains.						•	•		•

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Texas Oval *Patera roemeri*	**Global Status: G3; State Status: NR.** Snail of the Texas Cross Timbers and Edwards Plateau that may occur in south-central Oklahoma. Several *Patera*, *Mesodon*, and *Neohelix* shells are quite convergent and require expert identification.				•			•	•	
Ozark Snail-eating Beetle *Scaphinotus parisiana*	**Global Status: GNR; State Status: NR.** Rare beetle that is endemic to the Ozark Plateau and found in rocky, deciduous forests.					•		•		•
Ozark Slitmouth *Stenotrema labrosum*	**Global Status: G3; State Status: NR.** Widespread throughout the Ozark Plateau and the Ouachita Mountains where it is typically uncommon, but is occasionally locally abundant. Often associated with moderate to high relief rocky forests where it is found under logs or, less commonly, in piling rock.					•	•	•		•
Rich Mountain Slitmouth *Stenotrema pilsbryi*	**Global Status: G2; State Status: S2.** Uncommon snail with a very distinctive shell that occurs locally on rocky talus slopes and high-elevation, forested slopes on Rich, Black Fork, and Winding Stair mountains in the northern Ouachita Mountains.						•			•
Ouachita Slitmouth *Stenotrema unciferum*	**Global Status: G3; State Status: NR.** Uncommon and locally occurring in the higher ridges of the Ouachita Mountains. Most records reported from Arkansas, but found in Oklahoma in Le Flore County.						•			•
Ozark Threetooth *Triodopsis neglecta*	**Global Status: G3; State Status: NR.** Small tooth-lipped snail found under rocks and logs in dry oak woodlands in the western Ozarks.					•		•		
Western Dome *Ventridens brittsi*	**Global Status: G3; State Status: NR.** Uncommon and endemic to the southern Ozarks and Ouachitas. Found in forested, rocky ravines and hillsides with rock and leaf litter cover.					•	•	•		•
MAMMALS										
Rafinesque's Big-eared Bat *Corynorhinus rafinesquii*	**Global Status: G3; State Status: S3.** Rare and locally occurring in low-elevation mesic forests, river and creek valleys, and mature bottomland hardwood forests. All recent and most historic records are from the Little River watershed.						•		•	•
Ozark Big-eared Bat *Corynorhinus townsendii ingens*	**Global Status: T1; State Status: S1.** Federally listed as endangered. Very rare and with a total population of about 2,500 individuals. Restricted to a few karst areas in the southwestern Ozarks, primarily where the Springfield Plateau meets the Boston Mountains.					•				•
Northern Hoary Bat *Lasiurus cinereus*	**Global Status: G3; State Status: NR.** Common but declining, foliage-roosting bat. Large numbers migrate throughout Oklahoma during the spring and fall months, and smaller numbers remain through the summer in open woodlands and forests across the eastern one-half of the state.		•	•	•	•	•	•	•	•

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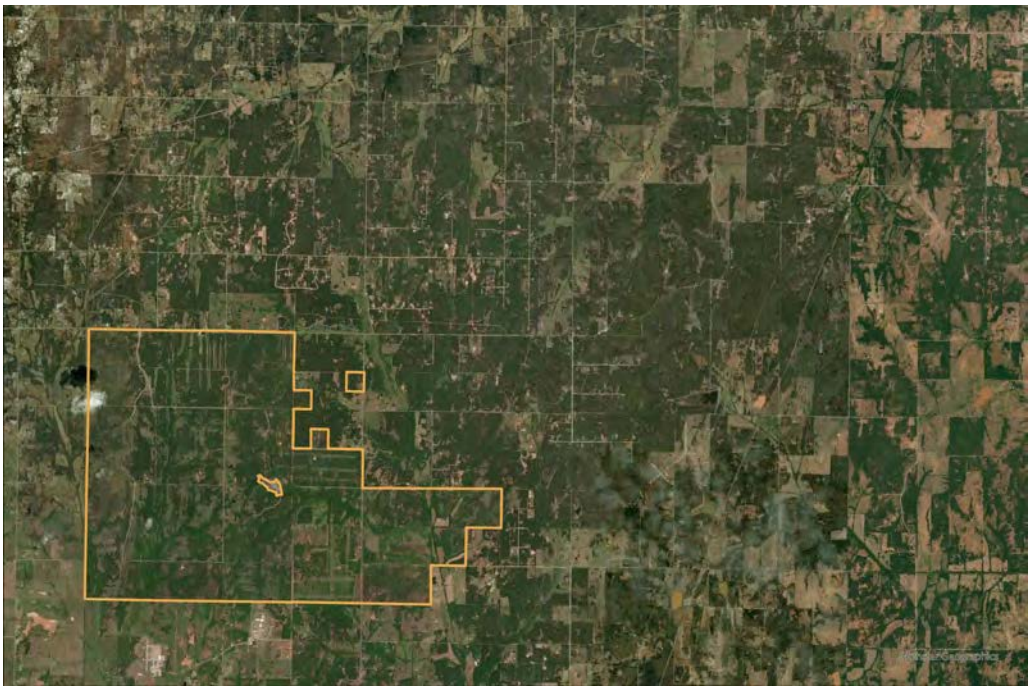
Woodcuck *Marmota monax*	**Global Status: G5; State Status: S3.** Uncommon, but increasing in open oak woodlands and forest edges in the Ozark Plateau and north-central Oklahoma. Slowly expanding its range westward and southward into southern Oklahoma.			•		•		•		
Southeastern Myotis *Myotis austroriparius*	**Global Status: G4; State Status: S1.** Rare and locally occurring in low-elevation mesic forests and bottomland forests in the Gulf Coastal Plain of southeastern Oklahoma. Documented only during the summer months and primarily in the Little River watershed.						•		•	•
Gray Myotis *Myotis grisescens*	**Global Status: G3; State Status: S1.** Federally listed as endangered. Locally common during the summer months in riparian and bottomland hardwood forests in the Ozark Plateau in the vicinity of caves that support maternity colonies. Oklahoma's breeding population appears to migrate east to hibernate in caves in other states. Frequently forages over water and in riparian forests.					•			•	•
Eastern Small-footed Myotis *Myotis leibii*	**Global Status: G4; State Status: S1.** Very rare and recorded fewer than five times in Oklahoma in association with rocky slopes and mature forests in the eastern Ouachita Mountains.						•			•
Little-brown Myotis *Myotis lucifugus*	**Global Status: G3; State Status: S1.** Rare migratory bat in Oklahoma that moves through the eastern one-quarter of the state during the spring and fall. Forages in oak and mixed hardwood woodlands and forests. There are a few summer records for this species in caves and buildings along the Arkansas stateline in Adair, Delaware, and McCurtain counties. Species also has been documented in Nowata County via a summer mist-net capture.					•	•	•	•	•
Northern Long-eared Myotis *Myotis septentrionalis*	**Global Status: G2; State Status: S2.** Federally listed as endangered. An increasing rare bat in recent years that is found in mature deciduous and mixed hardwood forests in the eastern one-quarter of Oklahoma during the summer months. Species has been reported during summer mist-net captures on the Ouachita National Forest in mixed hardwood forests. Its winter distribution is poorly known, but it is known to hibernate in caves in the Ozark Plateau.			•		•	•	•	•	•
Indiana Motis *Myotis sodalis*	**Global Status: G2; State Status: S1.** Federally listed as endangered. Occurs as a rare spring and fall migrant through the eastern one-fifth of Oklahoma in mature deciduous forests. There are a few winter records on Winding Stair Mountain, and recently a few summer records in bottomland and mesic forests in the southeast corner of the state. This species has been documented using tree roosts during the summer in McCurtain County.					•	•		•	•
Golden Mouse *Ochrotomys nuttalli*	**Global Status: G5; State Status: S2.** Rare resident of mesic and bottomland forest stands with dense thickets of understory shrubs. Found in southeastern Oklahoma in the Ouachita Mountains and Gulf Coastal Plain.						•		•	•

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat		
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Upland Post Oak – Blackjack Oak – Hickory Woodland and Forest	Bottomland Oak – Hickory Hardwood Forest	White Oak – Hickory Mesic Forest
Texas Marsh Rice Rat *Oryzomys texensis*	**Global Status: GNR; State Status: S3.** Uncommon but widespread in floodplains and bottomland habitats in southeastern and south-central Oklahoma. Occurs in the transition between bottomland forests and herbaceous wetlands.				•		•		•	
Tricolored Bat *Perimyotis subflavus*	**Global Status: G3; State Status: S3.** During the summer months, the tricolored bat occurs in forested habitats across the eastern one-half of Oklahoma, and in a few areas with wooded canyons and caves in western Oklahoma. During the winter, this species moves into caves, and similar sites with stable temperatures, to hibernate. Proposed for federal listing as an endangered species.		•	•	•	•	•	•	•	•
Lacey's White-ankled Mouse *Peromyscus laceianus*	**Global Status: G5; State Status: NR.** Locally common species of deermouse that is associated with forested and brushy hillsides and ravines underlaid by limestone bedrock. In Oklahoma, this habitat type is limited to a few areas in the south-central part of the state including the Arbuckle Mountains.				•			•		
Eastern Harvest Mouse *Reithrodontomys humulis*	**Global Status: G5; State Status: S2.** Uncommon and locally occurring. It has been documented in tallgrass prairies, open oak woodlands, and forest edges at scattered locations across the eastern one-half of the state.			•	•		•	•		
Plains Spotted Skunk *Spilogale interrupta*	**Global Status: G3; State Status: S2.** Rare, secretive, and partially arboreal. Its status is poorly known and most records within the past 30 years are from the eastern one-third of the state in rocky, oak forest habitats, particularly in the Ouachita and Boston mountains.				•	•	•	•	•	•
REPTILES										
American Alligator *Alligator mississippiensis*	**Global Status: G5; State Status: S4.** Rare and secretive but increasing in abundance. Found in sloughs and swamps in the flood plains of the Red and Little rivers in southeastern Oklahoma.						•		•	
Smooth Softshell *Apalone mutica*	**Global Status: G5; State Status: S5.** An uncommon turtle found in large soft-bottom streams and rivers as well as in sloughs and wetlands within bottomland forests across central and eastern Oklahoma.			•	•		•		•	
Common Scarletsnake *Cemophora coccinea*	**Global Status: G5; State Status: S2.** An uncommon and secretive burrowing species whose geographic range is still poorly delineated. It occurs in low densities in oak woodlands and forests, in particularly those with sandy and loamy soils in the Cross Timbers and Arkansas River Valley ecoregions.				•	•	•	•	•	•
Chicken Turtle *Deirochelys reticularia*	**Global Status: G5; State Status: S2.** Uncommon, semi-aquatic turtle that that occurs very locally in the Gulf Coastal Plain and along the Red River valley in southeastern Oklahoma. Typically occurs in forested landscapes with multiple sloughs, ponds, and forested wetlands in close proximity.				•		•		•	

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat		
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Upland Post Oak – Blackjack Oak – Hickory Woodland and Forest	Bottomland Oak – Hickory Hardwood Forest	White Oak – Hickory Mesic Forest
Red-bellied Mudsnake *Farancia abacura*	**Global Status: G5; State Status: S1.** Rare aquatic snake found in sloughs and forested wetlands in the Gulf Coastal Plain in southeastern Oklahoma.						•		•	
Glossy Swampsnake *Liodytes rigida*	**Global Status: G5; State Status: S1.** Uncommon aquatic snake of wetlands, sloughs, and swamps in the Gulf Coastal Plain and Kiamichi River valley.						•		•	
Texas Horned Lizard *Phrynosoma cornutum*	**Global Status: G4; State Status: S2.** Primarily a lizard of prairies in central and western Oklahoma, but found locally in open post oak woodlands and savannahs along the western and northern edges of the Cross Timbers Ecoregion.			•	•			•		
River Cooter *Pseudemys concinna*	**Global Status: G5; State Status: S4.** Large and uncommon aquatic turtle that is found in sloughs and wetlands within bottomland forests, as well as streams and small rivers across the eastern one-half of Oklahoma.			•	•	•	•		•	
Razor-backed Musk Turtle *Sternotherus carinatus*	**Global Status: G5; State Status: S4.** Secretive and uncommon turtle found throughout the Ouachita Mountains and in the tributaries to the Red River in southeastern and south-central Oklahoma.				•		•		•	
Three-toed Box Turtle *Terrepene triunguis*	**Global Status: G5; State Status: NR.** Common box turtle of deciduous forests. Found across the eastern one-half of Oklahoma in all forest types except those with extremely rocky or shallow soils.			•	•	•	•	•	•	•

Deciduous Woodlands and Forests Conservation Issues and Actions

Conservation Issue: Habitat Loss and Fragmentation



An aerial view shows the scope of habitat conversion near Lexington Wildlife Management Area in central Oklahoma.

All of Oklahoma's deciduous forest habitats have been affected by both large-scale (>100 acres) and small-scale (<100 acres) clearing and conversion of the habitat to other land uses and conditions. These conversions vary regionally and include the conversion into loblolly pine (Pinus taeda) plantations in southeastern Oklahoma; conversion to crop fields on sites with deep soils; conversion to residential and commercial development, especially in the Tulsa and Oklahoma City metropolitan areas; and the widespread conversion of woodlands to managed pastures planted to non-native tall fescue (Schedonorous arundinaceus), perennial rye (Lolium perenne), or bermudagrass (Cynodon dactylon). Each of these conversions results in a new land use or land cover type that provides poorer habitat conditions or are unsuitable for most of Oklahoma's Species of Greatest Conservation Need (SGCN). Conversions often occur following the mechanical cutting, dozing, and removal of trees, but many acres of upland oak-dominated woodlands have been treated with aerial applications of broadleaf herbicides like Spike to convert these woodlands to rangeland or pastureland for increased cattle production. Nearly 4,000,000 acres of Oklahoma's estimated 12,000,000 acres of historic forest land have been lost to habitat conversion and bottomland hardwood forests have been particularly affected by conversions because these often occur on relatively level, moist, deep soils that are valuable for crop and forage production. Tens of thousands of acres of bottomland hardwood forests also have been lost to inundation due to reservoir construction, and smaller acreages have been converted to commercial pecan orchards. Bottomland hardwood forests that were historically large continuous bands of habitat along streams and small rivers are now broken into many disjunct fragments.

The clearing and conversion of forest land has dual impact; it results in the direct loss of habitat on the converted acres as well as fragmenting the remaining habitat and isolating forest tracts from one another. As the size of the intact habitat tracts decrease, their quality and value to wildlife also decreases, particularly for those species whose life history strategies require a large acreage for their home range and those with poor dispersal or movement capabilities. Fragmentation is most obvious in landscapes where large tracts of forest have been converted to crop fields, pastures, and other open habitats, but a comparable or greater amount of fragmentation is caused by smaller-scale activities including the construction of roads, rural homes, cabins and vacation homes, pipeline and transmission line rights-of-way, and drilling pads. These smaller scale forms of forest fragmentation often are associated with an increase in erosion around disturbed sites, increased potential for pollution events such as oil, saltwater, or septic system spills, and increased noise associated with vehicles. Each of these can lead to a further reduction in the quality of habitat. Disturbed clearings and rights-of-way also can facilitate the introduction and spread of non-native and invasive plants and can be used as travel corridors for predatory wildlife such as coyotes (Canis latrans) and raccoons (Procyon lotor). Additionally, this clearing and fragmentation can facilitate the dispersal of brown-headed cowbirds (Molothrus ater), which can substantially reduce the reproductive success of SGCN songbirds such as the Kentucky warbler (Geothlypis formosa) and Wood thrush (Hylocichla mustelina) through nest parasitism (laying their eggs in the nests of these birds). Fragmentation and conversion of forests often benefit the populations of these highly adaptable predatory and brood-parasitic species, which further compounds the threats that they pose. Cumulatively, these large-scale and

small-scale habitat conversions fragment and isolate tracts of woodland and forest habitat and reduce their quality for SGCN to a degree that is difficult to quantify.

Conservation Actions

- Identify the landscapes that are most suitable for oak woodland restoration or management and rank those that have the greatest benefit for SGCN so that restoration, enhancement and protection efforts can be sufficiently focused.
- Develop programs to maintain large tracts of oak and 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 to get the greatest efficiency.
- Support research into the ecological effects of habitat fragmentation on SGCN and how to more effectively remediate and restore upland woodlands and forests.
- Develop and implement local conservation plans and funding programs that restore upland woodlands and forests from pastures and cropland to connect tracts and build larger areas of habitat that can support larger and more complete biological communities.
- Support greater 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 some may require seeding or planting.
- Encourage the placement of drilling pads and infrastructure additions near existing roads and in previously disturbed sites like crop fields and non-native pastures to minimize additional habitat loss and fragmentation. Further, encourage the co-location of pipelines, roads, and utility lines along the same or adjacent rights-of-way to reduce habitat fragmentation.
- Coordinate with other agencies and research institutions to develop Best Management Practices (BMPs) and management recommendations to minimize the ecological footprint left by the construction of roads, pipelines, and utility lines, and the maintenance of those rights-of-way. Distribute information materials with these practices and recommendations to landowners, agencies, and utility companies.
- Eliminate government funding assistance for the clearing of forests to establish pine plantations or non-native pasture grasses.
- Evaluate methods to effectively restore bottomland hardwood forests on pastures or crop fields and develop cost-share programs or grants to assist landowners who wish to restore these acres. Similar programs could restore the morphology and depth of stream channels and reconnect streams with their adjacent bottomland forests or otherwise conserve and enhance these acres for wildlife.
- Develop programs to maintain biologically meaningful tracts of bottomland hardwood forests and mesic hardwood 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 to SGCN birds, bats, and amphibians. Mitigation funds may be used to acquire existing bottomland hardwood forests and to protect them from future development.
- Develop educational materials for schools and landowners that highlight the ecological and economic value of hardwood trees and hardwood forest communities.
- Develop wildlife corridors to connect tracts of mixed oak and hickory forests in fragmented landscapes. These connections can include linkages between upland forests and bottomland forests to increase the overall size of forest tracts.
- Provide the results of ecological studies to land- and water-use planners, as well as the broader conservation community and the general public, and encourage the incorporation of these into federal, state, and local management plans.
- Explore economic alternatives to clearing and grazing hardwood forests including the development of hunting leases and nature-based tourism, creation

Habitat managers plant trees at a restoration site at Deep Fork National Wildlife Refuge. Photo by Sarah Southerland/ODWC.

of marketable carbon sequestration credits, and wetland mitigation or water quality enhancement credits in bottomland hardwood forests, as a supplemental revenue sources for landowners.
- Develop a landowner incentives program to encourage the retention and restoration of mesic forest and bottomland hardwood stands to reduce the fragmentation of forested tracts and prevent their conversion to other vegetation types such as introduced pasture. Cost-share programs, grants, or financial incentives could be used to encourage landowners to restore these areas.

A masticator thins the tree canopy at Cookson Wildlife Managment Area. Photo by ODWC.

Conservation Issue: Modification of Natural Ecosystem Processes

The structure and condition of Oklahoma's deciduous forests and woodlands have been altered over the past 150 years by the interactions between a combination of widespread fire suppression, large-scale timber harvests, and recent changes in grazing patterns.

Historic fire regimes have been lost or altered across much of Oklahoma to the point that woodlands and forests no longer experience periodic fire events. Oak-dominated woodlands in upland locations historically experienced late summer, fall, or winter fires at intervals of four to seven years, while bottomland forests and mesic forests on north- and east-facing slopes burned at longer intervals of seven to 10 years.

As a result of fire suppression, most forests experience fire much less frequently, and one result of this is an increase in tree density in many forest tracts relative to their historic condition. This increase in density manifests itself in multiple ways including increased canopy density and canopy closure to the point that formerly open woodlands have become dense shaded forests. Many forest tracts also have a higher abundance and density of woody understory and mid-story species such as eastern redcedar and winged elm, which were historically killed and thinned by period fires. Woodland and forest tracts with dense canopies and mid-story vegetation often have little ground-level vegetation due to excessive shading, and this reduces the survival of oak and hickory seedlings that are needed to replace the mature canopy trees when they die. The shading of oak and hickory seedings as well as herbaceous understory vegetation by winged elm and eastern redcedar is a concern particularly in the Upland Post Oak – Blackjack Oak – Hickory Woodland and Forest Habitat of the eastern Cross Timbers and the Ouachita Mountains ecoregions.

Another issue caused by fire suppression and less frequent burning in forests is that infrequent fires are often more damaging than periodic fire because the accumulation of vegetation during the fire-free period provides a greater fuel for the next fire that occurs. Stands with an abundance of the native but prolific eastern redcedar as a result of fire suppression, have an increased risk of stand-altering wildfires because of the heat and flame heights created by burning redcedars. Constraints such as insufficient personnel and financial resources, air quality concerns, logistical difficulties, and landowner liability issues make the use of management tools such as prescribed burning and selective tree harvest more difficult for most landowners, thereby limiting the feasibility of restoring woodlands and forests to their historic conditions.

Many oak woodland and forest communities, particularly in the central portion of Oklahoma, occur on land that is used for grazing. Historically, grazing was accomplished by nomadic herds of American bison or by resident American elk, but in the present day, most of the landscape is grazed continuously by cattle and horses that are confined by fences. With the use of supplemental winter feeding, domestic livestock can be stocked at greater densities in woodlands today than the densities at which native grazers occurred historically. Continuous grazing has subtle effects on habitat structure and species composition by diminishing highly palatable forbs and promoting grazing-tolerant grasses and forbs that are more characteristic of early successional habitats. One example of this habitat change is the reduction in the size and frequency of cane brakes within bottomland forests due to selective grazing of river cane by cattle. The net result is a reduction in the overall plant diversity, particularly highly palatable species of grasses and forbs, and a reduction in foliage, nectar, and seed resources for wildlife.

Prior to the mid-1880s, most of the deciduous forests across eastern Oklahoma were comprised of trees of diverse ages and heights and were dominated by very mature trees. However, in the present time, many of the deciduous forest stands in the Ozark Plateau and the Ouachita Mountains exist as relatively even-aged forests because of widespread, large-scale commercial timber harvesting that occurred between the 1880s and 1930s, which removed timber across expansive areas. The regrowth forests that developed afterward were typically dense, even-aged stands comprised of trees of similar age and size that competed for space and resources and developed dense canopies. The shading caused by dense canopies in these even-aged forests often limits the abundance and diversity of understory vegetation and sustained shading may limit the recruitment of the dominant oak and hickory species in favor of more shade-tolerant species in future generations of forests. Historic large-scale timber harvest followed by decades of fire suppression has had long-term effects on deciduous forests of all types including mesic and bottomland forests. Many private landowners are unaware of the altered present state of forested landscapes resulting from past activities such as forest clear-cutting, fire suppression, and the spread of invasive species.

Conservation Actions

- Work toward restoring historic grazing patterns by implementing 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.
- Evaluate the effectiveness of prescribed burning, mid-story thinning and selective tree removal or canopy thinning as tools to diversify forest structure and increase the diversity and abundance of understory vegetation.
- Restore sites to a woodland community structure on public lands and use these as research and demonstration areas to show the results of prescribed fire and grazing management practices.
- Develop monitoring standards and monitor the response of wildlife populations to various land management practices such as thinning, deferred grazing, and prescribed late winter or late summer burning.
- 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 pre-settlement fires occurred in late summer and fall when soil and air moisture were low and many of these species were dormant.
- 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 associations in cooperation with rural fire departments, county commissioners and Native American Nations. Provide financial and technical support for burning equipment and group insurance for prescribed burning associations to make the use of fire safer and more affordable to landowners.
- 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 will be 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.
- Encourage landowners who lease their hunting or fishing rights to incorporate lease stipulations that require the removal or management of eastern redcedar, winged elm, and other aggressive native plants by their lessees.
- Develop and promote the use of BMPs for logging bottomland hardwoods that encourage structural diversity and retain 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.
- Restrict the frequency and size of prescribed burns in mesic forest sites through

Prescribed fire is used as a management tool at Lexington Wildlife Management Area. Photo by Daisy Creager/ODWC.

education and produce informational materials for land managers regarding fire frequency and how it relates to different forest types.
- Purchase conservation easements or fee-title from willing sellers of biologically important tracts of mesic forest to maintain or enhance their habitat quality for SGCN.

Tenkiller Ferry Dam at Tenkiller Lake in Sequoyah County, Oklahoma. Photo by ODWC.

Conservation Issue: Modification of Natural Ecosystem Processes (Altered Hydrology)

In addition to the structural and compositional changes caused by historic large-scale timber harvest, and the alteration of fire and grazing systems, bottomland hardwood forests have been affected by the alteration of their seasonal flooding frequencies. Bottomland hardwood forests developed over centuries in stream and river floodplains where the soils were seasonally saturated with water, usually in the winter or spring, during high-rainfall and flood events. But across many floodplains, the natural cycle of flooding has been altered by the channelization of streams and the construction of reservoirs. In areas where streams have been channelized and straightened, the streams frequently become incised and disconnected from the bottomland forests in their floodplains. This can lead to the lowering of the shallow water table and a decrease in the magnitude and duration of flood events such that they are no longer sufficient to maintain the forests in their historic condition. In other locations where reservoirs or impoundments have been created, bottomland forests have been lost to continual inundation, or the soils remain saturated for periods of time that are too long to sustain their dominant oak and hickory species. Because of reservoir construction, the frequency and magnitude of natural, seasonal flood events also are altered for additional tracts of Bottomland Oak – Hickory Hardwood Forest Habitat downstream where there is a decrease in the duration and frequency of seasonal flooding.

Additionally, many of the temporary wetlands and vernal pools (small depressions that fill seasonally during the winter and spring) that once occurred within bottomland forests and the lower slopes of mesic forests have been lost due to the draining of wetlands, the alteration of the hydrology that supported them following changes in drainage patterns caused by the channelization of streams or the construction of levees, dikes, ditches, and roads, and the filling of wetlands by direct human action or indirectly by increased siltation following timber harvest. These sites support unique and diverse communities of plants and insects, serve as breeding areas for some amphibians. Vernal pools are especially important for some amphibian SGCN including ringed salamander (Ambystoma annulatum), mole salamander (Ambystoma talpoideum), and Hurter's spadefoot (Scaphiopus hurterii), which require them for the completion of their reproductive cycle.

Conservation Actions

- Research alternative flood control methods used in other parts of the country for applicability to Oklahoma including diversion of water during high flow events to flood specific areas within the floodplain, restore bottomland forests inside existing levees, and create wetland mitigation sites.
- Reconnect bottomland hardwood forests with the river or stream system along which they developed by restoring the natural meanders of the channels and the historic flooding patterns.
- Modify reservoir management to allow periodic flooding of bottomland hardwood tracts below dams to mimic historic hydrological patterns.
- End any remaining cost-share programs that would encourage the construction of new lakes on perennial streams that would inundate bottomland forests or would alter the hydrology that supports bottomland forests downstream. Instead, develop cost-share programs for the construction of low dams and dikes to restore hydrology and seasonal flooding to previously altered bottomland forests.
- Develop incentives for land managers to restore the morphology and depth of stream channels and reconnect the streams with their adjacent bottomland forests.
- Use mitigation funds to acquire conservation easements or fee title to biologically important bottomland hardwood forest tracts to protect them from future habitat conversion.
- Work with the avian habitat joint ventures to leverage state and private funds with North American Wetland Conservation Act funding to purchase fee title or

easements to protect or expand the remaining tracts of bottomland hardwood forest.
- Educate landowners about watershed connectivity, the importance of riparian and bottomland forests for minimizing bank erosion and stream movement, and the existing conservation cost-share programs that can help them enhance and maintain these habitats.
- Conduct surveys to identify vernal pools, seeps, and seasonal wetlands that are important to SGCN. Develop protection and management plans for vernal pools, seeps, and seasonal wetlands that are important to salamander SGCN. These plans can include activities such as fencing, dredging and removing accumulated sediments, developing conservation easements and cost-share programs, or constructing new vernal pools.
- Construct vernal pools and seasonal wetlands to provide breeding opportunities for amphibians such as the ringed salamander and develop monitoring programs to evaluate the success of vernal pool management plans and their effects on local populations of amphibians.

Conservation Issue: Human Intrusion and Disturbance

On a smaller scale, several other land use practices affect local stands of deciduous forests. The frequent and sustained use of all-terrain vehicles can compact soil, create soil erosion problems, and damage understory vegetation, as well as directly impacting small wildlife that live or nest in the leaf litter. Similarly, frequent and sustained equestrian activity can create erosion problems or facilitate the spread of non-native, weedy herbaceous plants when seeds are transported in horse feed or deposited in droppings.

Conservation Actions

- Develop informational materials describing the potential impacts of off-road vehicle use and equestrian activities on steeper slopes. Develop recommendations to minimize these impacts, including time of year when damage is the least or locations least prone to erosion.
- Continue to control the use of off-road and all-terrain vehicles on public lands by closing or gating roads to limit access.

Conservation Issue: Information Gaps

Across all forest types, the existing data regarding distributions, ecological needs, and population trends are incomplete for some of Oklahoma's SGCN. This is especially relevant for amphibians, bats, songbirds, and invertebrates in the mesic forests and bottomland forests in the eastern one-third of the state. To establish effective conservation actions, more complete data are needed, and more thorough evaluations are needed to determine the factors that limit population sizes or are responsible for population declines.

Similarly, our knowledge of the historic and current distributions, structural conditions, and plant community compositions in Oklahoma's deciduous forests are incomplete, and our understanding of historic forest conditions are based on a relatively small number of historic descriptions and a limited number of age-class studies of unharvested timber stands. While bottomland hardwood forest communities occur in predictable locations with specific soil types and close proximity to streams and rivers, their current and historic distributions and conditions have not been completely assessed. Similarly, mesic forests occur in predictable locations with specific rainfall, slope, and aspect conditions, but their current distribution and condition are poorly understood. Upland mixed oak and hickory forests are particularly difficult to characterize because they typically exist as mosaics of woodlands with canopy cover ranging from 30-70% and forests with varying degrees of canopy closure including those with more than 70% coverage, understory development, historic fire frequency, soil depth, slope, and aspect. More information is needed to determine the historic vegetation structure including species composition, age structure, and density of forests and woodlands, as well as the factors that influence whether sites are most suitable for the development of closed-canopy forest stands or more open woodland or savannah stands.

Oklahoma salamander at Cookson Wildlife Management Area. Photo by ODWC.

Conservation Actions

- Conduct targeted surveys to assess the current distribution, abundance, habitat preferences, and ecological needs of high-concern SGCN. Use these data to inform the selection

of geographic areas where conservation efforts should be directed to provide the greatest benefit for these species.

- Research the factors that appear to limit the population sizes and trajectories of SGCN and develop management recommendations to enhance their populations through improved habitat conditions or juvenile recruitment. Use the results of these surveys and studies to update the State Wildlife Action Plan via adaptive resource management.
- Develop population monitoring programs centered on representative SGCN to measure their abundance, geographic range, and the habitat condition of the forests in which they occur.

American burying beetle surveys are conducted at Fort Gibson Wildlife Management Area. Photo by ODWC.

- Continue to maintain a database to house and share the distributional and ecological data for Oklahoma's SGCN.
- Ensure the results of all ecological studies of SGCN and deciduous forest communities are published and archived where they can be easily accessed by land managers and conservation agencies that can incorporate these into site-specific, species-specific, and regional conservation plans.
- Develop methods, including aerial photography followed by extensive ground surveys, to accurately identify and map the current distribution and condition of each of the deciduous forest and woodland types: Upland Post Oak – Blackjack Oak – Hickory Woodland and Forest habitats, Bottomland Oak – Hickory Hardwood Forest habitats, and White Oak – Hickory Mesic Forest habitats to establish a baseline condition of distribution and abundance for future monitoring efforts.
- Create a long-term habitat monitoring program based upon photographic documentation of habitat structure and condition. Where feasible, locate existing historic photographs and their exact location and use those sites as the continuing long-term photo sites for habitat monitoring.
- Research the historic condition of the three deciduous forest types to develop realistic and biologically meaningful descriptions for how high-quality habitats should look. These should serve as the target conditions for habitat restoration, enhancement, and management efforts.
- Conduct biological inventories of the remaining forest tracts, or a representative subsample, to determine their species composition and the distribution of the SGCN that are associated with or dependent upon each forest habitat type. Use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest benefit for these species and identify the management practices that could enhance the value of these forest tracts for SGCN.

Conservation Issue: Invasive and Problematic Species

A wide range of invasive plant species, including sericea lespedeza (Lespedeza cuneata), garlic mustard (Alliaria petiolata), Japanese honeysuckle (Lonicera japonica), sweet autumn clematis (Clematis terniflora), beefsteak plant (Perilla frutescens), Japanese stiltgrass (Microstegium vimineum), tall fescue, and perennial ryegrass have become established in Oklahoma's forest communities where they now compete with and displace native plant species that are generally more beneficial to wildlife as sources of food and cover. In addition to displacing native plants, some invasive species, including autumn olive (Elaeagnus umbellata), amur honeysuckle (Lonicera maackii), Chinese privet (Ligustrum sinense), waxy leaf privet (Ligustrum quihoui), and kudzu (Pueraria montana) alter the structure of the forest understory and create dense thickets within and along the edges of forests that shade out native herbaceous plants and tree seedlings. These habitat changes created by these encroaching species threaten to reduce habitat suitability and quality for SGCN. In some cases, these non-native species were once recommended by natural resource professionals and government agencies as beneficial for uses like erosion control, livestock forage, and shelterbelts.

Where feral hogs have become established, they cause substantial damage to seeps, springs, glades, and vernal pools within the larger deciduous woodlands and forests, which are important breeding areas for amphibians. Additionally, they damage understory vegetation that affects a wide range of other SGCN. Feral cats can put additional predation pressure on local populations of reptile,

amphibian, bird, and small mammal SGCN. 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 facilitate invasions of non-native understory plants, which can affect density, survival and reproductive success of ground-nesting birds and amphibians.

Several non-native tree diseases and pests have become established in the United States and their expansion poses a threat to some SGCN by way of modifying the forest structure and biological composition across large areas. These diseases and pests include oak wilt (Ceratocystis fagacearum), emerald ash borer beetle (Agrilus planipennis), chestnut blight (Cryphonectria parasitica), and dogwood anthracnose (Discula destructiva) each of which threaten to alter forest communities if they become established. Because of the dominance and importance of oaks in Oklahoma's forests, oak wilt could substantially alter forest structure and diversity if it were to become established and widespread in the state.

Conservation Actions

- Invasive species are most effectively controlled when they first enter a habitat and before they become established. Develop early detection surveillance programs for invasive species and work with the Oklahoma Invasive Plant Council and OSU Extension Service to develop and promote educational materials to help landowners and sportsmen identify and report potentially problematic species.
- Work with the Oklahoma Invasive Plant Council to update and expand the state-level plan for non-native and invasive species control, eradication, and prevention, and support their efforts to research the most effective control methods for invasive species and to disseminate information to landowners and public agencies.
- Evaluate the severity and magnitude of the ecological damage done by invasive plant and animal species, including the displacement of native plant communities, predation on native animal populations, or hybridization with native species, to identify the invasive species causing the greatest impact to SGCN.
- Identify where invasive species are the most problematic or where their control could most effectively be achieved and conduct pilot management studies to determine successful strategies.
- Develop and implement management plans, including the use of prescribed burning programs, selective spot – treatment with herbicide, and mechanical removal, for the invasive species that cause the greatest ecological damage.
- Monitor the response of SGCN and other wildlife populations to various methods of invasive species control to determine best practices and effectiveness.
- Improve coordination between wildlife biologists, conservation agencies, and agricultural organizations so that these groups can share information about the negative effects of using invasive plants, and how to best manage invasive species.
- Encourage state, county, municipal, and utility right-of-way managers to only use native plant species in their revegetation efforts and recommend appropriate spraying methods that will target the management of invasive species without negatively effecting beneficial native species.
- Minimize damage to trees 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 Department of Agriculture, Food and Forestry's Forestry Services Division to implement management practices to stop the introduction and spread of emerging forest diseases.
- Develop cost-share or incentives programs for private landowners to encourage the management and control of non-native invasive 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.

Chinese privet can take over and dominate forest edges and understories. Photo by Leah Lowe/ODWC.

Potential Indicators for Monitoring the Effectiveness of the Conservation Actions

- number of acres of upland mixed oak and hickory forest and woodland that are regularly burned
- number of acres of native woodland and forest plant communities restored
- number of acres of oak-dominated woodlands and forest restored and placed into conservation ownership or easements
- number of even-age forest acres that are thinned and/or regularly burned to restore these stands to an uneven-aged forest condition or a woodland condition
- number of technical assistance visits provided and the number of acres on which recommendations were implemented
- changes in the population sizes and trends of SGCN that are representative of mesic forest or bottomland hardwood forest habitats and can serve as indicators of habitat quality; potential indicators for mesic forests include Kentucky, worm-eating, and cerulean warblers; potential indicators for bottomland forests include prothonotary and Swainson's warblers
- changes in the population sizes and trends of SGCN that are representative of mesic forest or bottomland hardwood forest habitats and can serve as indicators of habitat quality
- changes in acreage covered or impacted by non-native vegetation
- number of fire crews that are trained and conducting prescribed fires
- number of landowners participating in or the number of acres placed in conservation programs, including conservation easements
- response by specific plant species or by overall vegetation structure to different management treatments such as prescribed burning or grazing rotations
- forest stand health as measured by their species composition and structural diversity
- number of acres of bottomland hardwood forests restored from former pasture or cropland
- changes in the acreage of bottomland forest habitat region-wide and the population sizes, trends, and distributions of the SGCN associated with bottomland forests
- number of modified reservoir management plans to allow periodic flooding and natural hydrological saturation downstream
- number of acres of bottomland forests with restored hydrology (reconnected with their streams)
- number of snags per acre in bottomland hardwood forest under conservation management as a way of monitoring habitat quality for species such as bats
- changes in habitat quality such as changes in forest tract size, forest structure, and total acreage
- changes in tree diversity and age-structure at the stand level

Deep Fork Wildlife Management Area. Photo by ODWC.

Representative Conservation Areas Supporting Deciduous Woodlands and Forests

- Arbuckle Springs Wildlife Management Area (ODWC)
- Ardmore City Parks and Lakes (City of Ardmore)
- Arrowhead and Fountainhead State Parks (Oklahoma State Parks Division and ACOE)
- Atoka Wildlife Management Area (ODWC)
- Barren Fork Wildlife Management Area (ODWC)
- Bell Cow Lake (City of Chandler)
- Boggy Depot Historic Park (Chickasaw Nation)
- Bluestem Lake and Pawhuska Lake (City of Pawhuska)
- Boehler Seeps and Sandhills Preserve (The Nature Conservancy)
- Camp Classen (YMCA)
- Camp Gruber (Department of Defense)
- Cherokee Wildlife Management Area (ODWC)
- Chickasaw National Recreation Area (National Park Service)
- Chouteau Wildlife Management Area (ODWC and ACOE)
- Coalgate City Lake (City of Coalgate)
- Cookson Wildlife Management Area (ODWC)
- Copan Reservoir and Wildlife Management Area (ODWC and ACOE)
- Cross Timbers Range Research Station (Oklahoma State University)
- Cross Timbers Wildlife Management Area (ODWC)
- Cucumber Creek Preserve (The Nature Conservancy)
- Deep Fork National Wildlife Refuge (USFWS)
- Deep Fork Wildlife Management Area (ODWC)

Gray bat at Ozark Plateau National Wildlife Refuge. Photo by ODWC.

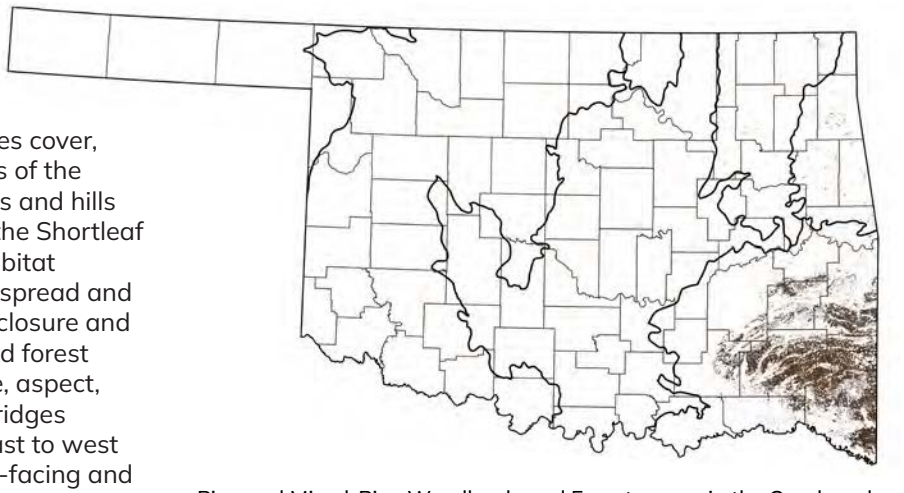
- Diamond H Scout Ranch (Scouting America)
- Dripping Springs and Okmulgee Lake State Parks (Oklahoma State Parks Division)
- Eufaula Reservoir and Wildlife Management Area (ODWC and ACOE)
- Fort Gibson Wildlife Management Area (ODWC and ACOE)
- Gary Sherrer Wildlife Management Area (ODWC)
- Grand Lake Reservoir and State Parks (Grand River Dam Authority and Oklahoma State Parks Division)
- Grassy Slough Wildlife Management Area (ODWC)
- Greenleaf State Park (Oklahoma State Parks Division)
- Heyburn Reservoir and Wildlife Management Area (ODWC, ACOE)
- Hickory Creek Wildlife Management Area (ODWC)
- Hottonia Bottoms Preserve (The Nature Conservancy)
- Hudson Reservoir and Park (Grand River Dam Authority)
- Hugo Reservoir and Wildlife Management Area (ODWC and ACOE)
- Hulah Reservoir and Wildlife Management Area (ODWC and ACOE)
- James Collins Wildlife Management Area (ODWC)
- Kerr Scout Ranch (Scouting America)
- Keystone Ancient Cross Timbers Preserve (City of Sand Springs)
- Keystone Reservoir and Wildlife Management Area (ODWC and ACOE)
- Lake Bixhoma Park (City of Bixby)
- Lake Eucha (City of Tulsa)
- Lake Longmire (City of Pauls Valley)
- Lake Murray State Park (Oklahoma State Parks Division)
- Lake Raymond Gary (ODWC and Oklahoma State Parks Division)
- Lake Stanley Draper (City of Oklahoma City)
- Lexington Wildlife Management Area (ODWC)
- Little River National Wildlife Refuge (USFWS)
- McAlester Army Ammunition Plant (U.S. Department of Defense)
- McClellan-Kerr Navigation System (ACOE)
- Mohawk Park (City of Tulsa)
- Natural Falls State Park (Oklahoma State Parks Division)
- J.T. Nickel Family Wildlife Preserve (The Nature Conservancy)
- Okmulgee Wildlife Management Area (ODWC)
- Oologah Reservoir and Wildlife Management Area (ODWC and ACOE)
- Ouachita National Forest Le Flore, Broken Bow, and Tiak Units (U.S. Forest Service)
- Oliver's Woods (Oklahoma Biological Survey)
- Osage Hills State Park (Oklahoma State Parks Division)
- Osage Wildlife Management Area (ODWC)
- Ozark Plateau National Wildlife Refuge (USFWS)
- Ozark Plateau Wildlife Management Area (ODWC)
- Pearl Jackson Cross Timbers Preserve (The Nature Conservancy)
- Pontotoc Ridge Preserve (The Nature Conservancy)
- Pushmataha Wildlife Management Area (ODWC)
- Sardis Reservoir (ACOE)
- Sequoyah National Wildlife Refuge (USFWS)
- Sequoyah State Park (Oklahoma State Parks Division)
- Skiatook Wildlife Management Area (ODWC, ACOE)
- Sparrowhawk Wildlife Management Area (ODWC)
- Spavinaw Hills Wildlife Management Area (ODWC)
- Spavinaw Reservoir (City of Tulsa)
- Sportsman Lake (City of Seminole)
- Stillwell City Lake (City of Stillwell)
- Tallgrass Prairie Preserve (The Nature Conservancy)
- Tenkiller Reservoir and State Park (Oklahoma State Parks Division and ACOE)
- Thunderbird Reservoir and State Park (Oklahoma State Parks Division and Bureau of Reclamation)
- Tishomingo National Wildlife Refuge (USFWS)
- Turkey Mountain Park (City of Tulsa)
- Wichita Mountains Wildlife Refuge (USFWS)
- Wister Reservoir and Wildlife Management Area (ODWC and ACOE)
- Woolaroc Nature Preserve (Phillips Foundation)
- Yourman Wildlife Management Area (ODWC)

Pine and Mixed-Pine Woodlands and Forests

Misty pines in the Ouachita National Forest. Photo by Kelly Adams/ODWC.

Shortleaf Pine – Oak – Hickory Woodland and Forest Habitat

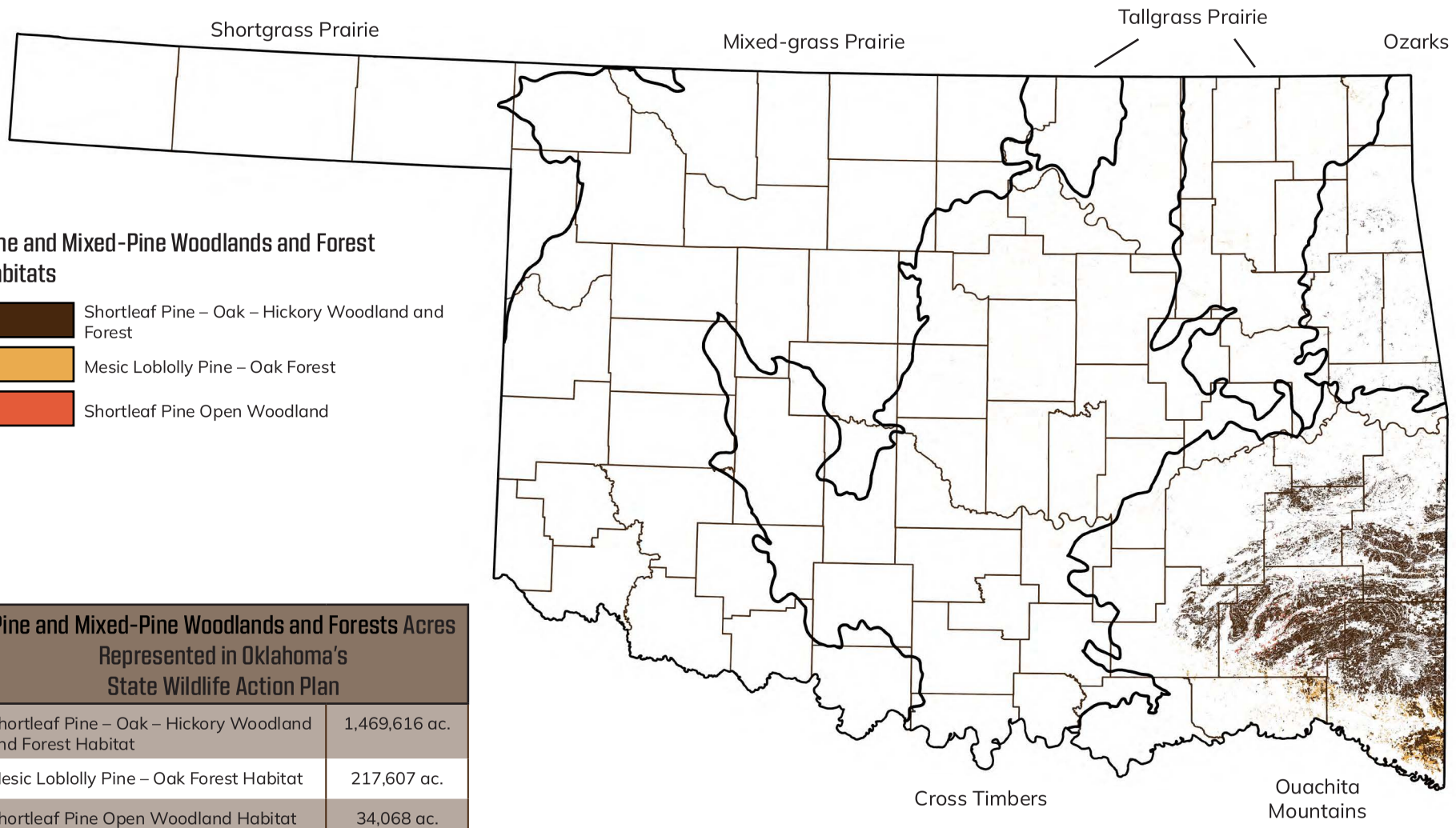
Complex mosaics of woodlands and forests dominated by shortleaf pine, oaks, and hickories cover, or once covered, all but the north-facing slopes of the Ouachita Mountains as well as the rocky ridges and hills within the Arkansas River Valley. Collectively, the Shortleaf Pine – Oak – Hickory Woodland and Forest Habitat comprises the Ouachita Mountain's most widespread and abundant habitat type. The degree of canopy closure and the species composition of these woodland and forest stands 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, creating long north-facing and south-facing slopes with different forest types and tree communities. Additionally, across the Ouachita Mountains, the average annual rainfall varies from 44 inches in the lower elevation ridges on the west end to more than 52 inches in the higher elevation ridges near the state line with Arkansas. Topographic conditions favor the development of Shortleaf Pine – Oak – Hickory Woodland and Forest habitats on moderate southern and western slopes, which are exposed directly to drying winds. Shortleaf pine (*Pinus echinata*) is the is the dominant conifer and co-occurs with several deciduous species including post oak (*Quercus stellata*), black oak (*Quercus velutina*), blackjack oak (*Quercus marilandica*), northern red oak (*Quercus rubra*), and white oak (*Quercus alba*), as well as black hickory



Pine and Mixed-Pine Woodlands and Forests occur in the Ozark and Ouachita Mountains ecoregions.

(*Carya texana*), and mockernut hickory (*Carya tomentosa*). In some stands, other hardwood trees may be present in substantial numbers including southern red oak (*Quercus falcata*), chinquapin oak (*Quercus muehlenbergii*), Shumard oak (*Quercus shumardii*), and bitternut hickory (*Carya cordiformis*).

Historically, periodic fires and drought kept approximately one-third to one-half of this mixed pine system in a woodland condition where the canopy was somewhat open (<70% canopy closure) and the abundances of fire-sensitive and drought-intolerant species were lower. The



Pine and Mixed-Pine Woodlands and Forest Habitats

- Shortleaf Pine – Oak – Hickory Woodland and Forest
- Mesic Loblolly Pine – Oak Forest
- Shortleaf Pine Open Woodland

Pine and Mixed-Pine Woodlands and Forests Acres Represented in Oklahoma's State Wildlife Action Plan	
Shortleaf Pine – Oak – Hickory Woodland and Forest Habitat	1,469,616 ac.
Mesic Loblolly Pine – Oak Forest Habitat	217,607 ac.
Shortleaf Pine Open Woodland Habitat	34,068 ac.
Total Acres Represented	**1,721,291 ac.**

Pushmataha Wildlife Management Area. Photo by Jason Manous.

more open woodland stands were more strongly dominated by shortleaf pine, post oak, and blackjack oak with a lesser abundance of black hickory and black oak. The understories of these open woodlands consisted primarily of herbaceous vegetation and low shrubs dominated by little bluestem (*Schizachyrium scoparium*), lowbush blueberry (*Vaccinium pallidum*), longbract wild indigo (*Baptisia bracteata*), St. John's wort (*Hypericum hypericoides*), and hairy sunflower (*Helianthus hirsutus*).

On slopes protected from drying winds, as well as steep slopes and ridge tops, environmental conditions are not as favorable for frequent fire. Therefore, these areas burn less frequently, and the conditions are more favorable for the development of forest communities. Mature Shortleaf Pine – Oak – Hickory Forest habitats typically have 80-100% canopy closure. Mature Shortleaf Pine – Oak – Hickory Forest habitats, with trees of mixed ages, typically contain a larger number and diversity of deciduous trees that includes some northern red oaks, mockernut hickories, and black hickories. Where trees of mixed ages co-occur, canopy variation exists, allowing light to penetrate to the forest floor and support a diverse community of understory vegetation that is often dominated by shrubs, including lowbush blueberry (*Vaccinium pallidum*), winged sumac (*Rhus copallinum*), blackberries (*Rubus sp.*), and American beautyberry (*Callicarpa americana*), and shade-tolerant forbs (e.g. butterfly pea (*Clitoria mariana*), birdfoot violet (*Viola pedata*), Rugel's plantain (*Plantago rugelii*)). However, when forests are comprised of trees of similar age, as occurs in regrowth forests following clear-cut logging or wildfire, the canopy can become a uniformly closed system that allows little light to penetrate to the forest floor. These forests often have sparse understory vegetation.

Although the acreage and distribution are limited in Oklahoma, Shortleaf Pine – Oak – Hickory Woodland habitats can be found also on sandhill-like areas with deep, sandy soil in the transition between the Ouachita Mountains to the north and the Gulf Coastal Plain to the south. In these pockets of dry woodlands, shortleaf pine co-occurs with post oak, bluejack oak (*Quercus incana*), and southern red oak.

Although most of the Shortleaf Pine – Oak – Hickory Woodland and Forest Habitat occurs in the Ouachita Mountains, small pockets of it occur also in the Ozark Plateau on ridgetops and on dry, rocky upper portions of east-, south-, and west-facing slopes in Cherokee and Delaware counties. This habitat is shaped by the combination of dry soils and periodic fire, and the plant community closely resembles that which is found in the Ouachita Mountains although often with a larger component of hickories and chinquapin oaks (*Quercus muehlenbergii*).

The Ouachita Mountains and the Ozark Plateau are home to several regionally endemic Plant Species of Conservation Need, and many of these are found in Shortleaf Pine – Oak – Hickory Woodlands and Forest habitats including the Ozark chinquapin (*Castanea ozarkensis*), Ouachita indigo (*Amorpha ouachitensis*), Waterfall's sedge (*Carex latebracteata*), pine-oak jewelflower (*Streptanthis squamiformis*), Ouachita bluet (*Houstonia ouachitana*), Baldwin's milkvine (*Matelea baldwyniana*), Barbed rattlesnake-root (*Prenanthes barbata*), Nuttall's cornsalad (*Valerianella nuttallii*), and Palmer's cornsalad (*Valerianella palmeri*). The small-headed pipewort (*Eriocaulon koernickianum*) has been found in a handful of sandhill seeps within woodlands dominated by shortleaf pine, bluejack oak, and southern red oak.

Recognized Shortleaf Pine – Oak – Hickory Woodlands and Forest Habitat Vegetation Associations

- Shortleaf Pine – Post Oak – Blackjack Oak Forest
- Shortleaf Pine – Northern Red Oak – Black Oak Forest
- Shortleaf Pine – White Oak – Black Oak Forest

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Shortleaf Pine Open Woodland Habitat

The Shortleaf Pine Open Woodland Habitat is currently one of the rarest plant communities in eastern Oklahoma, but historically it was widespread on dry, mid- and upper slopes of the Ouachita Mountains with southern and western aspects. This is a fire-maintained community in which frequent fires eliminate fire intolerant species

and maintain a low-density woodland dominated by fire-tolerant shortleaf pines and post oaks. Pines create an open canopy over an understory that is dominated by grasses and forbs, particularly little bluestem (*Schizachyrium scoparium*), poverty oatgrass (*Danthonia spicata*), several species of panic grass (*Dichanthelium sp.*), pale purple coneflower (*Echinacea pallida*), redpurple beebalm (*Monarda russeliana*), and elmleaf goldenrod (*Solidago ulmifolia*). The understory shrub density is low due to frequent fires and is comprised mainly of winged sumac (*Rhus copallinum*) and southern dewberry (*Rubus trivialis*). Plant Speciess of Conservation Need in these woodlands include waterfall's sedge, pineoak jewelflower (*Streptanthus squamiformis*), clasping twistflower (*Streptanthus maculatus*), Ouachita spurge (*Euphorbia ouachitana*), and Wright's dwarf dandelion (*Krigia wrightii*).

Shortleaf Pine Open Woodland Habitat at McCurtain County Wilderness Area. Photo by ODWC.

Open pine woodlands once occurred in large tracts of tens of thousands of acres along the drier slopes of the Ouachita Mountains and were an important habitat for pine-specialist wildlife species including the red-cockaded woodpecker (*Dryobates borealis*) and brown-headed nuthatch (*Sitta pusilla*). In the present day, most of the former Shortleaf Pine Open Woodland Habitat has been lost to either conversion to loblolly pine plantations or the effects of long-term fire suppression. Where open pine woodlands have not been converted into managed pine plantations, fire suppression has altered those stands and allowed oaks and hickories to dominate the mid-story, which has facilitated canopy closure. In the span of less than a century, most of the historic shortleaf pine-dominated woodlands have become mixed Shortleaf Pine – Oak – Hickory Forests.

Recognized Shortleaf Pine Open Woodland Habitat Vegetation Associations

- Shortleaf Pine-Little Bluestem Woodland

Shortleaf Pine Open Woodland Habitat at Pushmataha Wildlife Management Area. Photo by ODWC.

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Mesic Loblolly Pine – Oak Forest Habitat

Mesic forests dominated by native loblolly pine, several oak species, and sweetgum are confined to the Gulf Coastal Plain in Choctaw and southern McCurtain counties. These forests occur on relatively level, mesic loamy and sandy soils that are derived from ancient alluvial deposition. The dominant canopy trees include loblolly pine (*Pinus taeda*), southern red oak, water oak (*Quercus nigra*), American elm (*Ulmus americana*), sweetgum (*Liquidambar*

Mesic Loblolly Pine – Oak Forest Habitat. Photo by Mark Howery/ODWC.

styraciflua), green ash (*Fraxinus pennsylvanica*), and Shumard oak. Common understory plants include American holly (*Ilex opaca*), red maple (*Acer rubrum*), parsley hawthorn (*Crataegus marshallii*), and rattan vine (*Berchemia scandens*). Uncommon and locally occurring understory components of these forests are southern wax myrtle (*Myrica cerifera*), yaupon holly (*Ilex vomitoria*), and dwarf palmetto (*Sabal minor*). A large percentage of the historic Mesic Loblolly Pine – Oak Forest Habitat has been cut and converted into loblolly pine plantations, and many of the remaining stands are on the wettest sites that are more difficult to convert and manage. Plant Species of Conservation Need found within the Mesic Loblolly Pine – Oak Forest Habitat include Arkansas meadowrue (*Thalictrum arkansanum*), panicled indigobush (*Amorpha paniculata*), clasping twistflower, and Baldwin's milkvine.

Recognized Mesic Loblolly Pine – Oak Forest Habitat Vegetation Associations

- Loblolly Pine – Green Ash – American Elm Forest
- Loblolly Pine – Sweetgum Forest

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Pine and Mixed-Pine Woodlands and Forests Species of Greatest Conservation Need

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat		
		Tallgrass Prairie	Mixed-grass Prairie	Shortgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Shortleaf Pine-Oak-Hickory Woodland & Forest	Shortleaf Pine Open Woodland	Mesic Loblolly Pine-Oak Forest
AMPHIBIANS										
Ringed Salamander *Ambystoma annulatum*	**Global Status: G4; State Status: S2.** Locally common but patchily distributed in upland deciduous and pine-oak forests in the Ozark Plateau and in the Le Flore and McCurtain county portions of the Ouachita Mountains. Populations are tied to breeding pools. A secretive, burrowing, and nocturnal salamander that breeds in small ponds and vernal pools in the fall.					•	•	•		
Mole Salamander *Ambystoma talpoideum*	**Global Status: G4; State Status: S1.** Rare, secretive, burrowing species of salamander that is known only from a few bottomland and mesic pine-oak forests sites in the Gulf Coastal Plain portion of McCurtain County.						•			•
Many-ribbed Salamander *Eurycea multiplicata*	**Global Status: G4; State Status: S4.** Common stream-breeding salamander found in riparian forests, bottomland forests, and mesic forests, including pine-oak, throughout the Ouachita Mountains.						•	•		•
Kiamichi Slimy Salamander *Plethodon kiamichi*	**Global Status: G2; State Status: S2.** Locally common but restricted to moist, mature oak and pine-oak forests along the Kiamichi Mountain ridge and the upper Kiamichi River watershed in Le Flore and Pushmataha counties.						•	•		
Sequoyah Slimy Salamander *Plethodon sequoyah*	**Global Status: G1; State Status: S2.** Uncommon species that is restricted to forested habitats along the southern edge of the Ouachita Mountains in McCurtain County.						•	•		•
Southern Red-backed Salamander *Plethodon serratus*	**Global Status: G5; State Status: S3.** Locally common in mature forests but limited to the eastern half of the Ouachita Mountains Ecoregion in Le Flore and McCurtain counties.						•	•	•	•
BIRDS										
Chuck-will's-widow *Antrostomus carolinensis*	**Global Status: G5; State Status: NR.** Common but declining summer resident that nests on the ground in all types of upland deciduous and pine-oak forests throughout central and eastern Oklahoma.					•	•	•	•	•
Eastern Whip-poor-will *Antrostomus vociferus*	**Global Status: G5; State Status: S2.** Uncommon and locally occurring summer resident that nests in the Ozark Plateau and the eastern Ouachita Mountains. Recent research indicates a preference for woodland habitats with open canopies or in close proximity to forest edges.					•	•	•	•	

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat		
		Tallgrass Prairie	Mixed-grass Prairie	Shortgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Shortleaf Pine-Oak-Hickory Woodland & Forest	Shortleaf Pine Open Woodland	Mesic Loblolly Pine-Oak Forest
Chimney Swift *Chaetura pelagica*	**Global Status: G4; State Status: NR.** Uncommon but widespread summer resident throughout the main body of Oklahoma and occurs where suitable nesting sites exist. They adapted to man-made structures such as uncapped chimneys, and expanded their population size and range in the 1800s and 1900s. But, as the availability of uncapped chimneys declines, their populations are experiencing steep declines and more of the birds are using historic nesting sites such as hollow trees in forested habitats.					•	•	•	•	•
Red-cockaded Woodpecker *Dryobates borealis*	**Global Status: G3; State Status: S1.** Federally listed as threatened. Found exclusively in mature pine woodlands, and one of Oklahoma's rarest birds. A year-round resident and the only known population occurs in shortleaf pine woodlands in northern McCurtain County.						•		•	
Kentucky Warbler *Geothlypis formosa*	**Global Status: G5; State Status: NR.** Summer resident in deciduous forests across the eastern one-half of Oklahoma. This is a ground-nesting species that establishes breeding territories in mature forest stands with an abundance of woody understory vegetation. Kentucky warblers are common in mesic forests, and uncommon in the other forest types.					•	•	•		•
Swainson's Warbler *Limnothlypis swainsonii*	**Global Status: G4; State Status: S1.** Rare and locally occurring summer resident in scattered bottomland forest tracts along small rivers in the eastern one-third of Oklahoma. Nests primarily in large, mature bottomland hardwood forest and mesic pine-oak forest with thick understory shrubs or river cane (*Arundinaria gigantea*) thickets.					•	•			•
Red-headed Woodpecker *Melanerpes erythrocephalus*	**Global Status: G5; State Status: S4.** Uncommon and locally occurring, year-round resident in open woodlands and forests statewide, but usually in areas with many standing dead trees where trees have been killed by fire or by flooding caused by beaver activity. In winter, birds may move into oak forests and bottomland forests in search of acorns which comprise much of their winter diet.					•	•	•	•	
Bachman's Sparrow *Peucaea aestivalis*	**Global Status: G3; State Status: S2.** Rare and locally occurring summer resident that nests in open shortleaf pine woodlands and woodland edges with abundant warm-season grasses in the understory in the Ouachita Mountains. Very small numbers of birds have been documented in open pine and oak woodlands in the Ozark and Cross Timbers ecoregions.					•	•	•	•	
Eastern Towhee *Pipilo erythrophthalmus*	**Global Status: G5; State Status: S4.** Winter resident in pine-oak woodlands and forests across the eastern one-half of Oklahoma, and a rare year-round resident that breeds in the Ozark Plateau.					•	•	•		•
Prairie Warbler *Setophaga discolor*	**Global Status: G5; State Status: S3.** Summer resident in the eastern one-quarter of Oklahoma that nests in large brushy openings and clear-cuts within forested landscapes, as well as in open oak and pine woodlands. Can be common locally within the Ouachita Mountains, but is rare elsewhere in the state.					•	•	•	•	•

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat		
		Tallgrass Prairie	Mixed-grass Prairie	Shortgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Shortleaf Pine-Oak-Hickory Woodland & Forest	Shortleaf Pine Open Woodland	Mesic Loblolly Pine-Oak Forest
Brown-headed Nuthatch *Sitta pusilla*	**Global Status: G4; State Status: S1.** Uncommon, year-round resident in the Ouachita Mountains and Gulf Coastal Plain, where it occurs in large stands of mature shortleaf pine and mesic loblolly pine forest. Occurred historically in parts of the Ozark Ecoregion but not in recent decades.						•	•	•	•
Harris's Sparrow *Zonotrichia querula*	**Global Status: G5; State Status: NR.** Although a common winter resident in central Oklahoma, it is a rare winter resident in pine-oak woodlands in the Ouachita Mountains.						•	•		

INVERTEBRATES

Linda's Roadside-Skipper *Amblyscirtes linda*	**Global Status: G2; State Status: S2.** Uncommon butterfly that is active in the spring (April-June) and found in mesic and bottomland forest with a grassy understory that includes it's larval host plant Indian woodoats (*Chasmanthium latifolium*). In Oklahoma, it occurs in the eastern quarter of the state and appears to have one generation per year.					•	•	•		•
American Bumble Bee *Bombus pensylvanicus*	**Global Status: G3; State Status: S5.** Large, common and widespread bumble bee found in many habitats including pine woodlands and forest edges statewide. Populations are declining in the northern part of its range outside of Oklahoma.					•	•	•	•	•
Frosted Elfin *Callophrys irus*	**Global Status: G3; State Status: S1.** Uncommon, tiny butterfly that is active only in the early spring (March-early May). Found in south-central and southeastern Oklahoma in oak and oak-pine woodlands and in prairies where its host plants yellow wild indigo and Nuttall's wild indigo (*Baptisia sphaerocarpa* and *B. nuttalliana*) grow.						•	•	•	•
Ozark Liptooth *Daedalochila jacksoni*	**Global Status: G3; State Status: NR.** Fairly common and widespread land snail, but restricted to the Ozark Plateau. Found in upland oak and pine/oak woodlands and glades. Type locality near Fort Gibson, OK.					•		•		
Monarch *Danaus plexippus*	**Global Status: G4; State Status: NR.** Widespread, migratory butterfly that occupies a wide range of habitats including open woodlands, shrublands, herbaceous wetlands, and prairies. Monarchs are uncommon in Oklahoma during the spring and summer, but large numbers migrate through the state in the fall. Uses several milkweeds (*Asclepias*) as larval host plants including the green antelopehorn (*Asclepias viridis*).					•	•	•	•	•
Mottled Duskywing *Erynnis martialis*	**Global Status: G3; State Status: S3.** Uncommon butterfly whose adults are active in the early spring. Found in open pine-oak woodlands and forest edges in the eastern one-third of Oklahoma where it uses New Jersey tea (*Ceanothus americanus*) as the host plant for its larvae.					•	•	•	•	•
Ouachita Pillsnail *Euchemotrema imperforatum*	**Global Status: GNR; State Status: NR.** Recently elevated to species status and not yet recognized by NatureServe. It is endemic to the rocky pine-oak forests of the Ouachita Mountains, where it can be locally common.						•	•		•

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat		
		Tallgrass Prairie	Mixed-grass Prairie	Shortgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Shortleaf Pine-Oak-Hickory Woodland & Forest	Shortleaf Pine Open Woodland	Mesic Loblolly Pine-Oak Forest
Smooth-lip Shagreen *Inflectarius edentatus*	**Global Status: G2; State Status: NR.** Ozark endemic land snail with very few Oklahoma records, all from Boston Mountains in eastern Adair and Sequoyah counties less than five miles from the state line. Found in moist, forested, rocky hillsides and ravines.					•		•		
Cohn's Spur-throated Grasshopper *Melanoplus cohni*	**Global Status: GNR; State Status: NR.** Uncommon short-horned grasshopper found in tallgrass prairies and open pine-oak woodlands in the western portion of the Ouachita Mountains in Oklahoma where it is endemic.						•	•	•	
Oklahoma Spur-throated Grasshopper *Melanoplus oklahomae*	**Global Status: G2; State Status: S4.** Locally common short-horned grasshopper found in tallgrass prairies and open woodlands. It is endemic to the Ouachita Mountains and the adjacent portion of the Cross Timbers Ecoregion in southern Oklahoma.						•	•	•	
American Burying Beetle *Nicrophorus americanus*	**Global Status: G3; State Status: S1.** Uncommon to rare, but widespread in the eastern one-half of Oklahoma. Occurs in open woodlands, forest edges, savannas, and tallgrass prairies, but absent from areas with shallow or rocky soils. Federally listed as a threatened species. More common in the northern two-thirds of the state and less common in the southern one-third.						•	•	•	•
Marbled Mantleslug *Pallifera marmorea*	**Global Status: G3; State Status: NR.** Uncommon and widespread mantleslug, but easily overlooked. Found in rocky, upland oak-hickory and pine-oak forests across the eastern one-third of Oklahoma including the Ozark Plateau, Ouachita Mountains ecoregions, and eastern portion of the Cross Timbers Ecoregion.					•	•	•		
Rattlesnake Master Borer Moth *Papaipema eryngii*	**Global Status: G2; State Status: S1.** Uncommon moth that is dependent upon rattlesnake master (*Eryngium yuccifolium*) as the food plant for its larvae which bore into the stems and roots as they develop. The adults are nocturnal, short-lived and difficult to document. Potentially occurs where its host plant is common in moist tallgrass prairies and open pine woodlands.						•		•	
Half-lidded Oval *Patera binneyana*	**Global Status: G2; State Status: NR.** Locally common land snail found in a wide range of forest types but in Oklahoma it is restricted to the eastern Ouachita Mountains in Le Flore and McCurtain counties.						•	•		•
Lidded Oval *Patera indianorum*	**Global Status: G2; State Status: NR.** Rare species of land snail found in rocky, upland oak and pine-oak forests and known from only a few locations in the eastern Cross Timbers and western Ouachita Mountains.						•	•		
Drywoods Oval *Patera kiowaensis*	**Global Status: G2; State Status: NR.** Uncommon snail found in upland pine-oak forests and endemic to the Ouachita Mountains.						•	•		
Diana Fritillary *Speyeria diana*	**Global Status: G2; State Status: S2.** Uncommon butterfly found in mature mesic forests with abundant herbaceous vegetation including violets (*Viola*), which serve as its larval host plant. Found in the eastern one-third of Oklahoma.					•	•	•		•

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Ozark Slitmouth *Stenotrema labrosum*	**Global Status: G3; State Status: NR.** Widespread throughout the Ozarks and the Ouachitas, where it is typically uncommon, but is occasionally locally abundant. Often associated with moderate to high relief rocky forests where it is found under logs or, less commonly, in piling rock.					•	•	•		
Rich Mountain Slitmouth *Stenotrema pilsbryi*	**Global Status: G2; State Status: S2.** Uncommon snail with a very distinctive shell that occurs locally on rocky talus slopes and high-elevation, forested slopes on Rich, Black Fork, and Winding Stair mountains in the northern Ouachita Mountains.						•	•		
Ouachita Slitmouth *Stenotrema uncifernum*	**Global Status: G3; State Status: NR.** Uncommon and locally occurring in the higher ridges of the Ouachita Mountains. Most records reported from Arkansas, but found in Oklahoma in Le Flore County.						•	•		
a troglobitic millepede *Trigenotyla vaga*	**Global Status: GNR; State Status: S1.** Endemic to Oklahoma. Troglophilic millipede documented from limestone caves in Murray and Johnston counties in the Arbuckle Uplift and rocky forested slopes in Latimer and Le Flore counties in the Ouachita Mountains. Its status and distribution are poorly known.						•	•		
Western Dome *Ventridens brittsi*	**Global Status: G3; State Status: NR.** Uncommon and endemic to the southern Ozarks and Ouachitas. Found in forested, rocky ravines and hillsides with rock and leaf litter cover.					•	•	•		
MAMMALS										
Rafinesque's Big-eared Bat *Corynorhinus rafinesquii*	**Global Status: G3; State Status: S3.** Rare and locally occurring in low-elevation mesic forests, including loblolly pine-oak forests, in river and creek valleys, and mature bottomland hardwood forests. All recent and most historic records are from the Little River watershed.						•			•
Northern Hoary Bat *Lasiurus cinereus*	**Global Status: G3; State Status: NR.** Common but declining, foliage-roosting bat. Large numbers migrate throughout Oklahoma during the spring and fall months, and smaller numbers remain through the summer in pine-oak woodlands and forests across the eastern half of the state.					•	•	•	•	
Seminole Bat *Lasiurus seminolus*	**Global Status: G5; State Status: S3.** In Oklahoma, this is a solitary, rare summer resident that roosts in the foliage of trees. It is found primarily in the pine-dominated landscapes of the Gulf Coastal Plain where it occupies loblolly pine-oak forests.						•			•
Southeastern Myotis *Myotis austroriparius*	**Global Status: G4; State Status: S1.** Rare and locally occurring in low-elevation mesic forests and bottomland forests in the Gulf Coastal Plain of southeastern Oklahoma. Documented only during the summer months and primarily in the Little River watershed.						•			•
Eastern Small-footed Myotis *Myotis leibii*	**Global Status: G4; State Status: S1.** Very rare and recorded fewer than five times in Oklahoma in association with rocky slopes and mature forests in the eastern Ouachita Mountains.						•	•		

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Little Brown Myotis *Myotis lucifuga*	**Global Status: G3; State Status: S1.** Rare migratory bat in Oklahoma that moves through the eastern one-quarter of the state during the spring and fall. Forages in pine-oak woodlands and forests. There are a few summer records for this species in caves and buildings along the Arkansas stateline in Adair, Delaware, and McCurtain counties. The species has also been documented in Nowata County via a summer mist-net capture.					•	•	•		•
Northern Long-eared Myotis *Myotis septentrionalis*	**Global Status: G2; State Status: S2.** Federally listed as endangered. An uncommon to rare bat found in mature deciduous and pine-oak forests of all types in the eastern one-quarter of Oklahoma during the summer months. Species has been reported during summer mist-net captures on the Ouachita National Forest in mixed pine-hardwood forests. Its winter distribution is poorly known, but it's known to hibernate in caves in the Ozark Plateau.					•	•	•	•	•
Indiana Myotis *Myotis sodalis*	**Global Status: G2; State Status: S1.** Federally listed as endangered. Occurs as a rare spring and fall migrant through the eastern one-fifth of Oklahoma in mature deciduous forests. There are a few winter records on Winding Stair Mountain, and recently a few summer records in bottomland and mesic pine-oak forests in the southeast corner of the state. This species has also been documented using tree roosts during the summer in McCurtain County.					•	•			•
Golden Mouse *Ochrotomys nuttalli*	**Global Status: G5; State Status: S2.** Rare resident in mesic and bottomland forest stands with dense thickets of understory shrubs. Found in southeastern Oklahoma in the Ouachita Mountains and the Gulf Coastal Plain.						•			•
Tricolored Bat *Perimyotis subflavus*	**Global Status: G3; State Status: S3.** Proposed for federal listing as endangered. Occurs in oak and pine-oak forests across the eastern one-half of Oklahoma, and in a few areas with wooded canyons and caves in western Oklahoma during the summer months. During the winter, this species moves into caves and similar sites with stable temperatures to hibernate.					•	•	•		•
Plains Spotted Skunk *Spilogale interrupta*	**Global Status: G3; State Status: S2.** Rare, secretive and partially arboreal. Its status is poorly known and most records within the past 30 years are from the eastern one-third of the state in rocky oak-pine forests, particularly in the Ouachita and Boston mountains.					•	•	•		
REPTILES										
Common Scarletsnake *Cemophora coccinea*	**Global Status: G5; State Status: S2.** Uncommon and secretive burrowing species, whose geographic range is still poorly delineated. It occurs in low densities in woodlands and forests, in particularly those with sandy and loamy soils, and in mesic pine-oak forests in the Gulf Coastal Plain Ecoregion.						•	•		•
Western Diamond-backed Rattlesnake *Crotalus atrox*	**Global Status: G5; State Status: S4.** Uncommon with a patchy distribution that is tied to rocky upland habitats with sparse or open woody overstory vegetation. Occurs in rocky, open pine woodlands in portions of the Ouachita Mountains.					•	•	•	•	

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Three-toed Box Turtle *Terrapene triunguis*	**Global Status: G5; State Status: NR.** Common box turtle of pine-oak forests. Found across the eastern one-half of Oklahoma in all forest types except those with extremely rocky or shallow soils.					•	•	•	•	•

Pine and Mixed-Pine Woodlands and Forests Conservation Issues and Actions

Conservation Issue: Modification of Natural Ecosystem Processes

Mechanical thinning has been used as a management tool at Pushmataha Wildlife Management Area. Photo by ODWC.

Within the Ouachita Mountains, the ridgetops and the west-, south-, and east-facing slopes were historically a complex mosaic of uneven-age woodland and forest stands comprised of variable communities dominated by a diverse mix of shortleaf pine, seven species of oaks, and three hickory species. However, over time these woodland and forest stands have been altered by a combination of historic large-scale clear-cutting followed by decades of fire suppression that has resulted in a near-loss of Shortleaf Pine Open Woodland Habitat, a dramatic reduction in the acreage of mixed pine, oak, and hickory woodlands, and an increase in even-age, closed-canopy forest, except where forests have been converted to managed monocultures of loblolly pine or shortleaf pine. This change from woodlands and forests comprised of trees with diverse ages and heights to large, even-aged forest stands began with widespread timber harvest during a relatively short period of time between the late 1880s and the 1920s. Following timber harvest, the cut-over areas regrew into relatively dense stands of pines, oaks, and hickories of similar age competing for light, water, and nutrients and creating a closed-canopy forest where understory vegetation was suppressed by excessive shading in many places. The combination of even-aged stand structure and long-term fire suppression appears to be responsible for the greater tree densities that are present in the current landscape when compared to the landscape's historic condition. Private landowners may be unaware of these historic and gradual changes and may not have information or resources available to them to restore or enhance woodland habitat structure for SGCN.

The restoration of dense, even-aged forests into more diverse uneven-aged forests or to more open-canopy woodlands requires a combination of tree thinning and prescribed fire, but insufficient financial resources, air quality concerns, landowner liability concerns, and the difficulty of working on slopes or away from roads are impediments to this. The effects of prescribed burning on many SGCN are poorly known, particularly for 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 most species living in these fire-adapted communities; however, the timing, frequency, and size of burns affects species differently. In local areas where woodland conditions persist, continuous grazing by cattle may have subtle effects on the herbaceous understory vegetation that reduce overall plant density, limit the recruitment of grass and forb species that cattle find most palatable, contribute to erosion on steep slopes, and facilitate the spread of invasive, non-native vegetation such as sericea lespedeza, brome, and other pasture weeds.

Conservation Actions

- Develop a decision support tool that uses slope, aspects, soil condition, fire history, and the current vegetation community to evaluate and make long-term, site-specific recommendations regarding whether a stand should be managed in a forest condition or a woodland condition with an open canopy. Existing tools such as OK-FIRE on the Oklahoma Mesonet can help landowners make short-term decisions about when to burn.
- Reduce the impediments and constraints that limit the use of prescribed fire as a management tool. These may include providing funding to local burning associations to assist with conducting prescribed burns on private property, developing technical assistance materials for landowners, providing financial assistance or incentives to landowners to encourage woodland restoration, and

Prescribed fire is used at the McCurtain County Wilderness Area. Photo by ODWC.

developing affordable liability insurance that covers landowners conducting prescribed burns.

- Develop monitoring programs to evaluate the effects of management techniques such as prescribed fire and tree harvest on populations of SGCN and vegetation structure.
- Develop informational materials to inform landowners and the public about the benefits of woodland restoration, the importance of fire in maintaining woodland systems, and the wildlife benefits of restoring and maintaining Shortleaf Pine – Oak – Hickory Woodland Habitat.
- Develop programs to maintain large tracts of Shortleaf Pine – Oak – Hickory Woodland and Forest Habitat 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 to get the greatest conservation efficiency.
- Evaluate methods to restore woodlands from pastures or crop fields, and develop cost-share programs, grants, or financial incentives to encourage landowners to restore or replant these areas.
- Enhance understory vegetation by purchasing grazing rights to remove cattle for several growing seasons or by establishing rotational grazing programs to defer grazing on some areas during the growing season while still providing income for landowners.
- Develop site-specific recommendations to restore historic fire regimes via prescribed burning. These recommendations should evaluate the seasonal timing, sizes, and frequencies of prescribed burns to balance the needs of fire dependent species with fire sensitive taxa like reptiles and amphibians.
- Developing a financial assistance program for landowners that are willing to maintain mixed pine and oak woodland stands by using prescribed burning and grazing.
- Develop woodland management demonstration areas on public lands to show the results of prescribed burning and timber management practices. Develop corresponding technical assistance materials, including burning guidelines, workshops, and information about equipment rentals.
- Where appropriate, use regeneration cutting, thinning, or mid-story reduction to diversify forest stand ages and 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 SGCN and vegetation structure. Evaluate the effects on populations of species that are fire-dependent as well as on populations of species that are fire-sensitive.
- Integrate the research that has been done on the compatibility of timber management and livestock grazing management in Shortleaf Pine Open Woodland Habitat and use this to develop demonstration areas that showcase sustainable forestry and cattle management in open woodland systems.

Conservation Issue: Habitat Loss and Fragmentation

Oklahoma's pine-dominated forests and woodlands of all types have decreased in acreage due to habitat conversion and have decreased in quality due to multiple forms of habitat fragmentation. Approximately 600,000 acres have been converted into managed pine plantations, and an uncertain number of acres have been converted to other land uses such as modified pastureland that are often planted to monocultures of non-native perennial rye (*Lolium perenne*) or tall fescue (*Schedonorus arundinaceus*). Loblolly pine comprises nearly all of the pine plantations in Oklahoma and this conversion has affected both the Shortleaf Pine – Oak – Hickory Forest Habitat of the Ouachita Mountains and the Mesic Loblolly Pine – Oak Forest Habitat of the Gulf Coastal Plain. The regional timber market is based upon saw and pole timber trees, which encourages the management of genetically improved, fast-growing varieties of loblolly pine that can be harvested at 35-40 years of age. Many landowners believe they can earn higher profits by converting their forests to pine plantations than they can from managing them as mixed-aged and mixed-species forests. An increasing number of rural residential developments (primarily secondary homes and cabins), roads, utility lines, and pipelines have further converted and fragmented the habitat on a smaller scale. Expanded human development in the form

of recreational lodging (e.g., cabins) and associated small business infrastructure, has increased dramatically in the southern Ouachita Mountains near Broken Bow Reservoir. Additionally, ridgetop wind energy development has entered the landscape and is further dissecting forests and creating hazards for forest-dwelling bats and migratory birds. More broadly, the continued fragmentation of landownership has continued the trend of more individuals owning smaller tracts of land that are managed independently and often in very different ways, resulting in less contiguous forested habitat.

Conservation Actions

- Evaluate ways to make it economically feasible for private landowners to maintain their Shortleaf Pine – Oak – Hickory Woodland and Forest habitats. Possible actions could include encouraging markets for mature oak and hickory timber or encouraging groups of landowners to work together as a block to manage habitat for hardwood timber production, hunting leases or other nature-based recreational opportunities as alternatives for land management income. The harvesting of pine needle straw to sell as mulch and erosion control material is another potential revenue source for forest owners.
- Develop programs to maintain large tracts of Pine – Oak – Hickory Woodland and Forest Habitat such as conservation easements, conservation leases, purchase of development rights, or willing-seller land acquisitions. These programs should be preceded by a landscape-level assessment of habitat conditions to identify areas of greatest habitat value for multiple SGCN where the greatest conservation benefits can be gained.
- Evaluate methods to restore Shortleaf Pine – Oak – Hickory Woodland and Forest Habitat from pastures or crop fields, and develop cost-share programs, grants, or financial incentives to encourage landowners to restore or replant these areas.
- 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.
- Evaluate methods to restore Shortleaf Pine Open Woodland Habitat from pastures and pine plantations in the Ouachita Mountains, and to restore Mesic Loblolly Pine – Oak Forest Habitat from pastures and pine plantations in the Gulf Coastal Plain. Develop cost-share programs, grants or financial incentives modeled after the regional Longleaf Pine Initiative to encourage willing landowners to restore or replant pine woodlands and forests in ecologically appropriate areas to increase habitat acreage or tract size.
- Develop monitoring programs to evaluate the effects of management techniques such as selective tree thinning on populations of SGCN and vegetation structure.

Conservation Issue: Information Gaps

Existing data are incomplete regarding the habitat needs, geographic distribution, and population status of several SGCN that live in pine-dominated woodlands and forests, making it difficult to identify management recommendations to maintain or enhance their populations. More thorough evaluations and more complete data are needed to determine the population statuses, trends and factors that limit the populations of several of these SGCN.

Additionally, more complete information is needed to determine the current condition of pine woodlands and forests, particularly the Shortleaf Pine – Oak – Hickory Woodland Habitat, and an assessment is needed to better understand the historic distributions and acreages of Mesic Loblolly Pine – Oak Forest and Shortleaf Pine Open Woodland habitats.

Conservation Actions

- Conduct reviews of the existing literature and museum records to evaluate the historic distributions and abundances of SGCN bats, salamanders, and insects to compile relevant ecological and life history information.
- Conduct field surveys to assess the current distribution and habitat affinities for SGCN and use these data to identify the geographic areas where conservation

Many-ribbed salamander in the Ouachita National Forest – Oklahoma Ranger District. Photo by ODWC.

efforts should be directed to provide the greatest benefit for these species.

- Conduct ecological studies of SGCN to identify factors that limit population sizes, evaluate factors that may be responsible for population declines, and develop habitat management recommendations that may enhance populations.
- Develop population monitoring programs for representative SGCN and a monitoring program for measuring habitat abundance and condition.
- Research the historic condition of Shortleaf Pine – Oak Woodland and Forest Habitat to develop realistic and biologically meaningful descriptions for the structure and composition of high-quality habitats and the characteristics of sites that should support woodland versus forest stands. These assessments should serve as the range of target conditions for habitat restoration, enhancement and maintenance efforts.
- Research the effects of prescribed burning and selective timber harvest at different times of the year on SGCN, particularly salamanders, terrestrial snails, and bats that may be active or dormant in the leaf litter during specific times of the year.
- Develop methods to identify and map the distribution of the remaining habitat tracts and inventory these tracts to determine their condition and the SGCN living there. Identify the conservation practices that could enhance the value of these habitat tracts.
- Develop and disseminate information about Bachman's sparrow, red-cockaded woodpecker, brown-headed nuthatch and other SGCN that depend upon shortleaf pine woodlands. Develop and disseminate information about forest bats, songbirds, and salamanders that depend upon pine forests and woodlands.
- Maintain a database to store and analyze distributional and ecological data for SGCN.
- 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.

Research partners studied crawfish frog populations at Atoka Wildlife Management Area. Photo by ODWC.

Biologists monitor a small red-cockaded woodpecker population at the McCurtain County Wilderness Area. Photo by Blake Podhajsky/ODWC.

Conservation Issue: Invasive and Problematic Species

Non-native plant species such as sericea lespedeza (*Lespedeza cuneata*), tall fescue, perennial ryegrass, Japanese stiltgrass (*Microstegium vimineum*), beefsteak plant (*Perilla frutescens*), autumn olive (*Elaeagnus umbellata*), Chinese privet (*Ligustrum sinense*), Japanese honeysuckle (*Lonicera japonica*), and kudzu (*Pueraria montana*) have become established outside of cultivation and have displaced native plants and altered the habitat structure

Feral hogs at Red Slough Wildlife Management Area. Photo by David Arbour.

in ways that may impact wildlife SGCN as well as Plant Species of Conservation Need. The non-native Chinese tallow (*Triadica sebifera*), a medium-sized deciduous tree from southern Asia, has spread into southeastern Oklahoma where it proliferates in moist habitats such as the Mesic Loblolly Pine – Oak Forest Habitat in the Gulf Coastal Plain. In some instances, landscape-level fire suppression and soil disturbance associated with roads and timber harvest are facilitating the spread of these species. Feral swine (*Sus scrofa*) have become established across eastern Oklahoma where pine-dominated woodlands and forests occur, and the soil disturbance created by these animals has the potential to alter habitat conditions for SGCN that live on the forest floor and to further spread invasive plants into this ecological system.

Conservation Actions

- Evaluate the severity and magnitude of the ecological damage done by non-native and invasive plant and animal species and identify those causing the greatest impact to the habitat and SGCN. These damages may include displacement of native plant communities, predation on native animal and plant populations, or hybridization with native species.
- Develop control or management plans for the most problematic invasive species that can include prescribed burning programs, deferred grazing, herbicide treatment, and mechanical removal. Monitoring programs should follow these control programs to measure and evaluate the effectiveness of the management techniques.
- Invasive species are most effectively controlled when they first enter a habitat and before they become established. Develop early detection surveillance programs for invasive species, and work with the Oklahoma Invasive Plant Council and OSU Extension Service to develop and promote educational materials to help landowners and sportsmen identify and report potentially problematic species.
- Continue to provide cost-share funding to private landowners that encourages them to control invasive species on their property.
- Develop and implement an invasive species management plan for every public conservation land in the pine-dominated landscapes.

Potential Indicators for Monitoring the Effectiveness of the Conservation Actions

- Changes in acreage affected or dominated by invasive plant species
- Number of even-age forest acres that are thinned and/or regularly burned to restore these stands to an uneven-aged forest condition or a woodland condition
- Number of landowners participating in conservation programs and the number of acres of pine woodland-forest habitat under a conservation management plan
- Number of acres of both woodlands and forests that are restored from pastureland or pine plantations
- Changes over time in the number of acres managed as woodlands instead of forests
- Changes in population sizes and trends for representative SGCN that serve as indicators for habitat quality such as the red-cockaded woodpecker and Bachman's sparrow for the Shortleaf Pine Open Woodland Habitat, and the mole salamander and Kentucky warbler for the Mesic Loblolly Pine – Oak Forest Habitat
- Number of acres restored to shortleaf pine woodlands and number of landowners engaged in the national shortleaf pine initiative
- Changes in the condition and quality of open woodlands, including the average tract size and connectivity, average percentage of canopy closure, abundance and diversity of understory vegetation
- Number of acres placed into prescribed burning management programs and the changes in understory vegetation structure and diversity on those acres.
- Number of conservation easements and the acreages of forest and woodland stands managed under these
- Number of acres restored to Mesic Loblolly Pine – Oak Forest Habitat from pasture, cropland, and pine plantation
- Change in relative condition or quality of forest habitat, including tree species diversity, abundance of understory vegetation, and average tract size

Representative Conservation Areas Supporting Pine and Mixed-Pine Woodlands and Forests

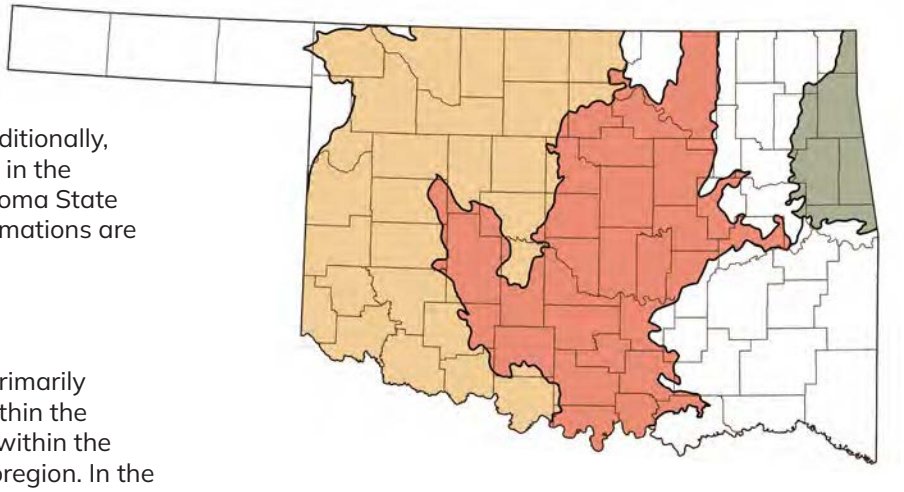
Robbers Cave State Park. Photo by ODWC.

- Atoka Wildlife Management Area (ODWC)
- Beaver's Bend State Park (Oklahoma State Parks Division)
- Cookson Wildlife Management Area (ODWC)
- Cucumber Creek Preserve (The Nature Conservancy)
- Grassy Slough Wildlife Management Area (ODWC)
- Hugo Reservoir and Wildlife Management Area (ODWC and ACOE)
- James Collins Wildlife Management Area (ODWC)
- Kiamichi Forestry Research Station (Oklahoma State University)
- Lake Eucha (City of Tulsa)
- Lake Nanih Waiya (ODWC)
- Lake Ozzie Cobb (ODWC)
- Lake Schooler (ODWC)
- Little River National Wildlife Refuge (USFWS)
- McCurtain County Wilderness Area (ODWC)
- McGee Creek Wildlife Management Area (ODWC and Bureau of Reclamation)
- McGee Creek State Park and Scenic Area (Oklahoma State Parks Division and Bureau of Reclamation)
- J.T. Nickel Family Wildlife Preserve (The Nature Conservancy)
- Ouachita National Forest Le Flore, Broken Bow, and Tiak Units (U.S. Forest Service)
- Pine Creek Reservoir and Wildlife Management Area (ODWC and ACOE)
- Pushmataha Wildlife Management Area (ODWC)
- Red Slough Wildlife Management Area (U.S. Forest Service)
- Robbers Cave State Park (Oklahoma State Parks Division)
- Robbers Cave Wildlife Management Area (ODWC)
- Sans Bois Wildlife Management Area (ODWC)
- Sardis Reservoir (ACOE)
- Spavinaw Hills Wildlife Management Area (ODWC)
- Spavinaw Reservoir (City of Tulsa)
- Stringtown Wildlife Management Area (ODWC)
- Whitegrass Flats Wildlife Management Area (ODWC)
- Wister Reservoir and Wildlife Management Area (ODWC and ACOE)
- Yourman Wildlife Management Area (ODWC)

Caves

Selman Bat Cave Wildlife Management Area.

Within Oklahoma, two types of true karst formations exist: Limestone Karst systems which occur in the Ozark and Cross Timbers Ecoregions and Gypsum Cave Habitat which occur in the Mixed-grass Prairie Ecoregion. Additionally, pseudo-karst features occur at a smaller scale in the Ozark Ecoregion. For the purpose of the Oklahoma State Wildlife Action Plan (SWAP), pseudo-karst formations are addressed within Limestone Karst.

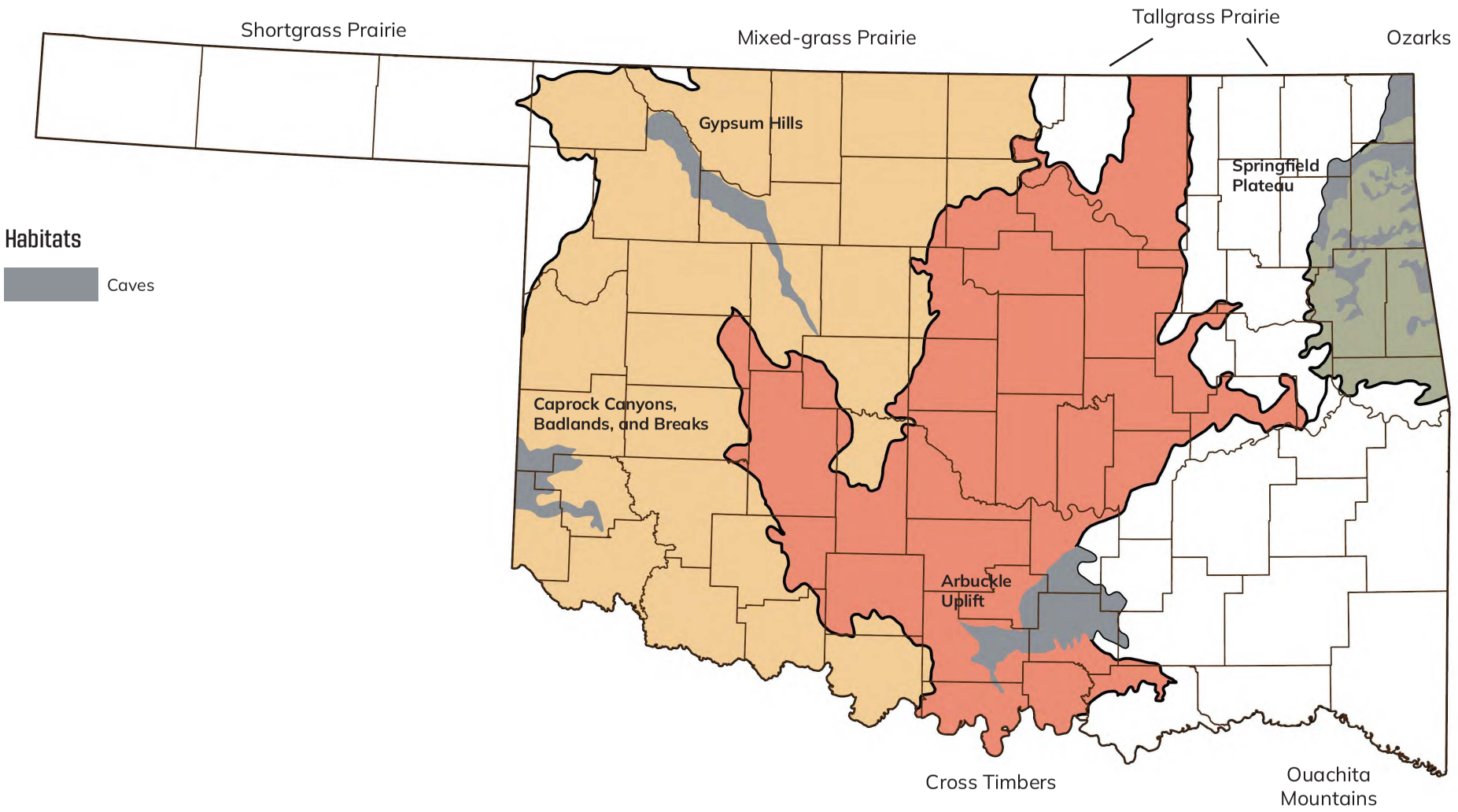


Caves occur in three Oklahoma ecoregions: the Mixed-grass Prairie, Cross Timbers, and Ozark ecoregions.

Limestone Karst Habitat

In Oklahoma, limestone karst formations are primarily found in two ecoregions, the Ozark Plateau within the Ozark Ecoregion and the Arbuckle Mountains within the south-central portion of the Cross Timbers Ecoregion. In the Ozark Ecoregion, these formations primarily occur within the southwestern end of the Ozark Plateau, also known as the Springfield Plateau, which extends from northeastern Oklahoma into southwestern Missouri and northern Arkansas. Limestone formations in the Springfield Plateau can be found in portions of Adair, Cherokee, Delaware, Mayes, Ottawa, and Sequoyah counties. The presence of caves and karst formations in the Cross Timbers Ecoregion is limited to the Arbuckle Mountains geomorphic province, in portions of Carter, Garvin, Johnston, Murray, and Pontotoc counties in south-central Oklahoma.

Much of the Ozark Ecoregion in Oklahoma is supported by the Springfield Plateau, a geological formation of Mississippian-age limestones and cherts. Portions of the Springfield Plateau contain deep fissures, numerous caves and springs, which developed in the Boone Formation of the Mississippian Period. Slightly acidic groundwater movement through fissures and cracks in the limestone dissolved and eroded the rock, creating subterranean stream channels and caves. This process has formed many complex systems of interconnected aquifers, cave networks, sinkholes, and springs within the Ozarks. The Boston Mountains section of the Ozark Plateau occurs in portions of Adair, Cherokee, Muskogee, and Sequoyah counites and is a formation of Pennsylvanian-age sandstones in which very few


Shortgrass Prairie
Mixed-grass Prairie
Tallgrass Prairie
Ozarks
Gypsum Hills
Springfield Plateau
Habitats
Caves
Caprock Canyons, Badlands, and Breaks
Arbuckle Uplift
Cross Timbers
Ouachita Mountains

A bluff line at Cookson Wildlife Management Area. Photo by ODWC.

dissolution caves exist. Instead, piles of large rock fragments and boulders create cave-like features, or talus caves, that provide important habitat for cave species including the tricolored bat (*Perimyotis subflavus*) and Ozark big-eared bat (*Corynorhinus townsendii ingens*). Furthermore, caves are numerous in the southern portion of the ecoregion where the Springfield Plateau and Boston Mountains converge. These systems support diverse communities of salamanders, bats, and numerous regionally endemic and subterranean-obligate species such as the Ozark cavefish (*Troglichthys rosae*), Oklahoma cave crayfish (*Cambarus tartarus*), and Bowman's cave amphipod (*Stygobromus bowmani*). Plant communities near cave openings and karst voids throughout the Ozark Plateau often include species such as Carolina buckthorn (*Frangula caroliniana*), northern spicebush (*Lindera benzoin*), wild hydrangea (*Hydrangea arborescens*), Christmas fern (*Polystichum acrostichoides*), and red columbine (*Aquilegia canadensis*). The karst formations within the Ozark Plateau host a total of eleven endemic Species of Greatest Conservation Need (SGCN).

The Arbuckle Hills and Plains make up the Arbuckle Mountains geomorphic province in the Cross Timbers Ecoregion of Oklahoma. This province is supported by the Arbuckle Uplift, a geological formation of complexly folded and faulted limestones, dolomites, sandstones, and granites of the Precambrian to Pennsylvanian Period. The Arbuckle Mountains contain limestone karst formations with numerous underground aquifers, surface caves, sinkholes, and rock shelters. Limestone caves in this ecoregion are understudied but are suspected to serve as seasonal roosts and hibernacula for SGCN bat species, such as the tricolored bat. Moreover, formations in the Cross Timbers Ecoregion provide habitat for several endemic invertebrates including the Oklahoma cave amphipod (*Allocrangonyx pellucidus*) and Racovitza's cave isopod (*Miktoniscus oklahomensis*). Calciphilic plant communities are common on rocky slopes and outcrops underlain by limestone throughout the Arbuckle Uplift, including Texas red oak (*Quercus buckleyi*), chinquapin oak (*Quercus muehlenbergii*), Ashe juniper (*Juniperus ashei*), Texas ash (*Fraxinus texensis*), and short-lobed oak (*Quercus sinuata var. breviloba*). A total of six endemic SGCN occur in the limestone karst formations of the Cross Timbers Ecoregion.

Recognized Ozark Plateau Vegetation Associations

- 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
- Post Oak – Eastern Redcedar Forest
- Sugar Maple – White Oak – Mockernut Hickory Forest
- Sugar Maple – Northern Red Oak – Bitternut Hickory Forest
- White Oak – Mockernut Hickory – American Basswood Forest
- Southern Red Oak – Mockernut Hickory Forest
- Chinquapin Oak – Sugar Maple Forest
- Chinquapin Oak – Shumard Oak Forest
- Northern Red Oak – Shumard Oak Forest

Recognized Arbuckle Mountains Vegetation Associations

- Texas Red Oak – Texas Ash – Chinquapin Oak Forest
- Ashe Juniper – Sideoats Grama – Hairy Grama Woodland
- Short-lobed Oak Shrubland
- Post Oak – Blackjack Oak – Black Hickory Forest
- Post Oak – Shumard Oak – Bitternut Hickory Forest
- Post Oak – Winged Elm Forest
- Post Oak – Eastern Redcedar Forest
- Chinquapin Oak – Shumard Oak Forest

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Gypsum Cave Habitat

Gypsum cave systems occur in three discreet areas within the Mixed-grass Prairie Ecoregion of western Oklahoma. The largest expanse of this habitat occurs within the Cimarron Gypsum Hills in northwestern Oklahoma, extending through portions of Blaine, Canadian, Harper, Major, Woods, and Woodward counties. This habitat also occurs within the Magnum Gypsum Hills in southwestern Oklahoma, in portions of Beckham, Caddo, Greer, Harmon,

Jackson, and Kiowa counties. The third locality is comprised of small, scattered pockets of gypsum within the Weatherford Gypsum Hills in west-central Oklahoma, in portions of Custer and Washita counties.

Sandy Sanders Wildlife Management Area. Photo by ODWC.

Through the process of dissolution, numerous caves and sinkholes were created in the Mixed-grass Prairie Ecoregion. Cave systems of the Cimarron and Magnum Gypsum Hills are formed in cyclical units of dolomites, gypsums, and shales, characteristic of the Permian Blaine Formation. Similarly, caves in the Weatherford Gypsum Hills developed in the Permian Cloud Chief Formation, which is primarily composed of gypsums and interbedded shales, sandstones, and dolomites. Years of groundwater movement through these formations carved cracks and fractures into the tunnels, passages, and caves we know today. The shallow, calcareous soils overlying layers of Permian-age rock support a unique community of low stature, drought-tolerant prairie grasses and forbs including little bluestem (*Schizachyrium scoparium*), hairy grama (*Bouteloua hirsuta*), dotted blazing star (*Liatris punctata*), Gordon's bladderpod (*Physaria gordonii*), and narrowleaf puccoon (*Lithospermum incisum*). Much less common and more restricted in range are redberry juniper (*Juniperus pinchotii*) woodlands, which occur on rocky, gypsum slopes in the southwestern part of the state in portions of Beckham, Greer, Harmon, and Jackson counties. Plant associations such as sideoats grama (*Bouteloua curtipendula*), blue grama (*Bouteloua gracilis*), and buffalograss (*Buchloe dactyloides*) grasslands are common on well drained soils and rocky slopes in western Oklahoma.

The gypsum caves of western Oklahoma serve as important hibernation and roosting sites for multiple bat species. These caves harbor the northernmost colonies of the Brazilian free-tailed bat (*Tadarida brasiliensis*) and the largest cave myotis (*Myotis velifer*) hibernacula in the state and possibly across its distribution in North America. There are no endemic vertebrate or invertebrate species associated with the gypsum cave formations of western Oklahoma.

Selman Bat Cave Wildlife Management Area. Photo by ODWC.

Recognized Gypsum Cave Habitat Vegetation Associations

- Little Bluestem – Lemon Paintbrush – Gordon's Bladderpod Grassland
- Sideoats Grama – Blue Grama – Buffalograss Grassland
- Gordon's Bladderpod – Little Bluestem Grassland
- Redberry Juniper – Sideoats Grama – Hairy Grama Woodland

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Caves
Species of Greatest Conservation Need

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat	
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Limestone Karst	Gypsum Cave
AMPHIBIANS									
Cave Salamander *Eurycea lucifuga*	**Global Status: G5; State Status S3.** Restricted to the Ozark Plateau of northeastern Oklahoma. Locally common in limestone caves, outcrops, and cliff fissures, rocky streams and springs, and moist hillsides below karst formations.					•		•	
Grotto Salamander *Eurycea spelaea*	**Global Status: G4; State Status: S3.** Endemic to the Ozark Plateau. Uncommon and locally occurring in limestone caves, springs, and shallow aquifers in the Ozarks of northeastern Oklahoma.					•		•	
Western Slimy Salamander *Plethodon albagula*	**Global Status: G5; State Status: NR.** Common throughout the Ozark and Ouachita Uplifts. Locally occurring in moist woodlands, wooded karst hillsides, cave entrances, rocky outcrops, and damp ravines of northeastern and southeastern Oklahoma.					•	•	•	
Ozark Zigzag Salamander *Plethodon angusticlavius*	**Global Status: G4; State Status: S2.** Endemic to the Ozark Plateau. Locally common in limestone caves and steep hillsides in moist forested areas within the Ozarks of northeastern Oklahoma.					•		•	
BIRDS									
American Barn Owl *Tyto furcata*	**Global Status: G5; State Status: S3.** Uncommon, year-round resident. Nests locally in gypsum caves and rocky outcrops.		•						•
FISH									
Ozark Cavefish *Troglichthys rosae*	**Global Status: G3; State Status: S1.** Rare and federally listed as a threatened species. Occupies limestone caves and shallow aquifers in the Springfield Plateau of the Ozark Highlands in northeastern Oklahoma.					•		•	
INVERTEBRATES									
Oklahoma Cave Amphipod *Allocrangonyx pellucidus*	**Global Status: G2; State Status: S2.** Endemic to the Arbuckle Uplift. Stygobitic amphipod only documented in subterranean waters and springs in Johnston, Murray, and Pontotoc counties of south-central Oklahoma. Presumed to be locally common, but its distribution is poorly known.				•			•	
A Cave Obligate Isopod *Amerigoniscus centralis*	**Global Status: G1; State Status: S1.** Endemic. Rare isopod only documented at one location in the Arbuckle Uplift of south-central Oklahoma.				•			•	

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat	
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Limestone Karst	Gypsum Cave
A Cave Obligate Isopod *Caecidotea acuticarpa*	**Global Status: G2; State Status: S1.** Endemic. Groundwater-dwelling isopod that occupies limestone caves and aquifers in the Arbuckle Uplift of south-central Oklahoma. Distribution is poorly known, but found in most accessible places.				•			•	
A Cave Obligate Isopod *Caecidotea adenta*	**Global Status: G1; State Status: S1.** Locally common isopod that is restricted to the limestone aquifer located north of the Wichita Mountains in southwestern Oklahoma.		•					•	
A Cave Obligate Isopod *Caecidotea ancyla*	**Global Status: G3; State Status: S2.** Locally common isopod that is restricted to wet, limestone caves in the southern two-thirds of the Ozark Ecoregion in northeastern Oklahoma.					•		•	
A Cave Obligate Isopod *Caecidotea antricola*	**Global Status: G5; State Status: S1.** Uncommon isopod that is limited to a few limestone caves located in Delaware County in northeastern Oklahoma.					•		•	
A Cave Obligate Isopod *Caecidotea mackini*	**Global Status: GNR; State Status: S1.** Endemic to Oklahoma. Uncommon isopod that is limited to one limestone cave complex located in Delaware County in northeastern Oklahoma.					•		•	
Bat Cave Isopod *Caecidotea macropropoda*	**Global Status: G3; State Status: S1.** Endemic to the Springfield Plateau. Uncommon, cave obligate isopod that is restricted to wet, limestone caves in Adair County of northeastern Oklahoma.					•		•	
Springfield Plain Groundwater Isopod *Caecidotea simulator*	**Global Status: G2; State Status: S2.** Uncommon isopod, but widespread in shallow limestone aquifers and caves in northeastern Oklahoma.					•		•	
Steeve's Cave Isopod *Caecidotea steevesi*	**Global Status: G3; State Status: S1.** Endemic to the Springfield Plateau. Uncommon, troglobitic isopod known from three limestone caves in northeastern Oklahoma. Currently restricted to Adair and Delaware counties.					•		•	
Slender-fingered Cave Isopod *Caecidotea stiladactyla*	**Global Status: G3; State Status: S2.** Locally common isopod in springs, seeps, and wet, limestone caves along the Arkansas state line in northeastern Oklahoma.					•		•	
Delaware County Cave Crayfish *Cambarus subterraneus*	**Global Status: G1; State Status: S1.** Rare crayfish that is restricted to the shallow limestone aquifer and caves in the northern one-third of Delaware County in northeastern Oklahoma. Only known from four different locations, but presumed to be composed of three distinct populations due to groundwater connectivity.					•		•	
Oklahoma Cave Crayfish *Cambarus tartarus*	**Global Status: G1; State Status: S1.** State listed as endangered. Rare crayfish restricted to the shallow limestone aquifer and caves in the Spavinaw Creek watershed of northeastern Oklahoma. Known from seven different cave systems, but presumed to be composed of only two distinct populations due to groundwater connectivity.					•		•	

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat	
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Limestone Karst	Gypsum Cave
A Cave Obligate Harvestman *Crosbyella spinturnix*	**Global Status: GNR; State Status: S1.** Uncommon and only documented from three limestone caves in the Ozarks of northeastern Oklahoma.					•		•	
A Cave Obligate Planarian *Dendrocoelopsis americana*	**Global Status: G3; State Status: S2.** Locally common, troglophilic flatworm restricted to the Ozark Plateau in northeastern Oklahoma. Known from limestone caves, subterranean waters, and seepage springs in Adair, Delaware, and Ottawa counties.					•		•	
A Cave Obligate Spider *Islandiana unicornis*	**Global Status: G2; State Status: S1.** Endemic to the Springfield Plateau. Uncommon and locally occurring cave obligate spider found in limestone caves in northeastern Oklahoma.					•		•	
Ozark Mantleslug *Megapallifera ragsdalei*	**Global Status: G3; State Status: NR.** Endemic to the Ozarks. Locally common and widespread land slug. Very distinctive color pattern and found in a variety of moist habitats. Most likely feeds on fungi and lichens.					•		•	
Racovitza's Cave Isopod *Miktoniscus oklahomensis*	**Global Status: G1; State Status: S1.** Endemic to the Arbuckle Uplift. Uncommon isopod in the limestone caves and aquifers of south-central Oklahoma.				•			•	
Tulsa Whitelip *Neohelix lioderma*	**Global Status: G1; State Status: NR.** Uncommon and locally occurring land snail typically associated with forested limestone outcrops in a small portion of the northern Cross Timbers Ecoregion in northeast Oklahoma.				•			•	
A Cave-dwelling Dung Beetle *Onthophagus cavernicollis*	**Global Status: GNR; State Status: NR.** Troglophilic scarab beetle known from limestone caves in Adair, Cherokee, and Delaware counties in the Ozark Plateau and Murray County in the Arbuckle Uplift. Status in Oklahoma is unknown.				•	•		•	
Domed Supercoil *Paravitrea significans*	**Global Status: G3; State Status: NR.** Uncommon land snail found in mesic oak-hickory forests and bottomland hardwood forests in the Ozark Plateau and Ouachita Mountains.					•	•	•	
A Cave Obligate Springtail *Pseudosinella dubia*	**Global Status: G3; State Status: S1.** Locally common, cave obligate springtail. Known from limestone caves in Adair County of northeastern Oklahoma.					•		•	
A Cave Obligate Springtail *Pygmarrhopalites jay*	**Global Status: G2; State Status: S1.** Uncommon and locally occurring cave obligate springtail. Documented from only two limestone caves in northeastern Oklahoma.					•		•	
Ozark Slitmouth *Stenotrema labrosum*	**Global Status: G3; State Status: NR.** Uncommon, but occasionally locally abundant land snail. Widespread throughout the Ozark Plateau and Ouachita Uplift, often associated with moderate to high relief rocky forests where it is found under logs or rock.					•	•	•	

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat	
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Limestone Karst	Gypsum Cave
Bowman's Cave Amphipod *Stygobromus bowmani*	**Global Status: G1; State Status: S1.** Endemic to Oklahoma. Rare amphipod documented from only one seep located in Mayes County in northeastern Oklahoma.					•		•	
Onondaga Cave Amphipod *Stygobromus onondagaensis*	**Global Status: G3; State Status: S2.** Endemic to the Ozark Plateau. Stygobitic amphipod restricted to limestone caves and subterranean waters of Adair, Cherokee, Delaware, Mayes, and Ottawa counties.					•		•	
Ozark Cave Amphipod *Stygobromus ozarkensis*	**Global Status: G4; State Status: S3.** Locally common amphipod in wet, limestone caves, springs, and seeps in the Ozarks of northeastern Oklahoma.					•		•	
Black's Cave Millipede *Trigenotyla blacki*	**Global Status: G1; State Status: S1.** Endemic to Oklahoma. Troglobitic millipede documented from limestone caves in Delaware and Adair counties in the Ozark Plateau of northeastern Oklahoma. Distribution poorly known.					•		•	
A Cave Millipede *Trigenotyla seminole*	**Global Status: G1; State Status: S1.** Endemic to Oklahoma. Troglophilic millipede documented from limestone caves in Seminole County of south-central Oklahoma. Distribution is poorly known.				•			•	
A Cave Millipede *Trigenotyla vaga*	**Global Status: GNR; State Status: S1.** Endemic to Oklahoma. Troglophilic millipede documented from limestone caves in Murray and Johnston counties in the Arbuckle Uplift and Le Flore County in the Ouachita Uplift. Distribution is poorly known.				•		•	•	

MAMMALS

Townsend's Big-eared Bat *Corynorhinus townsendii*	**Global Status: G4; State Status: S3.** Locally uncommon with small, isolated populations in the western one-third of the state, including the Oklahoma panhandle. Species is associated with gypsum caves and cave formations.		•						•
Ozark Big-eared Bat *Corynorhinus townsendii ingens*	**Global Status: T1; State Status: S1.** Federally listed as endangered. Regionally endemic to the Ozark Plateau. Rare and restricted to limestone caves and sandstone talus formations in limited parts of Adair, Cherokee, and Sequoyah counties in northeastern Oklahoma.					•		•	
Gray Myotis *Myotis grisescens*	**Global Status: G3; State Status: S1.** Federally listed as endangered. Locally common, but restricted to the vicinity of 12 limestone caves used as maternity sites and summer roosts. Known from Ottawa, Delaware, Mayes, Cherokee, Adair, and Muskogee counties of northeastern Oklahoma. The majority of the population migrate to Arkansas and Missouri for hibernation.					•		•	
Little Brown Myotis *Myotis lucifugus*	**Global Status: G3; State Status: S1.** Rare migratory bat that moves through the eastern one-quarter of the state during the spring and fall. There are a few summer records for this species in caves and buildings along the Arkansas stateline in Adair, Delaware, and McCurtain counties. Forages in oak and pine-oak woodlands and forests.					•	•	•	

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat	
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Limestone Karst	Gypsum Cave
Northern Long-eared Myotis *Myotis septentrionalis*	**Global Status: G2; State Status: S2.** Federally listed as endangered. Known to occur in forested habitats and limestone caves throughout the Ozark Plateau of northeastern Oklahoma. Species also reported utilizing sandstone caves in Le Flore County.					•	•	•	
Indiana Myotis *Myotis sodalis*	**Global Status: G2; State Status: S1.** Federally listed as endangered. Rare; potential year-round, sporadic occupancy across eastern Oklahoma. This species has been recorded hibernating in limestone and sandstone caves in Adair, Pushmataha, and Le Flore counties of eastern Oklahoma.					•	•	•	
Cave Myotis *Myotis velifer*	**Global Status: G4; State Status: S3.** Locally common, year-round resident in the western one-half of the state. Predominantly found in gypsum caves, but will also utilize bridges, mines, rock crevices, and buildings as roost sites.	•	•						•
Tricolored Bat *Perimyotis subflavus*	**Global Status: G3; State Status: S3.** Federally proposed as endangered. Occurs statewide. Uncommon and declining in gypsum caves and sinkholes in western Oklahoma. More common, but declining in limestone and sandstone-shale caves in forested areas across the eastern one-half of the state.	•	•		•	•	•	•	•
Brazilian Free-tailed Bat *Tadarida brasiliensis*	**Global Status: G5; State Status: S3.** Locally common, summer resident most commonly found in gypsum caves in the western two-thirds of the state. Four to five major maternity colonies are known to occur in western Oklahoma caves. There are also colonies in southeastern Oklahoma that use anthropogenic structures such as bridges.		•						•

Caves
Conservation Issues and Actions

Six overarching conservation issues have been identified for cave habitats in Oklahoma: information gaps, natural resource use, habitat loss and fragmentation, pollution, human intrusion and disturbance, and invasive and problematic species.

Rafinesque's big-eared bat at Little River National Wildlife Refuge. Photo by ODWC.

Conservation Issues Related to Information Gaps

Across Oklahoma's caves and karst systems, existing data are incomplete for SGCN, with respect to their distributions, ecological needs, and population trends. These information deficiencies create an impediment to the development and implementation of effective conservation strategies. Within limestone karst systems, data regarding the locations of caves and cave-bearing geologic formations are also incomplete because of the difficulty in locating and mapping cave and karst formations and gaining access to private property. There are likely more caves in the Ozarks than have been documented, and caves may have a greater degree of connectivity via underground connections and groundwater.

Conservation Actions

- Continue reviewing existing literature, reports, location, and museum records, along with interviews of technical experts to maintain historic and recent distributional data and ecological information for all cave-dependent and cave-associated SGCN.
- Continue research that establishes baseline data on the current distribution, abundance, habitat needs, and that identifies factors that may limit the abundance of SGCN.
  - » These assessments can be utilized to develop additional monitoring efforts to measure changes in abundance and geographic range, and management recommendations that enhance populations through improved habitat conditions or recruitment in geographic areas to provide the greatest benefit for all SGCN.
- Continue to identify and map the distribution of limestone karst and gypsum caves, with an emphasis on sites that support SGCN. Then, field studies that locate, map, and document the faunal communities of biologically important caves, karst, and aquifers can be conducted.
- Additionally, evaluate techniques to conduct biological surveys in shallow Ozark and Cross Timbers aquifers to measure the degree of connection between populations in neighboring caves and springs.
  - » These examinations could also be accomplished through genetic evaluation of populations in nearby caves and aquifers.
- Provide long-term funding and support to maintain local and national databases to store and analyze species distributional and ecological data, such as the North American Bat Monitoring Program.
  - » Similarly, databases can be utilized to store and track location and biological composition of biologically important sites.
  - » Make these data available to land managers, conservation agencies, and select partners to be incorporated into site-specific, species-specific, and regional conservation plans.
- Ensure that all conservation actions employed maintain location confidentiality to protect rare species and private landowners from unwanted visitation and disturbance.
- Routinely coordinate through working groups and organizations such as the Oklahoma Bat Coordinating Team and local chapters of the National Speleological Society to identify cave and karst conservation priorities statewide.

Conservation Issues Related to Natural and Biological Resource Use

Within the Arbuckle-Simpson Aquifer, there is a risk that water could be withdrawn 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. 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. Gypsum mining has converted local tracts of this habitat to quarries that are unusable by some wildlife. The heavy machinery and explosives used in this industry can threaten the stability of gypsum caves in the areas around the mining activity. Limestone quarrying also may alter cave habitats and the level of water within portions of the aquifer.

Arbuckle Springs Wildlife Management Area. Photo by ODWC.

Conservation Actions

- Develop partnerships between conservation organizations, recreational caving groups, and local landowners interested in the conservation of groundwater to manage the rate of groundwater withdrawal (providing flow for surface springs and streams), while maintaining the working landscape.
- Place caves and the land surrounding caves into conservation programs, including the 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.
- Alert residents in biologically important karst areas by developing public education and awareness materials regarding the sensitivity of ground water and their drinking water; the biological diversity of the cave and aquifer ecosystems; and landowner assistance programs and best management practices that may maintain or improve water quality.
- Map and prioritize sites with caves and tracts of habitat that have native vegetation communities for conservation purchase or easements.
- Conduct field studies to clarify the potential impacts of mining activity on sensitive SGCN and to evaluate the impact of limestone quarrying on ground water volume, quality and flow.
- Acquire fee-title ownership to protect sensitive sites from potentially harmful mineral exploration or conservation easements on acres containing and surrounding biologically important caves.
- 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 biologically important landscapes.

Conservation Issues Related to Habitat Loss and Fragmentation

Due to poor soil fertility and rough topography, some landowners allow wind energy development on their properties as an alternative revenue source. Wind energy development may reduce the suitability of gypsum caves and surrounding habitat. Furthermore, anthropogenic activities such as urban and suburban development, agricultural practices, and transportation infrastructure can result in the loss and fragmentation of habitat containing and surrounding biologically important caves and karst.

Conservation Actions

- Assess large development projects that are proposed within proximity to important caves to avoid, minimize and offset losses to caves and surrounding habitat.
- Continue to promote ‘Site Renewables Right’ efforts to local governments, landowners, and wind energy developers to aid in site selection for wind energy developments to minimize their impact on SGCN.
- Acquire fee title ownership to protect sensitive sites from potentially harmful energy, agricultural, or housing development or conservation easements or leases on acres containing and surrounding biologically important caves.
- Conduct field studies to clarify the potential impacts of wind power development on sensitive SGCN.
- Establish off-sets or mitigation for habitat and wildlife impacts when impacts cannot be avoided.

Conservation Issues Related to Pollution and Sedimentation

Groundwater passes through porous limestone in karst systems very quickly and the soil provides very little filtration. As a result, groundwater in karst aquifers is easily polluted by water-soluble pollutants and water quality degradation is a serious potential problem for aquatic species. Potential pollutants might include nutrients from septic systems and livestock and poultry operations; pesticides, hormones and endocrine system disruptors applied to crops or livestock; and toxic chemicals that might leach from household dumps and landfills.

Conservation Actions

- Continue to delineate and map primary recharge areas that surround biologically important caves and aquifers such as those containing populations of SGCN.
- Evaluate sites that have been mapped and pose potential problems for water quality maintenance, including potential sources of pollutants.
- Develop monitoring programs to measure groundwater quality and track populations of aquatic organisms in the aquifers.
- Establish water quality standards for subterranean streams and their associated shallow aquifers.
- Provide cost-share funding to landowners to remedy potential sources of pollutants.

Conservation Issues Related to Human Intrusion and Disturbance

Populations of cave-dwelling SGCN like bats, cavefish, and salamanders are sensitive to human disturbance within caves and habitat alterations surrounding caves. Uncontrolled recreational use of caves that serve as maternity or hibernation sites may affect local bat populations. Human disturbance may cause nursing female bats to abandon their dependent young or to abandon suitable caves for cooler, less suitable 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

- Continue to evaluate the relative biological importance of specific caves and cave systems within the context of the broader ecoregions so programs can be focused on the sites that are likely to make the most effective use of conservation funds.
- Develop recommendations and assistance and incentive programs to help private landowners implement cave management measures such as installing internal cave gates or enhancing habitat conditions surrounding 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 that would prevent unauthorized human entry of caves used by SGCN 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 nongovernmental organizations.

Conservation Issues Related to Invasive and Problematic Species

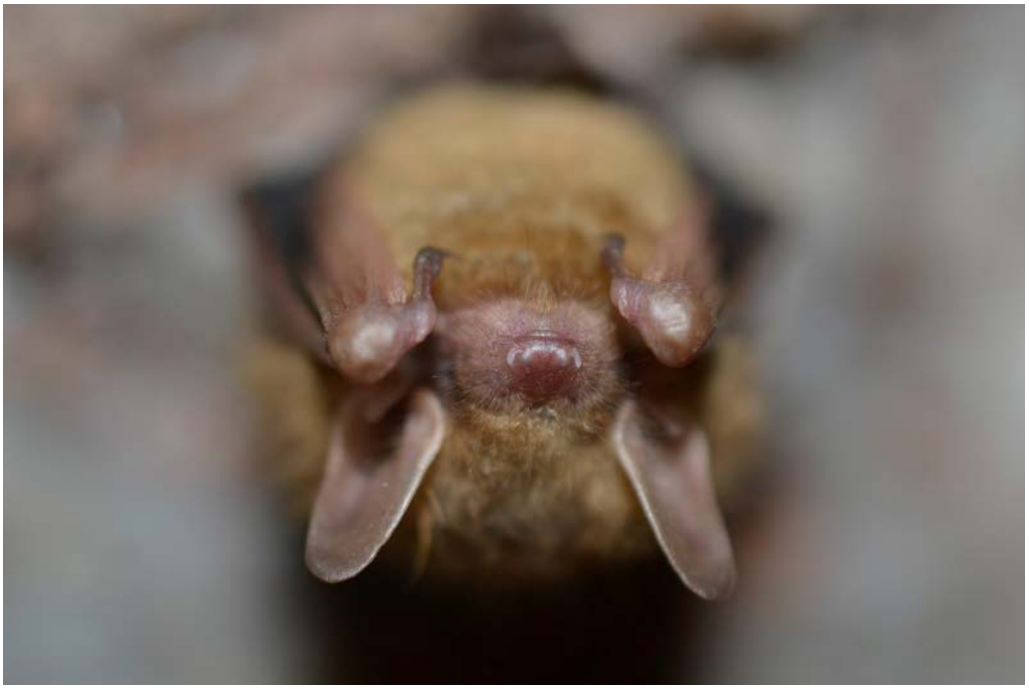
The introduction and spread of disease into native ecosystems can negatively impact the survival, reproductive success and abundance of native wildlife populations. When coupled with other stressors such as habitat loss and fragmentation, emergent diseases may increase in occurrence and severity especially in sensitive environments. White-nose syndrome (WNS) is a disease caused by the fungus *Pseudogymnoascus destructans* (Pd) that affects cave roosting bats during hibernation. The fungus thrives in damp, cold environments often characteristic of limestone karst systems. This disease has drastically impacted several species of cave roosting bats in eastern Oklahoma including the tricolored bat and northern long-eared myotis (*Myotis septentrionalis*), resulting in significant population declines. The presence of WNS in western Oklahoma is still in its incipient stages and its potential impacts on local, cave roosting bat communities remains largely

Iron Gate Cave, Spavinaw Wildlife Mangement Area. Photo by ODWC.

unknown.

Conservation Actions

- Continue surveillance and monitoring efforts of limestone karst and gypsum cave systems that serve as bat hibernacula.
- Conduct research to better understand the impacts of WNS on western Oklahoma bats.
- Continue to protect sensitive cave systems through the installation of bat-friendly gates at cave entrances.
- Continue to require permitted researchers to follow decontamination protocols set forth by the White-Nose Syndrome Disease Management Working Group.
- Promote minimally invasive research to better understand population sizes and status trends of cave-dependent bat SGCN.
- Avoid unnecessary winter disturbance at bat hibernaculum and set limits on cave entry during winter months.
- Educate the public on WNS and the values of conserving bats.
- Continue to coordinate with the Oklahoma Bat Coordinating Team to facilitate information flow to partners, scientific cooperators and stakeholders on bat and cave management, research, and diseases such as WNS in Oklahoma.



Tricolored bat hibernating at Alabaster Caverns State Park. Photo by ODWC.

Potential Indicators for Monitoring the Effectiveness of Conservation Actions

- Continued use of cave systems by all cave-dependent and cave-associated SGCN
- Population sizes and trends for SGCN
- Groundwater quantity and quality
- Relative condition and quantity of habitat near and adjacent to cave and karst openings
- Number of protected caves used by SGCN
- Number or extent of anthropogenic developments that may impact groundwater quality or subterranean environments within the recharge area of caves known to be used by SGCN

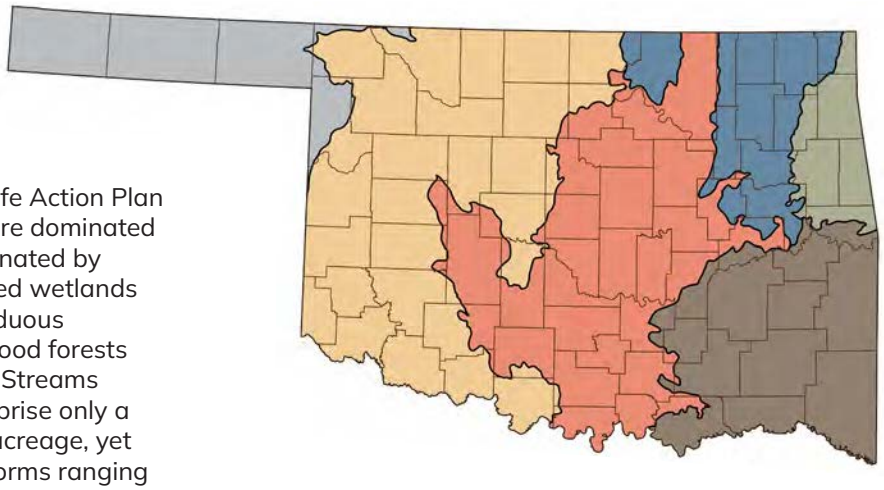
Representative Conservation Areas Supporting Caves

- Alabaster Caverns State Park (Oklahoma State Parks Division)
- Chickasaw National Recreation Area (National Park Service)
- Cookson Wildlife Management Area (ODWC)
- Grand Lake Reservoir and State Parks (Grand River Dam Authority and Oklahoma State Parks Division)
- Lake Eucha (City of Tulsa)
- Major County Wildlife Management Area (ODWC)
- Natural Falls State Park (Oklahoma State Parks Division)
- Ozark Plateau National Wildlife Refuge (USFWS)
- Ozark Plateau Wildlife Management Area (ODWC)
- Pontotoc Ridge Preserve (The Nature Conservancy)
- Selman Bat Cave Wildlife Management Area (ODWC)
- Selman Living Lab (University of Central Oklahoma)
- Spavinaw Hills Wildlife Management Area (ODWC)
- Spavinaw Reservoir (City of Tulsa)
- Stillwell City Lake (City of Stillwell)

Wetlands

Hackberry Flat Wildlife Management Area. Photo by ODWC.

Within Oklahoma, two types of wetland habitats exist: herbaceous wetlands and seeps and vernal pools.

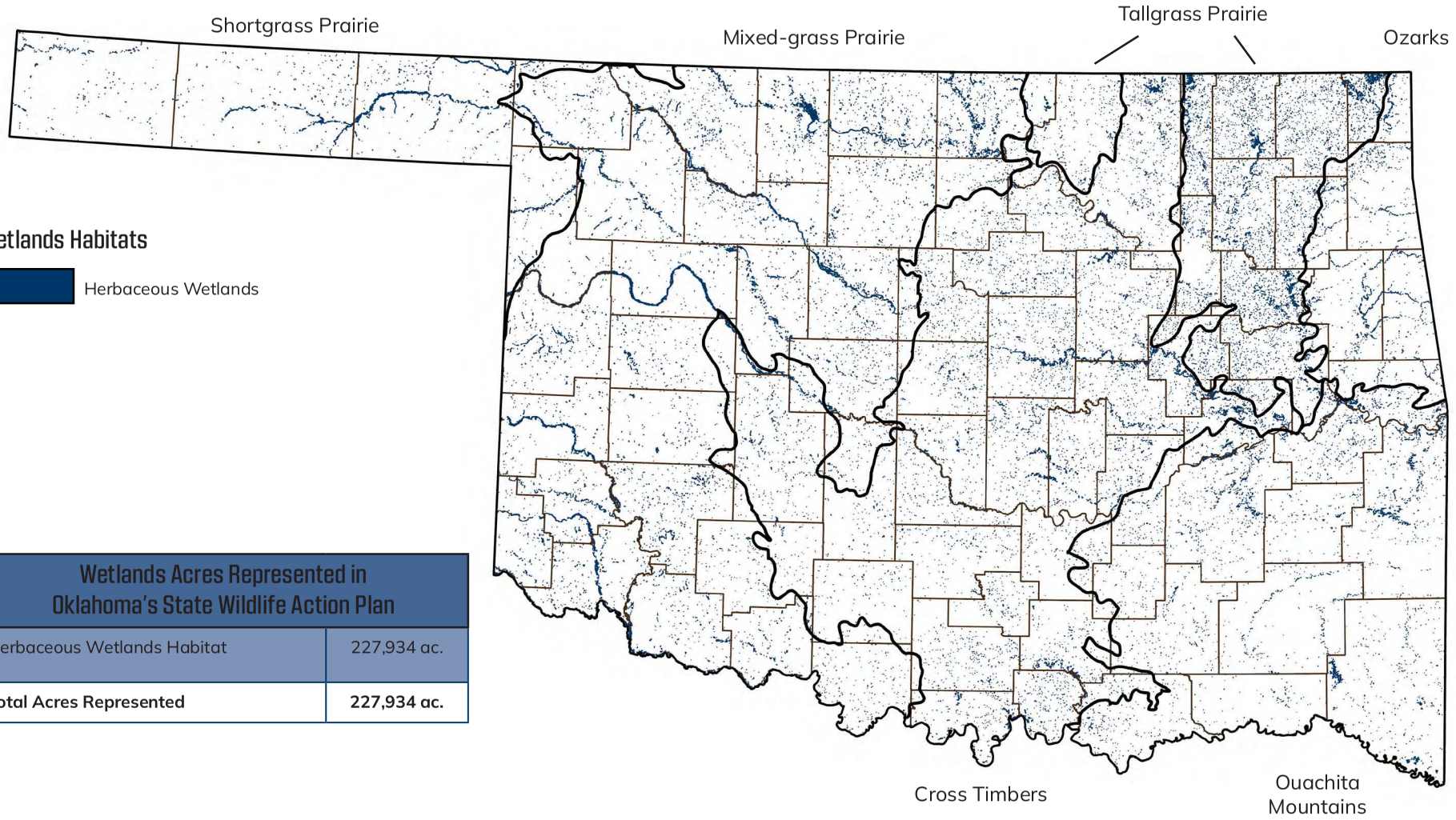


Wetlands occur in all Oklahoma ecoregions.

Herbaceous Wetland Habitat

For the purposes of the Oklahoma State Wildlife Action Plan (SWAP), herbaceous wetlands are ones that are dominated by non-woody plants. Wetlands that are dominated by woody plants are known as swamps or forested wetlands and are covered in the chapter related to Deciduous Woodlands and Forests as bottomland hardwood forests and in the chapter related to Small Rivers and Streams as riparian forests. Herbaceous wetlands comprise only a small fraction (less than <2%) of Oklahoma's acreage, yet they occur statewide and in several different forms ranging from seasonally flooded depressions in prairies such as playa lakes to permanently flooded marshes. Most of Oklahoma's herbaceous wetlands occur in the floodplains of meandering, low-gradient rivers and streams where sloughs, oxbows channels, and scoured depressions are frequent, or where beaver activity has impounded small reaches of streams and created permanently flooded marshes. The remaining wetlands occur in swales and depressions found in prairies, on terraces, and between stabilized dunes. The conditions that maintain herbaceous wetlands are poorly understood but appear to involve the complex interaction of periodic fire and fluctuating water levels. The majority of individual wetlands are small (less than two acres), but they often occur in clusters or complexes with multiple wetlands in close proximity along floodplains and terraces.

The playa lakes found in Oklahoma's panhandle are among the most well-known examples of herbaceous wetlands. Playas are round, clay-lined depressions that occur on level terrain within shortgrass prairies. These collect surface runoff after heavy rains to form small, temporarily flooded wetlands. Playa wetlands are small in size, averaging about 17 acres, and individual basins may be separated from the next nearest playa by 2-3 miles. Ecologists are still uncertain how these wetlands were formed originally, but they have become important habitats for migrating shorebirds and



Wetlands Habitats

Herbaceous Wetlands

Wetlands Acres Represented in Oklahoma's State Wildlife Action Plan	
Herbaceous Wetlands Habitat	227,934 ac.
Total Acres Represented	**227,934 ac.**

**Seep and Vernal Pool Habitat is not represented on this map.*

A Texas County, Oklahoma playa. Photo by ODWC.

breeding sites for the amphibians and waterbirds of the High Plains. Other notable herbaceous wetlands and wetland complexes in western Oklahoma include Hackberry Flat Wildlife Management Area, Drummond Flats Wildlife Management Area, and the Cimarron Terrace wetland complex. Hackberry Flat and Drummond Flats WMAs are restored wetlands within agriculturally dominated landscapes in southern Tillman County and southwestern Garfield County respectively. Both of these wetlands developed in naturally occurring, large shallow depressions of unknown origin. 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 near Dover in Kingfisher County west to Ames, in Major County. In eastern Oklahoma, herbaceous wetlands are common in the broad, low-gradient floodplains of the Arkansas and Poteau rivers, and the Red and Little rivers.

Wetland plant communities are diverse as a result of variations in soil conditions, the length of time that the soil is saturated, and the depth and frequency of seasonal flooding. Widespread herbaceous wetland plants include common spikerush (*Eleocharis palustris*), softstem bulrush (*Schoenoplectus tabernaemontani*), blunt spikerush (*Eleocharis obtusa*), pink smartweed (*Persicaria bicornis*), Pennsylvania smartweed (*Persicaria pensylvanicum*), three-square bulrush (*Schoenplectus pungens*), sand spikerush (*Eleocharis montevidensis*), saltmarsh aster (*Symphyotrichum subulatum*), Plains coreopsis (*Coreopsis tinctoria*), sweetscent (*Pluchea odorata*), marshelder (*Iva annua*), and prairie cordgrass (*Spartina pectinata*). In the eastern one-half of Oklahoma, where wetlands are more likely to be permanently inundated, or inundated for the majority of the year, the herbaceous wetlands community may include ravensfoot sedge (*Carex crus-corvi*), common rush (*Juncus effusus*), and broadleaf cattail (*Typha latifolia*), marsh willowprimrose (*Ludwigia palustris*), Torrey rush (*Juncus torreyi*), broadleaf arrowhead (*Sagittaria latifolia*), and powdery thalia (*Thalia dealbata*). The rare Hall's bulrush (*Schoenoplectus hallii*) is found in a small number of wetlands in central Oklahoma and in the vicinity of the Wichita Mountains. Other Plant Species of Conservation Need (PSCN) associated with wetland habitats include panicled indigobush (*Amorpha paniculata*), cypress-knee sedge (*Carex decomposita*), Oklahoma goldentop (*Euthamia oklahomensis*), western prairie white-fringed orchid (*Platanthera praeclara*), and Kansas arrowhead (*Sagittaria ambigua*).

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

Hackberry Flat Wildlife Management Area. Photo by ODWC.

and other seasonal wetlands have been plowed and converted to agricultural uses.

Recognized Herbaceous Wetland Habitat Vegetation Assoications

- Narrowleaf Cattail – Southern Cattail Semi-permanently Flooded Marsh
- Broadleaf Cattail – Powdery Thalia Semi-permanently Flooded Marsh
- Softstem Bulrush – Common Spikerush Semi-permanently Flooded Marsh
- Common Spikerush – Hairy Waterclover Temporarily Flooded Marsh
- Broadleaf Arrowhead – Longbar Arrowhead Semi-permanently Flooded Wetland
- Pennsylvania Smartweed – Curlytop Smartweed Semi-permanently Flooded Wetland
- Inland Saltgrass – Alkali Sacaton Temporarily Flooded Grassland
- Inland Saltgrass – Three-square Bulrush Temporarily Flooded Grassland
- Floating Primrose Willow – Swamp Smartweed Permanently Flooded Grassland
- Smooth Alder – Indigo Bush Temporarily Flooded Shrubland
- Buttonbush Semi-permanently Flooded Shrubland
- Prairie Cordgrass Temporarily Flooded Marsh
- Three-square Bulrush Semi-permanently Flooded Marsh

Red Slough Wildlife Management Area. Photo by ODWC.

- Common Reed Semi-permanently Flooded Marsh
- Broadleaf Cattail Semi-permanently Flooded Marsh
- Ravenfoot Sedge Seasonally Flooded Marsh
- Soft Rush Seasonally Flooded Marsh
- Water Smartweed Semi-permanently Flooded Wetland
- American Water-willow Temporarily Flooded Wetland

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Seep and Vernal Pool Habitat

For the purpose of the Oklahoma SWAP, we categorize Seeps and Vernal Pool habitats into a single habitat type to emphasize the similarities in structure and function of these wetland communities. Seeps and vernal pools are fairly small and uncommon terrestrial features that can be found almost statewide across all of Oklahoma's ecoregions. These habitats are classified as palustrine wetlands which are characterized by standing water or saturated soil, often occurring in low-lying areas across a variety of landscapes. Although seeps and vernal pools share many similarities, it is also important to highlight the differences that make these systems unique. Seeps are fed by groundwater discharge and often retain water permanently, to some degree. In contrast,

Deep Fork Wildlife Management Area. Photo by ODWC.

Seep Habitat at Grassy Slough Wildlife Management Area. Photo by ODWC.

vernal pools are seasonal wetlands that fill during precipitation events and only hold water temporarily. These habitats support a diverse assemblage of amphibians and invertebrates, such as the four-toed salamander (*Hemidactylium scutatum*) and isopod species such as *Lirceus trilobus*. However, the condition, distribution, and biological composition of seeps and vernal pools in Oklahoma are poorly known and understudied, primarily due to difficulties in locating and accessing these sites.

In the Shortgrass Prairie, Mixed-grass Prairie, and Tallgrass Prairie ecoregions seeps are relatively rare and occur primarily in association with stream channels, stream floodplains, and stabilized dunes. In the Arbuckle Uplift of the Cross Timbers Ecoregion and Ozark Plateau of the Ozark Ecoregion, seeps are common, widespread and often found in association with other wetland habitats, springs, headwater streams, and karst formations. Due to the limestone geology in the Arbuckle Mountains and Ozark Plateau, seeps are numerous and are often utilized by species that inhabit connecting groundwater aquifers, and subterranean and surface springs. Relative to the karst formations of the Ozark Plateau and Arbuckle Mountains, the Ouachita Mountains in the Ouachita Mountains Ecoregion has relatively few groundwater aquifers. Seeps in this ecoregion are less common but can be found near wetlands or at the headwaters of streams. Seeps that occur at the headwaters of or along mountain streams and springs are important to regionally endemic species including, the Ouachita dusky salamander (*Desmognathus brimelyorum*) and Ouachita spiketail (*Zoraena talaria*). Additionally, seeps occur in the Gulf Costal Plains geomorphic province of southern McCurtain, eastern Choctaw, and southern Atoka counties. Here, this habitat is typically found in areas of sandy soil near the bases of ridges and sandhills and can support uncommon, bog-like plant communities of ferns, aroids, orchids, and mosses. A few sites in Pushmataha and Atoka counties are known to support the rare and imperiled small-headed pipewort (*Eriocaulon koernickianum*). Other PSCN associated with seeps include Oklahoma goldentop, largeleaf grass-of-parnassus (*Parnassia grandifolia*), and Great Plains ladies' tresses (*Spiranthes magnicamporum*). Seeps are often vegetated with herbaceous wetland plants such as three-square bulrush, spikebrushes, and cattails.

Vernal pools, also known as ephemeral wetlands, are temporary bodies of water fed by precipitation that emerge in natural, shallow depressions for a portion of the year, but often dry out regularly. Bedrock or compact clay soils lie beneath these pools, acting as a semipermeable layer that helps retain collected water. Vernal pools occur across a variety of landscapes including upland and bottomland

Red Sough Wildlife Management Area. Photo by ODWC.

Vernal Pool Habitat on the Ouachita National Forest – Oklahoma Ranger District. Photo by ODWC.

forests, mesic forests, and floodplains, although they are most commonly associated with forested habitats. These wetlands can be found throughout eastern Oklahoma in the Tallgrass Prairie, Cross Timbers, Ozark, and Ouachita Mountains ecoregions. This habitat is common in the Ozark and Ouachita Mountains ecoregions, especially in mesic forests which support the greatest diversity of amphibians that depend on vernal pools for reproduction. These fishless pools provide important habitat for salamander Species of Greatest Conservation Need (SGCN) such as the ringed salamander (*Ambystoma annulatum*). Due to the ephemeral nature of vernal pools, these systems do not support diverse plant communities.

Recognized Seep and Vernal Pool Habitat Vegetation Associations

- Seep Muhly – Prairie Tea Seasonally Flooded Grassland
- Broom Witchgrass – Small-spike False Nettle – Orange Peatmoss – Common Haircap Moss Saturated Seepage Meadow
- Soft Rush Seasonally Flooded Marsh

All plant associations are based on “The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning,” (Hoagland 2000).

Wetlands
Species of Greatest Conservation Need

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat	
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Herbaceous Wetland	Seeps and Vernal Pools
AMPHIBIANS									
Ringed Salamander *Ambystoma annulatum*	**Global Status: G4; State Status: S2**. Locally common, but patchily distributed in upland deciduous and pine-oak forests in the Ozark Plateau and in the Ouachita Mountains in portions of Le Flore and McCurtain counties. A secretive, burrowing and nocturnal salamander that breeds in small ponds and vernal pools during the fall. Populations are tied to breeding sites. Fall breeding activity is closely tied to significant rain events.					•	•		•
Mole Salamander *Ambystoma talpoideum*	**Global Status: G4; State Status: S1.** Rare, secretive, burrowing species of salamander that is known only from sites in the Gulf Coastal Plain region of McCurtain County in Oklahoma.						•	•	•
Three-toed Amphiuma *Amphiuma tridactylum*	**Global Status: G5 ; State Status: S1.** Rare, secretive, and limited to the Gulf Coastal Plain region of southern McCurtain County.						•	•	
Chihuahuan Green Toad *Anaxyrus debilis*	**Global Status: G5; State Status: S3.** Locally common in rocky canyons and hillsides in the far southwest of the state, Black Mesa, and the Arbuckles. Usually found in close proximity to seasonal breeding ponds and wetlands.	•	•					•	
Texas Toad *Anaxyrus speciosus*	**Global Status: G5; State Status: S3.** Locally common in the vicinity of breeding ponds and seasonally flooded wetlands in southwestern Oklahoma.		•					•	
Ouachita Dusky Salamander *Desmognathus brimleyorum*	**Global Status: G4; State Status: S3**. Locally common in rocky, high-gradient headwater springs, seeps, and streams in the eastern half of the Ouachita Mountains Ecoregion.						•		•
Bird-voiced Treefrog *Dryophytes avivoca*	**Global Status: G5; State Status: S2.** Uncommon and locally occurring in bottomland hardwood forests and flood plain wetlands in the Gulf Coastal Plain portion of the Little River watershed.						•	•	
Many-ribbed Salamander *Eurycea multiplicata*	**Global Status: G4; State Status: S4.** Locally common and widespread stream-breeding salamander in seeps, springs, streams, and moist woodlands throughout the Ouachita Mountains.						•		•
Four-toed Salamander *Hemidactylium scutatum*	**Global Status: G5; State Status: S1.** Rare salamander in Oklahoma that has been found around seeps and bogs at very few high-elevation forest sites in the Ouachita Mountains.						•		•

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat	
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Herbaceous Wetland	Seeps and Vernal Pools
Crawfish Frog *Lithobates areolatus*	**Global Status: G5; State Status: S4.** Locally common frog that is found in level, clay-soil prairies in the eastern one-third of Oklahoma. Rarely seen above ground except during the relatively short early spring breeding season when they move into seasonal wetlands and vegetated ponds for breeding. Sometimes found in the transition between bottomland forests and open, grassy habitats.			•	•	•	•	•	
Strecker's Chorus Frog *Pseudacris streckeri*	**Global Status: G4; State Status: NR.** Endemic to the south-central United States, but widespread in the central one-third of Oklahoma. Typically found in herbaceous wetlands in open oak woodlands.		•	•	•			•	
Western Siren *Siren nettingi*	**Global Status: G5; State Status: NR.** Uncommon, aquatic salamander that is limited to streams, sloughs, herbaceous wetlands, and swamps in forested bottomlands throughout the Gulf Coastal Plain region of Oklahoma.						•	•	

BIRDS

LeConte's Sparrow *Ammospiza leconteii*	**Global Status: G3; State Status: S2.** Common migrant and winter resident of herbaceous wetlands with tall vegetation.	•	•	•	•	•	•	•	
Short-eared Owl *Asio flammeus*	**Global Status: G5; State Status: S3.** Uncommon winter resident of grasslands that hunts in tall, grassy vegetation around the margins of wetlands.	•						•	
Green Heron *Butorides virescens*	**Global Status: G5 ; State Status: S2.** Uncommon summer breeding season migrant to Oklahoma. Secretive and often solitary on shorelines of rivers, streams, and ponds.		•	•	•	•	•	•	
Baird's Sandpiper *Calidris bairdii*	**Global Status: G5; State Status: NR.** Common spring and fall migrant through Oklahoma. Prefers to rest and forage on mudflats, shores, and flooded crop fields.	•	•	•	•			•	
Red Knot *Calidris canutus*	**Global Status: G4; State Status: S1.** Federally listed as threatened. Rare migrant usually flying over Oklahoma with few records of birds stopping to rest on river or reservoir shorelines.		•	•				•	
White-rumped Sandpiper *Calidris fuscicollis*	**Global Status: G5; State Status: S3.** Common late spring migrant through Oklahoma, rarely seen in fall migration. Prefers shorelines, mudflats, and flooded crop fields.		•	•	•	•	•	•	
Stilt Sandpiper *Calidris himantopus*	**Global Status: G5; State Status: S3.** Common spring and fall migrant through Oklahoma. Usually found on mudflats of rivers and flooded crop fields.		•	•	•		•	•	
Pectoral Sandpiper *Calidris melanotos*	**Global Status: G5; State Status: NR.** Common spring and fall migrant through Oklahoma. Prefers foraging in wet grasslands, mudflats, and flooded crop fields or pastures.		•	•	•	•	•	•	
Semipalmated Sandpiper *Calidris pusilla*	**Global Status: G5; State Status: NR.** Common spring and fall migrant through Oklahoma. Often found in large flocks using shorelines and marshes with shallow water.	•	•	•	•	•	•	•	

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat	
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Herbaceous Wetland	Seeps and Vernal Pools
Buff-breasted Sandpiper *Calidris subruficollis*	**Global Status: G4; State Status: S3.** Uncommon spring and fall migrant through the central one-third of Oklahoma. Prefers mudflats and wetlands as stopover habitats.		•	•	•		•	•	
Piping Plover *Charadrius melodus*	**Global Status: G3; State Status: NR.** Federally listed as threatened. Rare spring and fall migrant that uses sandbars and mudflats statewide as feeding areas.		•	•	•		•	•	
Yellow Rail *Coturnicops noveboracensis*	**Global Status: G4; State Status: NR.** Rare spring and fall migrant throughout the eastern half of the state. Rare winter resident in the wetlands of the Gulf Coastal Plain region.			•	•	•	•	•	
Bobolink *Dolichonyx oryzivorus*	**Global Status: G5; State Status: S2.** Only occurs in Oklahoma during its spring and fall migrations. Uses marshes, hayfields, and prairies as stopover habitat in the eastern four-fifths of the state.		•	•	•	•	•	•	
Little Blue Heron *Egretta caerulea*	**Global Status: G5; State Status: NR.** Locally common summer resident in the eastern two-thirds of Oklahoma. Often nests in colonies with other species of herons and egrets.		•	•	•	•	•	•	
Rusty Blackbird *Euphagus carolinus*	**Global Status: G4; State Status: S3.** Uncommon winter resident in bottomland forests, and forested wetlands across the eastern half of the state.			•	•	•	•	•	
Whooping Crane *Grus americana*	**Global Status: G1; State Status: S1.** Federally listed as endangered. Rare spring and fall migrant in the western half of Oklahoma. Uses shallow river channels and sandbars as roosting habitat.	•	•		•			•	
Black Rail *Laterallus jamaicensis*	**Global Status: G3; State Status: S1.** Rare summer breeding resident in Oklahoma. Likely to breed in shallow floodplain wetlands along the Cimarron River and other rivers in northwestern Oklahoma.	•	•		•		•	•	
Short-billed Dowitcher *Limnodromus griseus*	**Global Status: G3; State Status: S1.** Uncommon spring and fall migrant through Oklahoma. Prefers mudflats and flooded crop fields for resting and foraging.			•	•		•	•	
Long-billed Dowitcher *Limnodromus scolopaceus*	**Global Status: G5; State Status: NR.** Common spring and fall migrant through Oklahoma. Prefers to rest and forage on mudflats and shallow pools.	•	•	•	•	•	•	•	
Marbled Godwit *Limosa fedoa*	**Global Status: G5; State Status: S2.** Uncommon spring and fall migrant through the western two-thirds of Oklahoma. Prefers prairies, pools, and shorelines.	•	•	•	•			•	
Hudsonian Godwit *Limosa haemastica*	**Global Status: G4; State Status: S2.** Uncommon spring migrant through the eastern three-quarters of Oklahoma. Prefers shallow water, side channels, and floodplain wetlands as foraging areas.		•	•	•	•	•	•	
Long-billed Curlew *Numenius americanus*	**Global Status: G4; State Status: S2.** Uncommon migrant in the western half of the state. Uncommon summer resident in the western one-third of the panhandle, where it nests in grasslands, often near playas.	•	•					•	

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat	
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Herbaceous Wetland	Seeps and Vernal Pools
American Golden-Plover *Pluvialis dominica*	**Global Status: G5; State Status: S2.** Common spring and fall migrant through Oklahoma. Prefers mudflats and shorelines as stop over and feeding habitats across the main body of the state.	•	•	•	•	•	•	•	
Black-bellied Plover *Pluvialis squatarola*	**Global Status: G5; State Status: S2.** Uncommon spring and fall migrant through Oklahoma. Forages on mudflats and shorelines.	•	•	•	•		•	•	
King Rail *Rallus elegans*	**Global Status: G4; State Status: S1.** Rare summer resident that nests very locally in herbaceous wetlands and sloughs along river channels in central and eastern Oklahoma.		•	•	•		•	•	
Least Tern *Sternula antillarum*	**Global Status: G4; State Status: S2.** Uncommon summer resident along the Arkansas, Cimarron, Canadian and Red rivers in Oklahoma. Nests locally in small colonies on islands and sandbars.		•	•	•	•	•	•	
Lesser Yellowlegs *Tringa flavipes*	**Global Status: G5; State Status: NR.** Common spring and fall migrant through Oklahoma. Prefers marshes, mudflats, and shoreline habitat.	•	•	•	•	•	•	•	
Greater Yellowlegs *Tringa melanoleuca*	**Global Status: G5; State Status: NR.** Common spring and fall migrant through Oklahoma. Prefers marshes, mudflats, and shoreline habitat.	•	•	•	•	•	•	•	
Willet *Tringa semipalmata*	**Global Status: G5; State Status: S3.** Uncommon spring and fall migrant through Oklahoma. Interior prairie population prefers marshes, mudflats, and wet meadow/pasture habitats.	•	•	•	•	•	•	•	
American Barn Owl *Tyto furcata*	**Global Status: G5; State Status: S3.** Uncommon, year-round resident that hunts in wetlands, but is dependent upon barns and buildings for nesting and as roost sites.	•						•	

INVERTEBRATES

A miner bee *Andrena arenicola*	**Global Status: GNR; State Status: NR.** Rare miner bee that is associated with willow trees and wetlands. It is active only in the early-spring (March/April) and has been documented in Atoka, Cleveland, and Canadian counties.		•		•			•	
Leonora's Dancer *Argia leonorae*	**Global Status: G3 ; State Status: S5.** Endemic to the southern Great Plains. Small damselfly found around seasonal wetlands and sandy-bottom streams. Most of the known populations occur in Texas, but its range extends into the southwestern part of the state in Comanche, Jackson and Kiowa counties.		•					•	
American Bumble Bee *Bombus pensylvanicus*	**Global Status: G3; State Status: S5.** Large, common and widespread bumble bee found in oak woodlands and forest edges statewide. Appears to be in decline in the northern parts of its range outside of Oklahoma.	•	•	•	•	•	•	•	
Swamp Metalmark *Calephelis muticum*	**Global Status: G3; State Status: S1.** Rare butterfly with few Oklahoma records, all in Ottawa County on wetlands associated with the Neosho River system. Swamp thistle (*Cirsium muticum*) is the primary larval foodplant, but species will also use tall thistle (*Cirsium altissimum*).					•		•	

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat	
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Herbaceous Wetland	Seeps and Vernal Pools
Ouachita Spiketail *Cordulegaster talaria*	**Global Status: G1; State Status: S1.** Endemic to the Ouachita Mountains. Extremely rare dragonfly that is believed to breed in seep runs. Only three known sites from Oklahoma, all in McCurtain County in southeastern corner of the state.						•		•
Monarch *Danaus plexippus*	**Global Status: G4; State Status: NR.** Widespread, migratory butterfly that occupies a wide range of habitats including open woodlands, shrublands, herbaceous wetlands, and prairies. Monarchs are uncommon in Oklahoma during the spring and summer, but large numbers migrate through the state in the fall. Uses several milkweeds as larval host plants, and especially green antelopehorn (*Asclepias viridis*).		•	•	•	•	•	•	
Oregon Fairy Shrimp *Eubranchipus oregonus*	**Global Status: G3; State Status: S4.** Uncommon and locally occurring in well vegetated, herbaceous wetlands. Its distribution is poorly documented.				•			•	
an isopod *Lirceus trilobus*	**Global Status: NR; State Status: S1.** Freshwater isopod species described from a single site in Mayes County in 1940. Found in "woodland pools." No other localities are known.					•			•
MAMMALS									
Southeastern Myotis *Myotis austroriparius*	**Global Status: G4; State Status: S1.** Rare and limited to the Little River watershed. Uses streams and small rivers for foraging habitat.						•	•	
Northern Long-eared Myotis *Myotis septentrionalis*	**Global Status: G2; State Status: S2.** Federally listed as endangered. Rare but widespread throughout the Ouachita Mountains and the Ozarks. Tree roosting bat that uses riparian and bottomland habitats for foraging and roosting.					•	•	•	
Texas Marsh Rice Rat *Oryzomys texensis*	**Global Status: GNR; State Status: S3.** Uncommon and known from scattered records throughout the eastern half of the state. Semiaquatic species that prefers marsh and wetland habitats that offer grasses and sedges.				•		•	•	
REPTILES									
American Alligator *Alligator mississippiensis*	**Global Status: G5; State Status: S4.** Rare but seen with increasing frequency in wetlands of the West Gulf Coastal Plain and the lower reaches of the Little, Kiamichi, and Boggy rivers.						•	•	
Smooth Softshell *Apalone mutica*	**Global Status: G5; State Status: S5.** Common in the Arkansas, Cimarron, Canadian, and Red rivers throughout Oklahoma. Prefers large rivers and streams, and also found in lakes, impoundments, and shallow bogs. Usually found in water with sandy or mud bottom and few aquatic plants.		•	•	•		•	•	
Spiny Softshell *Apalone spinifera*	**Global Status: G5; State Status: S5.** Common and widespread in all large rivers in Oklahoma. Preferred habitat includes large rivers, river impoundments, lakes, ponds along rivers, pools along intermittent streams, bayous, and oxbows. Usually present in waters with open sandy or mud banks and soft bottom.	•	•	•	•	•	•	•	

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat	
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Herbaceous Wetland	Seeps and Vernal Pools
Chicken Turtle *Deirochelys reticularia*	**Global Status: G5; State Status: S2.** Uncommon, semi-aquatic turtle that occurs very locally in the Gulf Coastal Plain and along the Red River valley in southeastern Oklahoma. Typically occurs in forested landscapes with multiple sloughs, ponds, and forested wetlands in close proximity.				•		•	•	
Red-bellied Mudsnake *Farancia abacura*	**Global Status: G5; State Status: S1.** Rare aquatic snake found in sloughs and forested wetlands in the Gulf Coastal Plain in southeastern Oklahoma.						•	•	
Glossy Swampsnake *Liodytes rigida*	**Global Status: G5; State Status: S1.** Uncommon aquatic snake of wetlands, sloughs, and swamps in the Gulf Coastal Plain and Kiamichi River valley.						•	•	
Western Alligator Snapping Turtle *Macrochelys temminckii*	**Global Status: G3; State Status: S2.** Federally proposed for listing as threatened. Uncommon and occurs at low densities, but distributed along most major streams and rivers, along with their associated floodplain wetlands, in the eastern one-third of the state.					•	•	•	
Ornate Box Turtle *Terrapene ornata*	**Global Status: G4; State Status: NR.** Widespread throughout the state, with the exception of the southeast. Found in all shrubland and prairie habitat types in the state. Often visits associated wetlands to forage and seek thermal refugia.	•	•	•	•	•	•	•	
Three-toed Box Turtle *Terrapene triunguis*	**Global Status: G5; State Status: NR.** Common box turtle of deciduous forests. Found across the eastern half of Oklahoma in all forest types except for extremely rocky upland sites with shallow soils. Often visits associated wetlands to forage and seek thermal refugia.		•	•	•	•	•	•	•
Terrestrial Gartersnake *Thamnophis elegans*	**Global Status: G5; State Status: S1.** Possibly extirpated from the state. Would only be found in western end of the panhandle.	•						•	

Wetlands Conservation Issues and Actions

Five overarching conservation issues have been identified for wetland habitats in Oklahoma: current and historic land use, natural system management and modification, information gaps, invasive and problematic species, and pollution.

Long-billed dowitchers at Hackberry Flat Wildlife Management Area. Photo by ODWC.

Conservation Issue: Habitat Loss and Fragmentation

Draining and filling of wetlands for cropland development has permanently eliminated some herbaceous wetlands. Conversely, 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 and reduces their value to species that depend upon shallow water or mud flats. Furthermore, 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 like saltcedar (*Tamarix sp.*). Heavy grazing by cattle may also remove plant cover for wildlife, reduce the abundance of some wetland plants, and lower overall plant diversity. Where plowed or cropped, perennial vegetation is reduced, altering the plant community composition and structure toward one that is dominated by annuals. Additionally, riparian and aquatic vegetation has been mechanically cleared around some seeps and grazed or browsed by livestock around others. Loss or degradation of vegetation surrounding seeps and vernal pools increases their susceptibility to siltation and changes in water temperature. Irrigation practices that lower shallow water tables may affect the hydrology of wetlands that are sustained through seeps, springs and other groundwater inputs. Additionally, man-made ponds and lakes have been constructed over herbaceous wetlands, seeps and vernal pools, inundating them with deeper water, and altering their normal habitat structure.

Conservation Actions

- Fund management-oriented research to determine effective wetland management protocols that will enhance or maintain habitat value for SGCN.
- Develop a monitoring program to measure the effectiveness of efforts to protect or restore herbaceous wetlands, seeps and vernal pools on populations of SGCN.
- Identify wetland habitats of high conservation value that could serve as focal areas for herbaceous wetland, seep and vernal pool management.
- Develop a regional Conservation Reserve Enhancement Program project for herbaceous wetlands, seeps, and vernal pools.
- Encourage landowners to enroll wetlands in the conservation programs.
  - » 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.
- Recognize landowners and businesses that practice good land, water, and wildlife stewardship through recognition and certification programs.
- Acquire conservation easements or fee-title from willing sellers to place herbaceous wetlands, seeps and vernal pools that support SGCN into conservation ownership.
- Develop financial or tax incentives to cover the cost of maintenance and conservation of herbaceous wetlands, seeps and vernal pools.
- Develop a program to provide landowners with financial incentives to protect herbaceous wetlands, seeps, and vernal pools.
- Provide cost-share funding or financial incentives to offset the costs of establishing vegetated buffers around wetlands and playa basins in agricultural fields.
- Provide cost-share funding or grants to landowners to restore the structure of herbaceous wetlands, seeps,

vernal pools and the riparian vegetation around them.
  - » These actions can include removal of pipes, concrete, low dams, or fencing of wetlands to limit access by livestock.
- Continue to distribute information about ecological value of playas, herbaceous wetlands, seeps and vernal pools, as well as their importance for groundwater recharge. Include best management practices for use, the biological diversity, and interconnection of herbaceous wetlands, seeps, springs, groundwater, and surface streams.
  - » For example, the Playa Lakes Joint Venture has developed helpful written, web-based, and radio resources.

Conservation Issue: Modification of Natural Ecosystem Processes

Several issues may alter the flow and inundation patterns of herbaceous wetlands, seeps and vernal pools. Excessive local groundwater withdrawal from shallow aquifers for municipal and agricultural purposes may lower the water table, thus reducing the flow volume of associated herbaceous wetlands and seeps. Surface water withdrawal, such as the draining or filling of wetlands, has completely eliminated some herbaceous wetlands and vernal pools from the landscape. These modifications can reduce the frequency or duration that wetlands hold water or maintain saturated soil, which can alter vegetation structure and the suitability of wetland communities for wildlife. The reduction in frequency and magnitude of periodic flooding has resulted in the loss or degradation of wetlands which can greatly impact amphibian and invertebrate populations. Furthermore, fire suppression and the loss of natural fire regimes in floodplains and riparian corridors has facilitated the encroachment of wetland habitats by undesirable, invasive non-native plant species including saltcedars, giant reed (*Arundo donax*) and Ravenna grass (*Saccharum ravennae*), by aggressive native plants that can dominate wetlands such as broadleaf cattail.

Some wetlands are dredged or deepened to create ponds to hold irrigation water, store water for cattle or for recreational fishing. This results in a loss of 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 invertebrate populations. Roads, berms, and terraces sometimes divert water away from wetland basins and reduce the magnitude or duration of seasonal inundation. Additionally, the installation of pipes or construction of low concrete dams to create pools for recreational uses or livestock has physically modified springs. The modification of these springs and streams can successionally alter smaller, fragile, interconnected habitats such as seeps which are easily influenced by activities around them. 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. Farming practices may fail to provide buffer vegetation around wetlands to control sediment in storm water runoff. These basins become repositories for sediment that eventually fills them and eliminates their potential for periodic or seasonal flooding.

Conservation Actions

- Asses the distribution and condition of herbaceous wetlands, seeps and vernal pools that support populations of SGCN, identify wetland complexes and systems of high quality or biological diversity, determine the current water quality and quantity, and evaluate existing or potential sources of degradation.
- Conduct hydrological studies to delineate the recharge area surrounding biologically important wetlands and seeps to determine the surface acreage that needs the attention of conservation programs.
- Develop monitoring programs for populations of SGCN, water quality, and water quantity to assess the effectiveness of groundwater and surface water conservation programs.
- Where feasible, involve private 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

Lake Evans Chambers in Beaver County, Oklahoma. Photo by ODWC.

Biologists replaced flashboard risers at Hackberry Flat Wildlife Management Area. Photo by Cheyenne Gonzales/ODWC.

monitoring programs to the appropriate regulatory or landowner assistance agencies, including the Oklahoma Water Resources Board, Oklahoma Department of Environmental Quality, Oklahoma Conservation Commission, local Conservation District, and Natural Resources Conservation Service.

- Develop, publish, and distribute best management practices and conservation recommendations for landowners to implement in order to protect groundwater and surface water quality and quantity around herbaceous wetlands, seeps, and vernal pools.
- Provide information to landowners and the public regarding the ecological values of wetlands, especially seasonal wetlands. This could include producing education and outreach materials about swamp buster laws and practices.
- Conduct management pilot studies to determine the most successful habitat management strategies in enhancing and maintaining populations of species of conservation need in wetland communities.
- Develop demonstration areas to show landowners the practices that can reduce soil erosion and halt the movement of sediment into wetland basins.
- Acquire former wetlands and vernal pools and restore them through a combination of dredging, diking, and revegetation.
- Remove berms and terraces that block the movement of surface water into wetland basins and diminish their seasonal hydrology.
- Repair semi-impervious substrates under wetlands that have been breached or broken and reduce the wetland's ability to hold water.
- Construct fences around herbaceous wetlands, seeps, and vernal pools and provide alternative water sources for livestock, including solar pumps or windmills with stock tanks, to exclude livestock and feral hogs.
- 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 wetlands, seeps, and vernal pools in conservation programs.
- Use land acquisition and conservation easement programs to place some herbaceous wetlands under conservation ownership or stewardship.
- 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.
- Continue providing 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.
- Promote the cost-share programs that help landowners conserve groundwater quantity within the recharge areas of biologically important seeps and remove financial assistance programs that encourage groundwater withdrawal.
- Continue to support the efforts of the waterfowl joint ventures, wildlife agencies, and the Natural Resources Conservation Service to develop comprehensive wetland and waterbird conservation plans.

Conservation Issue: Information Gaps

Existing data are incomplete regarding the current distributions, ecological needs, and population trends for SGCN that depend on herbaceous wetlands, seeps and vernal pools. These deficiencies create an impediment to the development and implementation of effective conservation actions and strategies. Additionally, baseline information about the historic and current distribution, structural condition, and community composition of herbaceous wetlands, seeps, and vernal pools is incomplete. Because these wetlands are often small, locally occurring habitats found primarily on private property, they are difficult to locate and monitor and are frequently overlooked in landscape planning. As a result, knowledge of their geographic locations and biological compositions is incompletely known.

Conservation Actions

Researchers from the University of Arkansas used baited traps to capture and study chicken turtles at Red Slough Wildlife Management Area. Photo by ODWC.

- Continue reviews of existing literature, reports, and museum records and interview technical experts to compile historic and current distributional, abundance, and ecological needs for herbaceous wetland, seep and vernal pool-dependent SGCN.
- Conduct field surveys to locate, inventory, and assess the current condition of wetlands, seeps and vernal pools.
  - » Map all wetland locations and conduct biological inventories to determine plant community composition.
- Conduct surveys and research to assess the current distributions, abundances, and habitat affinities for wetland-dependent SGCN.
  - » 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 these species.
  - » Then, 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 SGCN and examine the possible causes of any suspected population declines.
- Research the historic conditions of different wetland communities 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.
- Develop management recommendations to enhance populations of SGCN through improved habitat conditions or enhanced juvenile recruitment.
- Develop population and habitat monitoring programs for representative SGCN.
- Continue to maintain databases to store and analyze distributional and ecological data, track the locations of herbaceous wetlands, seeps and vernal pools, their biological communities, and water quality.
  - » Develop a database of specific to wetlands and associated ecological data for SGCN.
  - » Data should remain confidential to protect sensitive species and the privacy of landowners.
- Make the results of all ecological studies available to agencies and organizations that can use them to inform local and regional planning efforts including future revisions of the Oklahoma State Wildlife Action Plan.
- Synthesize existing and new literature to produce informational reports for landowners and conservation agency staff regarding the ecology of wetlands and their associated wildlife by wetland type.
- Update the National Wetlands Inventory data and enumerate losses and gains of wetlands.
- Inventory the mapped herbaceous wetlands 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.

Conservation Issue: Invasive and Problematic Species

Invasive and non-native plant species such as barnyard grass (*Echinochloa crus-galli*), Nepalese browntop (*Microstegium vimineum*), giant reed, curly dock (*Rumex crispus*), Chinese privet (*Ligustrum sinense*), tall fescue (*Schedonorous arundinaceus*), kudzu (*Pueraria montana*), Japanese honeysuckle (*Lonicera japonica*), parrot feather (*Myriophyllum aquaticum*), alligator weed (*Alternanthera philoxeroides*), and hydrilla (*Hydrilla verticillata*), that become established in wetlands and riparian forests will over-grow, out-compete or displace native vegetation. These species often dominate local communities where they alter the physical structure and overall plant diversity of the habitat. This expansion creates local monocultures, reduces the quality of shallow-water habitats, and reduces the overall value of wetlands as wildlife habitat. Non-native plant species often provide poorer food resources for wildlife and may become invasive. When shallow or seasonal wetlands are deepened to hold water for longer periods of time, the vegetation community can shift from one that is dominated by sedges, rushes, and arrowheads to one that is dominated by cattails. Unfortunately, the promotion of non-

native plants for erosion control, livestock forage, beautification programs, and wildlife habitat continues to be an ongoing practice. Additionally, feral hogs that forage and wallow in herbaceous wetlands, seeps and vernal pools damage riparian and wetland vegetation, increase erosion, and reduce water quality. Feral hogs cause substantial ecological damage to wetland communities and compete with native wildlife for food.

Nutria. Photo by Rolf Dietrich Brechner/CC BY-SA 2.0.

Conservation Actions

- Evaluate the severity and magnitude of the ecological damage done by non-native plant and animal species to identify the non-native species causing the greatest impact to the landscape and wetland-dependent SGCN.
- Develop proactive management strategies to detect and monitor invasive species when they first enter a habitat and before becoming established.
  - » Early detection and surveillance is one of the most effective strategies and often yields higher success in eradicating invasive species.
- Conduct studies that quantify the impact of non-native species on wetland, riparian forest, aquatic plant and animal communities.
- Remove non-native wetland plants and restore native plant communities using management or eradication strategies that have been researched and demonstrated to be effective and environmentally safe.
- Develop invasive and non-native species management plans to control and reduce their abundances and distributions.
  - » Encourage the implementation of these plants on all public lands that support wetlands.
- Monitor the response of native wetland vegetation and wildlife populations to the control practices that are implemented for invasive and non-native species.
- Improve coordination between wildlife biologists, conservation agencies, and agricultural organizations in order to share information and educational materials about the negative impacts of using non-native plants and to stop the encouragement and recommendation of planting invasive and non-native species.
- Work with the Oklahoma Invasive Plant Council and OSU Extension Service to develop and promote educational materials that help landowners and sportsmen identify and report potentially problematic species.
  - » Encourage landowners and anglers to be vigilant and report introductions of non-native wetland plants.
- Increase funding for the implementation of the Oklahoma Aquatic Nuisance Species Management Plan and update the plan to incorporate riparian species.
- Provide cost-share funding to landowners to encourage the removal and control of non-native wetland plants and the restoration of native wetland plant communities.

Conservation Issue: Pollution and Sedimentation

Pesticides, sediment, endocrine disruptors, and elevated concentrations of nutrients can be carried into wetlands systems via stormwater 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. Additionally, the removal of buffer vegetation around wetlands increases their exposure to the 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 many taxa that rely on wetlands including invertebrates, fish and amphibians. In areas with coarse, rocky or sandy soils, surface water enters the water table with very little filtration, easily carrying pesticides, fertilizers, animal wastes, and other water-soluble chemicals into the groundwater. These contaminants can then resurface at seeps and some herbaceous wetlands, negatively impacting aquatic and riparian communities.

Wetlands that are located near feedlots, dairy and pig farms, and chicken houses are at risk of contamination by the collection of excessive nutrient deposits from these operations via stormwater runoff. Increased nutrient inputs due to crop or pasture fertilizers and land application of animal waste result in increased algal and bacterial growth and can reduce water quality and dissolved oxygen. Grazing by cattle and feral hog activity around wetlands communities can alter the structure and diversity of wetland vegetation. Additionally, water quality of herbaceous wetlands, seeps and vernal pools may be affected by cattle and feral hogs watering in and grazing around these

habitats through increased siltation and nutrient input.

Conservation Actions

- Review and update best management practices for controlling nutrients and sediment around wetlands.
- 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 like cultivation, land application of animal waste, concentrated animal operations, and irrigation-dependent crop production, in the immediate watershed of wetlands.

King rail at Red Slough Wildlife Management Area. Photo by ODWC.

- Establish set-back distances around wetlands for "soil farming" of oil and 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 stormwater 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 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.

Potential Indicators for Monitoring the Effectiveness of Conservation Actions

- Number of acres or number of wetlands, seeps and vernal pools enrolled conservation programs
- Number of easements or cooperative agreements obtained to conserve seeps and vernal pools that support SGCN
- Population sizes and trends for representative SGCN
- Acreage of wetlands, seeps, and vernal pools that are fenced or burned
- Change in the acreage that is annually irrigated
- Change in acreages occupied by saltcedars in floodplain 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.
- Geospatial information system evaluation of the distribution and dispersion of wetlands, seeps, and vernal pools
- Aerial surveys that track the number of wetlands with vegetative buffers and number of restored to seasonal inundation and perennial vegetation
- Changes in both the shallow water table and deep aquifers in the region
- Changes in the number of wetlands, total acres of wetlands and average size of wetlands
- Number of farmed or drained wetlands that are restored
- Acreage and distribution of wetlands
- Changes in water quality parameters like nutrient and sediment loads
- Groundwater level around biologically important wetlands
- 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
- Number of herbaceous wetlands and vernal pools restored
- Number of herbaceous wetlands, seeps, and vernal pools for which biological surveys have been conducted
- Number of herbaceous wetlands, seeps, and vernal pools regularly monitored, including biological monitoring, flow monitoring, water quality monitoring
- Changes in population sizes and trends of representative SGCN that serve as indicators for the quality of seeps and vernal pools
- Changes in the relative condition of riparian vegetation surrounding herbaceous wetlands and seeps, including plant diversity or plant abundance
- Number of acres affected by non-native or invasive species
- Acres of native riparian habitat surrounding herbaceous

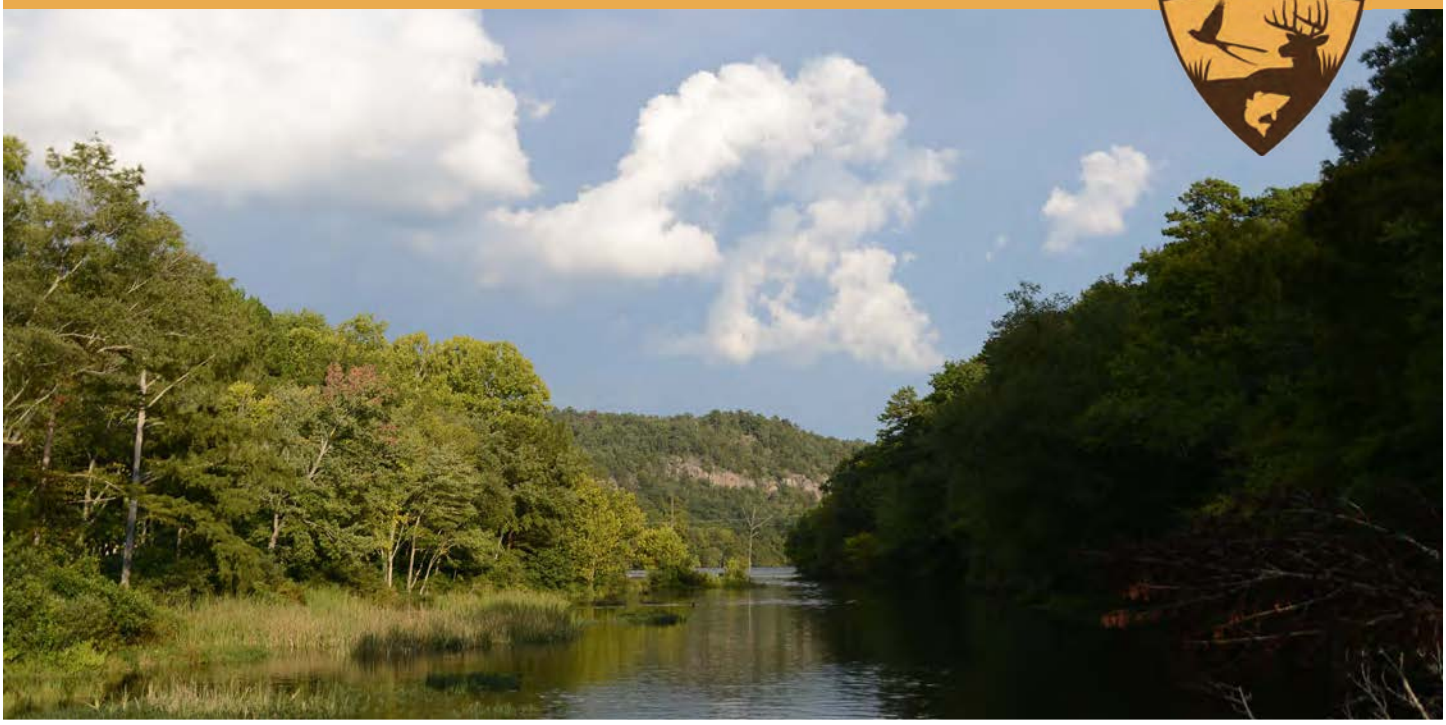
wetlands, seeps, and vernal pools
- Changes in discharge flow in associated seeps and wetlands

Representative Conservation Areas Supporting Wetlands

Hackberry Flat Wildlife Management Area. Photo by Darrin Hill/ODWC.

- Boehler Seeps and Sandhills Preserve (The Nature Conservancy)
- Canton Wildlife Management Area (ODWC and ACOE)
- Chouteau Wildlife Management Area (ODWC and ACOE)
- Copan Reservoir and Wildlife Management Area (ODWC and ACOE)
- Deep Fork National Wildlife Refuge (USFWS)
- Deep Fork Wildlife Management Area (ODWC)
- Drummond Flats Wildlife Management Area (ODWC)
- Ellis County Wildlife Management Area (ODWC)
- Eufaula Reservoir and Wildlife Management Area (ODWC and ACOE)
- Fort Gibson Reservoir and Wildlife Management Area (ODWC and ACOE)
- Gate Playas (City of Gate)
- Grassy Slough Wildlife Management Area (ODWC)
- Hackberry Flat Wildlife Management Area (ODWC)
- Hulah Reservoir and Wildlife Management Area (ODWC and ACOE)
- Kaw Reservoir and Wildlife Management Area (ODWC and ACOE)
- Keystone Reservoir and Wildlife Management Area (ODWC and ACOE)
- Little River National Wildlife Refuge (USFWS)
- Lunceford Playa (ODWC)
- Mountain Park Wildlife Management Area (ODWC and U.S. Bureau of Reclamation)
- Okmulgee Wildlife Management Area (ODWC)
- Oologah Reservoir and Wildlife Management Area (ODWC and ACOE)
- Optima Wildlife Management Area and National Wildlife Refuge (ODWC, USFWS, ACOE)
- Red Slough Wildlife Management Area (U.S. Forest Service)
- Salt Plains National Wildlife Refuge (USFWS.
- Sequoyah National Wildlife Refuge (USFWS)
- Tishomingo National Wildlife Refuge (USFWS)
- Vann's Lake and Marsh (ODWC and ACOE)
- Washita National Wildlife Refuge (USFWS)
- Waurika Wildlife Management Area (ODWC and ACOE)
- Whitegrass Flats Wildlife Management Area (ODWC)
- Wichita Mountains Wildlife Refuge (USFWS)
- Wister Reservoir and Wildlife Management Area (ODWC and ACOE)

Small Rivers and Streams

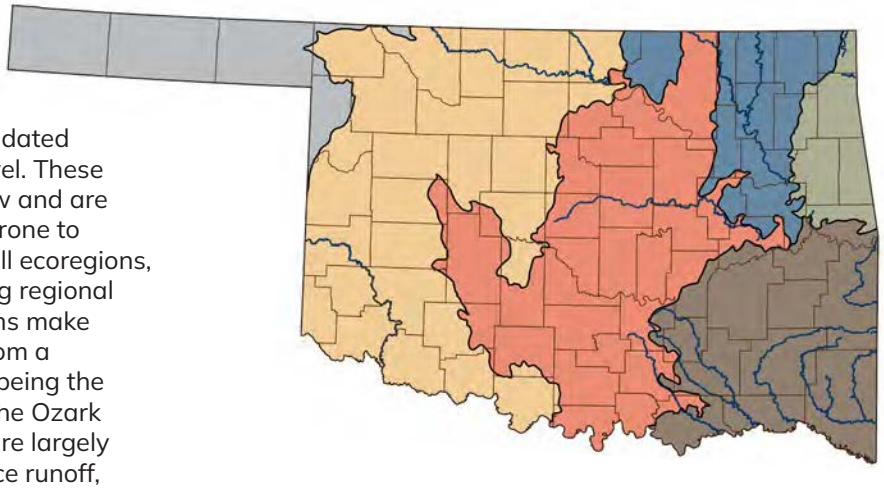


Lower Mountain Fork River. Photo by Brandon Brown/ODWC.

Soft-bottom Streams and Small Rivers

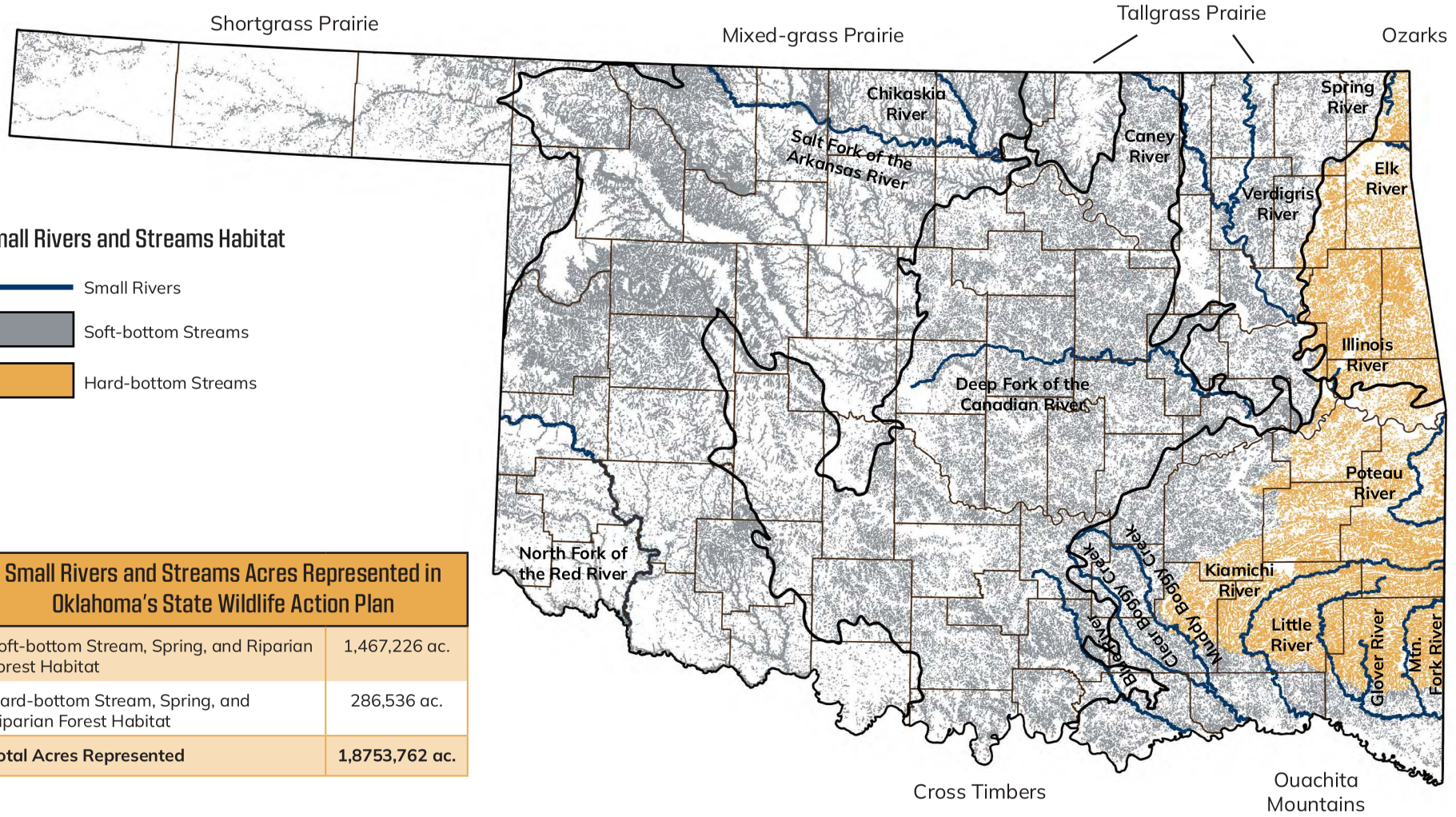
Soft-bottom stream habitats in Oklahoma are freshwater systems characterized by substrates composed primarily of unconsolidated materials such as sand, silt, clay, and fine gravel. These streams typically exhibit slow to moderate flow and are often meandering, with sediment-rich banks prone to seasonal flooding and erosion. Found across all ecoregions, these habitats play a crucial role in maintaining regional biological diversity. Soft-bottom stream systems make up the majority of the systems in Oklahoma from a geographical perspective with the exceptions being the Arbuckle uplift, the Ouachita Mountains, and the Ozark Plateau. Hydrologically, soft-bottom streams are largely influenced by precipitation patterns and surface runoff, with flow regimes that can vary from perennial in wetter, eastern areas to intermittent or ephemeral in drier, western regions. These systems play a vital ecological role by filtering pollutants, recharging groundwater, and providing flood control. Many prairie stream fish rely on seasonal flood pulses to complete reproductive cycles and benefit from large floodplain habitats.

Riparian areas along these streams commonly include flood-tolerant tree species such as black willow (*Salix nigra*), American elm (*Ulmus americana*), eastern cottonwood (*Populus deltoides*), sandbar willow (*Salix exigua*), roughleaf dogwood (*Cornus drummondii*), sugarberry (*Celtis laevigata*), green ash (*Fraxinus pennsylvanica*),



Small Rivers and Streams occur in all Oklahoma ecoregions.

western soapberry (*Sapindus drummondii*), buttonbush (*Cephalanthus occidentalis*), and sand plum (*Prunus angustifolia*), which help stabilize banks and contribute organic matter to aquatic food webs. In eastern Oklahoma, the riparian communities of soft-bottom streams are more diverse and include silver maple (*Acer saccharinum*), boxelder (*Acer negundo*), river birch (*Betula nigra*), and American sycamore (*Platanus occidentalis*). Many stream channels are lined with semi-aquatic vegetation such as cattails (*Typha angustifolia*), three-square bulrush (*Schoenoplectus pungens*), and spikerushes (*Eleocharis sp.*). Some of the herbaceous plants found along these systems include switchgrass (*Panicum virgatum*), sweetscent



Small Rivers and Streams Habitat

- Small Rivers
- Soft-bottom Streams
- Hard-bottom Streams

Small Rivers and Streams Acres Represented in Oklahoma's State Wildlife Action Plan	
Soft-bottom Stream, Spring, and Riparian Forest Habitat	1,467,226 ac.
Hard-bottom Stream, Spring, and Riparian Forest Habitat	286,536 ac.
Total Acres Represented	**1,8753,762 ac.**

**Spring Habitat is not represented on this map.*

Black Mesa. Photo by Stephen Ofsthun.

(*Pluchea odorata*), and germander (*Teucrium canadense*). Plant Species of Conservation Need found along and in the riparian zones of soft-bottom streams and rivers in Oklahoma include Kansas arrowhead (*Sagittaria ambigua*) and panicled indigobush (*Amorpha paniculata*).

Recognized Soft-bottom Stream and Riparian Habitat Vegetation Associations

- American/Red Elm — Chinquapin Oak Temporarily Flooded Forest
- American/Red Elm — Sugarberry/Hackberry — Green Ash Temporarily Flooded Forest
- Boxelder Temporarily Flooded Forest
- Buttonbush Semi-permanently Flooded Shrubland
- 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 Temporarily Flooded Forest
- Sandbar Willow/Switchgrass Temporarily Flooded Shrubland
- Silver Maple — Boxelder Temporarily Flooded Forest
- Smooth Alder — False Indigo Temporarily Flooded Shrubland
- Swamp Privet — Buttonbush Semi-permanently Flooded Shrubland
- Sycamore — Boxelder Temporarily Flooded Forest

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Nine small rivers could be characterized as soft-bottom rivers:

Salt Fork of the Arkansas River, North Fork of the Red River, and the Chikaskia River

The Salt Fork of the Arkansas River is a major tributary of the Arkansas River that flows through north-central and northwestern Oklahoma. Originating in southern Kansas, it enters Oklahoma near the town of Cherokee and winds southeastward before joining the Arkansas River near Ponca City. The river gets its name from the naturally occurring salt plains and salt springs found along its watershed. The North Fork of the Red River is a prominent tributary of the Red River that flows through southwestern Oklahoma. Originating in eastern New Mexico, it travels eastward across the Texas Panhandle and enters Oklahoma near the town of Hollis. It continues through

Salt Fork of the Arkansas River. Photo by Keith Flowers.

Joseph H. Williams Tallgrass Prairie Preserve. Photo by ODWC.

Greer and Kiowa counties before joining the main stem of the Red River near the town of Altus. The Chikaskia River is a relatively small but ecologically important river that flows through northern Oklahoma and southern Kansas. It originates in south-central Kansas and enters Oklahoma in Grant County, continuing southeastward until it joins the Salt Fork of the Arkansas River near Tonkawa. These rivers have been altered by historic channelization projects that have increased channel incision and increased sediment loads because of soil erosion within their watersheds. Additionally, their hydrological attributes have been altered through the loss of flood plain wetlands and the construction of impoundments on tributaries which has resulted in habitat conditions that are considered poor within these rivers.

Caney and Verdigris Rivers

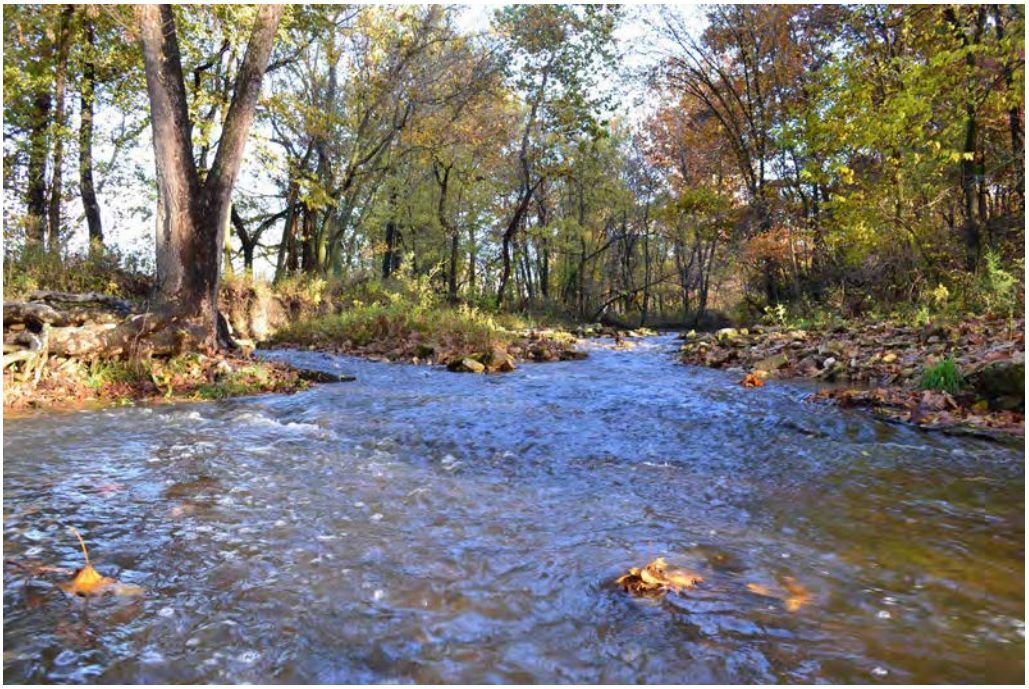
Both rivers originate in Kansas and flow into Oklahoma. The Caney River flows through a small portion of the Cross Timbers Ecoregion as well as the Flint Hills Section of Oklahoma's Tallgrass Prairie Ecoregion before its confluence with the Verdigris River in the western edge of the Osage Plains Section. 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 historically forested. The flood regimes and flow patterns of both rivers have been modified by the construction of Hulah and Oologah reservoirs on each main stem, 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 a series of locks and low dams and the dredging or deepening of the river's channel.

Blue, Clear Boggy, Muddy Boggy, and Deep Fork 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 and Deep Fork rivers, which are slow-moving rivers with silty to sandy substrates that meander across relatively broad floodplains. The water quality, flow conditions, and aquatic species compositions of these rivers are variable, and some species are restricted to specific rivers or river systems. Each of these is a relatively low-gradient river that meanders through a broad, predominately forested floodplain. The current condition of these small rivers is poorly understood. Water quality is generally stable, 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.

Blue River Public Fishing and Hunting Area. Photo by ODWC.

Hard-bottom Streams and Small Rivers



Flint Branch. Photo by ODWC.

Hard-bottom stream habitats in Oklahoma are defined by substrates composed primarily of bedrock, cobble, gravel, and large boulders, offering a more stable and erosion-resistant foundation compared to soft-bottom streams. These streams are found predominantly in the Ozark Plateau, Ouachita Mountains, and the Arbuckle Mountains, where underlying geology provides rugged terrain and well-defined channels. Hydrologically, these systems are typically spring-fed or sustained by consistent base flow from groundwater sources, resulting in perennial flow regimes with clear, cool, and well-oxygenated water. Seasonal variations in flow still occur, with higher discharge during spring rains and reduced levels during late summer or drought, though base flows often persist due to subsurface water input.

The surrounding vegetation in hard-bottom stream corridors often includes a rich assemblage of upland and riparian plant species. Riparian zones are lined with trees such as American sycamore, river birch (*Betula nigra*), and chinquapin oak (*Quercus muehlenbergii*), while understory plants include switchgrass, rushes (*Juncus spp.*), and sedges (*Carex spp.*). These plant communities help stabilize streambanks, provide shading that regulates water temperatures, and contribute to the overall ecological function of the stream ecosystem. Hard-bottom streams typically have a basic physical complexity of riffles, runs, and pool habitats that support diverse aquatic life, including many sensitive invertebrates and stream fish species adapted to clear, fast-moving water. Several Plant Species of Conservation Need occur within the riparian zones of hard-bottom streams and rivers including seaside alder (*Alnus maritima*), smooth indigobush (*Amorpha laevigata*), Hubricht's bluestar (*Amsonia hubrichtii*), rivergrass (*Calamovilfa arcuata*), narrowleaf ironweed (*Vernonia lettermannii*), and the federally endangered harperella (*Ptilimnium nodosum*).

Recognized Hard-bottom Stream and Riparian Habitat Vegetation Associations

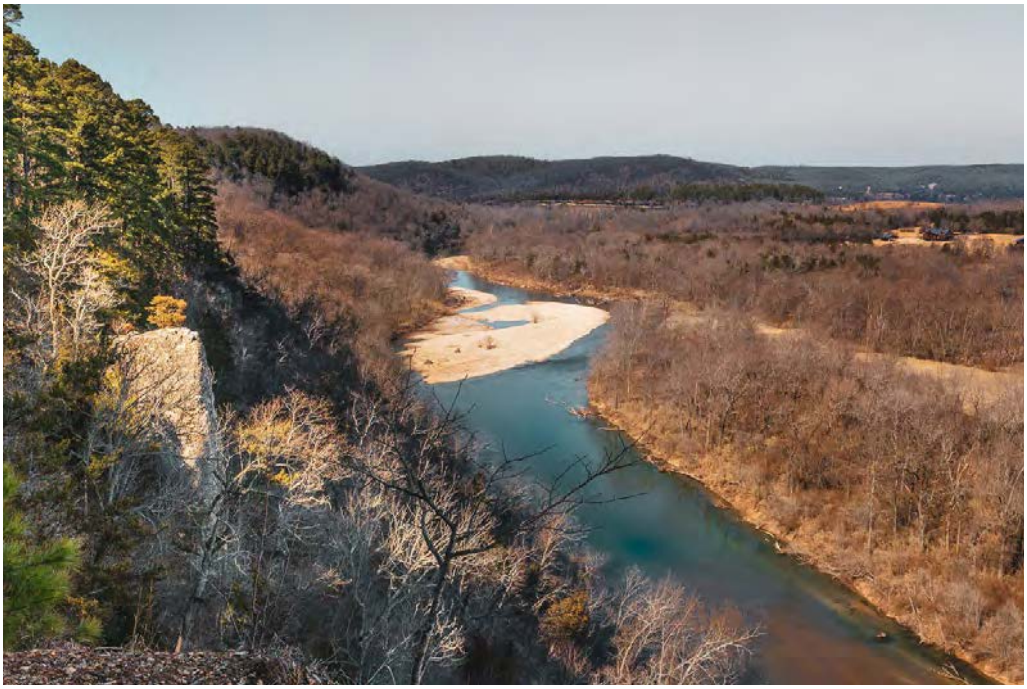
- American/Red Elm — Sugarberry/Hackberry — Green Ash Temporarily Flooded Forest
- American/Red Elm — Chinquapin Oak Temporarily Flooded Forest
- Eastern Cottonwood — American Elm — Sugarberry Temporarily Flooded Forest
- Green Ash — American Elm Temporarily Flooded Forest
- Green Hawthorn — Cockspur Hawthorn — Downy Hawthorn Temporarily Flooded Shrubland
- River Birch — Sycamore – Smooth Alder Temporarily Flooded Forest
- Seaside Alder — False Indigo Temporarily Flooded Shrubland
- Silver Maple — Boxelder Temporarily Flooded Forest
- Swamp Privet — Buttonbush Semi-permanently Flooded
- Shrubland Sycamore — Boxelder Temporarily Flooded Forest
- Smooth Alder — False Indigo Temporarily Flooded Shrubland
- Spring Witch-Hazel — Silky Dogwood Temporarily Flooded Shrubland
- Sycamore — Boxelder Temporarily Flooded Forest

All plant associations are based on "The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning," (Hoagland 2000).

Seven small rivers could be characterized as hard-bottom rivers:

Spring, Elk, and Illinois Rivers

Each of these rivers is found in the Ozarks and each is a tributary of the Neosho-Grand River system. The lower portions of each river have been affected by impoundments which have reduced their effective lengths. The Spring River flows for 20 miles into Oklahoma before meeting with the Neosho River at Grand Lake O' the Cherokees. The Elk River is the shortest of the three and flows three miles into the state from its origin in Missouri before being impounded by Grand Lake O' the Cherokees. The Illinois River has been impounded by Tenkiller Reservoir, which has reduced its length to approximately 60 miles of flowing water. Both the Spring and the Illinois rivers are clear, swift-flowing rivers with gravel to cobble substrates over limestone bedrock.



Illinois River at Sparrowhawk Wildlife Management Area. Photo by Sarah Southerland/ ODWC.

These small rivers contain some gravel bars and sloughs but not the dynamic mosaic of sandbars, mudflats, and sloughs typical of undisturbed hard-bottom streams. Sloughs along these rivers are typically rocky and surrounded by woody vegetation including river birch, American sycamore, and red maple (*Acer rubrum*).

Poteau, Glover, Mountain Fork, Little, and Kiamichi Rivers

Each river originates in the Ouachita Mountains, but the Poteau River flows north into the Arkansas River while the Glover, Mountain Fork, Little, and the Kiamichi rivers flow south to eventually enter the Red River. The Glover, Mountain Fork, and Little rivers collectively comprise the Little River System. The rivers in this system are similar in structure and share many of the same aquatic species, some of which are endemic to the Ouachita Mountains. 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, slow moving, and meander over a sandy substrate in broad, forested floodplains. Most sloughs along these rivers are dominated by woody vegetation including river birch, American sycamore, water oak (*Quercus nigra*), and red maple.

Springs

Springs and seeps in Oklahoma are unique and localized habitats where groundwater naturally emerges at the surface, and these often form or contribute to the headwaters of streams. These habitats occur across a variety of ecoregions, with notable concentrations in the Ozark Plateau, Arbuckle Mountains, and the western High Plains. Springs are typically characterized by perennial flow and cool, clear water with relatively stable temperatures. Substrates in these habitats often include gravel, sand, or exposed bedrock, depending on the geology of the area, with calcareous or mineral-rich soils common in limestone regions. The steady hydrology and groundwater influence create microhabitats that are biologically rich and climatically buffered, making them refugia for rare and endemic species.

The vegetation communities in and around springs are distinct and include hydrophytic and moisture-loving species not found in surrounding upland areas. The herbaceous components of these unique areas include sedge species (*Carex spp.*), rushes (*Juncus spp.*) three-square bulrush (*Schoenoplectus pungens*), spikerushes (*Eleocharis spp.*), cattails (*Typha spp.*), southern maidenhair fern (*Adiantum capillus-veneris*), and watercress (*Nasturtium officinale*), with the latter often found directly in spring-fed channels. Mosses and liverworts may carpet the wet soils and rocks,

Mountain Fork River. Photo by Chad Freeny.

taking advantage of the constant moisture. In forested areas, overstory trees such as red maple and American elm may be present, along with shrubs like spicebush (*Lindera benzoin*). Springs and seeps are ecologically significant for maintaining base flow in streams, supporting high biodiversity, and providing critical habitat for sensitive species, including certain amphibians and invertebrates that rely on cool, clean water. Their conservation is essential for sustaining aquatic ecosystems, especially in the face of groundwater depletion and land-use change.

Small Rivers and Streams
Species of Greatest Conservation Need

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat		
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Soft-bottom Stream, Spring, & Riparian Forest	Hard-bottom Stream, Spring, & Riparian Forest	Small River
AMPHIBIANS										
Ringed Salamander *Ambystoma annulatum*	**Global Status: G4; State Status: S2.** Locally common, but patchily distributed in upland deciduous woodlands, pine-oak forests, and riparian areas in the Ozark Plateau and in the Ouachita Mountains in portions of Le Flore and McCurtain counties. A secretive, burrowing and nocturnal salamander that breeds in small ponds and vernal pools during the fall. Populations are tied to breeding sites. Fall breeding activity is closely tied to significant rain events.					•	•		•	
Three-toed Amphiuma *Amphiuma tridactylum*	**Global Status: G5; State Status: S1.** Rare, secretive, and limited to the Gulf Coastal Plain Ecoregion of southern McCurtain County.						•	•		•
Chihuahuan Green Toad *Anaxyrus debilis*	**Global Status: G5; State Status: S3.** Locally common in rocky habitats in northwestern Cimarron County near wetlands and valleys of small streams.	•	•					•		
Ouachita Dusky Salamander *Desmognathus brimleyorum*	**Global Status: G4; State Status: S3.** Locally common in rocky, high-gradient headwater streams in the eastern one-half of the Ouachita Mountains Ecoregion.						•		•	
Cave Salamander *Eurycea lucifuga*	**Global Status: G5; State Status: S3.** Found in moist woodlands, cliff fissures, and caves in the Ozarks. Adults can be found in springs and swamps and larvae live in nearby streams and enter caves as adults.					•			•	
Many-ribbed Salamander *Eurycea multiplicata*	**Global Status: G4; State Status: S4.** Locally common and widespread in springs, streams and moist woodlands throughout the Ouachita Mountains.						•		•	
Western Grotto Salamander *Eurycea spelaea*	**Global Status: G4; State Status: S3.** Endemic to the Ozark Plateau. Uncommon and locally occurring in limestone caves, springs, streams, and shallow aquifers in the Ozarks of northeastern Oklahoma.					•			•	
Oklahoma Salamander *Eurycea tynerensis*	**Global Status: G3; State Status: S3.** Locally common and widespread throughout the Ozarks in the Spring and Illinois River watersheds.					•			•	•
Red River Mudpuppy *Necturus louisianensis*	**Global Status: G4; State Status: NR.** Rare and locally occurring in small rivers, streams, and well vegetated ponds in the eastern one-third of Oklahoma.					•	•	•	•	•

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat		
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Soft-bottom Stream, Spring, & Riparian Forest	Hard-bottom Stream, Spring, & Riparian Forest	Small River
Western Slimy Salamander *Plethodon albagula*	**Global Status: G5; State Status: NR.** Common throughout the Ozark and Ouachita Uplifts. Locally occurring in moist woodlands, wooded karst hillsides, cave entrances, rocky outcrops, and damp ravines of northeastern and southeastern Oklahoma.					•	•		•	
Ozark Zigzag Salamander *Plethodon angusticlavius*	**Global Status: G4; State Status: S2.** Endemic to the Ozark Plateau. Locally common in the vicinity of wet, rocky crevices in ravines, limestone caves and steep hillsides in moist forested areas within the Ozarks of northeastern Oklahoma.					•			•	
Kiamichi Slimy Salamander *Plethodon kiamichi*	**Global Status: G2; State Status: S2.** Endemic to the Kiamichi Mountains in the Ouachita Mountains Ecoregion. Locally common, but restricted to moist ravines and mature forests along the Kiamichi Mountain ridge and the upper Kiamichi River watershed in Le Flore and Pushmataha counties.						•		•	
Sequoyah Slimy Salamander *Plethodon sequoyah*	**Global Status: G1; State Status: S2.** Uncommon and restricted to forested habitats along the southern edge of the Ouachita Mountains in McCurtain County. Can be found in moist ravines and riparian habitats along stream tributaries of the Glover and Mountain Fork rivers.						•		•	
Strecker's Chorus Frog *Pseudacris streckeri*	**Global Status: G4; State Status: NR.** Generally uncommon throughout its range in Oklahoma. Occupies floodplains, prairies, and woodlands throughout the central part of the state. Typically associated with ravines, streams, swamps, and ponds.		•	•	•			•		
Western Siren *Siren nettingi*	**Global Status: G5; State Status: NR.** Uncommon, aquatic salamander that is found in shallow, low-gradient reaches of the rivers within the Gulf Coastal Plain Ecoregion of southeastern Oklahoma.						•	•		•
BIRDS										
Green Heron *Butorides virescens*	**Global Status: G5; State Status: S2.** Uncommon summer breeding season migrant to Oklahoma. Secretive and often solitary on shorelines of rivers, streams, and ponds.		•	•	•	•	•	•	•	•
Little Blue Heron *Egretta caerulea*	**Global Status: G5; State Status: NR.** Locally common summer resident in the eastern two-thirds of Oklahoma. Often nests in colonies with other species of herons and egrets.	•	•	•	•	•	•	•	•	•
Swainson's Warbler *Limnothlypis swainsonii*	**Global Status: G4; State Status: S1.** Rare summer resident occurring locally in bottomland forest tracts along small rivers in the eastern one-third of Oklahoma. Nests primarily in mature riparian and bottomland hardwood forests with thick understory shrubs or river cane (*Arundinaria gigantea*) thickets.					•	•	•		
Red-headed Woodpecker *Melanerpes erythrocephalus*	**Global Status: G5; State Status: S4.** Uncommon but can be found across most of Oklahoma during both breeding and wintering seasons. Is known to utilize river bottom and beaver pond habitats for breeding as well as the more common pine-woodland habitats.	•	•		•			•		

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat		
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Soft-bottom Stream, Spring, & Riparian Forest	Hard-bottom Stream, Spring, & Riparian Forest	Small River
Prothonotary Warbler *Protonotaria citrea*	**Global Status: G5; State Status: NR.** Uncommon summer resident that nests in riparian forests along many of the small rivers throughout the eastern one-half of the state.		•	•	•	•	•	•	•	•
Lesser Yellowlegs *Tringa flavipes*	**Global Status: G5; State Status: NR.** Common spring and fall migrant through Oklahoma. Prefers marshes, mudflats, and shoreline habitat.	•	•	•	•	•	•			•
Greater Yellowlegs *Tringa melanoleuca*	**Global Status: G5; State Status: NR.** Common spring and fall migrant through Oklahoma. Prefers marshes, mudflats, and shoreline habitat.	•	•	•	•	•	•			•
Bell's Vireo *Vireo bellii*	**Global Status: G5; State Status: S3.** Uncommon summer resident. Nests in riparian willow and deciduous shrub thickets.	•	•	•	•			•		
FISH										
Red River Shiner *Alburnops bairdi*	**Global Status: G4; State Status: S3.** Endemic to the Red River but has been introduced into the Cimarron River. Common and widespread throughout the Cimarron and Red rivers.		•		•					•
Ironcolor Shiner *Alburnops chalybaeus*	**Global Status: G4 ; State Status: S1.** Very rare and restricted to the lower Little River and its tributaries in southeastern Oklahoma.						•			•
Alabama Shad *Alosa alabamae*	**Global Status: G2; State Status: S2.** Likely extirpated from Oklahoma. Anadromous and historically migrated up the Red and Arkansas rivers in the summer to spawn in tributary streams.					•	•			•
Brown Bullhead *Ameiurus nebulosus*	**Global Status: G5 ; State Status: SH.** Potentially exotic and possibly extirpated from the state. Was rare and limited to the Gulf Coastal Plain portion of the Little River watershed in southeastern Oklahoma.						•			•
Western Sand Darter *Ammocrypta clara*	**Global Status: G3; State Status: S2.** Locally common in the Red River downstream from Lake Texoma. Prefers sandy substrate where it buries into the sand in moderate to slow flows.				•		•	•		•
Alligator Gar *Atractosteus spatula*	**Global Status: G3; State Status: S1.** Uncommon resident of the Red River in the eastern one-half of the state including Lake Texoma, and a rare resident of the Arkansas River in the eastern one-quarter of the state.				•		•			•
Crystal Darter *Crystallaria asprella*	**Global Status: G3; State Status: S1.** Rare species that is only known from a few sites in the Little and Kiamichi rivers.				•		•			•
Blue Sucker *Cycleptus elongatus*	**Global Status: G4; State Status: S2.** Uncommon species associated with deeper water systems. Present in the Red, Kiamichi, Arkansas, and Grand rivers. Most robust population inhabits the lower Red River including the Muddy Boggy, Blue River, and Kiamichi River tributaries.				•	•	•			•

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat		
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Soft-bottom Stream, Spring, & Riparian Forest	Hard-bottom Stream, Spring, & Riparian Forest	Small River
Bluntface Shiner *Cyprinella camura*	**Global Status: G5; State Status: S1.** Uncommon and locally occurring in clear streams, typically with gravel or sand substrate. Known from the Caney, Verdigris, Grand, Illinois, and Spring rivers.			•	•	•		•	•	•
Spotfin Shiner *Cyprinella spiloptera*	**Global Status: G5; State Status: S1.** Uncommon and geographically restricted to the Illinois River and its tributaries.					•				•
Red River Pupfish *Cyprinodon rubrofluviatilis*	**Global Status: G5; State Status: S4.** Common and widespread in Central and Western Oklahoma. Endemic to the Red River but has been introduced and become established in the Canadian and Cimarron rivers.		•					•		•
Chain Pickerel *Esox niger*	**Global Status: G5; State Status: NR.** Locally common in the Red River and tributaries in southeastern Oklahoma. Habitat includes vegetated lakes, swamps, and backwaters and quiet pools of creeks and rivers.						•			•
Creole Darter *Etheostoma collettei*	**Global Status: G4; State Status: S3.** Rare and only likely to occur in a few stream tributaries of the lower Little River watershed.						•	•		•
Arkansas Darter *Etheostoma cragini*	**Global Status: G3; State Status: S1.** Uncommon and locally occurring in vegetated springs and seeps in the Spring and Grand River tributaries. Also locally common in springs and seeps in tributaries of the Cimarron River.	•	•	•		•		•	•	
Blue River Orangebelly Darter *Etheostoma cyanorum*	**Global Status: G1; State Status: S1.** Endemic to the Blue River basin of southern Oklahoma. Locally common in rocky riffles and rapids in the mainstem and larger tributaries of the Blue River. Previously considered as a subspecies of the orangebelly darter (*Etheostoma radiosum*), but was elevated to a full species in 2019.				•	•			•	•
Harlequin Darter *Etheostoma histrio*	**Global Status: G5; State Status: S3.** Locally common in low-elevation, rocky tributaries of the Poteau and Little River watersheds.						•		•	•
Least Darter *Etheostoma microperca*	**Global Status: G3; State Status: S3.** Uncommon and locally occurring in spring fed streams in the Blue, Illinois, and Spring rivers, as well as tributaries of the Grand River such as Spring Creek.				•	•			•	•
Sunburst Darter *Etheostoma mihileze*	**Global Status: G4; State Status: S3.** Endemic to the Ozarks. Uncommon but widespread in springs and headwater streams throughout the Ozark Ecoregion.					•			•	
Goldstripe Darter *Etheostoma parvipinne*	**Global Status: G4; State Status: NR.** Rare and known only from a few sites in the lower Red River watershed. Seems to be tied to spring-fed sites throughout the watershed.						•	•		
Orangebelly Darter *Etheostoma radiosum*	**Global Status: G4; State Status: S4.** Common and restricted to the tributaries of the Red River in southeastern Oklahoma.				•		•		•	•

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat		
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Soft-bottom Stream, Spring, & Riparian Forest	Hard-bottom Stream, Spring, & Riparian Forest	Small River
Redfin Darter *Etheostoma whipplei*	**Global Status: G4; State Status: S4.** Common in low-gradient stream tributaries to the Arkansas and Grand Rivers as well as rocky tributaries of the Poteau River.			•		•	•	•	•	
Western Starhead Topminnow *Fundulus blairae*	**Global Status: G4; State Status S2.** Occurs locally in low-gradient, soft-bottom streams, sloughs, and ditches, in the Little River watershed in southern McCurtain County.						•	•		
Plains Topminnow *Fundulus sciadicus*	**Global Status: G4; State Status: S1.** Uncommon and restricted to a few locations in the Spavinaw Creek watershed.					•			•	
Mooneye *Hiodon tergisus*	**Global Status: G5; State Status: S2.** Rare and restricted to the Little River system.						•			•
Cypress Minnow *Hybognathus hayi*	**Global Status: G4; State Status: S1.** Uncommon species known from low-gradient tributaries of the Little River watershed.						•	•		•
Plains Minnow *Hybognathus placitus*	**Global Status: G4; State Status: S3.** Uncommon in the western portions of the state in the Canadian and Red rivers. Rare or extirpated in many reaches of the Cimarron River in northwestern Oklahoma, where it once was historically abundant.	•	•	•	•		•	•		•
Pallid Shiner *Hybopsis amnis*	**Global Status: G4; State Status: S1.** Uncommon in the lower Arkansas and Red rivers in the eastern one-third of Oklahoma. Prefers backwaters and side channels with low flows and quiet waters over sandy-silty bottoms.				•		•	•		•
Southern Brook Lamprey *Ichthyomyzon gagei*	**Global Status: G5; State Status: S2.** Uncommon and locally occurring throughout the Ozark and Ouachita Mountains ecoregions. Range is poorly defined but has been documented from the Grand River system, the Illinois River, Lee Creek, the Kiamichi River, and the Little River and its tributaries.					•			•	•
Black Buffalo *Ictiobus niger*	**Global Status: G5; State Status: NR.** Uncommon but widespread in the eastern one-half of Oklahoma in the Grand, Arkansas, Cimarron, and Red rivers. Preferred habitat includes pools and backwaters, small to large rivers, and reservoirs.			•			•			•
Cardinal Shiner *Luxilus cardinalis*	**Global Status: G4; State Status: S4.** Locally common and widespread throughout the Ozarks including the Illinois River and tributaries, and the Grand River system.			•		•		•	•	
Ribbon Shiner *Lythrurus fumeus*	**Global Status: G5; State Status: S3.** Uncommon in the eastern one-third of Oklahoma. Habitat includes lowland headwaters, creeks, and small rivers, usually with low gradient and bottom of sand and silt or clay. Prefers clear, vegetated pools with little current over sand.				•	•	•		•	•
Ouachita Shiner *Lythrurus snelsoni*	**Global Status: G3; State Status: S2.** Locally common in the headwater streams of the Little River in the Ouachita Mountains Ecoregion.						•		•	

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		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Soft-bottom Stream, Spring, & Riparian Forest	Hard-bottom Stream, Spring, & Riparian Forest	Small River
Prairie Chub *Macrhybopsis australis*	**Global Status: G3; State Status: S2.** Uncommon in tributaries of the upper Red River system.		•							•
Neosho Bass *Micropterus velox*	**Global Status: GNR; State Status: NR.** Locally common in Ozark streams and small rivers. Elevated to species status based on phylogenetic analysis of range wide smallmouth bass. Springs are used as overwinter thermal refugia.					•			•	•
Wedgespot Shiner *Miniellus greenei*	**Global Status: G5; State Status: S2.** Endemic to the Ozarks in Oklahoma and Arkansas. Common and widespread throughout the Ozark Ecoregion.					•				•
Ozark Minnow *Miniellus nubilus*	**Global Status: G5; State Status: S4.** Common and widespread in streams throughout the Ozark Plateau.					•			•	
Kiamichi Shiner *Miniellus ortenburgeri*	**Global Status: G3; State Status: S3.** Uncommon but widespread in rocky streams throughout the Ouachita Mountains. Also common in the headwaters of the Kiamichi, Little, and Poteau rivers.			•	•		•	•	•	•
Peppered Shiner *Miniellus perpallidus*	**Global Status: G3; State Status: S2.** Very rare species that may be extirpated from the state. Any remaining populations would occur in the Little River system.						•			•
Shorthead Redhorse *Moxostoma macrolepidotum*	**Global Status: G5; State Status: S2.** Rare and widespread at low-densities throughout the Ozark Ecoregion.					•			•	•
Redspot Chub *Nocomis asper*	**Global Status: G4; State Status: S4.** Locally common and occurring in the Blue River and widespread throughout the Ozark Ecoregion.				•	•			•	•
Blackspot Shiner *Notropis atrocaudalis*	**Global Status: G4; State Status: S1.** Uncommon to locally common minnow occurring in the Muddy Boggy, Kiamichi, and Little rivers.				•		•	•		•
Taillight Shiner *Notropis maculatus*	**Global Status: G5; State Status: S1.** Uncommon and restricted to backwaters and tributaries of the lower Little River watershed.						•	•		•
Rocky Shiner *Notropis suttkusi*	**Global Status: G3; State Status: S3.** Locally common but limited to the Blue, Boggy, Kiamichi, and Little rivers. Endemic to tributaries of the Red River in the Ouachita Mountains.				•		•		•	•
Mountain Madtom *Noturus eleutherus*	**Global Status: G4; State Status: S2.** Uncommon in the higher gradient reaches in the Little River watershed.						•			•
Stonecat *Noturus flavus*	**Global Status: G5; State Status: S2.** Large geographic range but uncommon in Oklahoma small rivers and streams, often under rocks in runs, riffles, and rapids. Male guards eggs and broods.			•		•		•	•	•

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Blackside Darter *Percina maculata*	**Global Status: G5; State Status: S2.** State listed as threatened. Rare species that occurs in low densities. Known from the Poteau River, Little River, and Lee Creek watersheds.					•	•		•	•
Longnose Darter *Percina nasuta*	**Global Status: G3; State Status: S1.** State listed as endangered. Rare darter that is limited to the Lee Creek watershed in Oklahoma.					•	•		•	•
Leopard Darter *Percina pantherina*	**Global Status: G2; State Status: S1.** Federally listed as threatened. Endemic to the Ouachita Mountains. Uncommon and restricted to the rocky reaches of the Little, Glover, and Mountain Fork rivers.						•			•
River Darter *Percina shumardi*	**Global Status: G5; State Status: S3.** Uncommon in the Neosho-Grand River and the lower Arkansas River. Difficult to document due to occupying deep water habitats.					•			•	•
Paddlefish *Polyodon spathula*	**Global Status: G4; State Status: S2.** Locally common in the Grand, Arkansas, Red and Cimarron rivers in the eastern one-half of Oklahoma. Adaptation to reservoirs has allowed for robust local populations.			•	•	•	•			•
Bluehead Shiner *Pteronotropis hubbsi*	**Global Status: G3; State Status: S1.** Uncommon and only documented in sluggish backwater habitats of the lower Little River watershed.						•			•
Shovelnose Sturgeon *Scaphirhynchus platorynchus*	**Global Status: G4; State Status: S1.** Uncommon in the Arkansas, Verdigris and Red rivers in the eastern one-half of Oklahoma. Difficult to detect due to small body size and preference for deep channels.			•						•
INVERTEBRATES										
Elktoe *Alasmidonta marginata*	**Global Status: G4; State Status: S1.** Rare mussel in Oklahoma that occurs only in the Spring and Illinois rivers.					•				•
Osage Snowfly *Allocapnia jeannae*	**Global Status: G3; State Status: S4.** Uncommon winter stonefly that is locally occurring in the southern Ozark streams.					•			•	•
Shield Snowfly *Allocapnia peltoides*	**Global Status: G3; State Status: S4.** Endemic to the Ouachita Mountains. Uncommon, winter-emerging stonefly known from small to medium-sized streams.						•		•	
Oklahoma Cave Amphipod *Allocrangonyx pellucidus*	**Global Status: G4; State Status: S3.** Endemic to the Arbuckle Uplift. Stygobitic amphipod only documented in subterranean waters and springs in Johnston, Murray, and Pontotoc counties of south-central Oklahoma. Presumed to be locally common, but its distribution is poorly known.				•				•	
Linda's Roadside-Skipper *Amblyscirtes linda*	**Global Status: G2; State Status: S2.** Uncommon and locally occurring along forested streams with its larval host plant, Indian woodoats (*Chasmanthium latifolium*). In Oklahoma, it occurs in the eastern one-quarter of the state and appears to have one generation per year.			•		•	•	•	•	

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A miner bee *Andrena arenicola*	**Global Status: GNR; State Status: NR.** Rare miner bee that is only active in the early spring and is associated with willow trees (*Salix*) and shrubs along streams and around wetlands in central Oklahoma. Species has been documented in Atoka County.		•		•			•		
A miner bee *Andrena unicostata*	**Global Status: GNR; State Status: NR.** Rare miner bee documented in Marshall, Love, and Atoka counties in central Oklahoma. It is active only in the early spring in association with willows in riparian habitats and around wetlands.				•			•		
Futile Small Minnow Mayfly *Apobaetis futilis*	**Global Status: G2; State Status: NR.** Uncommon and only known from streams in the upper Kiamichi River watershed.						•		•	
Ouachita Rock Pocketbook *Arcidens wheeleri*	**Global Status: G1; State Status: S1.** Federally listed as endangered. Very rare and restricted to the Kiamichi River and lower Little River.						•			•
Leonora's Dancer *Argia leonorae*	**Global Status: G3; State Status: S5.** Small damselfly that is endemic to the Southern Great Plains. Most of the known populations occur in Texas, but its range extends into the southwestern part of the state, including Comanche, Jackson, and Kiowa counties. It is found around seasonal wetlands and sandy-bottom streams.		•					•		
Kansas Well Amphipod *Bactrurus hubrichti*	**Global Status: G4; State Status: S1.** Uncommon and locally occurring in seeps, springs and open wells in the Ozarks and Osage Plains.			•		•		•	•	
a cave obligate isopod *Caecidotea acuticarpa*	**Global Status: G2; State Status: S1.** Endemic. Groundwater-dwelling isopod that occupies limestone caves and aquifers in the Arbuckle Mountains of south-central Oklahoma. Distribution is poorly known, but found in most accessible places.				•				•	
Bat Cave Isopod *Caecidotea macropropoda*	**Global Status: G3; State Status: S1.** Uncommon and limited to wet caves and springs in the southern one-half of the Ozarks.					•			•	
Water Slater *Caecidotea oculata*	**Global Status: G1; State Status: S1.** Uncommon and endemic species that is widespread throughout the Ouachita Mountains.						•		•	
Springfield Plain Groundwater Isopod *Caecidotea simulator*	**Global Status: G2; State Status: S2.** Uncommon and locally occurring in springs, seeps, and shallow aquifers in the eastern one-half of the Ozarks.					•			•	
Slender-fingered Cave Isopod *Caecidotea stiladactyla*	**Global Status: G3; State Status: S2.** Locally common in springs, seeps, and wet caves along the Oklahoma-Arkansas state line throughout the Ozarks.					•			•	

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Consort Underwing *Catocala consors*	**Global Status: G3; State Status: NR.** Uncommon moth that is found in riparian forests across the eastern one-half of Oklahoma. It is dependent upon swamp indigo (*Amorpha fruticosa*) as the host plant for its larvae.			•	•	•	•	•		
a caddisfly *Cernotina oklahoma*	**Global Status: G3; State Status: NR.** Uncommon tube-making caddisfly that is endemic to the rocky, limestone streams of the Arbuckle Mountains in Oklahoma and the Edwards Plateau in Texas. First described in Oklahoma.				•				•	
Flint's Net-spinning Caddisfly *Cheumatopsyche comis*	**Global Status: G3; State Status NR.** Poorly known southwestern species of caddisfly that reaches the northeastern limits of its known range in the rocky streams of the Wichita Mountains. Adults emerge in the late spring and early summer.		•						•	
Western Fanshell *Cyprogenia aberti*	**Global Status: G1; State Status: NR.** Rare but still persisting in very low numbers in the upper Verdigris River.			•						•
Little Dubiraphian Riffle Beetle *Dubiraphia parva*	**Global Status: G2; State Status: S1.** Rare with a poorly known distribution. Limited to streams in the southern one-quarter of the Cross Timbers Ecoregion.				•				•	
Butterfly Mussel *Ellipsaria lineolata*	**Global Status: G4; State Status: S2.** Uncommon and found in the lower reaches of the Kiamichi and Little rivers.			•			•			•
Ouachita Mountains Crayfish *Fallicambarus tenuis*	**Global Status: G3; State Status: S1.** Uncommon and locally occurring in clear rocky streams of the Ouachita Mountains.						•		•	
Blair's Fencing Crayfish *Faxonella blairi*	**Global Status: G4; State Status: S1.** Uncommon and endemic to the Gulf Coastal Plain. Only records are from the lower Little River.						•			•
Neosho Midget Crayfish *Faxonius macrus*	**Global Status: G3; State Status: S2.** Locally common in the Ozark Plateau tributaries to the Grand River system.					•			•	
Meek's Crayfish *Faxonius meeki*	**Global Status: G4; State Status: S2.** Uncommon and locally found throughout the Illinois River watershed and its tributaries.					•				•
Mena Crayfish *Faxonius menae*	**Global Status: G3; State Status: S2.** Locally common and found in the tributaries of the Little and Kiamichi rivers in the Ouachita Mountains.						•		•	
Midget Crayfish **Faxonius nana**	Global Status: G3; State Status: S3. Locally common and restricted to the Illinois River watershed.					•				•

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Painted Crayfish *Faxonius difficillis*	**Global Status: G3; State Status: S3.** Locally common and found throughout the Ouachita Mountains, the Boggy River system and tributaries to the Red River in southeast Oklahoma.				•		•	•	•	•
Kiamichi Crayfish *Faxonius saxatilis*	**Global Status: G1; State Status: S1.** Endemic to Oklahoma. Uncommon but locally occurring at several sites throughout the headwaters of the Kiamichi River.						•		•	
Ozark Clubtail *Gomphurus ozarkensis*	**Global Status: G4; State Status: S3.** Locally common dragonfly found along streams throughout the Ozarks.					•			•	
Ozark Springfly *Helopicus nalatus*	**Global Status: G3; State Status: NR.** Stonefly that is endemic to the Ozarks and found particularly in the eastern Ozarks in Oklahoma. Records indicate populations in the Flint Creek and Fourteenmile Creek watersheds. Adults typically emerge January through April.					•			•	
a purse casemaker caddisfly *Hydroptila melia*	**Global Status: G2; State Status: NR.** All Oklahoma records are from streams in the Arbuckle Mountains.				•				•	
a purse casemaker caddisfly *Hydroptila protera*	**Global Status: G1; State Status: NR.** Rare and limited to streams in the Arbuckle Mountains.				•				•	
Banner Clubtail *Hylogomphus apomyius*	**Global Status: G3; State Status: S2.** Small dragonfly whose adults are active in the spring. Found in low-gradient rocky streams in the Gulf Coastal Plain and the transition zone into the Ouachita Mountains.						•		•	
Ouachita Stripetail *Isoperla ouachita*	**Global Status: G3; State Status: NR.** Common stonefly that is endemic but widespread throughout the Ouachita Mountains and the southern Ozarks. The adults emerge in the spring (March – May).					•	•		•	
Plain Pocketbook *Lampsilis cardium*	**Global Status: G5; State Status: NR.** Common and widespread throughout many of the small rivers in Eastern Oklahoma. Less common but present throughout the Cross Timbers Ecoregion.			•	•	•	•			•
Neosho Mucket *Lampsilis rafinesqueana*	**Global Status: G1; State Status: S1.** Federally listed as endangered. Uncommon in the Illinois and Spring rivers.			•		•				•
a lepidostomatid caddisfly *Lepidostoma ozarkense*	**Global Status: G1; State Status: NR.** Rare and poorly studied in Oklahoma. Know from only a few sites in the Boston Mountains and the Ouachitas.						•		•	
Black Sandshell *Ligumia recta*	**Global Status: G4; State Status: S1.** Likely extirpated from the state but historical records suggest they potentially occurred in the Caney, Verdigris, and Poteau rivers.			•			•			•

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a microcaddisfly *Mayatrichia ponta*	**Global Status: G3; State Status: NR.** Uncommon and endemic to streams in the Arbuckle Mountains.				•				•	
Washboard *Megalonaias nervosa*	**Global Status: G5; State Status: S2.** Rare and found in the Caney, Verdigris, Boggy, Poteau, Kiamichi, and Little rivers.			•	•		•			•
Curved Stonefly *Neoperla falayah*	**Global Status: G3; State Status: NR.** Rare and poorly-studied in Oklahoma. This summer-emerging stonefly has limited historical records and occurs in the Ouachita Mountains and the Ozarks.					•			•	
Osage Stonefly *Neoperla osage*	**Global Status: G3; State Status: NR.** Rare and poorly studied, summer-emerging stonefly with no recent records from Oklahoma. Endemic to the Ozarks and Ouachita Mountains.					•	•		•	
a microcaddisfly *Neotrichia riegeli*	**Global Status: G3; State Status: NR.** Rare and endemic to the Ozarks. Occurrence records for Oklahoma are uncertain at this time.					•			•	
a flat-headed mayfly *Nixe flowersi*	**Global Status: G2; State Status: S4.** Locally common in the Spring Creek watershed within the Ozarks.					•			•	
Southern Hickorynut *Obovaria arkansasensis*	**Global Status: G3; State Status: S2.** Locally common in the Kiamichi, Little, Glover, and Mountain Fork rivers.						•			•
a purse casemaker caddisfly *Ochrotrichia capitana*	**Global Status: G2; State Status: NR.** Purse-maker caddisfly that was recently recorded in Oklahoma for the first time. Endemic to the rocky streams of the Arbuckle Mountains and the Edwards Plateau.				•				•	
a purse casemaker caddisfly *Ochrotrichia weddleae*	**Global Status: G1; State Status: NR.** Rare and only records are from the Ouachita Mountains in Latimer County.						•		•	
a longhorned caddisfly *Oecetis ouachita*	**Global Status: G2; State Status: NR.** Rare, summer-emerging caddisfly that is endemic to the Ouachita Mountains. Documented at four sites in Arkansas, but its occurrence in Oklahoma is uncertain at this time.						•		•	
Darkwing Stonefly *Perlesta baumanni*	**Global Status: G2; State Status: NR.** Rare summer-emerging stonefly that appears to be an endemic to the Ouachita Mountains and is known from approximately 10 stream sites throughout this region.						•		•	
Truncate Stonefly *Perlesta bolukta*	**Global Status: G2; State Status: S4.** Uncommon, stonefly whose adults emerge in the early summer (May-June). Widespread in the Ouachita Mountains and the eastern Ozarks.						•		•	
Toothed Stonefly **Perlesta browni**	Global Status: G3; State Status: S4. Rare early-summer emerging stonefly that has been documented only in the Ouachita Mountains.						•		•	

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Tinted Stonefly *Perlesta fusca*	**Global Status: G3; State Status: NR.** Rare, summer-emerging (May-June) stonefly that is known currently from only a few stream sites in the Arbuckle Mountains of Oklahoma. Species appears to occur in the Ozarks of Arkansas and Missouri.				•				•	
Two-step Flasher Firefly *Photinus dimissus*	**Global Status: G3; State Status: NR.** Rare firefly that is known only from central Texas and southern Oklahoma. Occupies riparian habitats and adjacent grasslands. Range in Oklahoma is uncertain at this time.				•		•	•		•
a small minnow mayfly *Plauditus texanus*	**Global Status: G2; State Status: NR.** Recently described species with very few records. Only Oklahoma occurrence is on Fort Sill in Comanche County.		•						•	
Ohio Pigtoe *Pleurobema cordatum*	**Global Status: G3; State Status: S2.** Broad geographic distribution and difficult to identify to species even among experts. Uncommon in Ozark small rivers.					•				•
Louisiana Pigtoe *Pleurobema riddellii*	**Global Status: G1; State Status: NR.** Very rare throughout remaining range, likely extirpated from Oklahoma.						•			•
Scaleshell *Potamilus leptodon*	**Global Status: G1; State Status: S1.** Federally listed as endangered. Very rare, possibly extirpated and only known from the Kiamichi and Little rivers.						•			•
Ozark Forestfly *Prostoia ozarkensis*	**Global Status: G3; State Status: NR.** Early spring stonefly with scattered records Oklahoma along the Oklahoma-Arkansas state line. It appears to be endemic to the Ozarks and Ouachita Mountains.					•			•	
Ouachita Kidneyshell *Ptychobranchus occidentalis*	**Global Status: G3; State Status: S2.** Primarily uncommon and populations persist in the Illinois River, Glover River, Little River and Kiamichi River. Was thought to be extirpated from the Verdigris but a single live individual was collected during surveys in 2023.			•	•	•	•		•	•
Wartyback *Pustulosa nodulata*	**Global Status: G4; State Status: S1.** Uncommon and known from the Caney, Verdigris, Poteau, and Boggy rivers.			•	•					•
Winged Mapleleaf *Quadrula fragosa*	**Global Status: G1; State Status: S1.** Rare and federally listed as endangered. A small population is thought to still persist in the lower Little River.						•			•
a rhyacophilid caddisfly *Rhyacophila kiamichi*	**Global Status: G3; State Status: NR.** Rare free-living caddisfly (constructs no case) that is known only from records collected from the Kiamichi River watershed.						•		•	
a leptocerid caddisfly *Setodes oxapius*	**Global Status: G3; State Status: NR.** Rare long-horned caddisfly that appears to be endemic to the southern Ozark Plateau.					•			•	

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a primitive minnow mayfly *Siphlonurus minnoi*	**Global Status: G3; State Status: NR.** Rare and is known from the Ozark portion of the Neosho River watershed.					•			•	•
Texas Emerald *Somatochlora margarita*	**Global Status: G2; State Status: NR.** Rare and endemic to the Gulf Coastal Plain with only records in Oklahoma from the Ouachita Mountains in McCurtain County.						•	•		•
Ozark Emerald *Somatochlora ozarkensis*	**Global Status: G3; State Status: S1.** Rare and locally occurring dragonfly found in small rivers and large streams in the Ozarks and Ouachita Mountains.					•	•		•	•
Kiamichi Willowfly *Strophopteryx cucullata*	**Global Status: G3; State Status: NR.** Locally common winter-emerging stonefly that is endemic to, but widespread throughout the Boston Mountains and Ouachita Mountains Ecoregion.					•	•		•	
Bowman's Cave Amphipod *Stygobromus bowmani*	**Global Status: G1; State Status: S1.** Rare endemic that is known from only one seep in Mayes County.					•			•	
Rabbitsfoot *Theliderma cylindrica*	**Global Status: G3; State Status: S1.** Federally listed as threatened. Rare and restricted to the Illinois, lower Verdigris, and lower Little rivers. Recently was rediscovered in the Caney River near the confluence of the Verdigris River.			•		•	•			•
Monkeyface Mussel *Theliderma metanevra*	**Global Status: GNR; State Status: NR.** Common but restricted to the Caney, Verdigris, and Arkansas River systems.			•	•					•
Purple Lilliput *Toxolasma lividum*	**Global Status: G3; State Status: NR.** Status unknown in Oklahoma but may occur in Poteau or Illinois rivers.					•	•			•
Texas Lilliput *Toxolasma texasiense*	**Global Status: G4; State Status: S1.** No current records for Oklahoma but may occur in the Little River system.						•			•
Marsh Triaenode Caddisfly *Triaenodes helo*	**Global Status: G3; State Status: NR.** Rare and occurs primarily along the Gulf Coastal Plain, but a disjunct population was recorded on the Fort Sill Military Base in southwestern Oklahoma.		•					•		
Three-toothed Triaenodes Caddisfly *Triaenodes tridontus*	**Global Status: G2; State Status: NR.** Thought to no longer exist in Oklahoma. Many recent surveys did not yield any individuals. May still occur but only as a very rare occurrence in the Gulf Coastal Plain.						•	•		
A caddisfly *Wormaldia strota*	**Global Status: G2; State Status: NR.** Rare and understudied in Oklahoma. Known from the Latimer, Le Flore, and Pushmataha counties in the Ouachita Mountains Ecoregion.						•		•	

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Cherokee Needlefly *Zealeuctra cherokee*	**Global Status: G3; State Status: S4.** Winter-season stonefly that is locally common but known from only a few sites in the Arkansas Valley and Ouachita Mountains.						•		•	
Early Needlefly *Zealeuctra warreni*	**Global Status: G3; State Status: NR.** Winter-season stonefly that is uncommon but widespread throughout the southern Ozarks and the Ouachita Mountains in Oklahoma.					•	•		•	
MAMMALS										
Townsend's Big-eared Bat *Corynorhinus townsendii*	**Global Status: G4; State Status: S3.** Rare resident species that is known from areas around Black Mesa. Uses riparian habitats for foraging.	•	•					•		
Southeastern Myotis *Myotis austroriparius*	**Global Status: G4; State Status: S1.** Rare and limited to the Little River watershed. Uses streams and small rivers for foraging habitat.						•	•		•
Gray Myotis *Myotis austroriparius*	**Global Status: G3; State Status: S1.** Locally common throughout northeast Oklahoma and occupy several maternity cave sites in the Ozarks. Uses small rivers and streams to forage along the riparian habitats.					•			•	
Northern Long-eared Myotis *Myotis septentrionalis*	**Global Status: G2; State Status: S2.** Federally listed as threatened. Rare but widespread throughout the Ouachita Mountains and the Ozarks. A tree roosting bat that uses riparian and bottomland habitats for foraging and roosting.			•			•	•	•	•
Texas Marsh Rice Rat *Oryzomys texensis*	**Global Status: GNR; State Status: S3.** Uncommon and known from scattered records throughout the eastern one-half of the state. A semiaquatic species that prefers marsh and wetland habitats that offer grasses and sedges.				•			•		
Eastern Harvest Mouse *Oryzomys texensis*	**Global Status: G5; State Status: S2.** The exact range and status of the species is unknown but all of the records indicate it's geographic range is restricted to the eastern one-half of the state. Has been reported to occupy various habitats including floodplains and riparian areas.				•			•		
Meadow Jumping Mouse *Zapus hudsonius*	**Global Status: G5; State Status: S1.** Very rare and only known from a few historic records from the Bird Creek watershed and in the Tulsa area.			•	•			•		
REPTILES										
American Alligator *Alligator mississippiensis*	**Global Status: G5; State Status: S4.** Rare but seen with increasing frequency in the lower reaches of the Little, Kiamichi, and Boggy rivers.						•	•		•
Smooth Softshell *Apalone mutica*	**Global Status: G5; State Status: S5.** Uncommon and locally found in tributaries to the Arkansas River, the Verdigris River, as well as the Ouachita Mountains and Gulf Coastal Plain.		•	•	•		•	•		•

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat		
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Soft-bottom Stream, Spring, & Riparian Forest	Hard-bottom Stream, Spring, & Riparian Forest	Small River
Spiny Softshell *Apalone spinifera*	**Global Status: G5; State Status: S5.** Locally common and widespread throughout much of Oklahoma. Preferred habitat includes large and small rivers, river impoundments, lakes, ponds along rivers, pools along intermittent streams, bayous, and oxbows. Usually present in waters with open sandy or mud banks and soft bottom.	•	•	•	•	•	•	•		•
Chicken Turtle *Deirochelys reticularia*	**Global Status: G5; State Status: S2.** Rare and occurs in scattered populations in the Red, Boggy, and Canadian River watersheds.				•			•	•	
Northern Map Turtle *Graptemys geographica*	**Global Status: G4; State Status: S1.** Rare and limited to streams along the Oklahoma-Missouri state line in the Ozark Ecoregion.					•			•	
Western Alligator Snapping Turtle *Macrochelys temminckii*	**Global Status: G3; State Status: S2.** Federally proposed as threatened. Uncommon and occurs at low densities but broad distribution throughout Verdigris, Illinois, Neosho, Deep Fork, and Caney rivers. This species is also found throughout the Ouachita Mountains Ecoregion and within tributaries to the Red River.			•	•	•	•	•	•	•
River Cooter *Pseudemys concinna*	**Global Status: G5; State Status: S4.** Uncommon but widespread in small rivers throughout eastern and parts of central Oklahoma.			•	•	•	•	•	•	•
Razor-backed Musk Turtle *Sternotherus carinatus*	**Global Status: G5; State Status: S4.** Secretive and uncommon turtle species found throughout the Ouachita Mountains and tributaries to the Red River in southeast Oklahoma.				•		•	•	•	•

Small Rivers and Streams Conservation Issues and Actions

Conservation Issue: Information Gaps

Prothonotary warbler. Photo by Ben Childers.

Ecological and distributional data are incomplete for many Species of Greatest Conservation Need (SGCN), particularly those species that are rare or restricted to one or a few watersheds. More complete data about the statuses and trends for species, and thorough evaluations and monitoring data may help establish effective conservation efforts and determine the factors that limit population sizes or are responsible for apparent declines. Unfortunately, some species are highly mobile and/or occur in aquatic habitats that are too deep to easily survey. 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. There are limited historical data from which to evaluate the conditions of streams and riparian forests prior to large scale human alteration in Oklahoma. This information is important as it can serve as a desired condition or baseline when establishing goals for conservation efforts.

Incomplete information exists regarding the historic and current structural condition, seasonal flow dynamics and community composition of streams and riparian habitats. Data also are incomplete for some SGCN with respect to their distributions, ecological needs, and population trends. These deficiencies create an impediment to the development and implementation of effective conservation strategies. 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. The biological resources within streams and springs, and riparian forests are difficult to monitor because most of the habitat occurs on private land and is distributed in small tracts across many individual landowners. While the locations and distributions of streams are well-known, our knowledge of the distribution of springs is incomplete with challenges associated with locating these small sites. There is incomplete

Razor-backed musk turtle at the Glover River. Photo by ODWC.

Leopard darter. Photo by ODWC.

information from which land managers can predict the effect of habitat changes on populations of SGCN.

Conservation Actions

- Conduct surveys of existing literature, reports, and museum records to evaluate historic distributions, abundances, and habitat affinities of SGCN.
- Research the historic condition of small rivers and springs, using historic literature, maps, aerial photography, and satellite imagery to evaluate the historic channel morphology, flow patterns, and water quality in order to develop a realistic and biologically meaningful target condition for habitat restoration, enhancement, and maintenance efforts.
- Conduct ecological studies to evaluate the factors responsible for population declines as well as targeted community surveys to assess the current distribution, status, and habitat needs of SGCN. Assess the restoration potential of impacted areas and use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest benefit for SGCN. Taxonomic groups in greatest need of survey attention include freshwater mussels, crayfish, and cyprinid fish.
- Develop monitoring programs to measure and track the abundance and geographic ranges of SGCN and the condition of the habitats on which they depend. Where applicable, link monitoring to existing efforts and coordination with other partners to ensure monitoring efficiency and decrease the potential for unhelpful survey duplication.
- Provide long-term funding to maintain a database to store and analyze distributional and ecological data for SGCN. Make these data available to natural resource planners such as other conservation agencies.
- Develop methods to identify and map the distribution of riffles, gravel beds, and other in-stream habitats as well as springs. Then, inventory these habitats to determine their condition and the biological community that each support. Where appropriate, identify the conservation practices that could enhance the value of these habitats for SGCN.
- Work with individual landowners to gain private land access to conduct biological inventories of springs and streams.
- 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 genetic studies to assess gene flow among populations of aquatic species, particularly those impacted by reservoir construction and other stream barriers.
- 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 SWAP.
- Continue to develop relational databases to monitor wildlife populations and the conditions of their habitats.

Conservation Issue: Modification of Natural Ecosystem Processes

Channelization and reservoir construction on the main stems of the small rivers work in concert with each other to alter channel morphology and hydrology. This often converts relatively shallow moving water habitat into deep, slow-moving or still water habitats. Reservoir construction reduces flows below the impoundments during drought periods as well as reducing the magnitude of seasonal and periodic flooding events while facilitating the channelization of rivers. This creates a more incised channel that becomes disconnected from its riparian zone and flood plain. Removing riparian vegetation negatively affects bank stability, and the loss of wetlands adjacent to the channel eliminates foraging and nesting habitat for shorebirds and wading birds. Wetland loss also leads to flashier flow conditions where the water volume rises and falls more quickly during and after rainfall events. Reservoirs also may block the downstream movement of gravel and sand, making the substrate below reservoirs coarser over time. The upstream dispersal and movement of aquatic organisms can be impacted by reservoirs, fragmenting and isolating upstream populations from those downstream. Dams on tributaries and surface water diversions also cause reductions in base and peak flows that shape and maintain in-stream habitats and channel structure.

Dams, low-water road crossings, diversion structures, and bridges can further impede the upstream movement of fish and other aquatic wildlife, alter the natural stream hydrology, and degrade in-stream habitats. Additionally, the construction of ponds and impoundments on stream tributaries and ephemeral drainages may be reducing the inflow that sustains streams.

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. Sand or gravel mining operations further alter the structure of the river channel and in-stream habitats. This further contributes to bank instability.

Groundwater withdrawal from the shallow aquifers and alluvia below streams and 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 a stream's surface flow will cease during drought conditions. 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. Water that is pumped from streams, especially during drought and low flow periods, diminishes stream flow and alters riparian hydrology. Existing water laws and permitting processes may allow for water withdrawals during periods of low flow that are excessive in the volume compared to the water in the base flow at that time. The need for water for irrigation, municipal use, and oil and gas production contributes to the reduction of water quantity and alteration of flow patterns.

Conservation Actions

- Conduct management-oriented research and pilot studies to determine the pattern and rate of flow needed to meet the ecological needs of the SGCN 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.
- 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. Incorporate ecological flow needs into the permitting process for water withdrawals. 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.
- 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 adequate ecological flow provisions for each of the small rivers that support populations of SGCN.
- Provide financial and technical support to landowners, conservation districts, and municipalities who are willing to restore the morphology of river channels, create and maintain riparian buffer zones, and restore flood plain wetlands on small rivers as well as their stream tributaries and headwaters.
- Encourage the development of alternative water sources (windmills or solar pumps with stock tanks) to prevent livestock from entering streams directly for water. Discourage the development of impoundments on streams and educate ranchers about alternative ways to provide water for their livestock.
- Increase funding for and landowner acceptance of Farm Bill conservation practices that protect riparian areas from grazing, haying, or cropping.
- Acquire conservation easements on 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.
- 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.
- 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

Leonora's dancer. Photo by Bob Nieman CC-BY 4.0.

The U.S. Forest Service renovated a 1950s-era crossing on Cedar Creek to allow for a more free-flowing river and fish and freshwater mussel communities. Photo by Joe Vacirca/ USFS.

barriers to fish passage.
- Provide the results of ecological studies to water use planners and encourage their incorporation into water management plans and permitting processes.
- Encourage water conservation and support research into methods for conserving water including the recycling of gray water for uses such as irrigation.
- Ensure that sound biological data, which demonstrates the ecological impacts of water sales, water withdrawals, and inter-basin transfers of water, are incorporated into the Oklahoma Water Management Plan.
- Remain involved with existing recharge rate studies to determine the sustainability of aquifers and springs that support fish and wildlife. Research the efficacy and ecological consequences of pumping water from reservoirs into aquifers as a means of recharging them.
- Delineate the recharge areas for biologically important springs and seeps to protect water quantity. Use conservation easements or fee-title acquisition to place springs and their recharge areas under conservation management to maintain groundwater to sustain surface flows at springs.
- Discourage the development of additional reservoirs that would affect the flow regimes of small rivers that provide important habitat for SGCN.
- 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 to reduce the incentives to armor banks and modify river channels to protect these structures.
- Increase awareness of the existing regulations and encourage the development of new regulations that restrict or prohibit channel modifications, in-stream gravel and sand mining, and dredging.
- Restore, enhance, or create seasonal wetlands or vernal pools to hold storm water and slowly release it to the river to limit development within sensitive floodplains and improve habitat conditions for wildlife SGCN.
- Discourage the pumping of water from shallow aquifers underlying streams and springs that support aquatic SGCN.
- 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.
- Manage the timing and volume of 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.
- Work with local communities and counties to reduce stream channel impacts including in-stream gravel mining, placement of riprap on stream banks at bridge crossings, and recreational use of streams by off-road vehicles.

Conservation Issue: Pollution and Sedimentation

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. This may contribute to the sedimentation of in-stream habitats. The further removal of riparian vegetation and its conversion to pastureland is detrimental to some SGCN as it reduces structure or cover along the riverbanks, reduces bank stability and reduces the shading of water which can alter water temperature. Further, the 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.

Some agricultural practices, including land application of animal wastes, inadequate control of runoff from fertilized fields, and concentrations of livestock, as well as residential areas and municipalities located near streams and small rivers can contribute excessive amounts of nutrients through storm water runoff that can lead to algal blooms or high fluctuations in dissolved oxygen concentrations.

Green heron. Photo by Stephen Ofsthun.

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.

Landowners and livestock operators sometimes modify springs by adding concrete structures or constructing small impoundments over the spring to facilitate cattle watering. Cattle loafing and drinking in springs can increase turbidity, modify substrates, reduce aquatic vegetation, and increase nutrients that favor increased algal growth.

In the northeastern corner of the state, the water quality and instream 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.

Water quality in small rivers is sometimes reduced by discharges of herbicides, nitrates, endocrine disruptors, and oil field pollution chemicals that may cause fish kills or impact survival or reproductive success of aquatic populations. Wetlands within river and stream floodplains have been filled or drained to create land that is suitable for agricultural and residential purposes and are not able 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 shorebirds.

Heavy recreational use may compact gravel bars, disturb mussel beds, alter channel structure via the removal of stabilizing woody debris, and cause the local loss of riparian vegetation. Additionally, the presence of people on the river can be a disturbance to some wildlife species and recreational activities often are accompanied by trash, some of which can be detrimental to a broad range of wildlife species.

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.
- 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.
- Provide cost-share funding to landowners to develop alternate water sources and fencing to keep livestock out of riparian areas.
- 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.
- 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.
- Support existing point-source and non-point-source pollution abatement efforts.
- Acquire conservation easements or fee-title to land in headwaters and 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.
- Develop local watershed-based citizen groups or river teams to address local concerns and monitor water quality and wildlife populations. Similar to what the Oklahoma Conservation Commission has established with the Blue Thumb stream monitoring program.
- Increase funding for the Agricultural Conservation Easement Program and increase the emphasis placed on enrolling acreage and restoring habitat in flood plains.
- 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 consistently available.
- Support research to develop a better understanding of the effects of water quality degradation, riparian degradation, in-stream flow alteration, and endocrine

disruptors on SGCN. 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 to conserve SGCN.

- Work with ranching groups 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 federal agencies to identify priority reaches and encourage landowners to enroll riparian areas into riparian buffers and conservation easements through landowner incentive programs.
- Increase the number of sites at which water quality is monitored so that multiple sites are monitored in all 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.
- 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 studies to evaluate both the negative impacts and positive benefits of recreation activities on fish and wildlife populations. Where negative impacts are found, develop recommendations to reduce these using a combination of education and regulations. Where positive benefits are found, use these to advance conservation education and habitat conservation.
- Establish set-back distances between streams and confined animal feeding operations, waste lagoons, and land application areas.

Non-native yellow flag iris near Norman, Oklahoma. Photo by Amy Buthod/CC-BY-NC.

Conservation Issue: Invasive and Problematic Species

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 eastern redcedar, saltcedar (*Tamarix sp.*), Ravenna grass (*Saccharum ravennae*), giant reed (*Arundo donax*) and Russian olive (*Elaeagnus angustifolium*). These plants displace more beneficial native vegetation, compete with native plants for water and have unnaturally altered the structure and density of riparian areas. Other plants, including Japanese honeysuckle (*Lonicera japonica*), johnsongrass (*Sorghum halpense*), yellow flag iris (*Iris pseudoacorus*), sericea lespedeza (*Lespedeza cuneata*), and Chinese and Japanese privet (*Ligustrum sp.*), have become established in riparian areas where they displace native plants and alter habitat conditions. Additionally, 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. The spread of common reed (*Phragmites australis*) is an emerging issue along streams and rivers in central and western Oklahoma. Common reed now forms long monocultures along some streams and rivers that constrain and modify the stream or river channel. It is uncertain whether these monocultures are created by native populations of common reed or plants with Eurasian or cultivated genetics.

Some invasive or over-abundant wildlife species such as feral hogs (*Sus scrofa*) and brown-headed cowbirds (*Molothurus ater*) 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 native birds and mammals. Cowbirds lay their eggs in the nests of migratory songbirds many of which are poorly adapted to raise cowbird chicks along with their own chicks.

Some agencies, organizations, and businesses still promote non-native and invasive plants for erosion control, livestock forage, beautification programs, and wildlife habitat. Invasive aquatic plants further reduce the diversity and stability of aquatic and riparian communities. Eurasian water milfoil (*Myriophyllum spicatum*) and parrot feather water milfoil (*Myriophllum aquaticum*) are likely to spread into small rivers unless control measures are implemented.

Common carp. Photo by Sam Stukel/USFWS.

The unintentional introduction of fish from other river systems, including the introduction of Red River pupfish (*Cyprinodon rubrofluviatilis*) from the Red River to tributaries of the Arkansas River, threatens native fish populations. Non-native fishes such as common carp (*Cyprinus carpio*), silver carp (*Hypophthalmichthys molitrix*), bighead carp (*Hypophthalmichthys nobilis*), and grass carp (*Ctenopharyngodon idella*) can reduce aquatic vegetation and compete for food with juvenile fish and mussel SGCN. Zebra mussels (*Dreissena polymorpha*) have become established in Oklahoma reservoirs and have spread into river and stream channels where they alter food and habitat for aquatic animal populations. Invasive invertebrates such as European earthworms (*Lumbricus sp.*), 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

- Financially support programs that help control invasive species and educate the public about the negative consequences of non-native species and the inter-basin movement of fish and aquatic invertebrates through bait bucket introductions and other live releases.
- Invasive species are most effectively controlled when they first enter a habitat and before they become established. Develop early detection surveillance programs for invasive species and work with the Oklahoma Invasive Plant Council and OSU Extension Service to develop and promote educational materials to help landowners and sportsmen identify and report potentially problematic species.
- Evaluate the severity and magnitude of the ecological damage done by non-native plant and animal species to identify those species causing the greatest impact on SGCN. Then develop control or management plans for those species, including herbicide treatment and mechanical removal. Then, develop monitoring programs to measure and evaluate the effectiveness of those measures.
- Provide financial incentives to private landowners to encourage them to participate in invasive species management programs.
- Conduct field studies to determine the factors responsible for the decreased level of eastern cottonwood regeneration in riparian areas.
- Coordinate with the NRCS and local conservation districts to disseminate information to private landowners, lessees and land management companies to discourage or stop the introduction of non-native and invasive plants.
- Increase educational efforts and public awareness of the ecological and economic impacts of non-native plant and animal populations including the unintentional consequences of bait bucket releases. Develop and distribute technical assistance materials to landowners and others concerning mechanisms for eradicating or managing invasive species.
- Continue educational programs that teach how to reduce the potential for spreading aquatic invasive plant and animal species.
- Modify erosion control recommendations to eliminate the planting of non-native species.
- Facilitate the establishment of demonstration plots showing successful techniques for the removal of saltcedar, Russian olive, and other riparian invasive species.
- 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.

Potential Indicators for Monitoring the Effectiveness of Conservation Actions

- Acres of riparian habitat restored
- Miles of river channel restored
- Changes in population sizes and trends for SGCN
- Changes in seasonal groundwater levels and rates of surface flow
- Changes in the number of miles of degraded streams
- Number of new local conservation groups and their effectiveness
- Number of mussel beds identified and protected
- 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
- Number of fish passage barriers removed or modified
- Number of springs restored and placed under conservation ownership or easement programs
- Adherence to water quality standards, including dissolved oxygen and nutrient parameters
- Stream and spring flow returning to a range of natural variation
- Public opinion toward conservation actions
- Creation of new local conservation groups
- Change in the number of active gravel and sand mining operations
- Changes in the relative condition and quantity of in-stream habitat like riffles, pools and gravel bars, and riparian habitats like riparian forests and sloughs
- Changes in hydrogeomorphic structure of river channels
- Changes in water quality parameters

Representative Conservation Areas Supporting Small Rivers and Streams

- Arbuckle Springs Wildlife Management Area (ODWC)
- Atoka Wildlife Management Area (ODWC)
- Barren Fork Wildlife Management Area (ODWC)
- Beaver's Bend State Park (Oklahoma State Parks Division)
- Black Kettle National Grassland (U.S. Forest Service)
- Blue River Public Fishing and Hunting Area (ODWC)
- Boiling Springs State Park (Oklahoma State Parks Division)
- Camp Gruber (Department of Defense)
- Camp Simpson (Scouting America)
- Cherokee Wildlife Management Area (ODWC)
- Chickasaw National Recreation Area (National Park Service)
- Chouteau Wildlife Management Area (ODWC and ACOE)
- Coalgate City Lake (City of Coalgate)
- Cookson Wildlife Management Area (ODWC)
- Copan Reservoir and Wildlife Management Area (ODWC and ACOE)
- Cross Timbers Range Research Station (Oklahoma State University)
- Cucumber Creek Preserve (The Nature Conservancy)
- Deep Fork National Wildlife Refuge (USFWS)
- Deep Fork Wildlife Management Area (ODWC)
- Dripping Springs and Okmulgee Lake State Parks (Oklahoma State Parks Division)
- Eufaula Wildlife Management Area (ODWC and ACOE)
- Fort Supply Reservoir and Wildlife Management Area (ODWC and ACOE)
- Gary Sherrer Wildlife Management Area (ODWC)
- Grassy Slough Wildlife Management Area (ODWC)
- Heyburn Reservoir and Wildlife Management Area (ODWC and ACOE)
- Hickory Creek Wildlife Management Area (ODWC)
- Hugo Reservoir and Wildlife Management Area (ODWC and ACOE)
- Hulah Reservoir and Wildlife Management Area (ODWC and ACOE)
- James Collins Wildlife Management Area (ODWC)
- Kerr Scout Ranch (Scouting America)
- Lake Bixhoma Park (City of Bixby)
- Lake Eucha (City of Tulsa)
- Lake Murray State Park (Oklahoma State Parks Division)
- Little River National Wildlife Refuge (USFWS)
- Martin Park Nature Center (City of Oklahoma City)
- McCurtain County Wilderness Area (ODWC)
- McGee Creek Wildlife Management Area (ODWC and Bureau of Reclamation)
- McGee Creek State Park and Scenic Area (Oklahoma State Parks Division and Bureau of Reclamation)
- Mohawk Park (City of Tulsa)
- J.T. Nickel Family Wildlife Preserve (The Nature Conservancy)
- Okmulgee Wildlife Management Area (ODWC)
- Oologah Reservoir and Wildlife Management Area (ODWC and ACOE)
- Ouachita National Forest Le Flore, Broken Bow, and Tiak Units (U.S. Forest Service)
- Oka'Yanahli Preserve (The Nature Conservancy)
- Osage Hills State Park (Oklahoma State Parks Division)
- Ozark Plateau National Wildlife Refuge (USFWS)
- Ozark Plateau Wildlife Management Area (ODWC)
- Pearl Jackson Cross Timbers Preserve (The Nature Conservancy)
- Pine Creek Reservoir and Wildlife Management Area

Alligator gar at the Tishomingo National Fish Hatchery. Photo by ODWC.

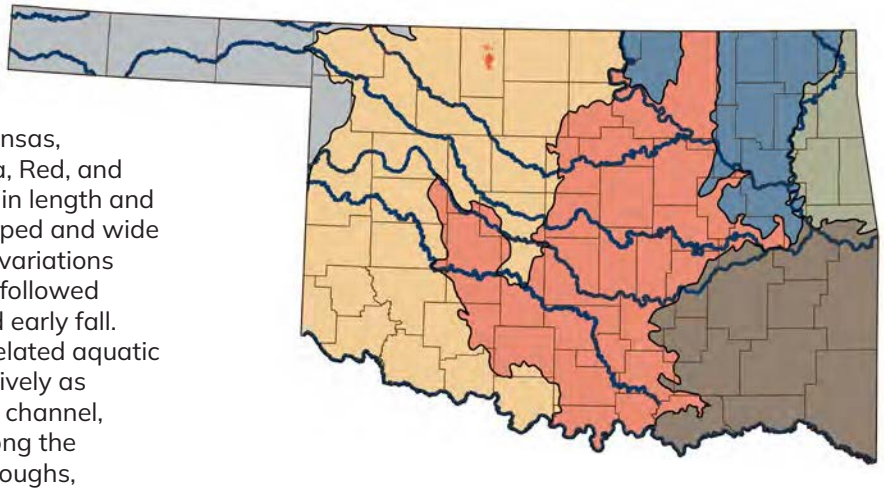
(ODWC and ACOE)
- Pontotoc Ridge Preserve (The Nature Conservancy)
- Pushmataha Wildlife Management Area (ODWC)
- Robbers Cave State Park (Oklahoma State Parks Division)
- Robbers Cave Wildlife Management Area (ODWC)
- Sandy Sanders Wildlife Management Area (ODWC)
- Sans Bois Wildlife Management Area (ODWC)
- Sardis Reservoir (ACOE)
- Skiatook Wildlife Management Area (ODWC, ACOE)
- Spavinaw Hills Wildlife Management Area (ODWC)
- Spavinaw Reservoir (City of Tulsa)
- Stillwell City Lake (City of Stillwell)
- Tallgrass Prairie Preserve (The Nature Conservancy)
- Waurika Wildlife Management Area (ODWC and ACOE)
- Wichita Mountains Wildlife Refuge (USFWS)
- Wister Reservoir and Wildlife Management Area (ODWC and ACOE)
- Woodward Park (City of Tulsa)
- Yourman Wildlife Management Area (ODWC)

Large Rivers

Canadian River at The Nature Conservancy's Four Canyon Preserve. Photo by ODWC.

Large Rivers Habitat

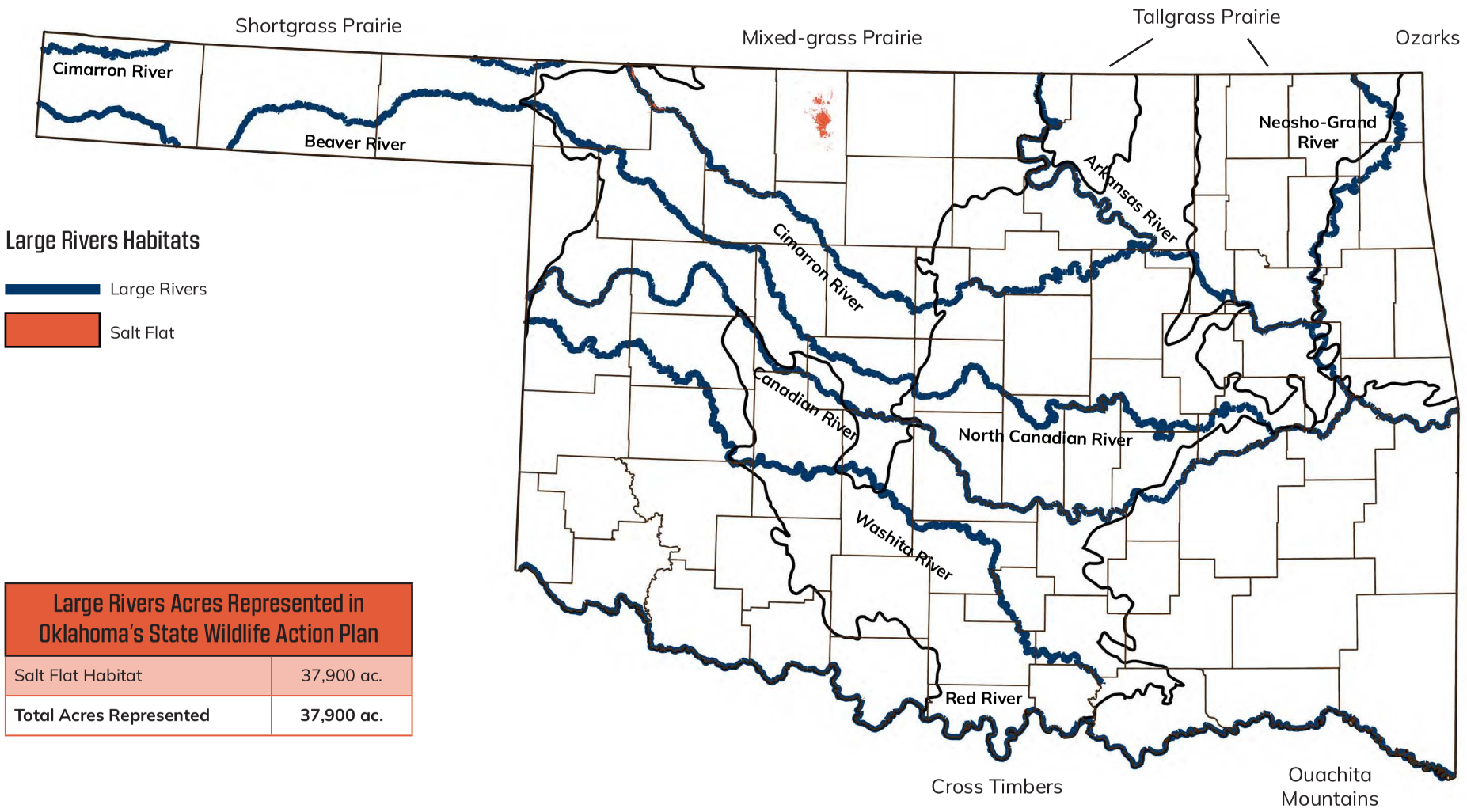
Seven rivers have been classified as Large Rivers Habitat for the purposes of the Oklahoma State Wildlife Action Plan: the Arkansas, Cimarron, North Canadian, Canadian, Washita, Red, and Neosho-Grand rivers. Each exceeds 150 miles in length and has a very large drainage basin, a well-developed and wide flood plain, and most have dramatic seasonal variations in the flow rates with peak flows in the spring followed by extremely low flows in the late summer and early fall. Associated with these rivers are several interrelated aquatic and terrestrial habitats that are treated collectively as one system. Aquatic habitats include the main channel, side channels, backwaters, shallow waters along the shoreline, submerged sandbars, off-channel sloughs, and shallow water wetlands within the river flood plain. Terrestrial habitats include shorelines, exposed sandbars, mudflats, and early-succession riparian communities along shifting riverbanks such as willow thickets and sedge-rush associations. These aquatic and terrestrial habitats are influenced by and can be dependent upon seasonal fluctuations in flow, periodic flooding, and scouring. Therefore, many of these habitats are spatially ephemeral and their distributions shift over time.



Large Rivers occur in all Oklahoma ecoregions.

Five of the large rivers, the Arkansas, Cimarron, North Canadian, Canadian, and Neosho-Grand rivers, connect to form the Arkansas River system that drains approximately the northern two-thirds of Oklahoma. The Arkansas River system also drains southwestern Missouri, the southern one-third of Kansas, southeastern Colorado, northeastern New Mexico, and the northern half of the Texas Panhandle. The remaining two rivers, the Washita and Red rivers, form the Red River system that drains the southern one-third of Oklahoma as well as a small part of northern Texas. Both the Arkansas River and Red River systems are western tributaries of the Mississippi River and share many of the same fish and invertebrate species.

As a general trend, Large River Habitat water quality has been improving since the end of the reservoir construction period between the 1940s and 1960s when large



Large Rivers Acres Represented in Oklahoma's State Wildlife Action Plan	
Salt Flat Habitat	37,900 ac.
Total Acres Represented	**37,900 ac.**

impoundments were constructed on most of Oklahoma's large rivers. The enactment of the Clean Water Act in 1972, and subsequently a 1977 amendment to the Act to regulate the discharge of untreated wastewater from municipalities and industries into rivers has also contributed to overall water quality improvement from the late 1900s into the twenty-first century. But water quantity has been declining due to water diversions and withdrawals from impoundments on the rivers themselves as well as 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 system have diminished in abundance and quality as a result of changes in seasonal flow rates and flood event magnitudes. Habitats that are most affected are the disturbance-dependent habitats such as sand bars, mud flats and sloughs.

Arkansas River. Photo by Randall Opper.

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 System, and Robert S. 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, Caney, Verdigris, and Illinois.

The downstream portion of the Arkansas River differs from the other large rivers in that it has been severely modified by a series of low dams to create the McClellan-Kerr Navigation System. These modifications have resulted in an increase in deep, slow-flowing water habitat which has altered the historic fluctuation in flow rates and the magnitude of flood events. Such alteration has diminished the abundance and condition of ephemeral habitats like sandbars. Additionally, the banks along this portion of the river are more stable and thus support mature riparian forests that are typically absent along the less altered, shifting and dynamic river channel upstream.

Canadian River. Photo by ODWC.

The **Cimarron, North Canadian, and Canadian rivers** are similar in that each river originates within or near the Rocky Mountains and flows from west to east through the High Plains and into the Cross Timbers Ecoregion of Oklahoma. Each river has a long, narrow watershed that encompasses portions of the Shortgrass Prairie, Mixed-grass Prairie and Cross Timbers ecoregions, 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 summer months, surface flow often ceases in the upstream portions of each river, triggering downstream seasonal movements by many aquatic species. Additionally, much of the flow in the upper reaches of the Cimarron and North Canadian rivers in the Oklahoma panhandle is subsurface with only sporadic surface flow. These rivers have varying degrees of shallow, braided channel structure, being particularly prominent in the Cimarron and Canadian rivers in the western one-half of Oklahoma. In all three rivers, the braided structure diminishes toward a single-channel structure as these rivers flow east and their volume increases. Each river has been modified to some extent by reservoir construction. The **Cimarron River** 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 the Conchas Reservoir and Ute Reservoir in eastern New Mexico. It is impounded again in the Texas panhandle to form Meredith Reservoir. The river flows freely through most of Oklahoma until it reaches Eufaula Reservoir, which impounds it a few miles upstream from its confluence with the Arkansas River.

Cimarron River. Photo by Darrin Hill/ODWC.

The **Washita River** is comprised of 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 Cross Timbers ecoregions. It is impounded by Foss Reservoir in western Oklahoma 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.

The **Red River** delineates the southern boundary of Oklahoma and drains the southern one-third of the state. 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 rivers. The upper portion of 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 than the other large rivers in the state. The Red River originates in the Texas panhandle, and, like the Cimarron and Canadian rivers, the upper reach of the Red River has a shallow, braided channel morphology that transitions to a single channel as its base flow increases downstream. Additionally, surface flows often 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 reservoir dam creates a substantial barrier to the upstream movement of fish.

Red River. Photo by Jim Burroughs.

Neosho River. Photo by Jason Schooley/ODWC.

The **Neosho-Grand River** originates as the Neosho River in the tallgrass prairies of eastern Kansas and joins the Spring River within 25 miles of entering Oklahoma, becoming the Grand River. It then flows southward to its confluence with the Arkansas River east of Muskogee, Oklahoma. This watershed drains the eastern portion of Oklahoma's Tallgrass Prairie Ecoregion and the northern one-half of Oklahoma's Ozark Ecoregion in addition to portions of southwestern Missouri and southeastern Kansas. Historically, the Neosho-Grand River was deep and swift-moving but has been modified by the construction of three reservoirs – Grand Lake O' the Cherokees, Hudson Reservoir, and Fort Gibson Reservoir – which have inundated most of the river's length in Oklahoma. This large river's habitat is comprised of the three impoundments, the remaining river channel that connects these impoundments, and the seasonally flooded areas along the river and reservoirs.

Salt Flats Habitat

Associated with Oklahoma's large rivers are Salt Flats Habitat. In Oklahoma, salt flats represent floral and faunal communities typically occurring as patches within a matrix of oligohaline, mesohaline, or polyhaline marshes and riverbank. These habitats accumulate salt through evaporation of seasonal flooding inputs of high salinity water, or when the shallow water table seeps through sandy soils to the surface and evaporates, leaving vast salt deposits behind. Salt flats can be quite ephemeral and may appear or disappear rapidly as marshes change and prairie river channels migrate and become braided. Dynamic subsurface water tables also contribute to the ephemeral nature of Oklahoma's Salt Flat Habitats.

Oklahoma salt flats are generally devoid of vegetation, but the plant community at the fringes of salt flats is comprised of a unique diversity adapted to saline conditions. Species such as prairie cordgrass (*Spartina pectinata*), seashore saltgrass (*Distichis spicata*), alkali sacaton (*Sporobolus airoides*), eastern annual saltmarsh aster (*Symphyotrichum subulatum*), Trans-Pecos sea lavender (*Limonium limbatum*), and willow baccharis (*Baccaris salicina*) are common near the edges of inland salt flats and contribute to the resilience of wetlands in the face of high-saline water intrusion. Invasive plant species such as saltcedar (*Tamarix sp.*) are a major threat to the structure and quality of salt flats and negatively impact available foraging and nesting habitat for migratory birds. Salt flats provide periodic shallow pools of standing water that produce thousands of invertebrates and large expanses of algae mats, which are important food sources for migratory shorebirds. Nesting birds such as snowy plover (*Anarhynchus nivosus*) and least tern (*Sternula antillorum*) utilize this habitat to dig out a small cup in the

A salt flat on the Cimarron River at Cimarron Hills Wildlife Management Area. Photo by ODWC.

Salt Plains Crystal Digging Area. Photo by Megan Childers.

sand to serve as a nest and their eggs are camouflaged with the sand to prevent predation.

Salt Plains National Wildlife Refuge in Alfalfa County is considered the largest inland expanse of salt flats east of the Rocky Mountains. The salt flats encompass approximately 32,000 acres and are bordered to the east by the Great Salt Plains Reservoir, which is about 8,700 surface acres of impounded water when full. The salt flats are also transected by several streams: the West Branch of the Salt Fork of the Arkansas River, Cottonwood Creek, Clay Creek, and Spring Creek.

The Salt Plains flats are believed to be the remnants of a prehistoric sea. Scientists believe that salt was deposited during repeated water level rises of a shallow sea millions of years ago. The ongoing supply of salt is kept intact by saline groundwater that flows just a few feet below the surface and continually seeps through the sandy soils to the surface, where upon evaporation, the salt is left behind.

Other major areas of inland salt flats are also found on the Arkansas River system along the Cimarron River and its tributaries. These include Big Salt Plain found in portions of Woods, Woodward and Harper counties. This significant flat encompasses about 4,300 acres in the vicinity and upstream of the confluence of Buffalo Creek and the Cimarron River. Approximately 6 miles further upstream in Woods County lies the Little Salt Plain. This smaller flat encompasses approximately 1,600 acres and is just west of the Cimarron Hills Wildlife Management Area. During summer months, much if not all of surface flows on both sections of this unique, braided river often reduce, with flows becoming subterranean.

Three other documented salt flats exist within the Arkansas River system but on a much smaller scale (Salt Creek Canyon Salt Plain, Okeene Salt Plain, and Drummond Salt Plain). Within the Red River drainage system, seven additional salt flats (Salton, Robinson, Kiser, Boggy Creek and Sandy Creek) of similar size are found, all in southwest Oklahoma.

Large Rivers
Species of Greatest Conservation Need

Species	Status NatureServe Rankings: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NR = Unranked; H = Possibly Extirpated	Ecoregion						Habitat	
		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Large Rivers	Salt Flats
AMPHIBIANS									
Red River Mudpuppy *Necturus louisianensis*	**Global Status: G4; State Status: NR.** Rare and locally occurring in large rivers, streams, and weedy ponds in the eastern one-third of Oklahoma.					•	•	•	
BIRDS									
Snowy Plover *Anarhynchus nivosus*	**Global Status: G3; State Status: S3.** Rare and locally occurring during the breeding season on sand bars and scoured bends on the Cimarron, Canadian, and Red rivers in central and western Oklahoma.		•		•			•	•
Green Heron *Anarhynchus nivosus*	**Global Status: G5; State Status: S2.** Uncommon summer breeding season migrant to Oklahoma. Secretive and often solitary on shorelines of rivers, streams, and ponds.		•	•	•	•	•	•	
Baird's Sandpiper *Calidris bairdii*	**Global Status: G5; State Status: NR.** Common spring and fall migrant through Oklahoma. Prefers to rest and forage on mudflats, shores, and flooded crop fields.	•	•	•	•			•	•
Red Knot *Calidris canutus*	**Global Status: G4; State Status: S1.** Federally listed as threatened. Rare migrant usually flying over Oklahoma with few records of birds stopping to rest on river or reservoir shorelines.		•	•				•	•
White-rumped Sandpiper *Calidris canutus*	**Global Status: G5; State Status: S3.** Common late spring migrant through Oklahoma, rarely seen in fall migration. Prefers shorelines, mudflats, and flooded crop fields.		•	•	•	•	•	•	•
Stilt Sandpiper *Calidris himantopus*	**Global Status: G5; State Status: S3.** Common spring and fall migrant through Oklahoma. Usually found on mudflats of rivers and flooded crop fields.		•	•	•		•	•	•
Pectoral Sandpiper *Calidris melanotos*	**Global Status: G5; State Status: NR.** Common spring and fall migrant through Oklahoma. Prefers foraging in wet grasslands, mudflats, and flooded crop fields or pastures.		•	•	•	•	•	•	•
Semipalmated Sandpiper *Calidris pusilla*	**Global Status: G5; State Status: NR.** Common spring and fall migrant through Oklahoma. Often found in large flocks using shorelines and marshes with shallow water.	•	•	•	•	•	•	•	•
Buff-breasted Sandpiper *Calidris subruficollis*	**Global Status: G4; State Status: S3.** Uncommon spring and fall migrant through the central one-third of Oklahoma. Prefers mudflats and wetlands as stopover habitats.		•	•	•		•	•	

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		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Large Rivers	Salt Flats
Piping Plover *Charadrius melodus*	**Global Status: G3; State Status: NR.** Federally listed as threatened. Rare statewide spring and fall migrant that uses sandbars and mudflats statewide as feeding areas.		•	•	•		•	•	•
Little Blue Heron *Egretta caerulea*	**Global Status: G5; State Status: NR.** Locally common summer resident in the eastern two-thirds of Oklahoma. Often nests in colonies with other species of herons and egrets.		•	•	•	•	•	•	
Whooping Crane *Grus americana*	**Global Status: G1; State Status: S1.** Federally listed as endangered. Rare spring and fall migrant in the western one-half of Oklahoma. Birds use shallow river channels and sandbars as roosting habitat.	•	•	•	•			•	
Black Rail *Laterallus jamaicensis*	**Global Status: G3; State Status: S1.** Rare summer breeding resident in Oklahoma. Likely to breed in shallow floodplain wetlands along the Cimarron River and other rivers in northwestern Oklahoma.	•	•		•		•		•
Short-billed Dowitcher *Limnodromus griseus*	**Global Status: G3; State Status: S1.** Uncommon spring and fall migrant through Oklahoma. Prefers mudflats and flooded crop fields for resting and foraging.	•		•	•		•	•	
Long-billed Dowitcher *Limnodromus scolopaceus*	**Global Status: G5; State Status: NR.** Common spring and fall migrant through Oklahoma. Prefers to rest and forage on mudflats and shallow pools.	•	•	•	•	•	•	•	
Marbled Godwit *Limosa fedoa*	**Global Status: G5; State Status: S2.** Uncommon spring and fall migrant through the western two-thirds of Oklahoma. Prefers prairies, pools, and shorelines.	•	•	•	•			•	
Hudsonian Godwit *Limosa haemastica*	**Global Status: G4; State Status: S2.** Uncommon spring migrant through the eastern three-quarters of Oklahoma. Prefers shallow water, side channels and floodplain wetlands as foraging areas.		•	•	•	•	•	•	
American Golden-Plover *Pluvialis dominica*	**Global Status: G5; State Status: S2.** Common spring and fall migrant through Oklahoma. Prefers mudflats and shorelines as stop over and feeding habitats across the main body of the state.	•	•	•	•	•	•	•	
Black-bellied Plover *Pluvialis squatarola*	**Global Status: G5; State Status: S2.** Uncommon spring and fall migrant through Oklahoma. Forages on mudflats and shorelines.	•	•	•	•		•	•	•
Horned Grebe *Podiceps auritus*	**Global Status: G4; State Status: S3.** Uncommon migrant through Oklahoma, with some winter residents in the southeastern one-quarter of the state. Prefers large open water and reservoirs.		•	•	•	•	•	•	
King Rail *Podiceps auritus*	**Global Status: G4; State Status: S1.** Rare summer resident that nests very locally in herbaceous wetlands and sloughs along river channels in central and eastern Oklahoma.		•	•	•		•	•	
Least Tern *Podiceps auritus*	**Global Status: G4; State Status: S2.** Uncommon summer resident along the Arkansas, Cimarron, Canadian, and Red rivers in Oklahoma. Nests locally in small colonies on islands and sandbars.		•	•	•	•	•	•	•

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		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Large Rivers	Salt Flats
Lesser Yellowlegs *Podiceps auritus*	**Global Status: G5; State Status: NR.** Common spring and fall migrant through Oklahoma. Prefers marshes, mudflats, and shoreline habitat.	•	•	•	•	•	•	•	
Greater Yellowlegs *Podiceps auritus*	**Global Status: G5; State Status: NR.** Common spring and fall migrant through Oklahoma. Prefers marshes, mudflats, and shoreline habitat.	•	•	•	•	•	•	•	
Willet *Tringa semipalmata*	**Global Status: G5; State Status: S3.** Uncommon spring and fall migrant through Oklahoma. Interior prairie population prefers marshes, mudflats, and wet meadow or pasture habitats.	•	•	•	•	•	•	•	
Bell's Vireo *Tringa semipalmata*	**Global Status: G5; State Status: S3.** Uncommon summer breeding resident in Oklahoma. Nests in willow thickets in the riparian zone adjacent to the large rivers in central and western Oklahoma.	•	•	•	•	•	•	•	
FISH									
Red River Shiner *Alburnops bairdi*	**Global Status: G4; State Status: S3.** Common and widespread in large Oklahoma rivers. Endemic to the Red River, but has been introduced into the Cimarron River. Prefers shallow, sandy waters with low flow.		•		•		•	•	
Arkansas River Shiner *Alburnops girardi*	**Global Status: G2; State Status: S1.** Federally listed as threatened. Current distribution is the Canadian River above Eufaula Lake. Extirpated from the Arkansas River in Oklahoma. Prefers the downstream side of large transverse sand ridges in rivers and streams.		•		•			•	
Chub Shiner *Alburnops potteri*	**Global Status: G4; State Status: NR.** Locally common but restricted to the main stem of the Red River across southern Oklahoma. Prefers flowing water with silt or sand substrate and is tolerant of high salinities.		•		•		•	•	
Alabama Shad *Alosa alabamae*	**Global Status: G2; State Status: S2.** Likely extirpated from Oklahoma. Anadromous and historically migrated up the Red and Arkansas rivers in the summer to spawn in tributary streams.					•	•	•	
Western Sand Darter *Ammocrypta clara*	**Global Status: G3; State Status: S2.** Locally common in the Red River downstream from Lake Texoma. Prefers sandy substrate where it buries into the sand in moderate to slow flows.				•		•	•	
Scaly Sand Darter *Ammocrypta vivax*	**Global Status: G5; State Status: S2.** Locally common in the lower Red River and its tributaries in slow flowing waters.				•		•	•	
Alligator Gar *Atractosteus spatula*	**Global Status: G3; State Status: S1.** Uncommon resident of the Red River in the eastern one-half of the state including Lake Texoma, and a rare resident of the eastern one-quarter of the Arkansas River. Requires inundated floodplain habitat to successfully spawn and hatch eggs.				•		•	•	
Blue Sucker *Cycleptus elongatus*	**Global Status: G3; State Status: S2.** Uncommon and difficult to detect due to its affinity for deeper water. Present in the Red, Kiamichi, Arkansas, and Grand rivers. Most robust population inhabits the Red River below Lake Texoma, including the Muddy Boggy and Kiamichi tributaries.				•	•	•	•	

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Bluntface Shiner *Cyprinella camura*	**Global Status: G5; State Status: S1.** Uncommon and locally occurring in unimpounded portions of rivers from the Chikaskia in northcentral Oklahoma to the Neosho-Grand River further east. Prefers riffle and run habitat that maintains sufficient flow throughout the summer months.			•	•	•		•	
Red River Pupfish *Cyprinodon rubrofluviatilis*	**Global Status: G5; State Status: S4.** Common and widespread in Oklahoma. Endemic to the Red River but have been introduced and become established in the Canadian and Cimarron rivers. Common in headwater streams of xeric grasslands in shallow waters where temperatures vary from 30-102 °F and salinity may exceed 3%.		•		•			•	
Chain Pickerel *Esox niger*	**Global Status: G5; State Status: NR.** Locally common in the Red River and tributaries in southeastern Oklahoma. Habitat includes vegetated lakes, swamps, and backwaters and quiet pools of creeks and rivers.						•	•	
Arkansas Darter *Etheostoma cragini*	**Global Status: G3; State Status: S1.** Locally common in two disjunct populations: northwest Oklahoma in the Cimarron River and spring creeks and pools, and northeast Oklahoma in the Neosho-Grand River system. Preferred habitat is spring-fed headwaters and creeks with cool, clear, shallow water, slow current, and herbaceous aquatic vegetation.	•	•	•		•		•	
Plains Minnow *Hybognathus placitus*	**Global Status: G4; State Status: S3.** Uncommon in large rivers in the western three-quarters of Oklahoma. Rangewide, declining in abundance. Rare or extirpated in many reaches of the Cimarron River in northwestern Oklahoma, where it once was historically abundant.	•	•	•	•			•	
Pallid Shiner *Hybopsis amnis*	**Global Status: G4; State Status: S1.** Uncommon in the lower Arkansas and Red rivers in the eastern one-third of Oklahoma. Prefers backwaters and side channels with low flows and quiet waters over sandy-silty bottoms, often near the ends of sand and gravel bars.				•	•	•	•	
Black Buffalo *Ictiobus niger*	**Global Status: G5; State Status: NR.** Uncommon but widespread in the eastern one-half of Oklahoma in the Grand, Arkansas, Cimarron, and Red rivers. Preferred habitat includes pools and backwaters, small to large rivers, and reservoirs.			•	•	•	•	•	
Ribbon Shiner *Lythrurus fumeus*	**Global Status: G5; State Status: S3.** Uncommon in the eastern one-third of Oklahoma. Habitat includes lowland headwaters, creeks, and small rivers, usually with low gradient and bottom of sand and silt or clay. Prefers clear, vegetated pools with little current over sand.				•	•	•	•	
Prairie Chub *Macrhybopsis australis*	**Global Status: G3; State Status: S2.** Uncommon and endemic to the upper Red River system upstream from Lake Texoma. This species occupies intermittent streams that may dry to isolated, salt-encrusted pools.		•		•			•	
Peppered Chub *Macrhybopsis tetranema*	**Global Status: G1; State Status: NR.** Considered extirpated from Oklahoma with most recent records from the mid 1900s. Historically occurred in the Arkansas River system in northwestern and northcentral Oklahoma.	•	•					•	
Peppered Shiner *Miniellus perpallidus*	**Global Status: G3; State Status: S2.** Rare in Red and Little River systems in Oklahoma. Preferred habitat includes pools and slow runs of warm, clear, small to medium rivers with gravel substrate, often in quiet water near vegetation.						•	•	

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Shorthead Redhorse *Moxostoma macrolepidotum*	**Global Status: G5; State Status: S2.** Uncommon and limited to the Grand River in northeastern Oklahoma. Prefers rocky pools, runs, and riffles of small to large rivers and impoundments.					•		•	
Neosho Madtom *Noturus placidus*	**Global Status: G2; State Status: S1.** Federally listed as Threatened. Rare and restricted to the Neosho River upstream from Grand Lake. Prefers moderately large, medium-gradient streams and moderate to strong flows. Usually found in fairly clear water under rocks in riffles with small, loosely packed gravel-pebble.					•		•	
River Darter *Percina shumardi*	**Global Status: G5; State Status: S3.** Uncommon in the Neosho-Grand River and the lower Arkansas River at Webbers Falls. Difficult to document due to occupying deep water.					•		•	
Flathead Chub *Platygobio gracilis*	**Global Status: G5; State Status: S2.** Very rare and limited to the headwaters of the Cimarron River near Black Mesa. Not documented in recent years and may be extirpated.	•						•	
Paddlefish *Polyodon spathula*	**Global Status: G4; State Status: S2.** Locally common in the Grand, Arkansas, Red and Cimarron rivers in the eastern one-half of Oklahoma. Adaptation to reservoirs has allowed for robust local populations.			•	•	•	•	•	
Shovelnose Sturgeon *Scaphirhynchus platorynchus*	**Global Status: G4; State Status: S1.** Rare in the Arkansas and Red rivers in the eastern one-half of Oklahoma. Difficult to detect due to small body size and preference for deep channels and embayments of large turbid rivers.			•	•	•	•	•	
INVERTEBRATES									
Consort Underwing *Catocala consors*	**Global Status: G3; State Status: NR.** Locally common in eastern half of Oklahoma. Prefers dry oak-hickory or oak-pine woodland or scrub with plentiful small hickories (especially after fire), often on sandy soils.			•	•	•	•	•	
Ghost Tiger Beetle *Ellipsoptera lepida*	**Global Status: G3; State Status: S4.** Uncommon and patchily distributed in the western half of Oklahoma. Narrow habitat requirements include dune crests, slopes, and interdunal bowls and requires deep, loose, well-drained, and sparsely vegetated sandy soils, within which larvae burrow 6.5-10 feet.	•	•	•	•			•	
Conchas Crayfish *Faxonius deanae*	**Global Status: G4; State Status: S3.** Locally common in the North Canadian (western) and Arkansas (eastern) rivers in Oklahoma. Prefers woody debris piles in sandy bottomed runs of creeks and rivers, and in small reservoirs. Burrows into substrate during dry periods.		•	•	•	•		•	
Crosstimbers Coil *Helicodiscus tridens*	**Global Status: G2; State Status: NR.** Historical records from river drift only. Recent dried tissue sample (2004) exists from the South Canadian River in Muskogee County, Oklahoma.				•	•		•	
Plain Pocketbook *Lampsilis cardium*	**Global Status: G5; State Status: NR.** Locally common in the Red and Neosho-Grand rivers in eastern Oklahoma. This generalist species is found in small streams to large rivers as well as reservoirs with mud, sand, and gravel substrates.					•	•	•	

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		Shortgrass Prairie	Mixed-grass Prairie	Tallgrass Prairie	Cross Timbers	Ozark Mountains	Ouachita Mountains	Large Rivers	Salt Flats
Neosho Mucket *Lampsilis rafinesqueana*	**Global Status: G1; State Status: S1.** Federally listed as endangered. Historical records from the Neosho-Grand River but likely extirpated now. Rare in the Illinois River system in eastern Oklahoma. Prefers shallow riffles and runs with a predominantly gravel substrate.					•		•	
Black Sandshell *Ligumia recta*	**Global Status: G4; State Status: S1.** Historical records (weathered shells) exist in the Grand River system in northeastern Oklahoma. Likely extirpated from Oklahoma.					•		•	
Washboard *Megalonaias nervosa*	**Global Status: G5; State Status: S2.** Uncommon locally in the Neosho-Grand and Caney rivers in northeastern Oklahoma, and in the Poteau and Kiamichi rivers in southeastern Oklahoma. A large river species living in the main channel and in some of the overbank areas of reservoirs, prefers areas with slow current with muddy to coarse gravel substrates, often in water up to 50 feet in depth.					•	•	•	
Two-step Flasher Firefly *Photinus dimissus*	**Global Status: G3; State Status: NR.** Historically uncommon in small isolated occurrences along riparian corridors, scattered throughout southern Oklahoma. This species is found in grasslands, meadows, pastures, and fields, often along wet muddy creeks, ephemeral streams, and rivers.				•		•	•	
Monkeyface Mussel *Theliderma metanevra*	**Global Status: NR; State Status: NR.** Locally common in the Neosho-Grand River in northeastern Oklahoma.					•		•	
REPTILES									
American Alligator *Alligator mississippiensis*	**Global Status: G5; State Status: S4.** Rare in the southeastern portion of Oklahoma. Locally common where established.						•	•	
Smooth Softshell *Apalone mutica*	**Global Status: G5; State Status: S5.** Common in the Arkansas, Cimarron, Canadian and Red rivers throughout Oklahoma. Prefers large rivers and streams, and also found in lakes, impoundments, and shallow bogs. Usually found in water with sandy or mud bottom and few aquatic plants.		•	•	•	•	•	•	
Spiny Softshell *Apalone spinifera*	**Global Status: G5; State Status: S5.** Common and widespread in all of the large rivers in Oklahoma. Preferred habitat includes large rivers, river impoundments, lakes, ponds along rivers, pools along intermittent streams, bayous, and oxbows. Usually present in waters with open sandy or mud banks and soft bottom.	•	•	•	•	•	•	•	
Western Alligator Snapping Turtle *Macrochelys temminckii*	**Global Status: G3; State Status: S2.** Federally proposed as threatened. Uncommon and occurs at low densities but broad distribution throughout the Red and Arkansas River systems. Reintroduced population expanding in the Washita River (Tishomingo NWR).			•	•	•	•	•	
River Cooter *Pseudemys concinna*	**Global Status: G5; State Status: S4.** Locally common and widespread in all of the large rivers in the eastern one-half of Oklahoma. Prefers streams with moderate current, abundant aquatic vegetation, basking sites, and rocky bottom.			•	•	•	•	•	

Large Rivers Conservation Issues and Actions

Conservation Issue: Information Gaps

Paddlefish. Photo by Sam Stukel/USFWS.

Distributional and ecological data are incomplete regarding many of the Species of Greatest Conservation Need (SGCN) that occupy the large rivers habitat. More complete data are needed to determine the population status and trend for many species, and more thorough evaluations are needed to determine various factors that limit population sizes or are responsible for apparent declines. Additionally, data are needed to determine management practices that may enhance SGCN, especially how populations respond to changes in flow rates. Knowledge of the historic patterns of seasonal flow, the structural condition of in-stream habitats, and the complete community composition found both historically and currently in each river is incomplete. Acquiring these missing data is challenging due to the complex nature of Large Rivers Habitat (deep water, extreme flow variation, and dynamic river morphology) and access to large rivers in a landscape dominated by private property.

Conservation Actions

- Conduct reviews of existing literature, technical reports, and museum records to evaluate the historic distributions, abundances, and habitat needs of SGCN. The validity of existing data should be verified before possible causes of suspected population declines or geographic range reductions or extensions are considered.
- Research the historic condition of large rivers and associated salt flats using historic literature, maps, and satellite imagery to evaluate the historic channel morphology, flow patterns, and water quality in order to develop a realistic and biologically meaningful target condition for habitat restoration, enhancement, and maintenance efforts.
- Conduct field surveys to assess the current distributions, abundances

Biologists conduct annual surveys for Arkansas River shiners. Photo by ODWC.

and habitat affinities of SGCN. The taxa in greatest need of survey effort are freshwater mussels and fish.
- Conduct ecological studies to evaluate factors responsible for population declines as well as targeted community surveys to assess the current distribution, status, and habitat needs of SGCN and use these data to identify the geographic areas where conservation efforts should be directed to provide the greatest benefit for these species. Taxonomic groups in greatest need of survey attention include freshwater mussels and fish.
- Identify optimal conditions for reproduction and recruitment of SGCN and develop strategies for their conservation and enhancement.
- Develop monitoring programs to measure and track the abundance and geographic range of SGCN and the condition of habitats on which they depend. Where applicable, link monitoring to existing efforts and coordination with conservation partners to ensure monitoring efficiency and decrease the potential for survey duplicability.
- Provide long-term funding to maintain databases to store and analyze distributional and ecological data for all SGCN. Make these data available to natural resource planners and conservation partners.
- Use historic literature and maps, in conjunction with present-day field studies, to evaluate the pre-settlement and current channel morphology, flow patterns, water quality, and water quantity of each of Oklahoma's seven large river systems.
- Investigate methods for restoring channel morphology and seasonal flow dynamics to improve habitat conditions for SGCN.
- Work with individual landowners to gain private land access to conduct biological inventories of large rivers and salt flats.

Conservation Issue: Habitat Alteration and Modification

Historically, our nation's valley bottoms were likely a complex network of flow-through wetlands with anastomosing channels vertically connected to the valley bottom-floodplain (Stage 0) which stored and slowly released precipitation and ground water, similar to a saturated sponge. The geomorphologies of large rivers and their tributaries have been altered by the combined effects of legacy activities such as widespread beaver removal, clear cutting, and agricultural development. These activities occurred rapidly across the landscape giving way to pervasive headcut erosion and the conversion to single-thread, incised channels.

Modification of these pre-disturbance wetlands resulted in volatile discharge and water temperature regimes, an overall loss of water table elevation, and an increase in stream power and sheer stress. It is this increased hydrologic energy that generates significant amounts of in-channel derived mobile bedload whereby laterally migrating channels actively carve out valley bottoms, leaving behind a simplified habitat condition. Systemic channel incision and the associated disconnection from historic floodplain surfaces is a common driver of the limiting factors negatively affecting many native aquatic species. Stage 0 is a relatively new perspective on lotic, gravel-bed systems in which proper hydrologic function, free from channel incision at the valley scale, represents the condition of greatest ecological benefit.

In addition, water diversions-withdrawal, blockage of sediment transport and reduction in peak flow rates by impoundments, dredging of sand and gravel, and the continued human development of historic floodplains are present-day activities that negatively affect aquatic ecosystems.

Reservoirs have been constructed on the main stems and major tributaries of Oklahoma's large rivers, primarily to reduce the magnitude of naturally occurring flood events and to protect human developments within river floodplains. These reservoirs alter the river's historic flooding frequencies and flow patterns, reducing the magnitude of small floods, especially the annual high-flow events that occur each spring and early summer, and can reduce flow rates during normal summer low-flow periods by holding back water. Reservoirs also reduce the amount of shallow, moving water and increase the amount of deep, still or slow-moving water immediately upstream of the dam.

Levees and dikes also 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

Least tern nest on Canadian River sandbar. Photo by ODWC.

them deeper and narrower. Rivers respond to channelization by attempting to restore natural meanders. In doing so, they erode the channelized banks which causes the deposition of sediment into the river. Upstream of dams and impounded waters, fine sediment from eroding streambanks can settle into gravel beds and riffles, which impairs their quality as spawning areas for fish and habitat for freshwater mussels. Conversely, downstream of dams, species that require shallow water conditions, like some shorebirds and some fish, have been negatively affected by the reduction in sediment transport and sand bar development that is caused by reservoir dams.

Grand Lake was formed by damming the Neosho-Grand River system. Photo by Tom Whipple.

Dams and water diversions also have altered the hydrology of the upper reaches of Oklahoma's large rivers and their tributaries. Dams alter the movement of sand, gravel, and other sediments within rivers by increasing their deposition within reservoirs. Over time, this alters the substrate below dams making these reaches rockier. Dams often impede or block the movement of fish within large rivers. These structures fragment and isolate fish populations and increase their risk of extirpation within some river reaches, especially when multiple dams are present in succession within a relatively short segment of river.

Withdrawal of water from rivers and reservoirs for irrigation and residential use has reduced water availability, and these withdrawals often have their greatest negative impact during periods of drought and high temperatures. 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. Further, the cumulative withdrawal of shallow groundwater beneath river flood plains in western Oklahoma can decrease surface flows, especially during the summer months. Maintaining an ecologically adequate in-stream flow that provides habitat for SGCN can be controversial because it may require reallocation of water from one user group to another. Minimal legal provisions exist to establish and maintain biologically acceptable ecological flows in Oklahoma's large rivers.

A once-proposed desalinization project in the Red River system to provide additional municipal water capacity for growing metropolitan developments would reduce water quality for the fish that are 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.

Recreational use of river channels and riverbeds by off-road and all-terrain vehicles can create local erosion and sedimentation problems. Off-road vehicle use can disturb local wildlife and 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.

Conservation Actions

- Promote the importance of functional floodplains to landowners, municipalities, and conservation districts. Focus on the loss of private lands to erosion and the detrimental effects of floods.
- Provide funding for landowners, municipalities, and conservation districts to restore floodplain connection to the maximum extent possible.
- Support research into the efficacy of floodplain reconnection techniques that incorporate Stage 0 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 in terms of volume and seasonality.
- Cultivate greater coordination and data sharing between wildlife conservation organizations and water regulatory agencies, including 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 SGCN.
- Increase the funding for and use of existing cost-share programs to restore functional floodplains that serve as storm water buffers and provide diverse aquatic

Western alligator snapping turtle. Photo by ODWC.

habitats.

- Inform the public, landowners, and industries about 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, including associated water withdrawal. 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 SGCN.
- Work with conservation partners to modify existing biological and water quality monitoring programs to more comprehensively monitor SGCN, habitat quality, and water quality. These are also important for assessing the effectiveness of habitat restoration and conservation easement programs.
- 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 like the U.S. Army Corps of Engineers and Oklahoma Water Resources Board so that water use decisions can be made using the best available information.
- Identify important spawning areas and spawning condition requirements for fish and the important sites for freshwater mussels so that they can be conserved or enhanced.
- Research 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 due to entrainment and stranding below reservoir dams.
- Conduct studies of the in-channel habitat needs and flow requirements for SGCN. Establish ecological flow standards or requirements that will meet the needs of these species and conserve populations within the large rivers 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.
- Discourage residential and infrastructure development within floodplains that would contribute to efforts to channelize rivers, construct flood control impoundments, or remove wetlands.
- 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 on the fish community and aquatic SGCN if the Red River chloride control project were implemented.
- Conduct research to better understand the effects of recreation like off-road vehicle use on the reproduction, recruitment, and longevity of SGCN, and on the quality of their habitat.

Conservation Issue: Pollution and Sedimentation

Impairment of water quality in streams and small rivers ultimately affects the water quality of large rivers as they are the downstream receptor of herbicides, insecticides, heavy metals, nitrates, fine sediment, salt, and other pollutants that are carried into aquatic systems through storm water runoff.

Nutrients, in excess of pre-settlement levels, are contributed to the large river systems by several sources including concentrated animal operations like dairies and feedlots, poultry houses, and their land application fields, septic systems from homes, plant nursery operations, fertilized crop fields and lawns, and municipal discharges. 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.

Several pesticides mimic growth hormones and are 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.

Wetlands within river floodplains have been filled or drained to create suitable land for agricultural and residential development. 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 migratory shorebirds.

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.

Conservation Actions

- Increase the use of Best Management Practices and conservation cost-share technical assistance 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.
- Encourage the protection of riparian areas from grazing by continuing to provide cost-share funding for the construction of fences and alternative sources of water to exclude livestock 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 of nutrients and sediment.
- 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.
- Purchase conservation easements from private landowners or acquire property in title from willing sellers in the floodplains of river and 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 SGCN.
- 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. Strengthen concentrated animal operation regulations that limit the volume of animal waste that can be applied on the land.
- Develop local watershed groups comprised of citizens and governmental organizations to address local concerns, monitor water quality, monitor wildlife populations, and provide public outreach and education.
- 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.
- Identify limits to chemical application such as phosphorous at the watershed level.
- Support existing point-source and non-point-source pollution abatement efforts.
- Work collaboratively with public water managers to enforce water quality standards below reservoirs and to ensure that the ecological flow necessary for aquatic species is consistently available.

Conservation Issue: Invasive and Problematic Species

Non-native riparian, wetland, and aquatic plant species have become established, at least locally, within parts of the Red and Arkansas river systems including alligator weed (*Alteranthera philoxeroides*), giant reed (*Arundo donax*),

Clean, drain, dry messaging has been shared at boat ramps across Oklahoma.

ravenna grass (*Saccharum ravennae*), saltcedar, kudzu (*Pueraria montana*), hydrilla (*Hydrilla verticillata*), and parrot feather watermilfoil (*Myriophyllum aquaticum*). Where these species occur, they often dominate shallow water or riparian habitats and compete with or crowd out more beneficial native vegetation. These non-native species often provide suboptimal habitat and food resources for native fish and wildlife than their native plant counterparts. Expansion of these non-native plants in Oklahoma's large rivers will further diminish habitat quality for many SGCN. The expansion of non-native saltcedars along the large rivers in western and central Oklahoma has reduced the quality of riparian habitats for many SGCN by displacing native vegetation such as cottonwood stands. The spread of common reed (*Phragmites australis*) is an emerging issue along streams and rivers in central and western Oklahoma. Common reed now forms long monocultures along some streams and rivers that constrain and modify the stream or river channel. It is uncertain whether these monocultures are created by native populations of common reed or plants with Eurasian or cultivated genetics.

Invasive species growing along the banks of the Canadian River. Photo by ODWC.

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 prolific native species such as the eastern redcedar and invasive non-native species such as Chinese privet (*Ligustrum sinense*), autumn clematis (*Clematis terniflora*), kudzu, saltcedars, and Russian olive (*Elaeagnus angustifolium*). These species have altered vegetation density and structure in local areas to the detriment of SGCN.

Additionally, non-native aquatic animals, including zebra mussels, silver carp, and bighead carp, are likely to expand their ranges within the Arkansas, Neosho-Grand, and Red river systems and affect native mussel, fish, and aquatic plant populations through resource competition and herbivory. The inter-basin transport and introduction of native aquatic species, including the 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.

Conservation Actions

- Evaluate the severity and magnitude of the ecological damage done by non-native plant and animal species, including the displacement of native plant communities and predation or competition with native animal populations, to identify those non-native species causing the greatest impact to this habitat and SGCN.
- Increase and secure funding to sustain Oklahoma's Aquatic Nuisance Species Management Plan.
- Provide the results of studies of non-native species impacts to landowners, conservation partners, and fish and wildlife organizations to encourage them to take actions to control the spread on non-native and invasive species.
- Improve coordination between wildlife biologists, conservation agencies, and agricultural organizations so that groups can share information and better focus on the restoration of native communities.
- Develop control or management plans that include herbicide treatment or mechanical removal of the non-native species that cause the greatest ecological damage. Then, 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 and waters.
- Develop early detection surveillance programs for invasive species and work with the Oklahoma Invasive Plant Council and OSU Extension Service to develop and promote educational materials to help landowners and sportsmen identify and report potentially problematic species.
- Identify preventative control measures for invasive species instead of reactionary measures. 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.

- Financially support programs that help control invasive species and educate the public about the negative consequences of non-native species and the inter-basin movement of fish and aquatic invertebrates through bait bucket introductions and other live releases.

White-rumped sandpipers at Hackberry Flat Wildlife Management Area. Photo by ODWC.

Potential Indicators for Monitoring the Effectiveness of Conservation Actions

- Acres of riparian habitat restored
- Miles of river channel restored
- Acres of wetlands within flood plains restored
- 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 SGCN
- Changes in seasonal flow volumes as measured through U.S. Geological Survey and other gauging stations
- Changes in the distribution and abundance of non-native, invasive species
- The condition of large river channels in terms of channel morphology, healthy riparian vegetation, and the vegetative structure of the flood plain
- Changes in the benthic macroinvertebrate density and species composition as a measure of ecological function of a river or segment of river
- Monitoring of river water to measure adherence to state water quality standards
- 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 freshwater mussel beds and sites with suitable spawning habitat for representative SGCN
- Changes in stream flow and habitat quality length and acres of riparian forests and woodlands with a 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 and structural condition of large, vegetated sand bars
- Recovery of federally listed fish and mussels occurring in large rivers

Representative Conservation Areas Supporting Large Rivers

- Beaver River Wildlife Management Area (ODWC)
- Canton Wildlife Management Area (ODWC and ACOE)
- Cimarron Bluff Wildlife Management Area (ODWC)
- Cimarron Hills Wildlife Management Area (ODWC)
- Dewey County Wildlife Management Area (ODWC)
- Eufaula Reservoir and Wildlife Management Area (ODWC and ACOE)
- Fort Gibson Reservoir and Wildlife Management Area (ODWC and ACOE)
- Four Canyons Preserve (The Nature Conservancy)
- Grand Lake Reservoir and State Parks (Grand River Dam Authority and Oklahoma State Parks Division)
- Hal and Fern Cooper Wildlife Management Area (ODWC)
- Hudson Reservoir and Park (Grand River Dam Authority)
- Kaw Reservoir and Wildlife Management Area (ODWC and ACOE)
- Keystone Reservoir and Wildlife Management Area (ODWC and ACOE)
- Little Sahara State Park (Oklahoma State Parks Division)
- Love Valley Wildlife Management Area (ODWC)
- McClellan-Kerr Navigation System (ACOE)
- Neosho Bottoms Wildlife Management Area (ODWC)
- Packsaddle Wildlife Management Area (ODWC)
- Salt Plains National Wildlife Refuge (USFWS)
- Sandhills Wildlife Management Area (ODWC)
- Sequoyah National Wildlife Refuge (USFWS)
- Tishomingo National Wildlife Refuge (USFWS)
- Washita National Wildlife Refuge (USFWS)

Monitoring and Evaluation

Shovelnose sturgeon. Photo by Sam Stukel/USFWS.

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 State Wildlife Action Plan in that it is evaluated in its entirety every 10 years and the information gained between reviews, including the data collected through projects that are funded by the State Wildlife Grants program, are used to re-evaluate species, habitats, issues, and actions. Standardized monitoring efforts are necessary to continually evaluate the status of target species, habitats, and ecological communities. It is critical that standard monitoring protocols and methods are employed, allowing for data comparisons at various ecological scales (local, regional, range wide, etc.).

Monitoring Species, Habitats, and Effectiveness

Potential monitoring approaches are identified for the set of conservation actions that are associated with each of the chapters highlighting the habitats that are key to the conservation of Oklahoma's Species of Greatest Conservation Need (SGCN). 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, habitat, and conservation action proposed within the SWAP, monitoring efforts are limited out of necessity. Most of the annual State Wildlife Grants funding in Oklahoma is intentionally invested in research and data acquisition for SGCN rather than monitoring, but that would change if a greater level of funding became available in the future.

Species Monitoring Efforts

Most of the current monitoring programs that are accomplished by the Oklahoma Department of Wildlife Conservation (ODWC) and its conservation partners are directed toward species or guilds of species. Because of limited resources and a growing desire to monitor species range wide rather than on a state-by-state basis, many monitoring programs are accomplished through collaborative efforts with conservation partners. Examples of existing monitoring programs include the multi-species bird monitoring approach of the national Breeding Bird Survey, and the multi-species fish community assessments conducted by ODWC's Streams Program's Community Sampling Program, the Oklahoma Conservation Commission's Water Quality Monitoring Program, the Oklahoma Department of Environmental Quality's Biomonitoring Program, and the Oklahoma Water Resources Board's Beneficial Uses Monitoring Program (BUMP). Monitoring programs and periodic status assessments for representative SGCN such as those that have been developed by national or regional

The Wildlife Department's Streams Program conducts annual community sampling efforts. Photo by ODWC.

working groups for the swift fox, black-tailed prairie dog, leopard darter, and Arkansas River shiner will continue to be supported. The ODWC Wildlife Diversity Program maintains a grant dedicated to field surveys and ongoing monitoring projects for SGCN statewide. Examples of species monitoring recommendations that are found in the SWAP include:

- Monitor the population trajectories of avian SGCN that are representative of Tallgrass Prairie Habitat
- Monitor the populations of SGCN fish species in hard-bottomed streams
- Monitor the population sizes of Bachman's sparrows, brown-headed nuthatches and other species dependent upon Shortleaf Pine Open Woodland Habitat
- Monitor bat population sizes at important hibernacula
- Monitor changes in the geographic ranges of SGCN forest birds

Habitat Monitoring Efforts

A majority of the monitoring recommendations that are found in the SWAP are focused on habitats because of the belief that habitats can be monitored as a surrogate for the many species that depend upon them. This is supported by the observation that many SGCN populations trend in the same direction as the abundance and/or quality of their preferred habitat or available habitat. Some monitoring of habitat is currently performed by other natural resource agencies. For example, the U.S. Forest Service and the Oklahoma Forestry Division cooperate in the monitoring of forest acreage and condition through the national Forest Inventory and Analysis program. Similarly, the Natural Resources Conservation Service has monitoring programs for grasslands and wetlands within working landscapes. The U.S. Geological Survey's National Land Cover Database uses remote imagery to monitor changes in course-scale vegetation and land use that provide valuable insights into trends in grassland and forest cover. One of the reasons for the development of the Oklahoma Ecological Systems Map was the potential for periodically updating the map to monitor changes in dozens of plant communities and habitats simultaneously and statewide. Examples of habitat monitoring adapted from the SWAP include:

- Changes in wetland acreage over time
- Changes in the distribution and connectivity of prairie tracts
- Change in the acreage of oak-dominated forests and woodlands
- Changes in acreage of Shinnery Oak Shrubland Habitat over time
- Changes in the acreage impacted by invasive, non-native shrubs

Effectiveness Monitoring Efforts

Effectiveness monitoring is critical for evaluating whether management practices are achieving their desired goals. Effectiveness monitoring measures that change in plant or animal populations, or in habitat quality, in response to a management practice. These types of monitoring programs help bridge the gap in the adaptive management process between data collection and management programs. Examples of this within the SWAP include:

- Changes in SGCN populations in response to prescribed burning
- Changes in plant diversity and the number of prairie-dependent species following prairie restoration or implementation of a rotational grazing program.
- Change in riparian vegetation structure following the exclusion of livestock
- Number of landowners participating in conservation programs
- Change in the acreage of grasslands and woodlands that are burned periodically
- Changes in water quality parameters (nutrients, pesticides) after wetland restoration
- Changes in the discharge from springs following habitat restoration

Potential for Additional Monitoring Programs

Because many of Oklahoma's SGCN 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 Programs 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.

Prescribed fire is a management tool used on several Wildlife Management Areas. Photo by Jeremiah Zurenda.

Coordination and Review

Townsend's big-eared bat. Photo by ODWC.

Strategy Review and Revision

The development and revision of the Oklahoma State Wildlife Action Plan (SWAP), formerly known as the Oklahoma Comprehensive Wildlife Conservation Strategy (OCWCS), is an additive process. The 2025 version of the Oklahoma SWAP builds upon the successes of a previous revision that was completed in 2015, which in turn was a revision of the original SWAP that was completed in 2005. Each revision has been a comprehensive update in that every page in every section was reviewed and edited so that it would reflect the current understanding of Oklahoma's fish and wildlife and the environments in which they live based upon new information and input from technical experts and the public. The details of the SWAP revision process are described in greater detail in the Introduction and Ecological Framework and this chapter focuses on engagement and collaborative revision of the SWAP with stakeholders, agencies, and the public.

For the 2025 edition of the SWAP, Oklahoma Department of Wildlife Conservation's (ODWC) Wildlife Diversity Program staff led the review and revision process with input from a range of partners. While the formal revision and editing of the SWAP didn't begin until 2023, the collection of new information began almost as soon as the 2015 version was completed. Additionally, throughout the 10-year interval between the two SWAP revisions, attempts were made to raise awareness of the conservation plan and to align relevant portions of it with the management plans of other natural resource agencies. As an example, the SWAP was used by the U. S. Fish and Wildlife Service (USFWS) in the development of the Comprehensive Conservation Plans for its national wildlife refuges (NWRs) in Oklahoma (e.g., Wichita Mountains Wildlife Refuge, Tishomingo NWR, and Ozark Plateau NWR), and ODWC incorporated objectives and priorities from these refuge plans into the SWAP. Likewise, the Department of Defense incorporated aspects of the SWAP into the Integrated Natural Resource Management Plans for their installations (e.g., Tinker AFB, Camp Gruber, and McAlester Army Ammunition Plant) and ODWC aligned the SWAP with their shared goals. ODWC is a member of the four avian habitat joint ventures (JVs) that overlap with portions of the state and it was a natural partnership to incorporate shared goals between the SWAP and the JV 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 SWAP also was used to develop successful projects for the U.S. Department of Agriculture's CRP-State Acres for Wildlife program and the Healthy Forest Reserve Program.

Coordination with Stakeholders, Agencies, and Native American Nations

Stakeholder involvement occurred at four points throughout the review and revision process. Because stakeholder involvement was a prominent and integral part of the

SWAP revision, some of these stakeholder engagement opportunities were discussed in the Introduction and Ecological Framework in the Approach and Methods section. The first of these was an invitation for stakeholders to provide input early in the process through a stakeholder survey that was administered in September and October 2024 as described in the Introduction and Ecological Framework. The survey was sent via email to 358 stakeholders from nongovernmental conservation organizations, academia, Native American Nations, state and federal natural resource agencies, and conservation-related businesses, and was designed to gain insight into how they use the Oklahoma SWAP and what changes could be made to make it more useable and applicable to their work. In addition to these stakeholders, we invited each biologist, biological technician, and communications specialist in ODWC's Fisheries, Wildlife, and Communication and Education divisions to participate in the survey and to review and edit the draft chapters of the SWAP. Altogether, 122 people participated in the survey (101 technical experts/stakeholders and 21 ODWC employees). Most of the survey respondents (81%) had some familiarity with the 2015 SWAP. A small number of survey participants used or referred to the SWAP several times per year, but most participants (56%) used the SWAP once per year or less frequently. The most common use of the SWAP was to search or reference the current Species of Greatest Conservation Need (SGCN) list (93% of users used it for that purpose). The next most frequent uses of the SWAP were obtaining information about important Oklahoma habitats (64% of users), descriptions of conservation issues (55%), and information about recommended conservation actions (49% of users). Most stakeholders do not perform their work within the framework of the traditional, hierarchical ecosystem classifications (i.e. the Environmental Protection Agency's Omernick Ecoregions or the U.S. Forest Service's Baily Ecoregions), but instead refer to their work in the context of broad descriptive ecoregions such as those used in the organization of the 2005 and 2015 SWAPs. Just under half of the survey respondents were satisfied with organizing the 2025 SWAP along ecoregion boundaries, while slightly more than half had no preference or preferred an organizational structure that didn't depend on ecoregions. The survey also revealed that most Oklahoma stakeholders (82%) preferred to have an SGCN list that was ranked and prioritized by tiers or a similar system. These survey results influenced how the 2025 SWAP was structured and was the basis for retaining a ranking system for the SGCN list.

Burrowing owls. Photo by Dave McGowen.

The next stakeholder engagement occurred after the SWAP revision team updated the proposed SGCN list with the revised selection criteria, new status information, and updated NatureServe global ranks. We worked with our stakeholders that work most closely with rare and at-risk species to review and evaluate the SGCN list and to ask if there were species that were missed and selection criteria that weren't considered. Those partners included the biologists with the USFWS's Oklahoma Field Office, Oklahoma Natural Heritage Inventory, The Nature Conservancy, and the Sutton Avian Research Center. Because ODWC has limited botanical expertise, the selection of the Plant Species of Conservation Need was heavily driven by partners and stakeholders including NatureServe, the Southeastern Plant Conservation Alliance, the Atlanta Botanical Garden, and the Oklahoma Biological Survey.

Between October 2024 and April 2025, while the SWAP was being revised, presentations were made to stakeholders about the SWAP revision and the opportunities to review document and provide comments and edits. One of these presentations was at the 2024 annual meeting of the Oklahoma Ornithological Society to engage with the birding community and avian technical experts. Another presentation was made at the 2025 Oklahoma Natural Resources Conference to an audience of private, federal, and state land managers, biologists, research scientists, range management specialists, and tribal natural resource professionals. Updates were provided as well during the annual coordination meetings with the Oklahoma Cooperative Fish and Wildlife Research Unit at Oklahoma State University, the Ouachita National Forest, the Oklahoma Natural Heritage Inventory, and the USFWS Oklahoma Field Office.

The list of stakeholders and technical experts was updated during the summer of 2025 to add new contacts from the

previous eight months and to remove some individuals who declined to be reviewers. An additional 11 people were removed due to state and federal retirements, resulting in a list of 355 external reviewers and 198 internal reviewers from within ODWC who were invited to edit the first draft of the revised Oklahoma SWAP as technical reviewers. These technical reviewers included zoologists, biologists, and ecologists from every university in the state and represented expertise with every vertebrate group and most higher-level invertebrate taxa. Other technical reviewers included biologists with every state and federal land management and water management agency in Oklahoma, biologists with nongovernmental conservation organizations (e.g. The Nature Conservancy and the Samuel Roberts Noble Foundation), biologists with the avian habitat Joint Ventures that operate in Oklahoma, and representatives from 20 of Oklahoma's Native American Nations and Tribes that have environmental and/or natural resources programs. The draft SWAP was emailed to the technical reviewers in two segments. The first contained four of the largest chapters and the remaining chapters were included in the second mailing. The technical reviewers were provided with a Microsoft Word file for each chapter so that they could use the Track Changes function to easily edit or insert comments into these files and return them. The technical reviewers provided comments for every chapter and table, and these were incorporated into the final draft that was released for public review. The final draft was sent also to the technical reviewers to provide them with a second opportunity for review.

Public Involvement

In the months leading up to the release of the Oklahoma SWAP for public review, ODWC launched some pre-release outreach. The SWAP revision was publicized in an article in the May/June issue of Outdoor Oklahoma, which is ODWC's bimonthly magazine that has nearly 7,000 subscribers. The article provided an overview of the revision process and timeline and invited people to contact the revision team to be included in the stakeholder and public reviews. In-reach was conducted through an article in ODWC's monthly employee newsletter called the Wildlife-O-Gram.

When the incorporation of edits was complete, the SWAP was reformatted into a more user-friendly layout to make it ready for public review and was posted on the ODWC website. The ODWC maintains a list of contact emails that is the summed total of all individuals who have purchased a license or permit from ODWC, registered for any agency-sponsored event, or subscribed to any of the agency's electronic outreach publications. Altogether, this contact list totals 1,183,489 unique addresses. A news release was prepared and emailed to the entire contact list through a program called GovDelivery, which enables the tracking of the number of emails that were opened and the number that opened the link to the review copy of the SWAP. The news release provided an overview of the SWAP and its purpose, an invitation to review and provide comments on the SWAP, and a link to the PDF version on ODWC's website. Two email addresses were provided as well for the submission of comments. The news release and a link to the SWAP was send also to all of the stakeholders and technical experts that were involved in the earlier review period to provide them with a second opportunity to provide comments. One week after the public release of the SWAP, social media posts were made to encourage the public to view the SWAP and provide input. During the comment period, 553,995 email accounts opened the SWAP news release and at least 3,632 people from the contact list opened the link to view the SWAP. The contact list included media outlets across the state and a front-page article about the Oklahoma SWAP and the comment period was printed in the state's fifth-largest newspaper, the *Norman Transcript*. A reminder of the public comment period was shared in the Wild Side, which is the Wildlife Diversity Program's monthly electronic newsletter that is sent to more than 18,000 subscribers. Overall, more than 5,400 active users visited the webpage that hosted the public review draft of the 2025 Oklahoma SWAP.

Blue sucker. Photo by Ryan Hagerty/USFWS.

Future Revisions of the SWAP

The SWAP, as with any planning document, requires periodic review and revision to remain current in an ever-changing landscape. Year by year, new information becomes available, the actions that are implemented reduce or resolve the impacts of issues, and new situations arise that were unforeseen when the SWAP was last revised. Since 2005, the implementation of the Oklahoma SWAP has been a foundational part of the

Strecker's chorus frog at Cross Timbers Wildlife Management Area. Photo by Kelly Adams/ ODWC.

operations of ODWC's Wildlife Diversity Program. It guides every project that the Program pursues and the information that is gained regarding the statuses, distributions, abundances, and population trends of SGCN, and changes in the condition of their habitats is used to prepare for the next SWAP revision. To maintain a SWAP that is current and relevant to Oklahoma's conservation community, the ODWC is committed to conducting a comprehensive revision on a schedule of at least every 10 years.

Each comprehensive revision will involve all conservation partners and will continue to address each of the eight required elements, as well as any additional elements that Congress may add. As new conservation partners are identified, they too will be integrated into the review and revision process.

Communication and coordination are perpetual aspects of ODWC's work and the Wildlife Diversity Program's monthly electronic newsletter, the Wild Side, will continue to highlight SWAP activities and the conservation of the state's SGCN. Program staff will continue to coordinate at least annually with key partners including the USFWS's Tulsa Field Office, Oklahoma Natural Heritage Inventory, The Nature Conservancy, Oklahoma Department of Transportation, Sutton Avian Research Center, U.S. Forest Service, and the Oklahoma Cooperative Fish and Wildlife Research Unit, which were integral to the development and revision of the Oklahoma SWAP.

Identifying Conservation Partnerships

The challenges associated with conserving and improving the status of rare and declining species are larger than can be accomplished by one program or agency. While the State Wildlife Grants Program (SWG) 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 at least 95% of the land within Oklahoma is privately owned, individual landowners are the most important partners for conservation, enhancement and restoration of the habitats needed by SGCN. Universities and nongovernmental organizations also have a large role because they 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-organization partnerships have formed within the past 20 years. Habitat-based avian joint ventures, 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 USFWS and the fish and wildlife agency associations in the Southeast and the Midwest recently established the Southeast Conservation Adaptation Strategy and the Midwest Landscape Conservation Initiative respectively that are based on the same principles but address larger geographic areas and a broader range of natural resources. Below is a list, generated from stakeholder input, that contains existing and potential future partners in the conservation of Oklahoma's SGCN.

Potential Conservation Partnerships

Federal Government

- Federal Energy Regulatory Commission
- National Park Service
  - » Southern Plains Inventory & Monitoring Network
- U.S. Army Corps of Engineers
- U.S. Bureau of Land Management
- U.S. Bureau of Reclamation
- U.S. Congress
- U.S. Department of Agriculture
  - » Animal and Plant Health Inspection Service
  - » Farm Service Agency
  - » Forest Service
    - – Black Kettle National Grasslands
    - – Ouachita National Forest
    - – Rita Blanca National Grasslands
  - » Natural Resources Conservation Service

- U.S. Department of Defense
  - » Tinker Air Force Base
  - » Fort Sill
  - » Camp Gruber
  - » McAlester Army Ammunition Plant
  - » Altus Air Force Base
  - » Vance Air Force Base
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
  - » At-risk Species Conservation Program
  - » Center for Pollinator Conservation
  - » Central Grasslands Conservation Program
  - » Ecological Services Program
  - » Endangered Species Recovery Program
  - » Midwest Landscape Conservation Initiative
  - » National Wildlife Refuge System
    - – Deep Fork National Wildlife Refuge
    - – Little River National Wildlife Refuge
    - – Ozark Plateau National Wildlife Refuge
    - – Salt Plains National Wildlife Refuge
    - – Sequoyah National Wildlife Refuge
    - – Tishomingo National Wildlife Refuge
    - – Washita National Wildlife Refuge
    - – Wichita Mountains Wildlife Refuge
  - » National Wetlands Inventory
  - » Partners for Fish and Wildlife Program
  - » Southeast Conservation Adaptation Strategy Program
- U.S. Geological Survey
  - » Cooperative Fish and Wildlife Research Units Program
  - » South Central Climate Adaptation Science Center
  - » Oklahoma-Texas Water Science Center

Prairie falcon. Photo by Sherman Barr.

Native American Nations

- Absentee Shawnee Tribe
- Alabama Quassarte Tribal Town
- Apache Tribe
- Caddo Nation
- Cherokee Nation
- Cheyenne and Arapaho Tribes
- Chickasaw Nation
- Choctaw Nation
- Citizen Potawatomi Nation
- Comanche Nation
- Delaware Nation
- Delaware Tribe of Indians
- Eastern Shawnee Tribe
- Fort Sill Apache Tribe
- Iowa Tribe
- Kaw Nation
- Kialegee Tribal Town
- Kickapoo Nation
- Kiowa Tribe
- Miami Tribe
- Modoc Nation
- Muscogee Nation
- Osage Nation
- Otoe Missouria Tribe
- Ottawa Tribe
- Pawnee Nation
- Peoria Tribe of Indians
- Ponca Tribe of Indians
- Quapaw Nation
- Sac and Fox Nation
- Seminole Nation
- Seneca Cayuga Nation
- Shawnee Tribe
- Thlopthlocco Creek Tribal Town
- Tonkawa Tribe
- United Keetoowah Band of Cherokee Indians
- Wichita and Affiliated Tribes
- Wyandotte Nation
- Yuchi/Euchee Tribe

State Government Including Academia

- Arkansas Natural Heritage Commission
- Arkansas River Compact Commission
- Association of Fish and Wildlife Agencies
- Grand River Dam Authority and Oklahoma Scenic Rivers Commission
- Kansas Natural Heritage Inventory
- Missouri Natural Heritage Program
- Natural Heritage New Mexico
- Oklahoma Biological Survey
- Oklahoma Commissioners of Land Office
- Oklahoma Conservation Commission
- Oklahoma Corporation Commission
- Oklahoma Department of Environmental Quality

- Oklahoma Department of Agriculture, Food and Forestry
- Oklahoma Department of Mines
- Oklahoma Department of Transportation
- Oklahoma Department of Wildlife Conservation
- Oklahoma Energy Resources Board
- Oklahoma Geological Survey
- Oklahoma Legislature
- Oklahoma Natural Areas Registry
- Oklahoma Natural Heritage Inventory
- Oklahoma Scenic Rivers Commission
- Oklahoma State University Cooperative Extension Service
- Oklahoma State University Department of Biology
- Oklahoma State University Department of Natural Resource Ecology and Management
- Oklahoma Tourism and Recreation Department
- Oklahoma Water Resources Board
- Southeast Conservation Adaptation Strategy
- Southeastern Association of Fish and Wildlife Agencies
- State universities and departments
- State wildlife, forestry and water regulating and management agencies of Arkansas, Kansas, Missouri, and Texas
- State-funded museums
- Texas Parks and Wildlife Department
- University of Arkansas Ancient Cross Timbers Consortium
- University of Kansas Monarch Watch
- University of Oklahoma Biological Station
- University of Oklahoma Sam Noble Oklahoma Museum of Natural History
- University of Oklahoma School of Biological Sciences
- Western Association of Fish and Wildlife Agencies
  - » Lesser Prairie Chicken Interstate Working Group
  - » Prairie Dog Conservation Team
  - » Swift Fox Conservation Team

Local Government

- County Commissioners
- Municipalities in Oklahoma, Arkansas, Missouri, Kansas, and Texas
- Oklahoma Association of Regional Councils
- Oklahoma Conservation Districts

Businesses, Nongovernmental Organizations, and Citizens Organizations

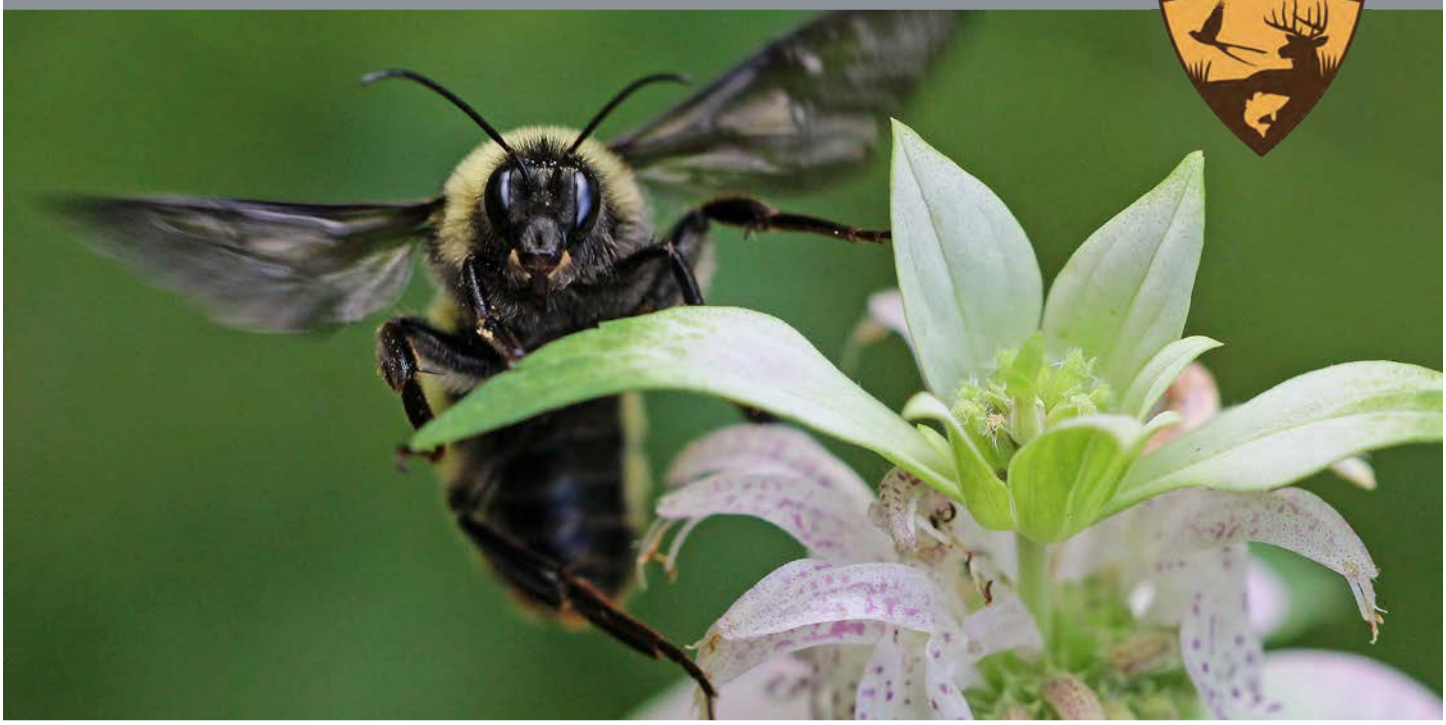
- American Bird Conservancy
- American Canoe Association
- American Farm Bureau Federation
- Bass Anglers Sportsman Society
- Bat Conservation International
- Bird Conservancy of the Rockies
- Central Hardwoods Joint Venture
- Chambers of Commerce
- Citizens for the Protection of the Arbuckle-Simpson Aquifer
- Ducks Unlimited and Local Chapters
- Electric cooperatives
- George Miksch Sutton Avian Research Center
- Hunting cooperatives
- Izaak Walton League of America
- Kerr Center for Sustainable Agriculture
- Land Legacy
- Lower Mississippi Valley Joint Venture
- Monarch Joint Venture
- National Alliance of Forest Owners
- National Audubon Society and Local Chapters
- National Fish Habitat Partnership
- National Speleological Society
- National Wild Turkey Federation
- National Woodland Owners Association
- North American Forest Owners Association
- North American Grouse Partnership
- Northwest Range Fire Management Association
- Oaks and Prairies Joint Venture
- Off-road vehicle clubs, associations and dealers
- Oklahoma Academy of Science
- Oklahoma Agricultural Cooperative Council
- Oklahoma Association of Conservation Districts
- Oklahoma Blue Thumb
- Oklahoma Cattlemen's Association
- Oklahoma Forestry Association
- Oklahoma Herpetological Society
- Oklahoma Hunters and Anglers
- Oklahoma Invasive Plant Council
- Oklahoma Monarch Society

Black-tailed prairie dog. Photo by Stephen Ofsthun.

- Oklahoma Native Plant Society
- Oklahoma Ornithological Society
- Oklahoma Prescribed Burn Association
- Oklahoma Prescribed Fire Council
- Oklahoma Renewable Energy Council
- Oklahoma Rural Water Association
- Oklahoma Section of the Society for Range Management
- Oklahoma sportsmen's groups
- Oklahoma Strategic Alliance
- Oklahoma Wildlife and Prairie Heritage Alliance
- Ozark Land Trust
- Ozark Society
- Petroleum Alliance of Oklahoma
- Pheasants Forever and Quail Forever and Local Chapters
- Playa Lakes Joint Venture
- Private landowners, famers, ranchers, and farm organizations
- Producer cooperatives
- Railroad companies
- Resource Conservation and Development Councils
- River Management Society
- Samuel Roberts Noble Foundation
- Sardis Lake Water Authority
- Sierra Club
- Southeast Aquatic Resource Partnership
- Southern Oklahoma Water Corporation
- Spring Creek Coalition
- Tallgrass Legacy Alliance
- The Nature Conservancy
- The Wildlife Society
- Urban development groups
- Vernal Pool Association
- Western Governors Association
- Wetland mitigation bankers
- Wind and other renewable energy developers
- Xerces Society for Invertebrate Conservation

Rufous hummingbird. Photo by Cletus Lee/CC BY-NC-ND 2.0.

Appendices



American bumble bee. Photo by Mary Keim/ CC BY-NC-SA 2.0.

Appendix A: Glossary of Terms

Term	Definition
Conservation Actions	A measure to address a conservation issue. These include but are not limited to conservation planning tools, partnership collaboration, species monitoring and inventories, policy change, habitat restoration, and conservation easements.
Conservation Issues	These refer to the environmental challenges and concerns arising primarily from human activities that threaten the sustainable protection of natural resources.
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 and have a generally stable population trend.
Comprehensive	Broad in scope and content as related to the conservation, protection, and 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.
Ecoregion	A hierarchical classification system based on a combination of climate, soils, and dominant vegetation. For the purposes of the SWAP, the Oklahoma Department of Wildlife Conservation has divided the state into six broad ecoregions that are intended to be compatible with both the Bailey and Omernick classification frameworks.
Habitat	The natural environment of an animal, plant, or other organism. Within the Oklahoma SWAP, species of greatest conservation need were placed into groups based upon their shared habitat needs. The document represents eight different habitat chapters.
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 on specific locations such as appropriate breeding sites or roosting sites. It is synonymous with a species whose populations are “patchy” “scattered” or “disjunct.”

Term	Definition
NatureServe	A non-profit organization that is the authoritative source for biodiversity data throughout North America. They work with a network of organizations and scientists to collect, analyze, and deliver biodiversity knowledge that informs conservation action. They provide proprietary wildlife conservation-related data, tools, and services to private and government clients, partner organizations, and the public. They also provide access to the conservation status, taxonomy, broad-scale distribution, and life history information for more than 95,000 plants, fungi, and animals in the U.S. and Canada. The NatureServe status ranks were used as a selection criterion to assist with determining if a species qualifies as a Species of Greatest Conservation Need.
Plant Species of Conservation Need	Rare and at-risk plant species that occur in Oklahoma. These plant species provide a linkage between them, and the animal species of greatest conservation need that occupy the same habitats. These species were identified by regional and state evaluation teams and met certain criteria to qualify for inclusion in the SWAP.
Rare	A group of organisms that are uncommon and have a low probability of detection. Rare species typically have declining population statuses and are often at risk of shifting into a more severe conservation status if negative factors persist.
Species of Greatest Conservation Need	A term used in the authorizing language of the State Wildlife and Tribal Grant Programs 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 the chapter of this document regarding Species of Greatest Conservation Need.
Species of Greatest Information Need	Species that could not be appropriately scored because they lack sufficient information. These species met one of the following criteria: NatureServe had not assigned a global conservation rank, the species is potentially extirpated from the state because there are no valid records for it within the past 60 years, there are fewer than 20 valid records in the state to adequately assess the geographic range and population status, or there is insufficient life history information available to assign it to an appropriate habitat classification.
Stewardship	The percentage of population size or geographic range that occurs in Oklahoma. For ranking criterion one, the species gets 1-3 point based on this percentage or stewardship.
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: References Relevant to Oklahoma's State Wildlife Action Plan

Mole salamander. Photo by Peter Paplanus/CC BY 2.0.

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Mountain plover. Photo by Ron Knight/CC BY 2.0.

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Northern metalmark. Photo by Judy Gallagher/CC BY 2.0.

Short-eared owl. Photo by Harry Burkhalter.

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Cave myotis at Alabaster Caverns State Park. Photo by ODWC.

Three-toed box turtle on the Ouachita National Forest – Oklahoma Ranger District. Photo by ODWC.

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Appendix C: SWAP Cross Walk from Chapter to Habitat to Oklahoma Ecological Systems Map Category

2025 SWAP Chapter	2025 SWAP Habitat Type	Oklahoma Ecological Systems Map Category
Grasslands (20,717,611 ac.)	**Shortgrass Prairie Habitat** (1,575,199 ac.)	High Plains: Shortgrass Prairie (1,575,199 ac.)
	Mixed-grass Prairie Habitat (8,252,463 ac.)	Canyon: Sparsely Vegetated (116 ac.)
		Canyon: Gyp Sparsely Vegetated (521 ac.)
		High Plains: Playa Grassland (3,107 ac.)
		Canyon: Grassland (58,164 ac.)
		Canyon: Gyp Grassland (166,559 ac.)
		Arbuckle: Prairie/Pasture (204,668 ac.)
		Central Mixedgrass: Sandy Prairie/Pasture (349,352 ac.)
		High Plains: Sand Prairie (870,091 ac.)
		Planted Non-native and/or Native Grasses (1,253,843 ac.)
		Central Mixedgrass: Prairie/Pasture (5,346,042 ac.)
	Tallgrass Prairie Habitat (10,889,949 ac.)	High Plains Tallgrass Prairie (7,873 ac.)
		Flint Hills Tallgrass Prairie/Pasture (541,336 ac.)
		Osage Plains Tallgrass Prairie/Pasture (2,007,930 ac.)
		Cross Timbers Prairie/Pasture (6,178,069 ac.)
		Grand Prairie Prairie/Pasture (42,347 ac.)
		Post Oak Savanna Grassland/Pasture (294,627 ac.)
		Ozark-Ouachita Prairie/Pasture (959,978 ac.)
		Arkansas Valley Prairie/Pasture (407,503 ac.)
		Arkansas Valley Sand Prairie/Pasture (2,461 ac.)
		Blackland Prairie/Pasture (8,132 ac.)
		West Gulf Coastal Plain Northern Calcareous Prairie/Pasture (35,453 ac.)
		West Gulf Coastal Plain Pasture (404,240 ac.)
Shrublands (1,757,134 ac.)	**Pinyon Pine – Juniper Shrubland Habitat** (38,653 ac.)	High Plains: Canyon Sparsely Vegetated (43 ac.)
		High Plains: Canyon Deciduous Shrubland (397 ac.)
		Black Mesa: Pinyon – Juniper Woodland (2,695 ac.)
		Black Mesa: Deciduous Shrubland and Woodland (13,537 ac.)
		Black Mesa: Pinyon – Juniper Shrubland (21,981 ac.)
	Sand Sagebrush – Bluestem Shrubland Habitat (618,887 ac.)	Ruderal Plains Shrubland (132,222 ac.)
		High Plains: Sandy Deciduous Shrubland (147,601 ac.)
		High Plains: Sandhill Shrubland (339,064 ac.)
	Shinnery Oak Shrubland Habitat (116,827 ac.)	High Plains: Sandhill Shinnery Shrubland (116,827 ac.)
	Canyon Shrubland Habitat (109,066 ac.)	Canyon Gyp Deciduous Shrubland (36,300 ac.)
		Canyon Deciduous Shrubland (72,766 ac.)
	Blackjack Oak – Post Oak Shrubland Habitat (593,740 ac.)	Arbuckle: Oak – Juniper Slope Forest (670 ac.)
		Arbuckle: Oak – Juniper Woodland (1,271 ac.)
		Arbuckle: Deciduous Shrubland (6,395 ac.)
		Wichita Mountains: Low Stature Oak Slope Woodland and Shrubland (13,720 ac.)
		Wichita Mountains: Low Stature Oak Woodland and Shrubland (14,157 ac.)
		Pleistocene Sands: Blackjack Oak – Eastern Redcedar Woodland (54,175 ac.)

2025 SWAP Chapter	2025 SWAP Habitat Type	Oklahoma Ecological Systems Map Category
Shrublands, cont.	**Blackjack Oak – Post Oak Shrubland Habitat, cont.**	Pleistocene Sands: Blackjack Oak Woodland (90,648 ac.)
		Crosstimbers: Sandyland Shrubland and Grassland (412,704 ac.)
	Mesquite Shrubland Habitat (78,993 ac.)	Canyon: Gyp Mesquite Shrubland (17,743 ac.)
		Ruderal Mesquite Shrubland (20,980 ac.)
		High Plains: Mesquite Shrubland (40,270 ac.)
	Juniper Shrubland Habitat (200,968 ac.)	Canyon Juniper Shrubland (55,427 ac.)
		Canyon Gyp Juniper Shrubland (23,235 ac.)
		Arbuckle Ashe Juniper Slope Forest (2,948 ac.)
		Arbuckle Ashe Juniper Woodland (8,076 ac.)
		Arbuckle Ashe Juniper Shrubland (11,941 ac.)
		Cross Timbers Eastern Redcedar Slope Woodland/Shrubland (9,059 ac.)
		Cross Timbers Eastern Redcedar Woodland/Shrubland (86,846 ac.)
		Wichita Mountains Eastern Redcedar Shrubland (3,436 ac.)
Deciduous Woodlands and Forests (7,534,684 ac.)	**Upland Post Oak – Blackjack Oak – Hickory Woodland and Forest Habitat** (5,173,545 ac.)	Post Oak Savanna: Post Oak – Eastern Redcedar Sandyland Woodland (184 ac.)
		Post Oak Savanna: Young Woodland Regrowth (1,604 ac.)
		Post Oak Savanna: Post Oak – Eastern Redcedar Woodland (2,045 ac.)
		Post Oak Savanna: Post Oak Sandyland Woodland (3,338 ac.)
		Wichita Mountains: Eastern Redcedar Slope Woodland (3,366 ac.)
		Crosstimbers: Post Oak – Eastern Redcedar Slope Forest (3,656 ac.)
		West Gulf Coastal Plain: Sandhill Oak Woodland (5,451 ac.)
		Wichita Mountains: Oak Slope Woodland (11,479 ac.)
		Arbuckle: Oak Slope Forest (12,459 ac.)
		West Gulf Coastal Plains: Young Upland Hardwood Woodland Regrowth (13,381 ac.)
		Wichita Mountains: Oak Woodland (17,155 ac.)
		Crosstimbers: Post Oak – Eastern Redcedar Forest and Woodland (28,102 ac.)
		Ozark-Ouachita: Dry Oak Woodland Young Regrowth (34,633 ac.)
		Arbuckle: Oak Woodland (45,928 ac.)
		Post Oak Savanna: Post Oak Woodland (86,527 ac.)
		Crosstimbers: Post Oak – Blackjack Oak Slope Forest (154,540 ac.)
		Crosstimbers: Sandyland Post Oak – Blackjack Oak Forest and Woodland (173,760 ac.)
		Crosstimbers: Young Post Oak – Blackjack Oak Woodland (176,378 ac.)
		West Gulf Coastal Plain: Dry Upland Hardwood Forest (222,973 ac.)
		Ozark-Ouachita: Dry Oak Woodland (1,617,309 ac.)
		Crosstimbers: Post Oak – Blackjack Oak Forest and Woodland (2,559,277 ac.)
	Bottomland Oak – Hickory Hardwood Forest Habitat (1,545,896 ac.)	Southeastern Great Plains: Bottomland Mixed Evergreen – Hardwood Forest (1,325 ac.)
		West Gulf Coastal Plain: Large River Bottomland Deciduous Shrubland (7,879 ac.)
		West Gulf Coastal Plain: Large River Bottomland Seasonally Flooded Hardwood Forest (65,450 ac.)
		West Gulf Coastal Plain: Large River Bottomland Hardwood Forest (179,632 ac.)

2025 SWAP Chapter	2025 SWAP Habitat Type	Oklahoma Ecological Systems Map Category
Deciduous Woodlands and Forests, cont.	**Bottomland Oak – Hickory Hardwood Forest Habitat cont.**	Southeastern Great Plains: Bottomland Hardwood Forest (211,779 ac.)
		South Central Interior: Bottomland Hardwood Forest (1,079,831 ac.)
	White Oak – Hickory Mesic Forest Habitat (815,243 ac.)	Ozark-Ouachita: Montane Stunted Oak Woodland (1,054 ac.)
		Ozark-Ouachita: Dry-Mesic Oak Woodland Young Regrowth (17,380 ac.)
		Ozark-Ouachita: Dry-Mesic Oak Forest (796,809 ac.)
Pine and Mixed-Pine Woodlands and Forests (1,721,291)	**Shortleaf Pine – Oak – Hickory Woodland and Forest Habitat** (1,469,616 ac.)	West Gulf Coastal Plain: Sandhill Shortleaf Pine Woodland (181 ac.)
		Ozark-Ouachita: Dry-Mesic Mixed Oak – Evergreen Forest (100,755 ac.)
		Pine Plantation – 1 – 3 meters (146,076 ac.)
		Pine Plantation (536,034 ac.)
		Ozark-Ouachita: Shortleaf Pine – Oak Forest (686,570 ac.)
	Shortleaf Pine Open Woodland Habitat (34,068 ac.)	Ozark-Ouachita: Dry Mixed Oak – Evergreen Woodland (34,068 ac.)
	Mesic Loblolly Pine – Oak Forest Habitat (217,607 ac.)	West Gulf Coastal Plain: Large River Bottomland Evergreen Woodland and Shrubland (2,479 ac.)
		West Gulf Coastal Plain: Pine Forest (17,054 ac.)
		South Central Interior: Bottomland Mixed Evergreen – Hardwood Forest (18,524 ac.)
		West Gulf Coastal Plain: Large River Bottomland Mixed Hardwood – Evergreen Forest (44,324 ac.)
		West Gulf Coastal Plain: Pine – Hardwood Forest (46,831 ac.)
		South Central Interior: Bottomland Shrubland and Young Woodland (88,395 ac.)
Caves	**Gypsum Cave Habitat**	There is no corresponding category in the Oklahoma Ecological Systems Map.
	Limestone Karst Habitat	There is no corresponding category in the Oklahoma Ecological Systems Map.
Wetlands (227,934 ac.)	**Herbaceous Wetland Habitat** (227,934 ac.)	Southeastern Great Plains: Riparian Herbaceous Wetland (818 ac.)
		Ozark-Ouachita: Riparian Herbaceous Wetland (1,038 ac.)
		High Plains: Playa Marsh (1,071 ac.)
		High Plains: Depression Herbaceous Wetland (1,688 ac.)
		High Plains: Riparian Herbaceous Wetland (3,369 ac.)
		High Plains: Salt Marsh (4,553 ac.)
		South Central Interior: Riparian Herbaceous Wetland (5,053 ac.)
		Southeastern Great Plains: Bottomland Herbaceous Wetland (6,237 ac.)
		Eastern Great Plains: Herbaceous Wetland (30,434 ac.)
		South Central Interior: Bottomland Herbaceous Wetland (52,637 ac.)
		High Plains: Bottomland Herbaceous Wetland (121,036 ac.)
	Seep and Vernal Pool Habitat	There is no corresponding category in the Oklahoma Ecological Systems Map.
Small Rivers and Streams (1,753,762 ac.)	**Soft-bottom Stream, Spring, and Riparian Forest Habitat** (1,467,226 ac.)	High Plains: Bottomland Hardwood – Eastern Redcedar Forest (339 ac.)
		West Gulf Coastal Plain: Small Stream Evergreen Woodland and Shrubland (1,640 ac.)
		West Gulf Coastal Plain: Small Stream Deciduous Shrubland (1,795 ac.)
		Southeastern Great Plains: Riparian Mixed Evergreen – Hardwood Woodland (2,894 ac.)
		West Gulf Coastal Plain: Small Stream Mixed Pine – Hardwood Woodland (4,369 ac.)
		High Plains: Bottomland Eastern Redcedar Woodland and Shrubland (4,662 ac.)

2025 SWAP Chapter	2025 SWAP Habitat Type	Oklahoma Ecological Systems Map Category
Small Rivers and Streams, cont.	Soft-bottom Stream, Spring, and Riparian Forest Habitat, cont.	Southeastern Great Plains: Riparian Eastern Redcedar Woodland and Shrubland (5,308 ac.)
		West Gulf Coastal Plain: Small Stream Seasonally Flooded Hardwood Woodland (5,660 ac.)
		South Central Interior: Riparian Eastern Redcedar Woodland and Shrubland (7,603 ac.)
		High Plains: Riparian Mixed Hardwood – Eastern Redcedar Woodland (9,760 ac.)
		South Central Interior: Riparian Mixed Evergreen – Hardwood Woodland (9,940 ac.)
		Southeastern Great Plains: Riparian Shrubland and Young Woodland (10,456 ac.)
		High Plains: Riparian Eastern Redcedar Woodland and Shrubland (11,511 ac.)
		High Plains: Deep Sand Woodland (32,656 ac.)
		West Gulf Coastal Plain: Small Stream Hardwood Woodland (33,065 ac.)
		South Central Interior: Riparian Shrubland and Young Woodland (38,626 ac.)
		High Plains: Riparian Deciduous Shrubland (74,187 ac.)
		Southeastern Great Plains: Riparian Hardwood Woodland (97,884 ac.)
		High Plains: Bottomland Deciduous Shrubland (133,254 ac.)
		High Plains: Riparian Hardwood Woodland (213,090 ac.)
		South Central Interior: Riparian Hardwood Woodland (314,686 ac.)
		High Plains: Bottomland Hardwood Forest (453,841 ac.)
	Hard-bottom Stream, Spring, and Riparian Forest Habitat	Ozark-Ouachita Riparian Deciduous Shrubland and Young Woodland (5,470 ac.)
		Ozark-Ouachita Riparian Evergreen Woodland and Shrubland (39,723 ac.)
		Ozark-Ouachita Riparian Hardwood Woodland (197,680 ac.)
		Ozark-Ouachita Riparian Mixed Evergreen-Hardwood Woodland (43,663 ac.)
	Small River Habitat	There is no corresponding category in the Oklahoma Ecological Systems Map.
Large Rivers	Large River Habitat	There is no corresponding category in the Oklahoma Ecological Systems Map.
	Salt Flat Habitat	High Plains: Salt Lake Shrubland (4,064 ac.)
		High Plains: Salty Grassland (11,988 ac.)
		High Plains: Saline Flat (14,265 ac.)

Appendix D: Acknowledgements for the 2025 Comprehensive Revision of the Oklahoma State Wildlife Action Plan

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Ozark zigzag salamander. Photo by Peter Paplanus/CC BY 2.0.

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Golden eagle. Photo by Jon Nelson/CC BY-NC-SA 2.0.

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Ozark big-eared bats. Photo by Richard Stark/USFWS.

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Lark bunting. Photo by Pete Richman/CC BY-SA 2.0.

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Hoary bat. Photo by J.N. Stuart/CC BY-NC-ND 2.0.

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Harris's sparrow. Photo by Stephen Ofsthun.