FINAL PERFORMANCE REPORT

Federal Aid Grant No. F13AF01060 (T-65-1)

Wildlife Diversity Inventory on Oklahoma Wildlife Management Areas with Emphasis on Species of Greatest Conservation Need

Oklahoma Department of Wildlife Conservation

Report Period: October 1, 2013 – September 30, 2018

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STATE: Oklahoma **GRANT NUMBER:** F13AF01060 (T-65-1)

GRANT TYPE: State Wildlife Grants

GRANT TITLE: Wildlife Diversity Inventory on Oklahoma Wildlife Management Areas with Emphasis on Species of Greatest Conservation Need

GRANT PERIOD: October 1, 2013 – September 30, 2018

PRINCIPAL INVESTIGATORS:
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ABSTRACT:

Between 2014 and 2018, we conducted biological inventories for nongame wildlife on six Oklahoma Department of Wildlife Conservation (ODWC) wildlife management areas (WMA) with an emphasis on species of greatest conservation need (SGCN). Each inventory was conducted through a series of surveys that targeted specific taxonomic groups during the season(s) in which they were most active and efficiently detected. All surveys were conducted by the staff of the ODWC's Wildlife Diversity Program in collaboration with the biologists and technicians stationed at those WMAs. On Cross Timbers WMA, we documented 176 vertebrate species including 9 SGCN; on Cookson WMA we documented 157 vertebrate species and 15 SGCN; on Okmulgee/Deep Fork WMAs we documented 173 vertebrate species including 17 SGCN, and on Cimarron Hills/Cimarron Bluff WMAs we documented 139 species and 18 SGCN. We recorded the number of individuals seen to approximate each species' relative abundance, and for many species we recorded location of each individual and the general habitat type in which it was found. We documented the survey techniques used in the inventory for each taxonomic group, and the level of survey effort (e.g. number of search hours, trap nights, or point-counts) so that these inventories could be repeated in the future to monitor the wildlife communities on these areas.

INTRODUCTION:

Public conservation lands provide many of the best opportunities to conserve populations of rare species and species undergoing regional or national declines. A key component of this is identifying where those opportunities exist and how species of greatest conservation need are distributed within the context of existing habitat conditions and co-occurring wildlife species. The 2015 revision of the Oklahoma Comprehensive Wildlife Conservation Strategy (aka Oklahoma Wildlife Action Plan) recognized 310 species as species of greatest conservation need, and many of these are incompletely understood in terms of their distributions, habitat needs and basic life history characteristics. To address a portion of this concern, the Oklahoma Wildlife Diversity Program conducted comprehensive vertebrate inventories on six agency-owned wildlife management areas in collaboration with the biologists and technicians stationed on those areas. A series of standard survey techniques were used to document and attempt to quantify the bird, mammal, amphibian, reptiles and fish communities on each area. These inventories can serve as a baseline condition for each WMA, and the survey methods and the level of survey effort were documented so that biologists may repeat this survey in the future to examine changes in the distributions and relative abundances of species over time.

We selected six wildlife management areas to represent a gradient of habitat and climate conditions from west to east across the state. In northwestern Oklahoma, we chose to inventory the Cimarron Hills and Cimarron Bluff WMAs (the Cimarron Hills / Cimarron Bluff complex). These areas are dominated by mixed-grass prairie and sand sagebrush shrubland communities and should support a portion of the fauna characteristic of the High Plains. Moving east, we chose Cross Timbers WMA in south-central Oklahoma and Okmulgee and Deep Fork WMAs (the Okmulgee / Deep Fork complex) in east-central Oklahoma to represent habitat conditions in the Cross Timbers Region. Cross Timbers WMA lies in the southwestern corner of the Cross Timbers region and should represent a drier component of the Cross Timbers on sandy soils, while Okmulgee/Deep Fork WMAs lie in the northeastern portion of the region and should represent a wetter component of the Cross Timbers on rocky, sandstone soils. The Okmulgee/Deep Fork WMA complex also contains a substantial acreage of bottomland forest along the Deep Fork River, which brings another general habitat type into the inventory project. The final area selected was Cookson WMA, which lies in the Ozark Region of northeastern Oklahoma less than 20 miles from the Arkansas state line. Cookson WMA has the wettest and coolest climate of the six areas and lies above a transition zone between the limestone bluffs of the Springfield Plateau and the sandstone hills of the Boston Mountains. This report is written as a series of four stand-along chapters; each chapter summarizes our findings from each of the four WMAs / WMA complexes.

OBJECTIVE:

Established survey techniques will be used to develop a series of survey protocols and to implement a biological inventory for all vertebrate and selected invertebrate classes, with an emphasis on species of greatest conservation need, on six state wildlife management areas.

SUMMARY OF ACCOMPLISHMENTS:

See the summary reports for WMAs below:

- Cimarron Hills and Cimarron Bluff Wildlife Management Areas
- Okmulgee and Deep Fork Wildlife Management Areas
- Cookson Wildlife Management Area
- Cross Timbers Wildlife Management Area

CIMARRON HILLS AND CIMARRON BLUFF WILDLIFE MANAGEMENT AREAS

We conducted a series of surveys to develop a biological inventory of Cimarron Hills WMA and Cimarron Bluff WMA during the final annual segment of the grant. These two relatively small wildlife management areas are geographically close to one another and are managed together under the same area manager/biologist, Larry Wiemers. This inventory was conducted in collaboration with Larry Wiemers and the Wildlife Diversity Program owes a great debt of appreciation to Larry for his permission to access all parts of these wildlife management areas, his assistance in the surveys, and his technical expertise and local knowledge.

Most of our field work was focused on Cimarron Hills WMA (Figure 1). This WMA has easier access and serves as the headquarters for both management areas. The Cimarron Hills WMA is located in northwestern Woods County adjacent to the east bank of the Cimarron River and approximately four miles south of the Oklahoma/Kansas state line. Most of its 3,770 acres consists of stabilized sand dunes that support a low shrubland community dominated by sand sagebrush (*Artemesia filifolia*), Sand Plum (*Prunus angustifolia*) and a diverse community of over 100 native prairie grasses and forbs. These dunes overlie layers of red clay and gypsum. Red shale and clay are exposed at the surface in the northeastern part of the WMA; this soil type supports a slightly different grass and forb community and generally lacks sand sagebrush. The underlying gypsum formation is exposed in several areas running north-to-south in the center of the WMA at the transition between the Cimarron River flood plain and the surrounding uplands. At these sites, the gypsum forms outcrops and small bluffs. These sites also support a slightly different plant community that includes several gypsum-associated forbs. Running roughly northeast to southwest across the WMA is a stream called West Anderson Creek. This creek is comprised of a series of pools that are connected by subsurface water flow. Surface flows are infrequent and occur for only a few days at a time following large rainfall events. West Anderson Creek supports an open riparian woodland community dominated by American elms (*Ulmus americana*) and a small number of plains cottonwoods (*Populus deltoides*), hackberry trees (*Celtis occidentalis*) and western soapberry trees (*Sapindus drummondii*). The western boundary of the WMA is formed by the Cimarron River. In this part of the state, the Cimarron River has a shallow, braided channel. A large salt flat, more than 500 acres in size, occurs in the northwestern corner of the WMA adjacent to the Cimarron River and it extends north onto the adjacent property. Private ranch lands occur on the adjacent properties to the north, east and south of the WMA. During the period from October 2017 through April 2018, the weather was unusually dry and under drought conditions; however, from May through September of 2018, the area received above average rainfall.

The Cimarron Bluff WMA is located in northeastern corner of Harper County adjacent to the west bank of the Cimarron River (Figure 2). Cimarron Bluff WMA lies approximately 8 miles due south of Cimarron Hills WMA, but because of the slight northwest to southeast course of the river, Cimarron Bluff WMA falls on the west-southwest side of the river rather than the east-northeast side. Because of its position west of the river, there are no active or stabilized sand dunes on the WMA. Its 3,340 acres overlie an area of layered red clay and gypsum sub-soil strata, identical to those that lie beneath the stabilized sand dunes on Cimarron Hills WMA. Across most of the Cimarron Bluff WMA, the soils are derived from red clay/shale, but in some locations, there are exposed gypsum outcrops and bluffs. The largest of these bluffs occurs along the eastern edge of the management area where it abuts the Cimarron River flood plain. At least eighty percent of the vegetation on the WMA is comprised of mixed-grass prairie dominated by little bluestem (*Schizachyrium scoparium*) with a diversity of forbs. An unnamed, intermittent stream flows from west to east across the WMA and nearly bisects it into northern and southern halves. Along this stream is a riparian woodland dominated by American elm, western soapberry and hackberry trees, with smaller numbers of plains cottonwood, black willow (*Salix nigra*), and eastern redcedar (*Juniperus virginiana*). There are a few man-made ponds on the area, but most were dry or nearly dry during our survey as a result of prolonged regional drought. Cimarron Bluff WMA is

surrounded by private ranchland on its north, west, and south sides. The Cimarron River forms the WMA's eastern boundary and there is a substantial bluff running the length of the eastern edge of the WMA that separates it from the river. This bluff varies in height from 75 to nearly 200 feet. Relatively little of our survey effort was devoted to Cimarron Bluff WMA because of its limited and difficult access.

Because of the recent regional drought and the limited availability of fresh surface water, no livestock grazing had taken place on the Cimarron Hills and Cimarron Bluff WMAs during the previous five growing seasons. As a result, much of the vegetation was taller and more dense than is usual for these areas. Both WMAs have a limited internal road network; most of the interior roads are closed to the public and not regularly maintained (e.g. graded or mowed); therefore, driving access is relatively limited; especially on the lesser-used Cimarron Bluff WMA.

The primary project personnel for the 2018 biological surveys were Curtis Tackett, Mark Howery, Jena Donnell, Matt Fullerton, Larry Wiemers and Melynda Hickman. We received help from the Oklahoma City Zoological Park staff during our February and August surveys and wish to acknowledge Jordan Long, Erik Kalen and Alicia Snellen. We conducted six surveys on the Cimarron Hills and Cimarron Bluff WMAs as follows:

5, 6, and 7 February 2018
24 and 25 April 2018
22, 23, and 24 May 2018
19, 20, and 21 June 2018
12 and 13 July 2018
21, 22, and 23 August 2018

Figure 1. Map of Cimarron Hills Wildlife Management Area

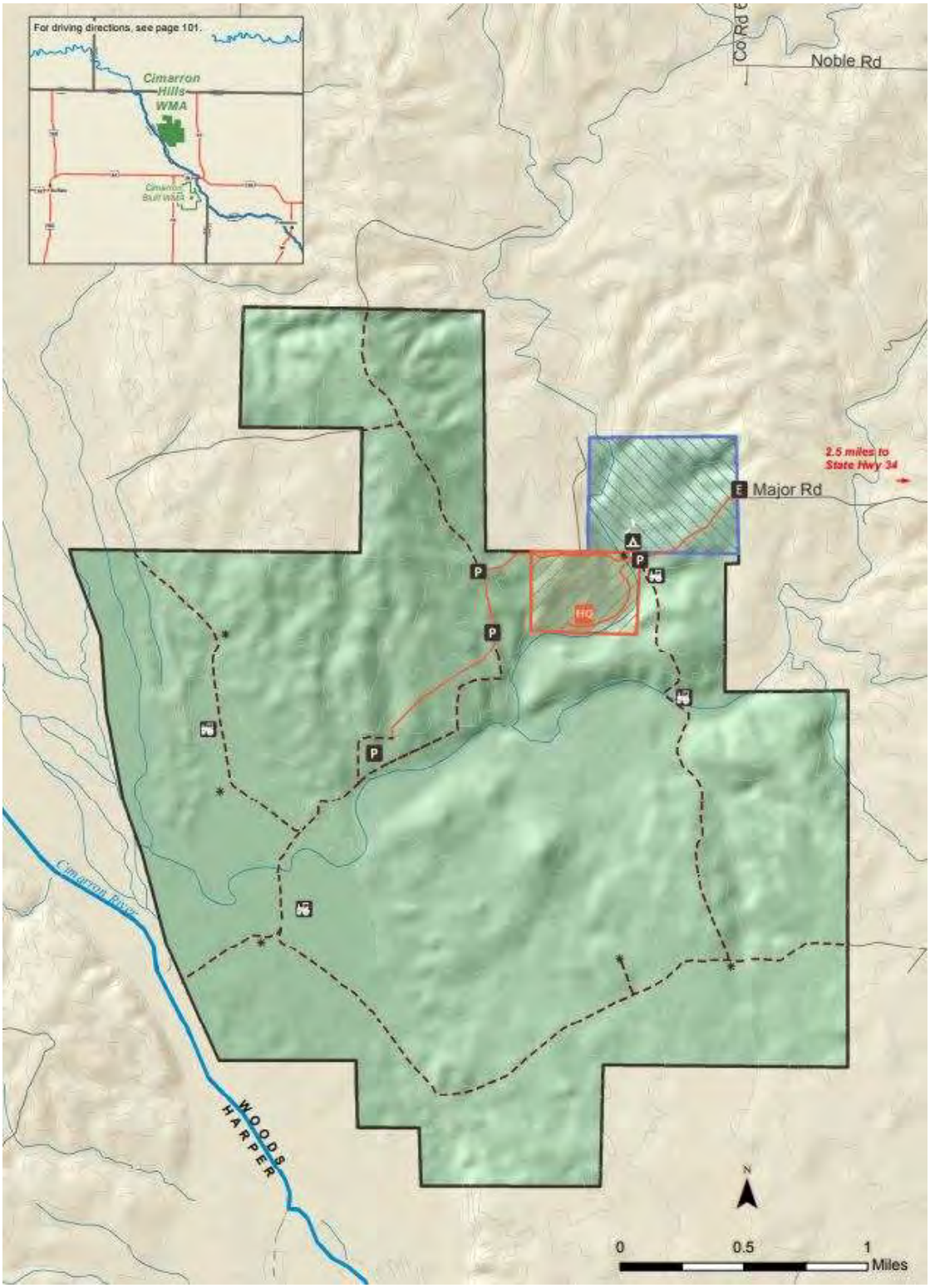
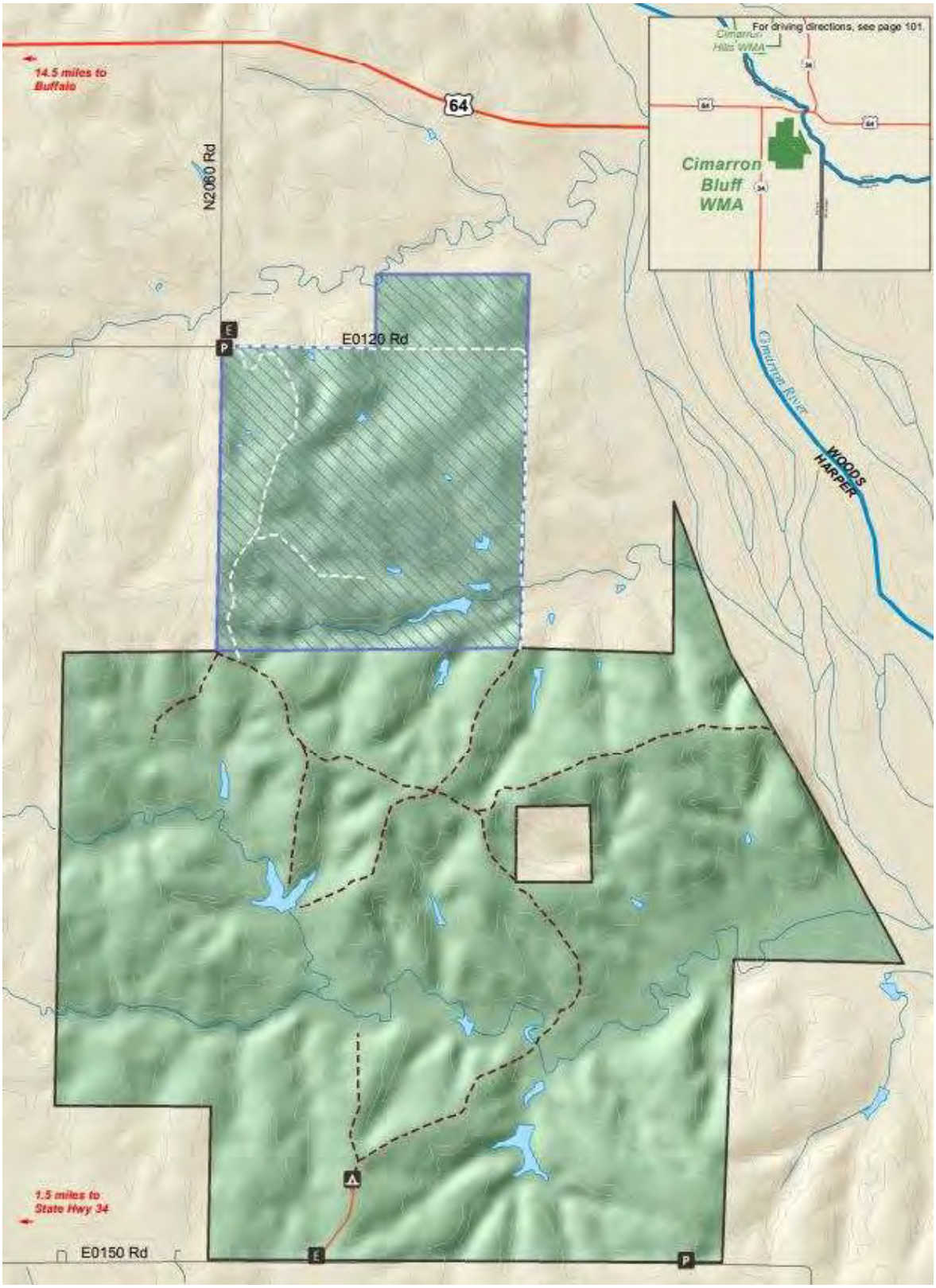


Figure 2. Map of Cimarron Bluff Wildlife Management Area



Our techniques varied between surveys based upon the focal taxa for that season. The most commonly used technique was the timed-search survey in which observers walked through specific habitats for a predetermined length of time (typically for 30 to 60 minutes at a time) and recorded every vertebrate that was seen or heard (in the case of birds and anurans). In cases where the observers acted independently, each observer's time and data were recorded separately; however, in cases where two or more observers remained together (e.g. traveling along a road or trail), the observers were considered to be a field party and their effort was treated as if they were a single individual. The timed-search was a very effective technique for surveying birds but was moderately successful for surveying amphibians and reptiles. During timed-searches that were focused on amphibians and reptiles (April, May and July), we lifted and searched under rocks and fallen logs where available; however, both of these cover objects are very limited in abundance on both WMAs. We used dip nets to sample the fish populations in pools within West Anderson Creek during the May survey. To assess the small mammal community, we used Sherman live traps baited with chicken scratch, black oil sunflower seeds and rolled oats to capture, record, and release rodents. Small mammal trapping was conducted in April, May and July. During the June survey (bird nesting season) we conducted a series of 42 5-minute point counts along the WMA roads to assess the breeding bird community.

Each survey trip had a different focus and targeted a specific group of taxa. The winter surveys focused on the bird community, although incidental mammal observations were recorded. The April, May, and July surveys were focused on reptiles and small mammals, although bird observations were made secondarily, and pools were searched for fish and amphibians. The focus of the June survey was an assessment of the breeding bird community, although incidental observations of reptiles and amphibians were made during the avian point counts and when scouting out the route for the point counts. The August survey was focused on assessing the bat community and mist-nets were set for three hours following sundown at two locations. Collectively, the level of effort expended on Cimarron Hills and Cimarron Bluff WMA during 2018 equaled 14.5 hours of diurnal timed-searches on foot with an emphasis on amphibians and reptiles; 19.5 hours of diurnal road-based timed-searches with an emphasis on birds and reptiles; 7.5 hours of nocturnal timed-searches (road cruising) during six nights with an emphasis on reptiles and mammals; 1.5 hours of dip-netting surveys for fish; 198 small mammal trap nights at eleven locations accompanied by 9 hours of incidental observations during set-up and take-down; six hours of mist-netting for bats and recording bat echolocations; 19.5 hours of timed-searches for wintering birds, and 42 five-minute point-counts for breeding birds.

We recorded all vertebrates observed or heard during our surveys, but the surveys were conducted at times and locations that were most likely to detect species of greatest conservation need (SGCN) as defined in the Oklahoma Comprehensive Wildlife Conservation Strategy. During our inventory, we detected the following 18 SGCN on the two areas - Texas Horned Lizard, Mexican Free-tailed Bat, Swainson's Hawk, Snowy Plover, Least Tern, Wilson's Phalarope, Burrowing Owl, Red-headed Woodpecker, Northern Bobwhite, Lesser Prairie-Chicken, Loggerhead Shrike, Bell's Vireo, Cassin's Sparrow, Painted Bunting, Harris's Sparrow, Bullock's Oriole, Arkansas Darter, and Arogos Skipper. Our experiences in conducting wildlife inventories on previously studied wildlife management areas (Cross Timbers WMA, Cookson WMA, and Okmulgee WMA) has taught us that single-year surveys tend to be less complete because the searching and trapping efforts are smaller and because annual variation in weather conditions, especially rainfall, during the spring and early summer months can alter the activity levels and abundances of many amphibian, reptile and small mammal species. The dry weather conditions that Cimarron Hills and Cimarron Bluff WMAs experienced in the spring may account for our relatively low detection rates for amphibians and reptiles, while the rainfall in June and July may account for our relatively low small mammal trapping success in July. We recommend that similar inventory efforts in the future be planned as two-year series of surveys.

Amphibians and Reptiles

Surveys for amphibians were particularly challenging on these wildlife management areas. The region has a naturally low diversity of amphibians, with only one species of salamander and nine species of anurans documented in the two-county area. Coupled with this, is the limited amount of fresh surface water that provides potential breeding habitats for amphibians on these WMAs. The Cimarron River in this area is too saline to support larval amphibians; the sandy soils that dominate Cimarron Hills WMA don't support ponds, and the potential breeding ponds in the clay soils on Cimarron Bluff WMA were almost entirely dry due to an on-going drought. Additionally, dry weather conditions persisted during what is normally the peak period for amphibian reproductive activity and nocturnal calling activity. Amphibians, particularly frogs and toads, are most easily detected in the months between March and June; however, in 2018 the region experienced a prolonged dry weather pattern through May and only began to recover from drought in June. We detected only three relatively common species of amphibians out of a potential amphibian community of 10 species; these results are summarized below in Table 1. We located Woodhouse's Toads (*Anaxyrus woodhousii*) at several locations across Cimarron Hills WMA, primarily during the early morning and evening hours. We located Blanchard's Cricket Frogs (*Acris blanchardi*) and Plains Leopard Frogs (*Lithobates blairi*) only in association with pools in West Anderson Creek. Unlike the other WMAs that we have surveyed, we did not detect any frogs or toads calling in the evenings due to the scarcity of suitable breeding ponds. Larry Wiemers confirmed the presence of Barred Tiger Salamanders (*Ambystoma mavortium*) based on his incidental observations during the past seven years, but we did not detect this species during our formal surveys. Suitable habitat exists on the WMAs for Great Plains Toads (*Anaxyrus cognatus*), Plains Spadefoots (*Spea bombifrons*), and Western Narrowmouth Toads (*Gastrophryne olivacea*), and we anticipate that these species are present and would have been detected if weather conditions had been more favorable. Additionally, potential habitat exists for Red-spotted Toads (*Anaxyrus punctatus*) around the gypsum outcroppings on both WMAs, and for Spotted Chorus Frogs (*Pseudacris clarkii*) on Cimarron Bluff WMA, so searches for these species should be pursued in the future.

Table 1. Summary of Amphibian Detections on Cimarron Hills/Cimarron Bluff WMAs

Common (Scientific) Name	Diurnal Timed Searches	Nocturnal Timed Searches
Woodhouse's Toad (*Anaxyrus woodhousii*)	2	3
Blanchard's Cricket Frog (*Acris blanchardi*)	7	
Plains Leopard Frog (*Lithobates blairi*)	3 adults, 2 tadpoles	

Surveys for reptiles were accomplished through a combination of diurnal timed-searches on foot, diurnal road cruises (driving roads slowly in the mornings and late afternoons looking for basking or foraging reptiles), and nocturnal road cruises. For these WMAs, we found the greatest detection success through diurnal road cruising, especially in the mid-mornings and in the late afternoons four to two hours before dark. Timed searches on foot were more difficult than we experienced during similar surveys on other wildlife management areas. Cimarron Hills and Cimarron Bluff WMAs have relatively few cover objects (e.g. rocks and logs) under which lizards and snakes can hide; therefore, many of these species appear to occupy burrows or take refuge from the heat in dense sagebrush or clumps of grass where they are difficult to observe or capture. With very few cover objects to lift and search for small reptiles, we had to rely on observing basking reptiles (often on sagebrush branches) or flushing animals as we walked. An additional constraint to our success was heat. In open grassland and shrubland habitats, the ground became very warm by noon and curtailed the activity of ground-dwelling reptiles. In contrast to our timed-searches on foot, we had greater than expected success searching roads by vehicle in the mornings

and late afternoons. Many of the common reptiles on the WMAs were species that would bask or forage along roads during the cooler times of the day.

The three most commonly detected reptiles during our surveys were Prairie Lizard (*Sceloporus consobrinus*), Texas Horned Lizard (*Phrynosoma cornutum*) and Prairie Racerunner (*Cnemidophorus sexlineatus viridis*). The Prairie Lizard was most often seen during timed-searches on foot – usually around Sand Sagebrush shrubs, while the Texas Horned Lizard and Prairie Racerunner were most often found on the edges of roads. The other two lizard species that were detected, Eastern Collared Lizard (*Crotaphytus collaris*) and Western Slender Glass Lizard (*Ophisaurus attenuatus*) were not seen in sufficiently large numbers to detect a pattern. Both Collared Lizards were seen in the vicinity of gypsum outcrops, and the Western Slender Glass Lizards were found in sagebrush shrubland habitat. Two other lizard species are likely to occur on the WMAs but were not detected – Great Plains Skinks (*Plestiodon obsoletus*) and Lesser Earless Lizards (*Holbrookia maculata*), which may occur on dunes with sparser vegetation.

As many as 22 species of snakes may occur on the two WMAs; however, we detected only eight of these, plus a ninth species (Coachwhip (*Masticophis flagellum*)) that was observed crossing a county road approximately three miles from Cimarron Hills WMA. Snakes were generally found opportunistically and nearly all of the individuals that we found were crossing roads or basking on roads. Most of the smaller species of snakes spend the majority of their time burrowing in the soil or leaf litter and can be found by lifting rocks and logs during cool weather or raking leaves. However, the scarcity of rocks, logs and leaf litter made finding species such as the Plains Black-headed Snake (*Tantilla nigriceps*) and Ring-necked Snake (*Diadophis punctatus*) difficult. We suspect that both of these species occur on one or both WMAs but were not able to confirm this. The one species of small snake that we found was represented by a single Variable Ground Snake (*Sonora semiannulata*) that we found on a sandy road north of the headquarters. Evening road cruises were productive for finding nocturnal species such as the Prairie Rattlesnake (*Crotalus viridis*) and Western Massasauga (*Sistrurus tergeminus*). The other snake species that we documented are summarized in Table 2. In addition to these species, we anticipate that the Great Plains Ratsnake (*Patherophis emoryi*), Western Hog-nosed Snake (*Heterodon nasicus*), Texas Nightsnake (*Hypsiglena jani*), Speckled Kingsnake (*Lampropeltis getula*), Long-nosed Snake (*Rhinochelius lecontei*), and Marcy's Checkered Gartersnake (*Thamnophis marcianus*) could be found on one or both WMAs with additional search effort because suitable habitat exists for each. Although we did not confirm the presence of Western Diamond-backed Rattlesnake (*Crotalus atrox*), this species has been documented on Cimarron Bluff WMA by Larry Wiemers.

Three species of turtles were located during the inventory. Yellow Mud Turtles (*Kinosternon flavescens*) were documented in two ponds on Cimarron Hills WMA and Red-eared Slider (*Trachemys scripta elegans*) was documented in a pond on Cimarron Bluff WMA. Ornate Box Turtles appear to be common on both WMAs and were seen at multiple locations. Despite the location of both WMAs in the flood plain of a large river, the Cimarron River did not appear to enhance the suitability of these WMAs for aquatic turtles. The Cimarron River is sufficiently saline that it appears to be unsuitable, or at least seasonally unsuitable, for aquatic turtles, and none were seen in the river.

Table 2. Summary of Reptile Detections on Cimarron Hills/Cimarron Bluff WMAs

Common (Scientific) Name	Diurnal Timed-Searches on Foot	Diurnal Road Cruising	Nocturnal Road Cruising
Yellow Mud Turtle (*Kinosternon flavescens*)	7		
Red-eared Slider (*Trachemys scripta elegans*)	1		
Ornate Box Turtle (*Terrapene ornata*)	1	4	

Collared Lizard (*Crotaphytus collaris*)	1	1	
Prairie (Fence) Lizard (*Sceloporus consobrinus*)	11	2	
Texas Horned Lizard (*Phrynosoma cornutum*)	3	12	
Prairie Racerunner (*Cnemidophorus sexlineatus*)	3	14	
Western Slender Glass Lizard (*Ophisaurus attenuatus*)	1	1	
Kansas Glossy Snake (*Arizona elegans*)	1	1	
Eastern Racer (*Coluber constrictor*)		1	
Diamond-backed Watersnake (*Nerodia rhombifer*)	1		
Coachwhip (*Masticophis flagellum*)		1	
Bullsnake (*Pituophis catenifer sayi*)		1	
Variable Ground Snake (*Sonora semiannulata*)		1	
Red-sided Gartersnake (*Thamnophis sirtalis*)		1	
Prairie Rattlesnake (*Crotalus viridis*)		1	2
Western Massasauga (*Sistrurus tergeminus*)		1	2

Mammals

As many as 38 species of native mammals potentially occur on and in the vicinity of Cimarron Hills and Cimarron Bluff Wildlife Management Areas, with nearly 2/3 of these being bats (9 species) and rodents (17 species). We did not use any survey methods that targeted game mammals (e.g. White-tailed Deer (*Odocoileus virginianus*) and furbearers), but we recorded sightings of these animals during our timed-search surveys and noted identifiable tracks of furbearers to document their presence. We observed White-tailed Deer during almost every survey, and one or more Coyotes were observed during two surveys. We observed many track-lines for both of these species as well as several track-lines from Raccoons (*Procyon lotor*) and Striped Skunks (*Mephitis mephitis*), and one track-line from an American Badger (*Taxidea taxus*). Although not detected during the formal surveys, Larry Wiemers had observed Bobcat (*Felis rufa*), Virginia Opossum (*Didelphis virginiana*), and Red Fox (*Vulpes vulpes*) on multiple occasions during 2018.

Because of the potential diversity of bats in this part of the state and the fact that none of these species were endangered, we attempted to capture and release bats in mist nets. During the August survey, mist nets were set up at two locations on Cimarron Hills WMA for a single night each and were operated for three hours each night. While the mist nets were being monitored for bat captures, an *Echo Meter Touch* device from Wildlife Acoustics was used to record bat vocalizations at the site. Mist nets were set up in a partially wooded area near the Cimarron River one night and over a pool in West Anderson Creek near a gypsum outcrop the other night. Two Evening Bats (*Nycticeius humeralis*) and six Mexican Free-tailed Bats (*Tadarida brasiliensis*), were captured, photographed and released during the two-night survey. The Evening Bats were noteworthy because they represented a new county record for this species. At the site adjacent to the Cimarron River, the survey crew recorded 191 identifiable bat vocalizations, and at the West Anderson Creek site they obtained 274 identifiable vocalizations. Although it is impossible to determine how many bats of each species were present at these sites, the vocalizations document the presence of at least one bat for each species and provide an estimate of the relative abundance of each species. At the Cimarron River site, 29% of the recordings were from Cave Bats (*Myotis velifer*), 27% were from Evening Bats, 19% were from Mexican Free-tailed Bats, 16% were from Eastern Red Bats (*Lasiurus borealis*), 5% were from Western Small-footed Bats (*Myotis ciliolabrum*) and 4% were from Big Brown Bats (*Eptesicus fuscus*). At the West Anderson Creek site, 58% of the recordings were from Cave Bats, 15% were from Western Small-footed Bats, 8% were from Pallid Bats (*Antrozous pallidus*), 7% were from Eastern Red Bats, 6% were from Evening Bats, and 6%

were from Mexican Free-tailed Bats. With the combination of mist-netting and acoustic recordings, we documented seven species of bats on Cimarron Hills WMA and these same species should be present on Cimarron Bluff WMA as well because of their habitat similarities.

We used Sherman live-traps as our method for assessing the WMAs' rodent population. We set live traps in arrays of 10 to 25 traps at eleven locations on Cimarron Hills WMA which were operated for a single night at each site. Our total trap effort was 198 trap nights – 50 trap nights during one night in April; 78 trap nights during one night in May and 70 trap nights distributed across two nights in July. Trapping success was relatively low on the WMA and ranged from 16% in April to 5% in May. This is much lower than our success rates on Cross Timbers, Cookson, and Okmulgee/Deep Fork WMAs and may reflect lower rodent abundance due to habitat differences or the effects of prolonged drought. In 198 trap nights, we captured and released five Ord's Kangaroo Rats (*Dipodomys ordii*), two Western Harvest Mice (*Reithrodontomys megalotis*), two White-footed Mice (*Peromyscus leucopus*), three North American Deer Mice (*Peromyscus maniculatus*), two Hispid Cotton Rats (*Sigmodon hispidus*) and a single Southern Plains Woodrat (*Neotoma micropus*) for a cumulative trap success rate of 7.5%. We observed a third Hispid Cotton Rat during a diurnal timed search and two additional Ord's Kangaroo Rats during a nocturnal road cruise. Three North American Porcupines (*Erethizon dorsatum*) were observed incidentally during our diurnal survey for wintering birds, and a Thirteen-lined Ground Squirrel (*Spermophilus tridecmlineatus*) was observed during a diurnal timed-search. Larry Wiemers reported that he observed numerous ground squirrels on the area each spring. Based on his description, most were probably Thirteen-lined Ground Squirrels, but some of the observations on Cimarron Hills WMA were likely to be Spotted Ground Squirrels (*Spermophilus spilosoma*). Based upon the available habitat, we suspect that at least three other rodent species occur on one or both WMAs – Plains Pocket Mouse (*Perognathus flavescens*), Hispid Pocket Mouse (*Chaetodipus hispidus*) and Northern Grasshopper Mouse (*Onychomys leucogaster*). The other mammal species observed during the inventory were Nine-banded Armadillo (*Dasypus novemcinctus*), Eastern Cottontail (*Sylvilagus floridanus*) and Black-tailed Jackrabbit (*Lepus californicus*), each of which appears to be common on the WMAs and was observed during both diurnal and nocturnal surveys.

Table 3. Summary of Mammals Detected on Cimarron Hills and Cimarron Bluff WMAs

Common Name	Diurnal Timed Searches	Nocturnal Timed Searches	Live Traps
Western Small-footed Bat (*Myotis ciliolabrum*)		calls	
Cave Bat (*Myotis velifer*)		calls	
Big Brown Bat (*Eptesicus fuscus*)		calls	
Eastern Red Bat (*Lasiurus borealis*)		calls	
Evening Bat (*Nycticeius humeralis*)		2	
Pallid Bat (*Antrozous pallidus*)		calls	
Mexican Free-tailed Bat (*Tadarida brasiliensis*)		6	
Nine-banded Armadillo (*Dasypus novemcinctus*)	3	1	
Eastern Cottontail (*Sylvilagus floridanus*)	3	3	
Black-tailed Jackrabbit (*Lepus californicus*)	4	4	
Thirteen-lined Ground Squirrel (*Spermophilus tridecmlineatus*)	1		
Ord's Kangaroo Rat (*Dipodomys ordii*)		2	5
Western Harvest Mouse (*Reithrodontomys megalotis*)			2
White-footed Mouse (*Peromyscus leucopus*)			2
North American Deer Mouse (*Peromyscus maniculatus*)			3
Hispid Cotton Rat (*Sigmodon hispidus*)	1		2

Southern Plains Woodrat (*Neotoma micropus*)			1
North American Porcupine (*Erethizon dorsatum*)	3		
Coyote (*Canis latrans*)	3		
Raccoon (*Procyon lotor*)	track lines		
Striped Skunk (*Mephitis mephitis*)	track lines		
American Badger (*Taxidea taxus*)	track line		
White-tailed Deer (*Odocoileus virginianus*)	19	4	

Birds

As a group, birds are very mobile and many of Oklahoma's species are migratory. Because of this, we've divided our bird data into three seasons to identify the bird communities that winter on Cimarron Hills and Cimarron Bluff WMAs, the communities that occur on the WMAs during the summering / nesting season, and the species that occur during the transitional migration seasons. Our winter season bird community is based upon data from our February survey; the migration season bird community is based upon the data collected during our April survey, and our breeding season community is based upon data collected during our May, June and July surveys. Across all three seasons, 91 species of birds were detected on the two management areas during our surveys.

Wintering Bird Community

The wintering bird community was surveyed during February 5 – 7, 2018 by a team consisting of Mark Howery, Jena Donnell and Larry Weimers from the Oklahoma Department of Wildlife Conservation and Jordan Long, Erik Kalen and Alicia Snellen from the Oklahoma City Zoo. The survey was conducted as a series of timed searches by a team of two or three observers that traveled as a group and recorded every bird that was seen or heard and could be positively identified by at least one member of the team. The timed-searches were accomplished by driving WMA roads and observing birds from the vehicle (using the vehicle as a form of bird-blind) and by walking through tracts of grassland and shrubland habitat and along reaches of riparian habitat. Because the members of each survey team traveled together and most of the birds that they saw were observed by all of the team members, their search times were recorded as "party hours" to reflect that more than one observer was present during the search. In general, a group of two to four people can locate and confirm the identification of a greater number of birds than a single observer can because there are more observers and a greater probability that each bird will be seen and identified by more than one person.

Wintering birds were surveyed on Cimarron Bluff WMA in two sessions – four hours during the afternoon of 5 February 2018 and four hours during the morning of 7 February 2018. The survey crew worked as one large team during both timed-search sessions because of the limited accessibility of the area. Twenty-six species of birds were recorded on the area during the two sessions combined (Table 4). Nine of these were found only on Cimarron Bluff WMA (Barn Owl, Red-bellied Woodpecker, Carolina Chickadee, Brown Creeper, Northern Cardinal, Fox Sparrow, Red-winged Blackbird, House Finch, and American Goldfinch), and the remaining 17 were also observed on Cimarron Hills WMA. Some of the more noteworthy birds included a Brown Creeper and seven Fox Sparrows seen in riparian habitat along the unnamed intermittent creek, and a Barn Owl that was flushed from a group of redcedar trees at the base of a gypsum bluff. The most numerous species on the WMA were Dark-eyed Junco, American Tree Sparrow, American Robin and Brewer's Blackbird – the last species because of a large flock that settled on the area to roost. Five meadowlarks were seen on the area (all flushed from tallgrass), but none of these vocalized and we were not able to determine whether they were Eastern or Western meadowlarks. It is likely that both species are present on the area, but the tall, rank herbaceous vegetation that existed on the area during the survey is more likely to support Eastern Meadowlarks. Ironically, grassland bird

species such as meadowlarks, Savannah Sparrows and Northern Bobwhites were probably under-sampled during our survey because of the abundance of cover provided by the tall vegetation that had not been grazed or burned in four growing seasons. The survey team made a concerted effort to walk through areas of tallgrass to locate wintering Le Conte's Sparrows, but was unsuccessful. We had hoped to encounter Chestnut-collared or Lapland Longspurs on the area, but the grassland vegetation appeared to be too tall and dense for these species. All but one pond on the WMA was dry and a flock of Mallards was the only aquatic species that we observed. During wetter weather cycles, it is likely that other species of waterfowl, Great Blue Herons, and Belted Kingfishers winter on the WMA.

The survey for wintering birds on Cimarron Hills WMA was conducted on 6 February 2018. Because of a cold front that passed through the area during the night prior to the survey, the weather conditions were overcast, cold, and windy with a strong northerly wind that held temperatures below freezing all day. For the survey, the WMA was divided in half and each half was searched by a team of three people. Because of the weather conditions, most observations were made from vehicles or on foot close to WMA roads. Twenty-three species were observed by the two teams combined (Table 4). Six species were observed only on Cimarron Hills WMA (Greater Roadrunner, Loggerhead Shrike, White-crowned Sparrow, Merlin, American Kestrel, and American Crow) while the remaining 17 were observed also on Cimarron Bluff WMA. The most commonly observed species on Cimarron Hills WMA were American Tree Sparrow, White-crowned Sparrow, meadowlark (Eastern and Western combined), American Robin and Savannah Sparrow. Numerous mixed-species flocks of native sparrows were observed and most of these were seen in and around the shelter provided by large sand plum thickets. American Tree Sparrows dominated these flocks, but they frequently included smaller numbers of White-crowned, Harris's, Field, and Savannah sparrows.

Table 4. Summary of the Wintering Bird Community on Cimarron Hills and Cimarron Bluff WMA.

Common Name (Scientific Name)	Cimarron Bluff WMA February 5 & 7, 2018 8 party hours - (6 on foot / 2 by vehicle)	Cimarron Hills WMA February 6, 2018 11.5 party hours - (2.0 on foot / 9.5 by vehicle)	Survey Total
Mallard (*Anas platyrhynchos*)	7	12	19
Northern Bobwhite (*Colinus virginianus*)	16	22	38
Northern Harrier (*Circus cyaneus*)	8	6	14
Red-tailed Hawk (*Buteo jamaicensis*)	3	8	11
Merlin (*Falco columbarius*)		1	1
American Kestrel (*Falco sparverius*)		3	3
Mourning Dove (*Zenaida macroura*)	2	1	3
Greater Roadrunner (*Geococcyx californianus*)		1	1
Barn Owl (*Tyto alba*)	1		1
Northern Flicker (*Colaptes auratus*)	10	6	16
Red-bellied Woodpecker (*Melanerpes carolinus*)	2		2
Loggerhead Shrike (*Lanius ludovicianus*)		1	1
American Crow (*Corvus brachyrhynchos*)		2	2
Carolina Chickadee (*Poecile carolinensis*)	6		6
Brown Creeper (*Certhia americana*)	1		1
Eastern Bluebird (*Sialia sialis*)	1	7	8
American Robin (*Turdus migratorius*)	39	43	82
Yellow-rumped Warbler	8	2	10

(*Setophaga coronata*)			
Northern Cardinal (*Cardinalis cardinalis*)	6		6
Savannah Sparrow (*Passerculus sandwichensis*)	7	27	34
American Tree Sparrow (*Spizella arborea*)	35	196	231
Field Sparrow (*Spizella pusilla*)	4	9	13
Dark-eyed Junco (*Junco hyemalis*)	77	7	84
Fox Sparrow (*Passerella iliaca*)	7		7
Song Sparrow (*Melospiza melodia*)	15	7	22
White-crowned Sparrow (*Zonotrichia leucophrys*)		26	26
Harris's Sparrow (*Zonotrichia querula*)	2	19	21
Meadowlark species (*Sturnella* sp.)	5	46	51
Red-winged Blackbird (*Agelaius phoeniceus*)	4		4
Brewer's Blackbird (*Euphagus cyanocephalus*)	160	20	180
House Finch (*Carpodacus mexicanus*)	1		1
American Goldfinch (*Carduelis tristis*)	1		1

Spring Migration Bird Community

The data for the spring migration bird community are somewhat limited because the only survey conducted during the spring migration window was the one on 24 and 25 April 2018. The survey that was conducted in May was too late in the season to capture most of the migrating songbirds and shorebirds that move through Oklahoma; therefore, those observations were included with the summer/nesting season observations. The results of the April survey are summarized in Table 5 and include 54 species. The summary is not a comprehensive representation of areas' bird community during the spring because many potential migrants and nesting species were missed. The survey was well-timed to document a portion of the migrating shorebird community (seven species plus two summer residents) and common grassland-dependent songbirds (e.g. Vesper and Clay-colored sparrows), but many migrants were missed. Songbird species that are likely to migrate through the area but were missed include House Wren (*Troglodytes aedon*), Gray Catbird (*Dumetella carolinensis*), Swainson's Thrush (*Catharus ustulatus*), American Pipit (*Anthus rubescens*), Nashville Warbler (*Vermivora ruficapilla*), Yellow Warbler (*Dendroica petechia*), Wilson's Warbler (*Wilsonia pusilla*), Common Yellowthroat (*Geothlypis trichas*), Chipping Sparrow (*Spizella passerina*), Lincoln's Sparrow (*Melospiza lincolnii*), and Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*). To help identify those species that occur in this region as migrants, the residence status of each one is shown. Species were classified as either year-round residents, winter residents (that lingered into the early spring), early-arriving summer residents (breeding species that arrive in March and April), and migrants (species which neither winter nor breed in the region).

Table 5. Spring Birds on Cimarron Hills and Cimarron Bluff WMAs. (Based on 8.0 Hours of Timed Searches for Birds and Incidental Observation During 2.5 Hours of Timed Searches for Amphibians and Reptiles)

Common Name (Scientific Name)	# Detected	Residence Status
Wild Turkey (*Meleagris gallopavo*)	3	(year-round resident)

Northern Bobwhite (*Colinus virginianus*)	2	(year-round resident)
Ring-necked Pheasant (*Phasianus colchicus*)	1	(year-round resident)
Mallard (*Anas platyrhynchos*)	1	(year-round resident)
Blue-winged Teal (*Anas discors*)	5	(migrant)
Turkey Vulture (*Cathartes aura*)	8	(early-arriving summer resident)
Red-tailed Hawk (*Buteo jamaicensis*)	2	(year-round resident)
American Kestrel (*Falco sparverius*)	4	(year-round resident)
Snowy Plover (*Charadrius alexandrinus*)	10	(early-arriving summer resident)
Semipalmated Plover (*Charadrius semipalmatus*)	6	(migrant)
Killdeer (*Charadrius vociferous*)	3	(early-arriving summer resident)
Spotted Sandpiper (*Actitis macularia*)	2	(migrant)
Lesser Yellowlegs (*Tringa flavipes*)	2	(migrant)
Least Sandpiper (*Calidris minutilla*)	12	(migrant)
Semipalmated Sandpiper (*Calidris pusilla*)	19	(migrant)
Baird's Sandpiper (*Calidris bairdii*)	3	(migrant)
Wilson's Phalarope (*Phalaropus tricolor*)	24	(migrant)
Forster's Tern (*Sterna forsteri*)	1	(migrant)
Eurasian Collared Dove (*Streptopelia decaocto*)	2	(year-round resident)
Mourning Dove (*Zenaida macroura*)	33	(year-round resident)
Burrowing Owl (*Athene cunicularia*)	1	(migrant)
Red-bellied Woodpecker (*Melanerpes carolinus*)	1	(year-round resident)
Downy Woodpecker (*Picoides pubescens*)	1	(year-round resident)
Northern Flicker (*Colaptes auratus*)	5	(year-round resident)
Say's Phoebe (*Sayornis saya*)	3	(migrant)
Scissor-tailed Flycatcher (*Tyrannus forficatus*)	7	(early-arriving summer resident)
Bell's Vireo (*Vireo bellii*)	1	(early-arriving summer resident)
Loggerhead Shrike (*Lanius ludovicianus*)	4	(year-round resident)
Blue Jay (*Cyanocitta cristata*)	2	(year-round resident)
Barn Swallow (*Hirundo rustica*)	6	(early-arriving summer resident)
Cliff Swallow (*Petrochelidon pyrrhonota*)	6	(early-arriving summer resident)
Tree Swallow (*Tachycineta bicolor*)	2	(migrant)
Ruby-crowned Kinglet (*Regulus calendula*)	1	(winter resident and migrant)
Eastern Bluebird (*Sialia sialis*)	2	(year-round resident)
American Robin (*Turdus migratorius*)	2	(year-round resident)
Brown Thrasher (*Toxostoma rufum*)	3	(early-arriving summer resident)
Cedar Waxwing (*Bombycilla cedrorum*)	9	(winter resident)
Orange-crowned Warbler (*Vermivora celata*)	2	(migrant)
Yellow-rumped Warbler (*Setophaga coronata*)	2	(winter resident and migrant)
Northern Cardinal (*Cardinalis cardinalis*)	2	(year-round resident)
Grasshopper Sparrow (*Ammodramus savannarum*)	1	(early-arriving summer resident)
Cassin's Sparrow (*Aimophila cassinii*)	2	(early-arriving summer resident)
Lark Sparrow (*Chondestes grammacus*)	12	(early-arriving summer resident)
Vesper Sparrow (*Pooecetes gramineus*)	10	(migrant)
Clay-colored Sparrow (*Spizella pallida*)	7	(migrant)
Field Sparrow (*Spizella pusilla*)	15	(year-round resident)
White-crowned Sparrow (*Zonotrichia leucophrys*)	34	(winter resident)
Swamp Sparrow (*Melospiza georgiana*)	1	(migrant)
Song Sparrow (*Melospiza melodia*)	1	(winter resident)
Eastern Meadowlark (*Sturnella magna*)	34	(year-round resident)
Western Meadowlark (*Sturnella neglecta*)	1	(year-round resident)
Red-winged Blackbird (*Ageaius phoeniceus*)	6	(year-round resident)

Common Grackle (*Quiscalus quiscala*)	4	(year-round resident)
American Goldfinch (*Carduelis tristis*)	1	(year-round resident)

Breeding Bird Community

We used road-based, five-minute point-counts as our primary tool for assessing the relative abundance and composition of the breeding bird community on Cimarron Hills WMA. We identified and recorded every bird that was seen or heard during a five-minute period within 200 meters at 42 locations on 20 and 21 June 2018. The point-count locations were placed along WMA roads and were spaced at intervals of 0.4 miles to maximize the number of stops that could be made while minimizing the potential for double-recording birds. We conducted the point-counts between 6:15 am (approximately 20 minutes after snrise) and 10:30 am. Because we did not begin the point counts until after sunrise, we did not detect any nocturnal birds such as owls or Common Poorwills (*Phalaenoptilus nuttallii*), but we did observe Common Nighthawks (*Chordeiles minor*) because they forage actively during the morning hours. We attempted to sample the different habitat types on the wildlife management area in proportion to their abundance. We divided the point-count locations between two broad habitat types: 1) sand sagebrush shrubland and grassland habitat, and 2) riparian woodland/shrubland habitat. We considered riparian habitat to be any point-count location that contained 20% or more tree cover within a 200-meter radius of the observer. Most of these riparian sites were located near West Anderson Creek as it meandered through the WMA. No site was entirely riparian woodland; most of the riparian sites contained 50% or more sagebrush shrubland and/or grassland vegetation cover. Ten of our point-count sites had some riparian vegetation (usually elm or cottonwood trees) and the remaining 32 sites were a mosaic of sagebrush shrubland and prairie vegetation. Point-counts are an effective technique for measuring the frequency of occurrence and relative abundances of most songbirds, but they are less effective for detecting rare songbirds and species that do not sing to signal the boundaries of their territories (e.g. Wild Turkeys, woodpeckers and raptors).

Forty species of birds were detected at the 42 point-count stations (Table 6). Fifteen additional species of birds were observed incidentally during either the June or July survey, suggesting that these species also breed on the WMA in at least small numbers. These species were Wild Turkey (*Meleagris gallopavo*), Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*), Mallard (*Anas platyrhynchos*), Great Blue Heron *(Ardea herodius*), Green Heron (*Butorides virescens*), Swainson's Hawk (*Buteo swainsonii*), Snowy Plover (*Charadrius alexandrinus*), Killdeer (*Charadrius vociferous*), Least Tern (*Sternulla antillarum*), Eurasian Collared Dove (*Streptopelia decaocto*), Great Horned Owl (*Bubo virginianus*), Common Poorwill (*Phalaenoptilus nuttallii*), Loggerhead Shrike (*Lanius ludovicianus*), American Crow (*Corvus brachyrhynchos*), and Horned Lark (*Eremophila alpestris*). Most of these species were seen in small numbers or as single individuals (Table 7); however, 14 Snowy Plovers and ten Least Terns were counted on the salt flat on the western boundary of the WMA where they nest. Noteworthy among these species are five SGCN – the Snowy Plover, Least Tern, Lesser Prairie-Chicken, Loggerhead Shrike, and Swainson's Hawk.

Table 6. Summary of 5-minute Point Counts for Assessing Breeding Birds on Cimarron Hills WMA. Point counts were conducted at 42 locations. (The number detected is shown followed by the average number of individuals per location in that habitat type.)

Common Name (Scientific Name)	Grassland/Shrubland Sites – 32 locations	Riparian Sites 10 locations
Northern Bobwhite (*Colinus virginianus*)	96 (3.0)	17 (1.7)
Ring-necked Pheasant (*Phasianus colchicus*)	13 (0.41)	1 (0.1)
Turkey Vulture (*Cathartes aura*)	1 (0.03)	1 (0.1)

Mississippi Kite (*Ictinia mississippiensis*)	3 (0.09)	10 (1.0)
Red-tailed Hawk (*Buteo jamaicensis*)	3 (0.09)	2 (0.2)
Mourning Dove (*Zenaida macroura*)	57 (1.78)	32 (3.2)
Yellow-billed Cuckoo (*Coccyzus americanus*)	0 (0)	4 (0.4)
Common Nighthawk (*Chordeiles minor*)	17 (0.53)	3 (0.3)
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	0 (0)	4 (0.4)
Red-bellied Woodpecker (*Melanerpes carolinus*)	0 (0)	1 (0.1)
Northern Flicker (*Colaptes auratus*)	1 (0.03)	2 (0.2)
Eastern Phoebe (*Sayornis phoebe*)	0 (0)	1 (0.1)
Great Crested Flycatcher (*Myiarchus crinitus*)	2 (0.06)	3 (0.3)
Eastern Kingbird (*Tyrannus tyrannus*)	4 (0.13)	9 (0.9)
Scissor-tailed Flycatcher (*Tyrannus forficatus*)	9 (0.28)	7 (0.7)
Bell's Vireo (*Vireo bellii*)	3 (0.09)	0 (0)
Blue Jay (*Cyanocitta cristata*)	0 (0)	3 (0.3)
N. Rough-winged Swallow (*Stelgidopteryx serripennis*)	0 (0)	1 (0.1)
Barn Swallow (*Hirundo rustica*)	0 (0)	8 (0.8)
Cliff Swallow (*Petrochelidon pyrrhonota*)	9 (0.28)	7 (0.7)
Bewick's Wren (*Thryomanes bewickii*)	0 (0)	2 (0.2)
Eastern Bluebird (*Sialia sialis*)	0 (0)	1 (0.1)
Brown Thrasher (*Toxostoma rufum*)	9 (0.28)	4 (0.4)
Northern Mockingbird (*Mimus polyglottos*)	11 (0.34)	27 (2.7)
Northern Cardinal (*Cardinalis cardinalis*)	0 (0)	1 (0.1)
Blue Grosbeak (*Guiraca caerulea*)	2 (0.06)	4 (0.4)
Painted Bunting(*Passerina ciris*)	0 (0)	2 (0.2)
Dickcissel (*Spiza americana*)	97 (3.03)	21 (2.1)
Grasshopper Sparrow (*Ammodramus savannarum*)	14 (0.44)	2 (0.2)
Cassin's Sparrow (*Aimophila cassinii*)	72 (2.25)	10 (1.0)
Field Sparrow (*Spizella pusilla*)	9 (0.28)	12 (1.2)
Lark Sparrow (*Chondestes grammacus*)	21 (0.66)	15 (1.5)
Eastern Meadowlark (*Sturnella magna*)	87 (2.72)	25 (2.5)
Western Meadowlark (*Sturnella neglecta*)	7 (0.22)	0 (0)
Red-winged Blackbird (*Ageaius phoeniceus*)	5 (0.16)	8 (0.8)
Common Grackle (*Quiscalus quiscala*)	1 (0.03)	2 (0.2)
Brown-headed Cowbird (*Molothrus ater*)	8 (0.25)	1 (0.1)
Orchard Oriole (*Icterus spurius*)	0 (0)	4 (0.4)
Bullock's Oriole (*Icterus bullockii*)	0 (0)	5 (0.5)
Baltimore Oriole (*Icterus galbula*)	1 (0.03)	3 (0.3)

Table 6 displays the point-count data in two ways – the raw number of individual birds of each species observed in the two habitat categories, and the average number of birds of each species in each habitat category. These data provide an indication of the relative abundance of each species. In the sagebrush shrubland and grassland habitat category, the most abundant species were Dickcissel, Eastern Meadowlark, Northern Bobwhite, Cassin's Sparrow and Mourning Dove. Each of these species was seen at an average of more than one bird per point-count. Ring-necked Pheasant, Common Nighthawk, and Grasshopper Sparrow were less common, but were seen more frequently in the shrubland/grassland sites than in the riparian-associated sites. Although not obvious from the summary table, Grasshopper Sparrows were typically detected at sites that had lower sagebrush cover and greater cover of bunch grasses. The abundance of Cassin's Sparrows on the WMA is noteworthy because this species has a

somewhat restricted range and is an SGCN; however, it is common in the sagebrush-dominated grasslands on Cimarron Hills WMA.

The riparian-associated point count sites had greater number of birds overall and many species were more common in this habitat than in the surrounding upland grasslands. The most frequently detected bird species in the riparian sites were Mourning Dove, Northern Mockingbird, Eastern Meadowlark, Dickcissel, Northern Bobwhite, Lark Sparrow and Field Sparrow. Some of the several species that were found only in these sites include Yellow-billed Cuckoo, Red-headed Woodpecker, Bewick's Wren, Painted Bunting, Orchard Oriole, and Bullock's Oriole.

Table 7. Birds Seen Incidentally During Summer Surveys

Common Name (Scientific Name)	# Detected
Wild Turkey (*Meleagris gallopavo*)	6
Northern Bobwhite (*Colinus virginianus*)	50
Lesser Prairie Chicken (*Tympanuchus pallidicinctus*)	1
Ring-necked Pheasant (*Phasianus colchicus*)	7
Mallard (*Anas platyrhynchos*)	1
Great Blue Heron *(Ardea herodius*)	1
Green Heron (*Butorides virescens*)	1
Turkey Vulture (*Cathartes aura*)	8
Red-tailed Hawk (*Buteo jamaicensis*)	2
Swainson's Hawk (*Buteo swainsonii*)	1
Snowy Plover (*Charadrius alexandrinus*)	14
Killdeer (*Charadrius vociferous*)	4
Least Tern (*Sternulla antillarum*)	10
Eurasian Collared Dove (*Streptopelia decaocto*)	1
Mourning Dove (*Zenaida macroura*)	128
Yellow-billed Cuckoo (*Coccyzus americanus*)	3
Great Horned Owl (*Bubo virginianus*)	1
Common Nighthawk (*Chordeiles minor*)	33
Common Poorwill (*Phalaenoptilus nuttallii*)	3
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	8
Red-bellied Woodpecker (*Melanerpes carolinus*)	2
Northern Flicker (*Colaptes auratus*)	2
Eastern Phoebe (*Sayornis phoebe*)	2
Great Crested Flycatcher (*Myiarchus crinitus*)	2
Eastern Kingbird (*Tyrannus tyrannus*)	17
Scissor-tailed Flycatcher (*Tyrannus forficatus*)	26
Bell's Vireo (*Vireo bellii*)	5
Loggerhead Shrike (*Lanius ludovicianus*)	1
American Crow (*Corvus brachyrhynchos*)	1
Blue Jay (*Cyanocitta cristata*)	2
Barn Swallow (*Hirundo rustica*)	16
Cliff Swallow (*Petrochelidon pyrrhonota*)	9
Horned Lark (*Eremophila alpestris*)	1
Bewick's Wren (*Thryomanes bewickii*)	1
Eastern Bluebird (*Sialia sialis*)	2
Brown Thrasher (*Toxostoma rufum*)	6
Northern Mockingbird (*Mimus polyglottos*)	22

Northern Cardinal (*Cardinalis cardinalis*)	2
Blue Grosbeak (*Guiraca caerulea*)	4
Dickcissel (*Spiza americana*)	73
Grasshopper Sparrow (*Ammodramus savannarum*)	11
Cassin's Sparrow (*Aimophila cassinii*)	56
Lark Sparrow (*Chondestes grammacus*)	73
Field Sparrow (*Spizella pusilla*)	8
Eastern Meadowlark (*Sturnella magna*)	71
Western Meadowlark (*Sturnella neglecta*)	7
Red-winged Blackbird (*Ageaius phoeniceus*)	24
Common Grackle (*Quiscalus quiscala*)	4
Brown-headed Cowbird (*Molothrus ater*)	3
Orchard Oriole (*Icterus spurius*)	1
Bullock's Oriole (*Icterus bullockii*)	4
Baltimore Oriole (*Icterus galbula*)	3

Fish

We used dip nets to conduct timed searches for fish in two sections of West Anderson Creek and in the Cimarron River about a quarter of a mile downstream from the confluence of West Anderson Creek near the site of a former U.S. Geological Survey water gauge station. In the two West Anderson Creek sites combined, we netted 92 Western Mosquito Fish (*Gambusia affinis*), 2 Green Sunfish (*Lepomis cyanellus*), and 31 Arkansas Darters (*Etheostoma cragini*) in a total of 1.25 hours. At the Cimarron River site, we netted 63 Red River Pupfish (*Cyprinodon rubrofluviatilis*) and 17 Northern Plains Killifish (*Fundulus kansae*) in 0.75 hours.

The fish community of West Anderson Creek contains a limited number of species, but the presence of the Arkansas Darter is noteworthy because this is an Oklahoma species of greatest conservation need and a former candidate for federal listing under the Endangered Species Act. We found these Arkansas Darters in an area where several springs or seeps feed groundwater into the stream. This section of the creek was shallow, but the water temperature was relatively cool because of the ground water connection. The stream channel was vegetated with a mix of cattails (*Typha* sp.), bullrushes (*Schoenoplectus* sp) and watercress (*Rorippa nasturtium-aquaticum*) that provided cover for the darters and indicated that this portion of the stream supported surface water year-round. Elsewhere on West Anderson Creek there are several deep pools that support sport fish – Bluegill (*Lepomis macrochirus*), Green Sunfish, and Largemouth Bass (*Micropterus salmoides*) and catch-and-release fishing is allowed, but other than the two Green Sunfish, we saw no evidence of the other sport fish in the reach where the Arkansas Darters occurred.

The fish community within the Cimarron River appears to have limited species richness as well. We did not collect water quality parameters, but this reach of the river is known to have an elevated salinity because of the upwelling of saline ground water under the salt flat that lies adjacent to the river's left descending bank. Red River Pupfish and Northern Plains Killifish have relatively high salt tolerances for freshwater fish and can survive in this area. We sampled this area during the July survey when water temperatures were elevated and when flows are diminished. It is likely that a greater diversity of fish would have been detected if we had sampled during a period with greater flow when there was greater dilution of locally contributed salinity.

Invertebrates

We did not conduct any surveys specifically for invertebrate taxa; however, we maintained a list of all butterfly species that were observed incidentally during our bird, amphibian and reptile surveys. Twenty-eight species were observed on the area and these are listed in Table 8. Most of the species that we observed are common and widespread in Oklahoma; however, we found several Arogos Skippers (*Atrytone arogos*), a species of greatest conservation need, nectaring on Baldwin's Ironweed (*Vernonia baldwinii*) during the July survey.

Table 8. Butterflies Observed on Cimarron Hills and Cimarron Bluff WMAs

Common Name / (*Scientific Name*)	**Common Name / (*Scientific Name*)**
Checkered White (*Pontia protodice*)	American Painted Lady (*Vanessa virginiensis*)
Giant Cloudless Sulphur (*Phoebis sennae*)	Red Admiral (*Vanessa atalanta*)
Orange Sulphur (*Colias eurytheme*)	Common Buckeye (*Junonia coenia*)
Dainty Sulphur (*Nathalis iole*)	Hackberry Emperor (*Asterocampa celtis*)
Gray Hairstreak (*Strymon melinus*)	Common Wood-Nymph (*Cercyonis pegala*)
Juniper Hairstreak (*Callophrys gryneus*)	Silver-spotted Skipper (*Epargyreus ciarus*)
Eastern Tailed Blue (*Everes comyntas*)	Hayhurst's Scallopwing (*Staphylus hayhurstii*)
Melissa Blue (*Lycaeides melissa*)	Funereal Duskywing (*Erynnis funeralis*)
Reakirt's Blue (*Hemiargus isola*)	Common Sootywing (*Pholisora catullus*)
Monarch (*Danaus plexippus*)	Comm. Checkered Skipper (*Pyrgus communis*)
Queen (*Danaus gilippus*)	Sachem Skipper (*Atalopedes campestris*)
Goatweed Leafwing (*Anaea andria*)	Arogos Skipper (*Atrytone arogos*)
Variegated Fritillary (*Euptoieta claudia*)	Eufala Skipper (*Lerodea eufala*)
Pearl Crescent (*Phyciodes tharos*)	Nysa Roadside Skipper (*Amblyscirtes nysa*)

Plants

To the best of our identification ability, we documented the plant species that we observed incidentally on Cimarron Hills and Cimarron Bluff WMAs during our wildlife surveys. The list shown in Table 9 does not represent an exhaustive survey effort but provides an indication of the more common plants on these areas.

Table 9. Plant Species, Arranged by Family, Documented on Cimarron Hills and Cimarron Bluff WMAs.

Herbaceous Plants

Cyperaceae
Sand Spikerush (*Eleocharis montevidensis*)
Threesquare Bullrush (*Schoenoplectus pungens*)
Equisetaceae
Smooth Horsetail (*Equisetum laevigatum*)
Agavaceae
Soapweed Yucca (*Yucca glauca*)
Commelinaceae
Slender Day-Flower (*Commelina erecta*)
Prairie Spiderwort (*Tradescantia occidentalis*)
Juncaceae
Torrey's Rush (*Juncus torreyi*)
Liliaceae
Drummond's Onion (*Allium drummondii*)
False Garlic (*Nothoscordum bivalve*)
Poaceae
Big Bluestem (*Andropogon gerardii*)
Sand Bluestem (*Andropogon hallii*)
Silver Bluestem (*Bothriochloa saccharoides*)
Sideoats Grama (*Bouteloua curtipendula*)
Blue Grama (*Bouteloua gracilis*)
Giant Sandreed (*Calamovilfa gigantea*)

Tumble Windmill Grass (*Chloris verticillata*)
Scribner's Panicgrass (*Dichanthelium oligosanthes*)
Inland Saltgrass (*Distichlis spicata*)
Purple Lovegrass (*Eragrostis spectabilis*)
Common Witchgrass (*Panicum capillare*)
Switchgrass (*Panicum virgatum*)
Little Bluestem (*Schizachyrium scoparium*)
Indian Grass (*Sorghastrum nutans*)
Sand Dropseed (*Sporobolus cryptandrus*)
Purpletop Tridens (*Tridens flavus*)
Eastern Gamagrass (*Tripsacum dactyloides*)

Amaranthaceae
Careless Weed (*Amaranthus palmeri*)
Plains Snakecotton (*Froelichia floridana*)
Woolly Tidestromia (*Tidestromia lanuginosa*)
Apiaceae
Plains Sandparsley (*Ammoselinum popei*)
Apocynaceae
Prairie Dogbane (*Apocynum cannabinum*)
Asclepiadaceae
Sand Milkweed (*Asclepias arenaria*)
Spider Milkweed (*Asclepias asperula*)
Engelmann's Milkweed (*Asclepias engelmanniana*)
Broadleaf Milkweed (*Asclepias latifolia*)
Plains Milkweed (*Asclepias pumila*)
Showy Milkweed (*Asclepias speciosa*)
Asteraceae
Yarrow (*Achillea millefolium*)
Western Ragweed (*Ambrosia psilostachya*)
Arkansas Dozedaisy (*Aphanostephus skirrhobasis*)
White Sagebrush (*Artemesia ludoviciana*)
White Rose Heath (*Chaetopappa ericoides*)
Yellowspine Thistle (*Cirsium ochrocentrum*)
Mare's Tail (*Conyza canadensis*)
Plains Coreopsis (*Coreopsis tinctoria*)
Hooker's Scratchdaisy (*Croptilon hookerianum*)
Clasping Coneflower (*Dracopis amplexicaulis*)
Prairie Purple Coneflower (*Echinacea angustifolia*)
Engelmann's Daisy (*Engelmannia peristenia*)
Western Fleabane (*Erigeron belliadiastrum*)
Prairie Daisy Fleabane (*Erigeron strigosus*)
Bighead Pygmy Cudweed (*Evax prolifera*)
Red Dome Blanketflower (*Gaillardia pinnatifida*)
Rose-ring Blanketflower (*Gaillardia pulchella*)
Spanish Gold Gumweed (*Grindelia papposa*)
Bitter Sneezeweed (*Helenium amarum*)
Annual Sunflower (*Helianthus annuus*)
Prairie Sunflower (*Helianthus petiolaris*)
Hoary False Goldenaster (*Heterotheca canescens*)
Stiffleaf False Goldenaster (*Heterotheca stenoplylla*)
Camphorweed (*Heterotheca subaxillaris*)
Woolly-White (*Hymenopappus scabiosaeus*)
Chalk Hills Woolly-White (*Hymenopappus tenuifolius*)
Dotted Blazing Star (*Liatris punctata*)
Lacy Tansy Aster (*Machaeranthera pinnatifida*)
Tanseyleaf Tansy Aster (*Machaeranthera tanacetifolia*)
Prairie Ragwort (*Packera plattensis*)
Sweetscent (*Pluchea odorata*)
Wooly Paperflower (*Psilostrophe tagetina*)
Tuberous False Dandelion (*Pyrrhopappus grandiflorus*)
Upright Prairie Coneflower (*Ratibida columnifera*)
Canada Goldenrod (*Solidago canadensis*)
White Heath Aster (*Symphyotrichum ericoides*)
Stemmy Four-nerve Daisy (*Tetraneuris scaposa*)
Hopi Tea Greenthread (*Thelesperma megapotamicum*)
Yellow Goat's Beard (*Tragopogon dubis*)
Baldwin Ironweed (*Vernonia baldwinii*)
Rough Cockleburr (*Xanthium strumarium*)
Plains Zinnia (*Zinnia grandiflora*)
Boraginaceae
Little Cryptantha (*Cryptantha minima*)
Phlox Heliotrope (*Heliotropium convolvulaceum*)
Narrowleaf Puccoon (*Lithospermum incisum*)
Brassicaceae
Western Tansymustard (*Descurainia pinnata*)
Palmer's Spectaclepod (*Dimorphocarpa candicans*)
Veiny Pepperweed (*Lepidium oblongum*)
Gordon's Bladderpod (*Lesquerella gordonii*)
Watercress (*Rorippa nasturtium-aquaticum*)
Campanulaceae
Clasping Venus Looking-glass (*Triodanis perfoliata*)
Capparaceae
Redwhisker Clammyweed (*Polanisia dodecandra*)
Caryophyllaceae

James Nailwort (*Paronychia jamesii*)
Chenopodiaceae
Desert Goosefoot (*Chenopodium pratericola*)
Kochia (*Kochia scoparia*)
Russian Thistle (*Salsola tragus*)
Convolvulaceae
Shaggy Dwarf Morning-glory (*Evolvulus nuttallianus*)
Bush Morning-glory (*Ipomoea leptophylla*)
Cucurbitaceae
Missouri Gourd (*Cucurbita foetidissima*)
Euphorbiaceae
Sand Dune Sandmat (*Chamaesyce carunculata*)
Ribseed Sandmat (*Chamaesyce glyptosperma*)
Tropical Croton (*Croton glandulosus*)
Texas Croton (*Croton texensis*)
Snow-on-the-Mountain (*Euphorbia marginata*)
Queen's Delight (*Stillingia sylvatica*)
Fabaceae
Woolly Locoweed (*Astragalus mollissimus*)
Cream Milkvetch (*Astragalus racemosus*)
Showy Partridge Pea (*Chamaecrista fasciulata*)
Golden Prairie Clover (*Dalea aurea*)
White Prairie Clover (*Dalea candida*)
Nineanther Dalea (*Dalea enneandra*)
Purple Prairie Clover (*Dalea purpureum*)
Illinois Bundleflower (*Desmanthus illinoensis*)
American Licorice (*Glycyrrhiza lepidota*)
Scarlet Indigo (*Indigofera miniata*)
Yellow Sweet Clover (*Melilotus officinalis*)
Nuttall's Sensitive Briar (*Mimosa nuttallii*)
Palmleaf Indian Breadroot (*Pediomelum digitatum*)
Subterranean Indian Breadroot (*Pediomelum hypogaeum*)
James Rushpea (*Pomaria jamesii*)
Lemon Scurfpea (*Psoralidium lanceolatum*)
Slim-flowered Scurfpea (*Psoralidium tenuiflora*)
Silky Sophora (*Sophora nuttalliana*)
Goat's Rue (*Tephrosia virginiana*)
Fumariaceae
Curvepod Fumewort (*Corydalis curvisiliqua*)
Gentianaceae
Showy Prairie Gentian (*Eustoma exaltatum*) ?
Geraniaceae
Redstem Cranesbill (*Erodium cicutarium*)
Hydrophyllaceae
Gypsum Scorpion-weed (*Phacelia integrifolia*)
Krameriaceae
Trailing Krameria (*Krameria lanceolata*)
Lamiaceae
Henbit (*Lamium amplexicaule*)
Lemon Beebalm (*Monarda citriodora*)
Spotted Beebalm (*Monarda punctata*)
Pitcher Sage (*Salvia azurea*)
Woodland Germander (*Teucrium canadense*)
Malvaceae
Rose Poppy Mallow (*Callirhoe involucrata*)
Scarlet Globemallow (*Sphaeralcea coccinea*)
Molluginaceae
Green Carpetweed (*Mollugo verticillata*)
Nyctaginaceae
Smooth Four O'Clock (*Mirabilis glabra*)
Narrowleaf Four O'Clock (*Mirabilis linearis*)
Onagraceae
Yellow Sundrops (*Calylophus serrulatus*)
Biennial Gaura (*Gaura biennis*)
Scarlet Gaura (*Gaura coccinea*)
Woolly Gaura (*Gaura villosa*)
Showy Evening Primrose (*Oenothera grandis*)
Cutleaf Evening Primrose (*Oenothera laciniata*)
False Gaura (*Stenosiphon linifolius*)
Papaveraceae
Crested Pricklypoppy (*Argemone polyanthemos*)
Pedaliaceae
Devil's Claw (*Proboscidea louisianica*)
Phytolaccaceae
Pokeweed (*Phytolacca americana*)
Plantaginaceae
Woolly Plantain (*Plantago patagonica*)
Redseed Plantain (*Plantago rhodosperma*)
Polygalaceae
White Milkwort (*Polygala alba*)
Polygonaceae
Annual Buckwheat (*Eriogonum annuum*)
Portulacaceae
Largeflower Flameflower (*Phemeranthus (Talinum) calycinus*)
Common Purslane (*Portulaca oleracea*)
Slenderleaf Purslane (*Portulaca pilosa*)
Ranunculaceae
Carolina Larkspur (*Delphinium carolinianum*)
Cursed Buttercup (*Ranunculus sceleratus*)
Scrophulariaceae
Yellow Indian Paintbrush (*Castilleja purpurea citrina*)
White Penstemon (*Penstemon albidus*)
Solanaceae
Gray Five Eyes (*Chamaesaracha coniodes*)
Prairie Ground Cherry (*Physalis hispida*)
Chinese Lantern (*Quincula lobata*)
Silverleaf Nightshade (*Solanum elaeagnifolium*)

Buffalo Bur (*Solanum rostratum*)
Verbenaceae
Dakota Verbena (*Glandularia bipinnatifida*)
Bigbract Verbena (*Verbena bracteata*)
Hoary Verbena (*Verbena stricta*)

Woody Plants:
Cupressaceae
Eastern Redcedar (*Juniperus virginiana*)
Anacardiacea
Fragrant Sumac (*Rhus aromatica*)
Asteraceae
Sand Sagebrush (*Artemisia filifolia*)
Great Plains False Willow (*Baccharis salicina*)
Cornaceaae
Roughleaf Dogwood (*Cornus drummondii*)
Fabaceae
Swamp False Indigo (*Amorpha fruticosa*)
Honey Locust (*Gleditsia triacanthos*)
Honey Mesquite (*Prosopis glandulosa*)
Grossulariaceae
Golden Current (*Ribes aureum*)
Moraceae
White Mulberry (*Morus alba*)
Rosaceae
Chickasaw Plum (*Prunus angustifolia*)
Rubiaceae
Violaceae
Field Pansy (*Viola bicolor*)
Zygophyllaceae
Goathead Puncture Vine (*Tribulus terrestris*)

Common Buttonbush (*Cephalanthus occidentalis*)
Salicaceae
Eastern Cottonwood (*Populus deltoides*)
Sandbar Willow (*Salix exigua*)
Black Willow (*Salix nigra*)
Sapindaceae
Western Soapberry (*Sapindus saponaria*)
Sapotaceae
Chittamwood (*Sideroxylon* (*Bumelia*) *lanuginosa*)
Tamariacaceae
Fivestamen Saltcedar (*Tamarix chinensis*)
Ulmaceae
Netleaf Sugarberry (*Celtis laevigata reticulata*)
American Elm (*Ulmus americana*)
Siberian Elm (*Ulmus pumila*)
Vitaceae
Mapleleaf Grape (*Vitis acerifolia*)

OKMULGEE AND DEEP FORK WILDLIFE MANAGEMENT AREAS

We initiated a series of surveys in 2017 and 2018 to conduct a biological inventory of the Okmulgee and Deep Fork Wildlife Management Areas in collaboration with Jeff Howard (area biologist), Steven Bray (area technician), Jeff Pennington (regional supervisor) and Bruce Burton (regional supervisor and former area biologist for these WMAs). The authors owe a great debt of appreciation to Jeff, Steven, Jeff, and Bruce who gave us access to the wildlife management areas, assisted with the surveys, helped us identify representative habitats across the WMAs and provided incidental observations of species that they observed on the areas but that we were unable to detect during the survey

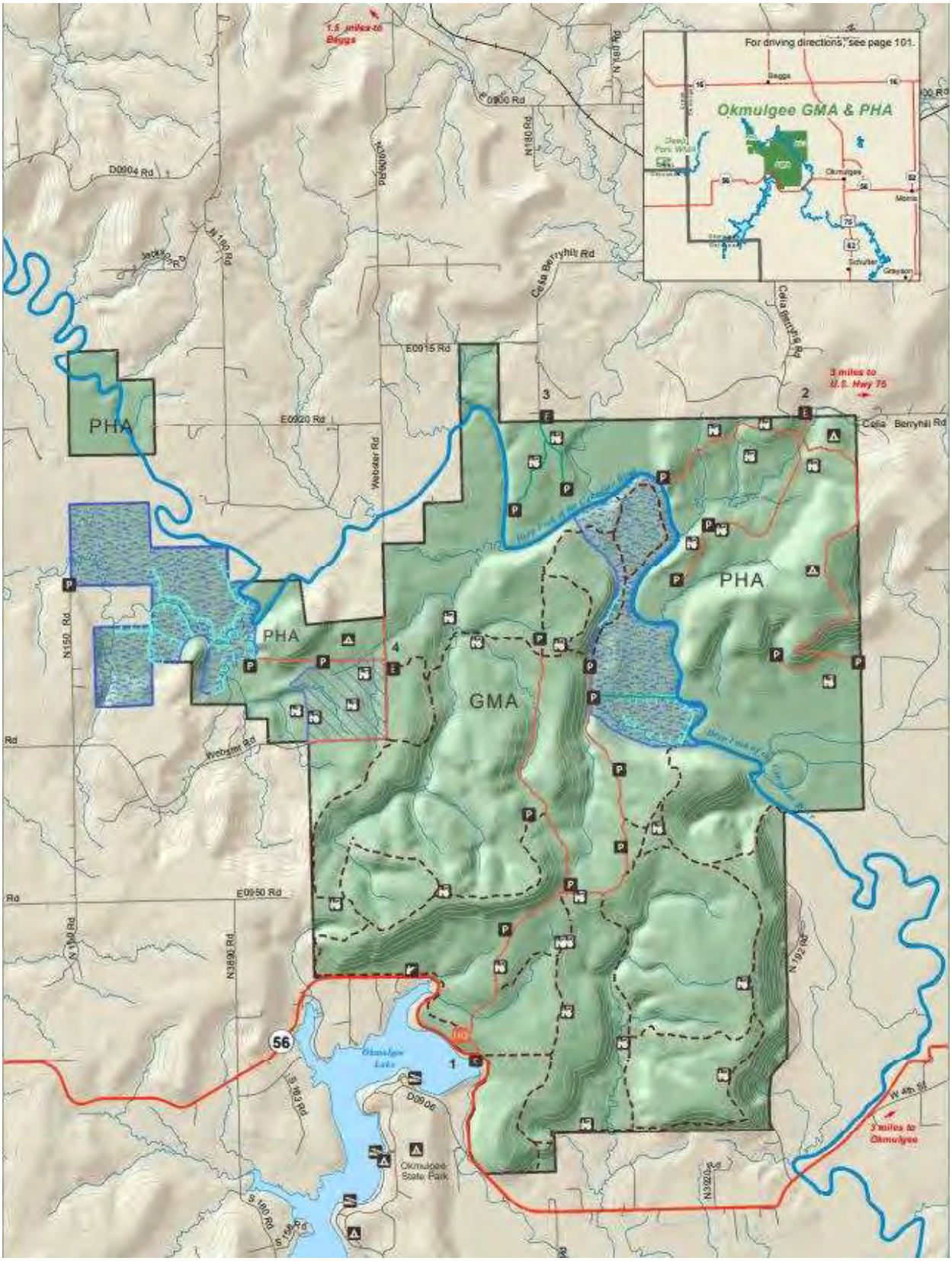
Okmulgee Wildlife Management Area is approximately 10,900 acres in size and lies in Okmulgee County, Oklahoma approximately five miles west of the town of Okmulgee (Figure 1). The area consists of rocky hillsides comprised of sandstone and covered by oak-dominated woodlands. Post Oak (*Quercus stellata*), Blackjack Oak (*Quercus marilandica*), Black Hickory (*Carya texana*) and Winged Elm (*Ulmus alata*) are the most common trees in these woodlands. Despite the short stature of most of these trees, the upland woodlands are very mature and many of their Post Oak trees exceed 200 years of age. The Deep Fork River, a tributary of the North Canadian River, bisects the wildlife management area and its flood plain supports mature bottomland hardwood forest comprised of a diversity of trees including Pin Oak (*Quercus palustris*), Pecan (*Carya illinoenensis*), Sycamore (*Platanus occidentalis*), River Birch (*Betula nigra*), and Bur Oak (*Quercus macrocarpa*). The area includes several natural and man-made wetlands in the floodplains of the Deep Fork River and its tributaries; these are dominated by several forbs as well as Swamp Privet (*Forestiera acuminata*) and Common Buttonbush (*Cephalanthus occidentalis*). On the west side of the wildlife management area is a tallgrass prairie remnant that is managed as a hay meadow with several bands of shrubland habitats within it and around its edges. The Deep Fork Wildlife Management Area is comprised of approximately 11,000 acres in ten tracts scattered along the Deep Fork River in Creek and Okfuskee counties. Approximately one third of the area is forested bottomland habitat dominated by oaks, pecans, elms and sycamores, while the remaining acreage is vegetated by upland oak woodlands and early succession habitat. Because of the logistical challenges of traveling between the widely spaced units of the Deep Fork WMA, we spent a relatively small proportion of the survey effort on this area and focused our work on the larger unit that is Okmulgee WMA.

The primary project personnel for the biological surveys were Curtis Tackett, Mark Howery, Jena Donnell, Matt Fullerton, and Russ Horton. Jeff Pennington, Jeff Howard, Bruce Burton and Steven Bray assisted with two or more surveys each, and during the wintering bird survey we had the help of Jennifer D'Agostino, Jordan Long, Erik Kalen and Courtney Tennison from the Oklahoma City Zoo. We conducted 14 short-duration surveys on Okmulgee/Deep Fork WMA during 2017 and 2018 as follows:

11 January 2017	12 and 13 July 2017
30 January - 2 February 2017	28 and 29 March 2018
8 March 2017	10 April 2018
30 and 31March 2017	6 – 8 June 2018
18 and 19 April 2017	17 and 18 July 2018
10 May 2017	16 and 21 August 2018
16 and 17 May 2017	27 September 2018

Our techniques varied between surveys based upon the focal taxa for that season. The most commonly used technique was the timed-search in which observers walked through specific habitats for a predetermined length of time (typically for 30 to 60 minutes at a time) and recorded every vertebrate that was seen or heard (in the case of birds and anurans). This was a very effective technique for surveying birds but was only moderately successful for surveying the other terrestrial vertebrate groups. During timed searches in March, April, and May, we lifted and searched under rocks and fallen logs to find

Figure 1. Map of Okmulgee Wildlife Management Area



amphibians and reptiles and searched small ponds with dip nets for amphibian larvae and adults. We used dip nets and minnow traps to sample fish populations. To assess the small mammal community, we used Sherman live traps baited with chicken scratch, black oil sunflower seeds and rolled oats to capture, record, and release rodents. Small mammal trapping was conducted in April and May of 2017 and in March and July of 2018. During the June 2018 survey (bird nesting season) we conducted a series of 44 5-minute point-counts along the WMA's roads to assess the breeding bird community. In August of 2018, we conducted a survey for fish in two shallow, tributary streams to the Deep Fork River by seining and later using a backpack electrofishing device with dip nets.

Each survey trip had a different focus that targeted specific species groups. The winter surveys focused on the bird community and a few mammal observations were made incidentally. The spring surveys were focused on amphibians and reptiles, although bird observations were made secondarily, and small mammal trapping occurred during three of those surveys. The summer survey was focused the assessment of the breeding bird community, although incidental observations of reptiles and amphibians were recorded, and a particular effort was made to listen for calling anurans at night. Collectively, the level of effort expended on Okmulgee/Deep Fork WMA during 2017 and 2018 equaled 23.5 hours of diurnal timed-searches on foot with an emphasis on amphibians and reptiles; 9.5 hours of diurnal timed-searches by vehicle with an emphasis on reptiles; 8.5 hours of nocturnal timed-searches during six nights with an emphasis on amphibians; 21.5 hours of timed searches with a focus on spring/summer birds; 222 small mammal trap nights at nine locations; 2.0 hours of timed-searches netting for fish; 35.5 hours of timed-searches for wintering birds, and 44 five-minute point-counts for breeding birds.

Although we recorded all vertebrates observed or heard during our surveys, the surveys were designed with a special emphasis on species of greatest conservation need (SGCN) as defined by the Oklahoma Comprehensive Wildlife Conservation Strategy. Prior to the survey, we identified 18 SGCN that might occur on Okmulgee/Deep Fork WMA including: Alligator Snapping Turtle, Ouachita Map Turtle, Bald Eagle, Snowy Egret, Little Blue Heron, Northern Bobwhite, American Woodcock, Red-headed Woodpecker, Bell's Vireo, Prothonotary Warbler, Louisiana Waterthrush, Kentucky Warbler, Rusty Blackbird, Painted Bunting, Harris's Sparrow, LeConte's Sparrow, Prairie Mole Cricket, and Arogos Skipper. During the inventory, we detected eleven of these species – Ouachita Map Turtle, Bald Eagle, Northern Bobwhite, Red-headed Woodpecker, Bell's Vireo, Prothonotary Warbler, Kentucky Warbler, Louisiana Waterthrush, Rusty Blackbird, Painted Bunting, and Harris's Sparrow - plus Swainson's Warbler, and Redfin Darter that we did not expect.

Amphibians

The potential amphibian community on Okmulgee/Deep Fork WMA includes two salamanders (Central Newt (*Notophthalmus viridescens*) and Smallmouth Salamander (*Ambystoma texanum*)), and eleven species of anurans. We detected eight or nine species of amphibians (we could not accurately distinguish the calls of the two species of gray treefrogs, so we can't confirm which species is/are present). One of the amphibian species was a species of greatest conservation need – the Crawfish Frog (*Lithobates aereolata*). During the evening of 28 March 2018, we heard Crawfish Frogs calling from five locations near the WMA and located at least two calling males within crayfish burrows in the prairie hay meadow on the western boundary of the WMA. A rain event had occurred the day before this survey and the weather conditions were warm and humid during the night when we heard the frogs calling. There were also numerous Cajun Chorus Frogs (*Pseudacris fouquettei*) and Dwarf American Toads (*Anaxyrus americanus charlesmithi*) calling that night. Nocturnal listening surveys for anurans were very effective when wet weather conditions existed. We were able to find, by sound, multiple choruses of Cajun Chorus Frog, Southern Leopard Frog (*Lithobates sphenocephala utricularia*), Great Plains Narrowmouth Toad (*Gastrophryne olivacea*), Dwarf American Toad, Blanchard's Cricket Frog (*Acris blanchardi*) and Gray and/or Cope's Gray Treefrog (*Hyla versicolor* and/or *H. chrysoscelis*). We observed a small percentage

of our amphibians during the timed-search sessions in which we lifted rocks and logs, but most of our diurnal and nocturnal amphibian detections occurred by hearing calling males.

Table 1. Summary of Adult Amphibian Detections on Okmulgee/Deep Fork WMAs.

Common Name	Diurnal Timed-Searches	Nocturnal Timed-Searches
Dwarf American Toad (*Anaxyrus americanus charlesmithi*)	7	29
Great Plains Narrowmouth Toad (*Gastrophryne olivacea*)	4	26
Blanchard's Cricket Frog (*Acris blanchardi*)	24	44
Cajun Chorus Frog (*Pseudacris fouquettei*)	14	252
Gray & Cope's Gray Treefrog (*Hyla chrysoscelis & Hyla versicolor*)	23	62
Crawfish Frog (*Lithobates aereolata*)		2
Southern Leopard Frog (*Lithobates sphenocephala utricularia*)	17	74
American Bullfrog (*Lithobates catesbeiana*)	1	3

Reptiles

Okmulgee WMA contains an abundance of rocks and fallen logs that serve as ground-level cover for small reptiles, as well as amphibians. Because of this, we did not attempt to place any cover boards on the area. Most of our reptile detections were made by lifting, looking under, and replacing rocks and logs during timed-searches in the spring. This accounted for most of our detections of skinks in the genus *Plestiodon* and small snakes (e.g. Western Wormsnake (*Carphophis vermis*), Ring-necked Snake (*Diadophis punctatus*), Flathead Snake (*Tantilla gracilis*), Rough Earthsnake (*Virginia striatula*), and Smooth Earthsnake (*Virginia valeriae*)). The Southern Prairie Skink (*Plestiodon septentrionalis*) and Western Wormsnake (*Carphophis vermis*) observations were noteworthy to us because both are fossorial species that are rarely encountered. It is likely that the Northern Scarlet Snake (*Cemophora coccinea copei*) occurs on the WMA, but this species is rare, secretive and fossorial making it difficult to detect even in places where it is present.

Most of our encounters with the larger snake species, Collared Lizards (*Crotaphytus collaris*), and Prairie Racerunners (*Cnemidophorus sexlineatus viridis*) were opportunistic and many of these animals were observed on or along WMA roads. We found that slowly driving WMA roads in the mid-morning and late afternoons was an effective way to locate these reptiles, although our encounter rates were only about one animal an hour. All of the Eastern Collared Lizards that we found were observed as they basked on rocks along four segments of WMA roads. Roughly half of our Prairie Lizard (*Sceloporus consobrinus*) observations were of basking animals on rocks and logs as well. Our observations of Eastern Racer (*Coluber constrictor*), Eastern Hog-nosed Snake (*Heterodon platirhinos*), Prairie Kingsnake (*Lampropeltis calligaster*), Coachwhip (*Masticophis flagellum*), Western Black Ratsnake (*Patherophis obsoletus*), Western Pygmy Rattlesnake (*Sistrurus miliarius*) and two of the Copperheads (*Agkistrodon contortrix*) were animals that we observed basking on or crossing roads.

Our turtle observations were generally opportunistic. We located all of the aquatic turtles in three ponds and two sites on the Deep Fork River where there were log piles that provided basking sites. The eleven Three-toed Box Turtle observations were at scattered locations with about half of the animals observed along roads and about half observed during timed-searches on foot. Altogether, we documented five species of turtles from a potential community of nine species. We documented six species of lizards

from a potential community of seven species; the Western Slender Glass Lizard (*Ophisaurus attenuatus*) almost certainly occurs on the area but we did not find any. We documented 17 species of snakes out of a potential community of 28 species.

Although not recorded in Table 2. Bruce Burton, Steven Bray and Jeff Howard reported other reptile species to us that they had observed on the WMA in recent years but were not seen by us during the scheduled surveys. These species were the Common Snapping Turtle (*Chelydra serpentina*), Spiny Softshell (*Apalone spinifera*), Speckled Kingsnake (*Lampropeltis getula*), Diamond-backed Watersnake (*Nerodia rhombifer*), and Timber Rattlesnake (*Crotalus horridus*).

Table 2. Summary of Reptile Detections on Okmulgee/Deep Fork WMAs.

Common Name	Diurnal Timed-Searches	Nocturnal Timed-Searches
Stinkpot (*Sternotherus odortus*)	1 (shell found)	
Ouachita Map Turtle (*Graptemys ouachitensis*)	2	
Eastern River Cooter (*Pseudemys concinna*)	2	
Red-eared Slider (*Trachemys scripta elegans*)	54	
Three-toed Box Turtle (*Terrapene carolina*)	11	
Collared Lizard (*Crotaphytus collaris*)	12	
Prairie (Fence) Lizard (*Sceloporus consobrinus*)	21	
Prairie Racerunner (*Cnemidophorus sexlineatus*)	5	
Five-lined Skink (*Plestiodon fasciatus*)	6	
Southern Prairie Skink (*Plestiodon septentrionalis*)	1	
Brown Skink (*Scincella lateralis*)	18	
Western Wormsnake (*Carphophis vermis*)	2	
Eastern Racer (*Coluber constrictor*)	4	
Ring-necked Snake (*Diadophis punctatus*)	3	
Eastern Hog-nosed Snake (*Heterodon platirhinos*)	1	
Prairie Kingsnake (*Lampropeltis calligaster*)	1	
Coachwhip (*Masticophis flagellum*)	2	
Plain-bellied Watersnake (*Nerodia erythrogaster*)	2	
Rough Greensnake (*Opheodrys aestivus*)	3	
Western Black Ratsnake (*Patherophis obsoletus*)		1
Brown Snake (*Storeria dekayi*)	1	
Flathead Snake (*Tantilla gracilis*)	10	
Western Ribbonsnake (*Thamnophis proximus*)	1	
Rough Earthsnake (*Virginia striatula*)	7	
Smooth Earthsnake (*Virginia valeriae*)	2	
Copperhead (*Agkistrodon contortrix*)	2	2
Cottonmouth (*Agkistrodon piscivorus*)	1	
Western Pygmy Rattlesnake (*Sistrurus miliarius*)		1

Mammals

As many as 38 species of native mammals potentially occur on and in the vicinity of Okmulgee and Deep Fork Wildlife Management Areas, with bats (6 species) and rodents (16 species) comprising

more than half of these. Although our survey methods were not designed to target game mammals (e.g. White-tailed Deer and furbearers), we recorded sightings of these animals during our timed-search surveys and noted identifiable tracks of furbearers to record their presence. We did not use any survey methods that targeted bats (e.g. evening mist-netting over water and in forest openings), but we observed four bats incidentally during evening surveys for calling amphibians. On July 5, 2017, the staff of the neighboring Deep Fork National Wildlife Refuge conducted an acoustic survey for bats and a portion of their route crossed through Okmulgee WMA. On the WMA, they recorded vocalizations for at least two Eastern Red Bats and one Evening Bat. While we can't positively identify the bats that we observed during our survey, we can infer that these were likely to be Eastern Red Bats and/or Evening Bats because of their location and habitat similarity to the bats that were identified during the USFWS survey. If we include the data from the USFWS acoustic bat survey, 21 species of mammals were detected on Okmulgee and Deep Fork WMAs during our inventory (Table 3). Most of these mammals were encountered opportunistically while conducting timed searches for birds, reptiles and amphibians; however, 47 individual rodents of five species were live-trapped during 222 trap nights of effort at nine locations (average trap success of 21.2%).

Four Nine-banded Armadillos (*Dasypus novemcinctus*), five Eastern Cottontails (*Sylvilagus floridanus*), one Swamp Rabbit, ten Fox Squirrels (*Sciurus niger*), and nine Gray Squirrels (*Sciurus carolinensis*) were encountered during diurnal timed searches for birds, amphibians, and reptiles. Additionally, a group of three River Otters (*Lutra canadensis*) was observed in the Deep Fork River during our wintering bird survey. Two Virginia Opossums (*Didelphis virginiana*), two Nine-banded Armadillo, ten Eastern Cottontails, one Raccoon (*Procyon lotor*), and one Striped Skunk (*Mephitis mephitis*) were observed during nocturnal surveys for calling anurans during the March, April, May and June surveys. Although we observed at least nine White-tailed Deer (*Odocoileus virginianus*) opportunistically, the local population of this species is monitored with much greater precision by Jeff Howard and Steven Bray than we could hope to accomplish through this project.

Sherman live-traps were used as our method for assessing the rodent population. We set live traps at nine locations during five nights of trapping for a total trapping effort of 222 trap nights. Our overall trapping success fairly high (21.2%), but our rodent diversity was low. The rodent community at our trapping locations appeared to be strongly dominated by the White-footed Mouse (*Peromyscus leucopus*). Of the 47 rodents that we captured and released, 31 (66%) were White-footed Mice. The remaining rodents were eleven Hispid Cotton Rats (*Sigmodon hispidus*), three Eastern Woodrats (*Neotoma floridana*), one Fulvous Harvest Mouse (*Reithrodontomys fulvescens*), and one North American Deer Mouse (*Peromyscus maniculatus*). Based upon existing museum records from Okmulgee and surrounding counties, it appears that only three other rodent species are likely to occur on the area – Hispid Pocket Mouse (*Perognathus hispidus*), Texas Brush Mouse (*Peromyscus attwateri*), and Woodland Vole (*Microtus pinetorum*).

Table 3. Summary of Mammals Detected on Okmulgee/Deep Fork WMAs

Common Name	Diurnal Timed Searches	Nocturnal Timed Searches	Live Traps
Virginia Opossum (*Didelphis virginiana*)	Multiple Track Lines	2	
Eastern Mole (*Scalopus aquaticus*)	Multiple Tunnels		
Eastern Red Bat (*Lasiurus borealis*)		2 (USFWS)	
Evening Bat (*Nycticeius humeralis*)		1 (USFWS)	
unidentified bat		4	
Nine-banded Armadillo (*Dasypus novemcinctus*)	4	2	
Eastern Cottontail (*Sylvilagus floridanus*)	5	10	
Swamp Rabbit (*Sylvilagus aquaticus*)	1		

Fox Squirrel (*Sciurus niger*)	10		
Gray Squirrel (*Sciurus carolinensis*)	9		
Fulvous Harvest Mouse (*Reithrodontomys fulvescens*)			1
White-footed Mouse (*Peromyscus leucopus*)			31
North American Deer Mouse (*Peromyscus maniculatus*)			1
Hispid Cotton Rat (*Sigmodon hispidus*)			11
Eastern Woodrat (*Neotoma floridana*)			3
American Beaver (*Castor canadensis*)	1		
Coyote (*Canis latrans*)	Multiple Track Lines		
Raccoon (*Procyon lotor*)	Multiple Track Lines	1	
Striped Skunk (*Mephitis mephitis*)	Multiple Track Lines	1	
River Otter (*Lutra canadensis*)	3		
Bobcat (*Felis rufa*)	Multiple Track Lines		
White-tailed Deer (*Odocoileus virginianus*)	4	5	

Birds

Birds are the largest group of vertebrates in Oklahoma and they represented over 70% of the vertebrate species that we documented. The results below are divided into three sections: Wintering Season (based upon data from our January and February surveys); Spring Season (based upon data from our March, April and May surveys, and Breeding Season (based upon data collected during our early July survey). Across all three seasons, 99 species of birds were detected on the two management areas during the course of our surveys.

Wintering Bird Community

The wintering bird community on Okmulgee and Deep Fork WMAs was measured through a series of timed searches that were conducted by teams of three or five observers on 11, 30, and 31 January, and 1 and 2 February 2017. During these surveys, the teams walked prescribed areas and drove WMA interior roads recording every bird that they could identify by sight and/or sound. Fifty-eight species of wintering birds were recorded during this survey (Table 4). The most frequently encountered species were the White-throated Sparrow (286), American Robin (198), Dark-eyed Junco (168), Tufted Titmouse (154) and Northern Cardinal (127). All of these are species that commonly travel in flocks, and in the case of Tufted Titmice, are frequently vocal. Noteworthy observations, because of their rarity and/or secretive behavior, were three Brown Creepers, two Marsh Wrens, four Brown Thrashers, eight Hermit Thrushes, and five Swamp Sparrows. Two species of greatest conservation need that were noteworthy were the Red-headed Woodpecker and Rusty Blackbird. Red-headed Woodpeckers were unusually abundant during the winter of 2016/2017 on both areas and we observed at least 53 individuals. These birds were seen in nearly every tract of forested habitat that we surveyed and were especially numerous in the hardwood bottomlands along the Deep Fork River. In contrast to the wintering numbers, Red-headed Woodpeckers were uncommon during our spring and summer surveys, indicating that the nesting population on the WMAs is relatively small. Red-headed Woodpeckers are someone nomadic during the winter months and birds move into central and eastern Oklahoma from nesting populations in western Oklahoma and states north of Oklahoma. Two flocks of Rusty Blackbirds were observed during the survey - one on a unit of the Deep Fork WMA and the other on the Okmulgee WMA. In both situations, the birds were observed in forested bottomland habitat associated with wetland units. We observed two Harris's Sparrows in an old-field habitat on one unit of the Deep Fork WMA but did not observe this species on Okmulgee WMA. We searched two prairie sites on Okmulgee WMA for LeConte's Sparrows but were unsuccessful in flushing or observing any. As a result of a dry, regional weather pattern that persisted from late September 2016 through February 2017, most of the wetland

habitats on both areas were dry. This contributed to the relatively small number of waterfowl that we observed, although we were fortunate to find four Wilson's Snipe in a partially dry unit.

Table 4. Summary of Winter Bird Community on Okmulgee and Deep Fork WMAs 2017 (Based on 35.5 Hours of Timed Searches)

Common Name	# Seen/Heard January / February 2017
Wild Turkey (*Meleagris gallopavo*)	4
Wood Duck (*Aix sponsa*)	3
Mallard (*Anas platyrhynchos*)	21
American Wigeon (*Anas americana*)	2
Ring-necked Duck (*Aythya collaris*)	4
Hooded Merganser (*Lophodytes cucullatus*)	4
Great Blue Heron (*Ardea herodias*)	3
Turkey Vulture (*Cathartes aura*)	18
Black Vulture (*Coragyps atratus*)	2
Cooper's Hawk (*Accipiter cooperii*)	1
Red-shouldered Hawk (*Buteo lineatus*)	9
Red-tailed Hawk (*Buteo jamaicensis*)	9
Bald Eagle (*Haliaeetus leucocephalus*)	2
American Kestrel (*Falco sparverius*)	1
Wilson's Snipe (*Gallinago gallinago*)	4
Barred Owl (*Strix varia*)	1
Belted Kingfisher (*Ceryle alcyon*)	1
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	53
Red-bellied Woodpecker (*Melanerpes carolinus*)	33
Yellow-bellied Sapsucker (*Sphyrapicus varius*)	15
Downy Woodpecker (*Picoides pubescens*)	26
Northern Flicker (*Colaptes auratus*)	25
Pileated Woodpecker (*Dryocopus pileatus*)	10
Eastern Phoebe (*Sayornis phoebe*)	1
American Crow (*Corvus brachyrhynchos*)	49
Blue Jay (*Cyanocitta cristata*)	43
Carolina Chickadee (*Poecile carolinensis*)	97
Tufted Titmouse (*Baeolophus bicolor*)	154
White-breasted Nuthatch (*Sitta carolinensis*)	18
Brown Creeper (*Certhia americana*)	3
Carolina Wren (*Thryothorus ludovicianus*)	49
Marsh Wren (*Cistothorus palustris*)	2
Northern Mockingbird (*Mimus polyglottos*)	7
Brown Thrasher (*Toxostoma rufum*)	4
Ruby-crowned Kinglet (*Regulus calendula*)	5
Golden-crowned Kinglet (*Regulus satrapa*)	1
Eastern Bluebird (*Sialia sialis*)	81
American Robin (*Turdus migratorius*)	198
Hermit Thrush (*Catharus guttatus*)	8
Cedar Waxwings (*Bombycilla cedrorum*)	3
Yellow-rumped Warbler (*Setophaga coronata*)	8
Northern Cardinal (*Cardinalis cardinalis*)	127

Eastern Towhee (*Pipilo erythropthalmus*)	22
Spotted Towhee (*Pipilo maculatus*)	2
Dark-eyed Junco (*Junco hyemalis*)	168
Field Sparrow (*Spizella pusilla*)	13
Fox Sparrow (*Passerella iliaca*)	14
Song Sparrow (*Melospiza melodia*)	41
Lincoln's Sparrow (*Melospiza lincolnii*)	1
Swamp Sparrow (*Melospiza georgiana*)	5
Harris's Sparrow (*Zonotrichia querula*)	2
White-crowned Sparrow (*Zonotrichia leucophrys*)	2
White-throated Sparrow (*Zonotrichia albicollis*)	286
Eastern Meadowlark (*Sturnella magna*)	18
Red-winged Blackbird (*Agelaius phoeniceus*)	28
Rusty Blackbird (*Euphagus carolinus*)	24
Common Grackle (*Quiscalus quiscala*)	2
American Goldfinch (*Carduelis tristis*)	7

Spring Birds (Transition between Winter and Summer Seasons)

We conducted timed-searches for birds in March, April, and May on dates which corresponded to the early, middle and later portions of the spring migration period. The results of these surveys are combined and summarized in Table 5. The summary is not a completely accurate representation of the relative abundances of birds during the spring, because it is biased toward the year-round resident (e.g. Tufted Titmouse and Northern Cardinal), and the early-arriving (e.g. Blue-gray Gnatcatcher, Common Yellowthroat) species because they had the potential to be recorded on two or more of the surveys. To help place these species in context, the residence status of each one is shown. Bird species were classified as year-round residents, winter visitors (that lingered into the early spring), early-arriving summer residents (breeding species that arrive in March and early April), later-arriving summer residents (breeding species that arrive between mid-April and mid-May), or migrants (species which neither winter nor breed in the region).

The list of spring birds provides some insights into the breeding bird community because it includes early-nesting species such as the Black-and-White Warbler, Yellow-throated Warbler and White-eyed Vireo that had largely finished their nesting season when our breeding bird survey was conducted. It also lists some of the more common migrants that pass through the area in the spring en-route to their breeding range north of Oklahoma (e.g. Lesser Yellowlegs, Gray Catbird, Swainson's Thrush, Orange-crowned Warbler and Chipping Sparrow).

Table 5. Spring Birds on Okmulgee and Deep Fork WMAs. (Based on 21.5 Hours of Timed Searches for Birds and Incidental Observation During 21.0 Hours of Timed Searches for Amphibians and Reptiles)

Wild Turkey (*Meleagris gallopavo*)	2	(year-round resident)
Pied-billed Grebe (*Podilymbus podiceps*)	2	(winter resident)
Double-crested Cormorant (*Phalacrocorax auritus*)	6	(winter resident)
Canada Goose (*Branta canadensis*)	4	(year-round resident)
Wood Duck (*Aix sponsa*)	7	(year-round resident)
Blue-winged Teal (*Anas discors*)	11	(migrant)
Ring-necked Duck (*Aythya collaris*)	21	(winter resident)
Great Blue Heron (*Ardea herodias*)	1	(year-round resident)

Great Egret (*Ardea alba*)	2	(early-arriving summer resident)
Turkey Vulture (*Cathartes aura*)	16	(year-round resident)
Black Vulture (*Coragyps atratus*)	2	(year-round resident)
Broad-winged Hawk (*Buteo platypterus*)	1	(later arriving summer resident)
Red-shouldered Hawk (*Buteo lineatus*)	1	(year-round resident)
Red-tailed Hawk (*Buteo jamaicensis*)	2	(year-round resident)
American Kestrel (*Falco sparverius*)	1	(winter resident)
Lesser Yellowlegs (*Tringa flavipes*)	1	(migrant)
Spotted Sandpiper (*Actitis macularia*)	2	(migrant)
Mourning Dove (*Zenaida macroura*)	2	(year-round resident)
Barred Owl (*Strix varia*)	2	(year-round resident)
Eastern Screech-Owl (*Otus asio*)	2	(year-round resident)
Chuck-wills-widow (*Caprimulgus carolinensis*)	2	(later arriving summer resident)
Ruby-throated Hummingbird (*Archiochus colubris*)	1	(later arriving summer resident)
Belted Kingfisher (*Ceryle alcyon*)	1	(year-round resident)
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	2	(year-round resident)
Red-bellied Woodpecker (*Melanerpes carolinus*)	17	(year-round resident)
Downy Woodpecker (*Picoides pubescens*)	11	(year-round resident)
Pileated Woodpecker (*Dryocopus pileatus*)	5	(year-round resident)
Northern Flicker (*Colaptes auratus*)	3	(winter resident)
Eastern Wood Pewee (*Contopus virens*)	6	(later arriving summer resident)
Acadian Flycatcher (*Empidonax virescens*)	3	(later arriving summer resident)
Great Crested Flycatcher (*Myiarchus crinitus*)	8	(later arriving summer resident)
Scissor-tailed Flycatcher (*Tyrannus forficatus*)	3	(early-arriving summer resident)
White-eyed Vireo (*Vireo griseus*)	22	(early-arriving summer resident)
Bell's Vireo (*Vireo bellii*)	3	(later arriving summer resident)
Red-eyed Vireo (*Vireo olivaceus*)	15	(later arriving summer resident)
Blue-headed Vireo (*Vireo solitarius*)	2	(migrant)
American Crow (*Corvus brachyrhynchos*)	5	(year-round resident)
Fish Crow (*Corvus ossifragus*)	2	(later arriving summer resident)
Blue Jay (*Cyanocitta cristata*)	6	(year-round resident)
Carolina Chickadee (*Poecile carolinensis*)	51	(year-round resident)
Tufted Titmouse (*Baeolophus bicolor*)	97	(year-round resident)
White-breasted Nuthatch (*Sitta carolinensis*)	8	(year-round resident)
Carolina Wren (*Thryothorus ludovicianus*)	53	(year-round resident)
Brown Thrasher (*Toxostoma rufum*)	4	(year-round resident)
Gray Catbird (*Dumetella carolinensis*)	1	(migrant)
Blue-gray Gnatcatcher (*Polioptila caerulea*)	88	(early-arriving summer resident)
Ruby-crowned Kinglet (*Regulus calendula*)	5	(winter resident)
Eastern Bluebird (*Sialia sialis*)	17	(year-round resident)
Swainson's Thrush (*Catharus ustulatus*)	4	(migrant)
American Robin (*Turdus migratorius*)	19	(winter resident)
Nashville Warbler (*Vermivora ruficapilla*)	1	(migrant)
Orange-crowned Warbler (*Vermivora celata*)	3	(migrant)
Black and White Warbler (*Mniotilta varia*)	21	(early-arriving summer resident)
Prothonotary Warbler (*Protonotaria citrea*)	3	(later arriving summer resident)
Northern Parula (*Setophaga americana*)	6	(early-arriving summer resident)
Yellow-throated Warbler (*Setophaga dominica*)	2	(early-arriving summer resident)
Yellow-rumped Warbler (*Setophaga coronata*)	14	(winter resident)
American Redstart (*Setophaga ruticilla*)	1	(migrant)
Kentucky Warbler (*Geothlypis formosa*)	2	(later arriving summer resident)

Common Yellowthroat (*Geothlypis trichas*)	11	(early-arriving summer resident)
Yellow-breasted Chat (*Icteria virens*)	7	(later arriving summer resident)
Summer Tanager (*Piranga rubra*)	18	(later arriving summer resident)
Northern Cardinal (*Cardinalis cardinalis*)	97	(year-round resident)
Blue Grosbeak (*Guiraca caerulea*)	1	(later arriving summer resident)
Indigo Bunting (*Passerina cyanea*)	17	(later arriving summer resident)
Painted Bunting (*Passerina ciris*)	1	(later arriving summer resident)
Eastern Towhee (*Pipilo erythrophthalmus*)	3	(winter resident)
Grasshopper Sparrow (*Ammodramus savannarum*)	1	(later arriving summer resident)
Dark-eyed Junco (*Junco hyemalis*)	17	(winter resident)
Chipping Sparrow (*Spizella passerina*)	4	(migrant)
Field Sparrow (*Spizella pusilla*)	21	(year-round resident)
Fox Sparrow (*Passerella iliaca*)	1	(winter resident)
Song Sparrow (*Melospiza melodia*)	5	(winter resident)
Lincoln's Sparrow (*Melospiza lincolnii*)	1	(winter resident)
White-throated Sparrow (*Zonotrichia albicollis*)	43	(winter resident)
Harris's Sparrow (*Zonotrichia querula*)	2	(winter resident)
Eastern Meadowlark (*Sturnella magna*)	7	(winter resident)
Common Grackle (*Quiscalus quiscala*)	1	(year-round resident)
Brown-headed Cowbird (*Molothrus ater*)	6	(year-round resident)
Orchard Oriole (*Icterus spurius*)	4	(later arriving summer resident)
American Goldfinch (*Carduelis tristis*)	24	(year-round resident)

Breeding Bird Community

We used road-based, five-minute point counts as our primary tool for assessing the relative abundance and composition of the Okmulgee/Deep Fork WMA breeding bird community. We identified and recorded every bird that was seen or heard during a five-minute period at 44 locations. These point counts between 6:10 am (approximately 20 minutes after sunrise) and 10:30 am on the mornings of 7 and 8 June 2018. The point count locations were placed along WMA roads and were spaced at intervals of 0.4 miles to maximize the number of stops that could be made while minimizing the potential for double-recording birds. Because we did not begin the point counts until shortly after sunrise, we did not detect any nocturnal birds such as Chuck-wills-widows, despite the fact this species appears to be common in forested habitats on the WMA based upon the numbers that we heard during our evening amphibian surveys. We attempted to sample the range of habitat conditions on the wildlife management area in approximate proportion to their abundance; however, bottomland habitats were under-sampled because the area's roads are laid out to avoid these habitats because of the greater maintenance needed for roads in flood plains. Point-counts are an effective technique for measuring the frequency of occurrence and relative abundances of most songbirds, but they are often less effective for detecting rare songbirds and species that do not sing to signal the boundaries of their territories (e.g. Wild Turkeys, woodpeckers and raptors, which may appear to be less common than they probably are). On 13 and 14 July 2017, we conducted point-counts at 26 locations on Okmulgee WMA; however, those dates were later than ideal and some species that nest early in the summer season had already completed their nesting cycle and were not vocal. Additionally, the greater heat in July caused us to end our surveys earlier in the morning and fewer point-counts were conducted. Few individual birds and fewer species were detected during the 2017 point-counts (40 species in 2017 versus 58 species in 2018) so we omitted the 2017 data and replaced it with the 2018 data. Only one species, a single Bell's Vireo (*Vireo bellii*) was detected in 2017 and not in 2018. However, a Bell's Vireo was heard incidentally in 2018 while driving between two point-count stations. We kept records of incidental bird observations during July of 2018 and June of 2017 to supplement the breeding bird data because we assumed that not every nesting bird on the WMA

would be detected at a point-count location. Even with 44 point-count stations, 15 of the 58 bird species that we documented were found at only one location.

Fifty-eight species of birds were detected at the 44 point-count stations (Table 6). We divided the point-count stations into three groups based upon their habitat and the slightly different breeding bird communities. Six of the point-count stations were located in sites that were dominated by prairie (two of these were adjacent to a native prairie hay meadow) or shrubby old-field habitat. A site was considered to be grassland/shrubland if more than 50% of the area within a 200-meter radius of the point was dominated by grassland or old-field vegetation. Another 14 point-count stations were located in bottomland forest or adjacent to riparian forest. A site was included within this category if at least 25% of the landcover within a 200-meter radius of the point-count's center was in riparian or bottomland forest. The remaining 24 point-count stations were classified as oak woodland or forest, and each of these sites occurred in an upland location and contained more than 50% oak-dominated canopy within a 200-meter radius of the point-count's center. Within Table 5, the number of individual birds of each species is listed followed by the average number of individuals per point-count station for that species.

The most common birds in the upland oak woodland and forest habitats were Tufted Titmouse, Northern Cardinal, Blue-gray Gnatcatcher, Indigo Bunting, Summer Tanager, Yellow-billed Cuckoo, Carolina Wren and Red-eyed Vireo. Each of these species was represented by an average of ≥0.9 and ≥2.0 individuals per point-count station. Eastern Wood Pewee, Great Crested Flycatcher, Eastern Bluebird and Black-and-White Warbler reached their highest frequencies of occurrence in oak woodland and forest habitats. The most common birds in the bottomland forest and riparian forest point count sites were Northern Cardinal, Tufted Titmouse, Red-eyed Vireo, Blue-gray Gnatcatcher, White-eyed Vireo, and Carolina Wren. Each of these species was detected at a frequency of more than one individual per point-count station. Several species were found exclusively in bottomland and riparian forest habitat including Acadian Flycatcher, Northern Parula, Yellow-throated Warbler, Swainson's Warbler, and Prothonotary Warbler; while Red-bellied Woodpecker, Pileated Woodpecker, Yellow-throated Vireo, Carolina Chickadee, and Kentucky Warbler reached their highest frequencies of occurrence in this habitat. The most common birds in the old-field and prairie/shrubland habitats were Indigo Bunting, Northern Cardinal, Yellow-breasted Chat, Field Sparrow and Tufted Titmouse. Although this habitat was relatively uncommon on Okmulgee WMA, it is the only habitat in which Northern Bobwhite, Scissor-tailed Flycatcher, Dickcissel and American Goldfinch were found, and it is the habitat type in which Mourning Dove, Common Yellowthroat and Blue Grosbeak reached their highest frequencies of occurrence.

In addition to the birds that were observed during our point-counts, we observed single individuals of Yellow-crowned Night-Heron (*Nyctanassa violacea*), Canada Goose (*Branta canadensis*), Hairy Woodpecker (*Picoides villosus*), and Bell's Vireo (*Vireo bellii*) either while driving between point-count stops or while scouting the roads the evening before. During nocturnal surveys for calling frogs in July of 2017 and June of 2018, we heard multiple Chuck-wills-widows callings, thus raising the number of nesting species to at least 63. Based upon their occurrence during our surveys in March, April and May, at least another seven species of birds are likely to nest on Okmulgee/Deep Fork WMA including Wood Duck (*Aix sponsa*), Great Blue Heron (*Ardea herodias*), Black Vulture (*Coragyps atratus*), Eastern Screech-Owl (*Otus asio*), Barn Swallow (*Hirundo rustica*), Northern Rough-winged Swallow (*Stelgidopteryx serripennis*), and Brown Thrasher (*Toxostoma rufum*).

Seven of the breeding birds on Okmulgee/Deep Fork WMA are species of greatest conservation need in Oklahoma – Northern Bobwhite, Bell's Vireo, Prothonotary Warbler, Swainson's Warbler, Kentucky Warbler, Louisiana Waterthrush (*Parkesia motacilla*), and Painted Bunting. The Swainson's Warbler is the rarest of these species and was found in bottomland hardwood forest along the Deep Fork River (this species is known to nest in fewer than ten locations in Oklahoma). The Painted Bunting was

the most commonly detected species of greatest conservation need and was found in open oak woodlands, old-field sites and in openings in bottomland forest. The Kentucky Warbler was the second most commonly detected species and was found in both upland oak forest and bottomland forest sites. The Northern Bobwhite and Bell's Vireo are rare on the area and appear to be limited to the hay meadow and old-field habitat on the west side of Okmulgee WMA. The Prothonotary Warbler and Louisiana Waterthrush were found in the same bottomland forest habitat as the Swainson's Warbler.

Table 6. Summary of 5-minute Point Counts for Assessing Breeding Birds on Okmulgee WMA.

Common Name	**Upland Oak Forest**	**Bottomland Forest**	**Grassland/ Savannah**
# Stops	**24**	**14**	**6**
Wild Turkey (Meleagris gallopavo)	2 (0.08)		
Northern Bobwhite (*Colinus virginianus*)			2 (0.33)
Great Egret (*Ardea alba*)		1 (0.07)	
Green Heron (*Butorides virescens*)		1 (0.07)	
Turkey Vulture (*Cathartes aura*)	1 (0.04)	1 (0.07)	1 (0.17)
Mississippi Kite (*Ictinia mississippiensis*)			1 (0.17)
Red-tailed Hawk (*Buteo jamaicensis*)	1 (0.04)		
Red-shouldered Hawk (*Buteo lineatus*)		1 (0.07)	
Broad-winged Hawk (*Buteo platypterus*)		1 (0.07)	
Mourning Dove (*Zenaida macroura*)	10 (0.42)	5 (0.36)	3 (0.50)
Yellow-billed Cuckoo (*Coccyzus americanus*)	30 (1.25)	9 (0.64)	2 (0.33)
Barred Owl (*Strix varia*)		1 (0.07)	
Common Nighthawk (*Chordeiles minor*)		1 (0.07)	
Chimney Swift (*Chaetura pelagica*)	1 (0.04)	1 (0.07)	
Ruby-throated Hummingbird (*Archiochus colubris*)	1 (0.04)	2 (0.14)	2 (0.33)
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	1 (0.04)	1 (0.07)	
Red-bellied Woodpecker (*Melanerpes carolinus*)	4 (0.17)	9 (0.64)	1 (0.17)
Downy Woodpecker (*Picoides pubescens*)	3 (0.13)	1 (0.07)	
Pileated Woodpecker (*Dryocopus pileatus*)	1 (0.04)	4 (0.29)	
Acadian Flycatcher (*Empidonax virescens*)		4 (0.29)	
Eastern Phoebe (*Sayornis phoebe*)	2 (0.08)		1 (0.17)
Eastern Wood-Pewee (*Contopus virens*)	18 (0.75)	5 (0.36)	
Great Crested Flycatcher (*Myiarchus crinitus*)	11 (0.46)	5 (0.36)	1 (0.17)
Eastern Kingbird (*Tyrannus tyrannus*)	1 (0.04)		
Scissor-tailed Flycatcher (*Tyrannus forficatus*)			1 (0.17)
White-eyed Vireo (*Vireo griseus*)	5 (0.21)	18 (1.29)	3 (0.50)
Red-eyed Vireo (*Vireo olivaceus*)	22 (0.92)	20 (1.43)	1 (0.17)
Yellow-throated Vireo (*Vireo flavifrons*)	1 (0.04)	6 (0.43)	
Cliff Swallow (*Petrochelidon pyrrhonota*)			5 (0.83)
American Crow (*Corvus brachyrhynchos*)	4 (0.17)	6 (0.43)	1 (0.17)
Fish Crow (*Corvus ossifragus*)		2 (0.17)	
Blue Jay (*Cyanocitta cristata*)	2 (0.08)	4 (0.29)	
Carolina Chickadee (*Poecile carolinensis*)	2 (0.08)	6 (0.43)	2 (0.33)
Tufted Titmouse (*Baeolophus bicolor*)	49 (2.04)	25 (1.79)	8 (1.33)
White-breasted Nuthatch (*Sitta carolinensis*)	3 (0.13)	1 (0.07)	
Carolina Wren (*Thryothorus ludovicianus*)	26 (1.08)	18 (1.29)	2 (0.33)
Blue-gray Gnatcatcher (*Polioptila caerulea*)	39 (1.63)	20 (1.43)	4 (0.67)

Eastern Bluebird (*Sialia sialis*)	3 (0.13)		
Northern Parula (*Setophaga americana*)		8 (0.57)	
Yellow-throated Warbler (*Setophaga dominica*)		1 (0.07)	
Black-and-White Warbler (*Mniotilta varia*)	4 (0.17)	1 (0.07)	
Prothonotary Warbler (*Protonotaria citrea*)		4 (0.29)	
Kentucky Warbler (*Geothlypis formosus*)	2 (0.08)	4 (0.29)	
Swainson's Warbler (*Limnothlypis swainsonii*)		1 (0.07)	
Louisiana Waterthrush (*Parkesia motacilla*)		1 (0.07)	
Common Yellowthroat (*Geothlypis trichas*)	1 (0.04)	2 (0.14)	5 (0.83)
Yellow-breasted Chat (*Icteria virens*)	7 (0.29)	5 (0.36)	9 (1.50)
Summer Tanager (*Piranga rubra*)	30 (1.25)	9 (0.64)	
Northern Cardinal (*Cardinalis cardinalis*)	41 (1.71)	28 (2.0)	9 (1.50)
Blue Grosbeak (*Guiraca caerulea*)	2 (0.08)		1 (0.17)
Indigo Bunting (*Passerina cyanea*)	33 (1.38)	12 (0.86)	10 (1.67)
Painted Bunting (*Passerina ciris*)	7 (0.29)	2 (0.14)	2 (0.33)
Dickcissel (*Spiza americana*)			2 (0.33)
Field Sparrow (*Spizella pusilla*)	9 (0.38)		7 (1.17)
Common Grackle (*Quiscalus quiscala*)	2 (0.08)		
Brown-headed Cowbird (*Molothrus ater*)	8 (0.33)		2 (0.33)
Orchard Oriole (*Icterus spurius*)	1 (0.04)		
American Goldfinch (*Carduelis tristis*)			2 (0.33)

Fish

We conducted a fish survey in one large pond near the west entrance (Entrance #4) of Okmulgee WMA that appeared to be representative of the ponds on the area. We placed a series of six minnow traps along the edge of the pond in vegetation and left them in place for approximately 16 hours. We captured four species of common fish – 13 Western Mosquitofish (*Gambusia affinis*), 2 Redear Sunfish (*Lepomis microlophus*), 6 Green Sunfish (*Lepomis cyanellus*), 9 Bluegill (*Lepomis macrochirus*) and 3 fish that appeared to be Green Sunfish X Bluegill hybrids. We also placed six minnow traps in one of the WMA's wetland units inside Entrance #4. In these we captured another 8 Western Mosquitofish, 18 Southern Leopard Frog tadpoles (*Lithobates sphenocephala utricularia*), 3 Gray Treefrog tadpoles (*Hyla* sp.), 32 Dwarf American Toad tadpoles (*Anaxyrus americanus charlesmithi*) and 29 White River Crayfish (*Procambarus acutus*).

A second fish survey was conducted on a small tributary of the Deep Fork River in a location that was relatively shallow and open such that it could be seined easily. In one pool, we used a backpack electrofishing device to stun fish and dip them out with nets to identify them. The fish were collected in five-gallon buckets, identified and then released back into the stream after we were finished. In another pool immediately upstream, we used a seine to capture fish in 10, 10-meter seine hauls. Despite the small size of the tributary, we were surprised to capture 17 species of fish (Table 7). The fish that were captured are typical of streams in the Cross Timbers Region of eastern Oklahoma and most of them are tolerant of turbid, warm water conditions with limited flow during the summer months. One species that we caught, the Redfin Darter (*Etheostoma whipplei*), was a species of greatest conservation need. This fish is not rare, but it is regionally endemic to streams in the Arkansas River Valley of Oklahoma and Arkansas.

Table 7. Fish Captured in Deep Fork River Tributary on Okmulgee WMA

Central Stoneroller (*Campostoma anomalum*)	3
Red Shiner (*Cyprinella lutrensis*)	9
Golden Shiner (*Notemigonus crysoleucas*)	3
Emerald Shiner (*Notropis atherinoides*)	1
Fathead Minnow (*Pimephales promelas*)	1
Western Mosquitofish (*Gambusia affinis*)	126
Brook Silverside (*Labidesthes sicculus*)	8
Green Sunfish (*Lepomis cyanellus*)	5
Warmouth (*Lepomis gulosus*)	14
Orangespot Sunfish (*Lepomis humilis*)	3
Bluegill (*Lepomis macrochirus*)	53
Longear Sunfish (*Lepomis megalotis*)	3
Redear Sunfish (*Lepomis microlophus*)	17
Largemouth Bass (*Micropterus salmoides*)	2
White Crappie (*Pomoxis annularis*)	4
Slough Darter (*Etheostoma gracile*)	3
Redfin Darter (*Etheostoma whipplei*)	1

Invertebrates

We did not place an emphasis on invertebrate surveys on Okmulgee and Deep Fork WMAs; however, we listened for Prairie Mole Crickets (*Gryllotalpa major*) during the April 2017 survey in the prairie tract on the west side of Okmulgee WMA. We were not successful in detecting mole crickets, but the weather conditions may have been too cool that night and not ideal. We also maintained an incidental list of the butterfly species that were encountered during our vertebrate surveys. Fifty-three species were observed on the area and these are listed in Table 8. While the diversity of butterflies was high, none of the species that we documented are species of greatest conservation need.

Table 8. Butterflies Observed on Okmulgee/Deep Fork WMAs 2017

Common Name / (*Scientific Name*)	**Common Name / (*Scientific Name*)**
Pipevine Swallowtail (*Battus philenor*)	Reakirt's Blue (*Hemiargus isola*)
Giant Swallowtail (*Papilio cresphontes*)	American Snout (*Libytheana carinenta*)
Eastern Tiger Swallowtail (*Papilio glaucus*)	Monarch (*Danaus plexippus*)
Falcate Orangetip (*Anthocharis midea*)	Goatweed Leafwing (*Anaea andria*)
Checkered White (*Pontia protodice*)	Gulf Fritillary (*Agraulis vanilla*)
Giant Cloudless Sulphur (*Phoebis sennae*)	Variegated Fritillary (*Euptoieta claudia*)
Alfalfa Sulphur (*Colias eurytheme*)	Pearl Crescent (*Phyciodes tharos*)
Common Sulphur (*Colias philodice*)	Silvery Checkerspot (*Chlosyne nycteis*)
Southern Dogface (*Colias cesonia*)	Question Mark (*Polygonia interrogationis*)
Sleepy Orange (*Eurema nicippe*)	Viceroy (*Limenitis archippus*)
Little Yellow (*Eurema lisa*)	Red-spotted Purple (*Limenitis arthemis*)
Dainty Sulphur (*Nathalis iole*)	American Painted Lady (*Vanessa virginiensis*)
Gray Hairstreak (*Strymon melinus*)	Painted Lady (*Vanessa cardui*)
Red-banded Hairstreak (*Calycopis cecrops*)	Red Admiral (*Vanessa atalanta*)
Eastern Tailed Blue (*Everes comyntas*)	Common Buckeye (*Junonia coenia*)

Hackberry Emperor (*Asterocampa celtis*)
Common Wood Nymph (*Cercyonis pegala*)
Northern Pearly Eye (*Enodia anthedon*)
Gemmed Satyr (*Cyllopsis gemma*)
Little Wood Satyr (*Megisto cymela*)
Carolina Satyr (*Hermeuptychia sosybius*)
Silver-spotted Skipper (*Epargyreus ciarus*)
Hoary Edge (*Achalarus lyciades*)
Southern Cloudywing (*Thorybes bathyllus*)
Scalloped Sootywing (*Staphylus hayhurstii*)
Sleepy Duskywing (*Erynnis brizo*)
Juvenile's Duskywing (*Erynnis juvenalis*)
Funereal Duskywing (*Erynnis funeralis*)
Wild Indigo Duskywing (*Erynnis baptisiae*)
Horace's Duskywing (*Erynnis horatius*)
Common Sootywing (*Pholisora catullus*)
Comm. Checkered Skipper (*Pyrgus communis*)
Southern Broken Dash Skipper (*Wallengrenia otho*)
Sachem Skipper (*Atalopedes campestris*)
Tawny-edged Skipper (*Polites themistocles*)
Delaware Skipper (*Anatrytone logan*)
Dun Skipper (*Euphyes vestris*)
Common Roadside Skipper (*Amblyscirtes vialis*)

Plants

To the best of our ability, we tried to document the plant species on Okmulgee and Deep Fork Wildlife Management Areas. The list shown in Table 7 does not represent an exhaustive survey effort, but instead it provides an indication of the more common plants on the area.

Table 9. Plant Species, Arranged by Family, Documented on Okmulgee/Deep Fork WMAs.

Herbaceous Plants
Aspleniaceae
Ebony Spleenwort (*Asplenium platyneuron*)
Azollaceae
Carolina Mosquitofern (*Azolla caroliniana*)
Dryopteridaceae
Marginal Wood Fern (*Dryopteris marginalis*)
Equisetaceae
Field Horsetail (*Equisetum hyemale*)
Ophioglossaceae
Adder-tongue Fern (*Ophioglossum* sp.)

Agavaceae
Soapweed Yucca (*Yucca glauca*)
Commelinaceae
Slender Day-Flower (*Commelina erecta*)
Ohio Spiderwort (*Tradescantia ohiensis*)
Iridaceae
Narrowleaf Blue-eyed Grass (*Sisyrinchium angustifolium*)
Juncaceae
Grassleaf Rush (*Juncus marginatus*)
Liliaceae
Wild Onion (*Allium canadense*)
Eastern Wild Hyacinth (*Camassia scilloides*)
Rain Lily (*Cooperia drummondii*)
White Dogtooth Lilly (*Erythronium albidum*)
Yellow Star Grass (*Hypoxis hirsuta*)
False Garlic (*Nothoscordum bivalve*)

Poaceae
Big Bluestem (*Andropogon gerardii*)
Broomsedge Bluestem (*Andropogon virginicus*)
Broadleaf Woodoats (*Chasmanthium latifolium*)
Poverty Oatgrass (*Dianthonia spicata*)
Scribner's Panicgrass (*Dichanthelium oligosanthes*)
Switchgrass (*Panicum virgatum*)
Little Bluestem (*Schizachyrium scoparium*)
Indian Grass (*Sorghastrum nutans*)
Purpletop Tridens (*Tridens flavus*)
Eastern Gamagrass (*Tripsacum dactyloides*)
Smilacaceae
Saw Greenbriar (*Smilax bona-nox*)

Acanthaceae
American Water-willow (*Justica americana*)
Smooth Wild Petunia (*Ruellia humilis*)
Amaranthaceae
Prairie Snake Cotton (*Froelichia floridana*)
Apiaceae
Hairyfruit Chervil (*Chaerophyllum taintureri*)
Queen Anne's Lace (*Daucus carota*)
Rattlesnake Master (*Eryngium yuccifolium*)
Nuttall's Prairie Parsley (*Polytaenia nuttallii*)
Laceflower Bishopwed (*Ptilimnium nuttallii*)
Clustered Blacksnake root (*Sanicula odorata*)
Spreading Hedge Parsley (*Torilis arvensis*)

Apocynaceae
Prairie Dogbane (*Apocynum cannabinum*)
Aristolochiaceae
Woolly Pipevine (*Aristolochia tomentosa*)
Asclepiadaceae
Butterfly Milkweed (*Asclepias tuberosa*)
Whorled Milkweed (*Asclepias verticillata*)
Greenflower Milkweed (*Asclepias viridiflora*)
Green Milkweed (*Asclepias viridis*)
Asteraceae
Yarrow (*Achillea millefolium*)
White Snakeroot (*Ageratina altissima* / *Eupatorium rugosum*)
Common Ragweed (*Ambrosia artemesifolia*)
Western Ragweed (*Ambrosia psilostachya*)
Giant Ragweed (*Ambrosia trifida*)
Parlin's Pussytoes (*Antennaria parlinii*)
Plantain-leaf Pussytoes (*Antennaria plantaginifolia*)
Prairie Indian Plantain (*Arnoglossum plantaginea*)
Western Daisy (*Astranthium integrifolium*)
Coreopsis Beggarticks (*Bidens aristosa*)
Soft Golden Aster (*Chrysopsis* (*Bradburia*) *pilosa*)
Tall Thistle (*Cirsium altissimum*)
Blue Mistflower (*Conoclinium coelestinum*)
Mare's Tail (*Conyza canadensis*)
Largeflower Coreopsis (*Coreopsis grandiflora*)
Plains Coreopsis (*Coreopsis tinctoria*)
Slender Scratch Daisy (*Croptilon divaricatum*)
Clasping Coneflower (*Dracopis amplexicaulis*)
Pale Coneflower (*Echinacea pallida*)
Elephant's Foot (*Elephantopus carolinianus*)
American Burnweed (*Erechtites hieraciifolia*)
Prairie Daisy Fleabane (*Erigeron strigosus*)
Slender Fleabane (*Erigeron tenuis*)
Late Thoroughwort (*Eupatorium serotinum*)
Prairie Goldentop (*Euthamia gymnospermoides*)
Spanish Gold Gumweed (*Grindelia papposa*)
Bitter Sneezeweed (*Helenium amarum*)
Rough Sunflower (*Helianthus hirsutus*)
Ashy Sunflower (*Helianthus mollis*)
Prairie Sunflower (*Helianthus petiolaris*)
Jerusalem Artichoke (*Helianthus tuberosus*)
Woolly-White (*Hymenopappus scabiosaeus*)
Wild Lettuce (*Lactuca canadensis*)
Tall Blazing Star (*Liatris aspera*)
Butterweed (*Packera glabella*)
Roundleaf Ragwort (*Packera obovata*)
Sweetscent (*Pluchea odorata*)
Sweet Cudweed (*Pseudognaphalium obtusifolium*)
False Dandelion (*Pyrrhopappus carolinianus*)
Great Coneflower (*Rudbeckia grandiflora*)
Black-eyed Susan (*Rudbeckia hirta*)
Brown-eyed Susan (*Rudbeckia triloba*)
Prairie Goldenrod (*Solidago canadensis*)
Giant Goldenrod (*Solidago gigantea*)
Western Rough Goldenrod (*Solidago radula*)
Elmleaf Goldenrod (*Solidago ulmifolia*)
Southern Annual Aster (*Symphyotrichum divaricatum*)
Drummond's Aster (*Symphyotrichum drummondii*)
Heath Aster (*Symphyotrichum ericoides*)
Smooth Blue Aster (*Symphyotrichum laevis*)
Aromatic Aster (*Symphyotrichum oblongifolius*)
Late Purple Aster (*Symphyotrichum patens*)
Willowleaf Aster (*Symphyotrichum praealtus*)
Yellow Ironweed (*Verbesina alternifolia*)
Frostweed (*Verbesina virginica*)
Baldwin Ironweed (*Vernonia baldwinii*)
Rough Cockleburr (*Xanthium strumarium*)
Brassicaceae
Sand Bittercress (*Cardamine parviflora*)
Pepperweed species (*Lepidium* sp.)
Cactaceae
Prickly Pear Cactus (*Opuntia humifusa*)
Campanulaceae
Cardinal Flower (*Lobelia cardinalis*)
Clasping Venus Looking-glass (*Triodanis perfoliata*)
Caryophyllaceae
Mouse-ear Chickweed (*Cerastium glomeratum*)
Common Chickweed (*Stellaria media*)
Clusiaceae
St. Andrew's Cross (*Hypericum hypericoides*)
Dwarf St. Johnswort (*Hypericum mutilum*)
Convolvulaceae
Small White Morning glory (*Ipomoea lacunosa*)
Wild Potato Vine (*Ipomoea pandurata*)
Euphorbiaceae
Tropical Croton (*Croton glandulosus*)
Warty Spurge (*Euphorbia spathulata*)
Fabaceae
Lead Plant (*Amorpha canescens*)
Longbract Wild Indigo (*Baptisia bracteata*)
White Wild Indigo (*Baptisia lactea*)
Showy Partridge Pea (*Chamaecrista fasciulata*)
Butterfly Pea (*Clitoria mariana*)
Purple Prairie Clover (*Dalea purpureum*)

Illinois Bundleflower (*Desmanthus illinoensis*)
Smooth Ticktrefoil (*Desmodium laevigatum*)
Panicled Ticktrefoil (*Desmodium paniculatum*)
Sessileleaf Ticktrefoil (*Desmodium sessilifolium*)
Sericea Lespedeza (*Lespedeza cuneata*)
Creeping Bush Clover (*Lespedeza repens*)
Slender Bush Clover (*Lespedeza virginica*)
Yellow Sweet Clover (*Melilotus officinalis*)
Nuttall's Sensitive Briar (*Mimosa nuttallii*)
Yellow Neptune (*Neptunia lutea*)
Slim-flowered Scurfpea (*Psoralidium tenuiflora*)
Maryland Senna (*Senna marilandica*)
Bladderpod (*Sesbania vesicaria*)
Smooth Seed Wild Bean (*Strophostyles leiosperma*)
Sidebeak Pencilflower (*Stylosanthes biflora*)
Goat's Rue (*Tephrosia virginiana*)
Hop Clover (*Trifolium dubium*)
White Clover (*Trifolium repens*)
Pygmyflower Vetch (*Vicia minutiflora*)
Smooth Vetch (*Vicia sativa*)
Hairy Vetch (*Vicia villosa*)

Fumariaceae

Smallflower Fumewort (*Corydalis micrantha*)

Gentianaceae

Squarestem Rose-Gentian (*Sabatia angularis*)
Prairie Rose-Gentian (*Sabatia campestris*)

Geraniaceae

Carolina Cranesbill (*Geranium carolinianum*)

Hydrophyllaceae

Ovate False Fiddleleaf (*Hydrolea ovata*)

Lamiaceae

Henbit (*Lamium amplexicaule*)
Wild Beebalm (*Monarda fistulosa*)
Spotted Beebalm (*Monarda punctata*)
Red-purple Beebalm (*Monarda russeliana*)
Self-Heal (*Prunella vulgaris*)
Narrowleaf Mountain Mint (*Pycnanthemum tenuifolium*)
Pitcher Sage (*Salvia azurea*)
Woodland Germander (*Teucrium canadense*)

Lythraceae

Winged Loosestrife (*Lythrum alatum*)

Malvaceae

Light Poppymallow (*Callirhoe alcaeoides*)
Rose Poppy Mallow (*Callirhoe involucrata*)
Halberd-leaved Hibiscus (*Hibiscus laevis*)

Menispermaceae

Carolina Coralbead (*Cocculus carolinus*)

Onagraceae

Tall Gaura (*Gaura longiflora*)
Smallflower Gaura (*Gaura parviflora*)
Seedbox Water Primrose (*Ludwigia alternifolia*)
Floating Water Primrose (*Ludwigia peploides*)
Biennial Evening Primrose (*Oenothera biennis*)
Cutleaf Evening Primrose (*Oenothera laciniata*)
Threadleaf Evening Primrose (*Oenothera linifolia*)
Showy Evening Primrose (*Oenothera speciosa*)

Oxalidaceae

Yellow Wood Sorrel (*Oxalis stricta*)
Violet Wood Sorrel (*Oxalis violacea*)

Passifloraceae

Purple Passionflower (*Passiflora incarnata*)

Phytolaccaceae

Pokeweed (*Phytolacca americana*)

Plantaginaceae

Rugel's Plantain (*Plantago rugelii*)
Dwarf Plantain (*Plantago virginica*)

Polemoniaceae

Prairie Phlox (*Phlox pilosa*)

Polygalaceae

Pink Milkwort (*Polygala incarnata*)

Polygonaceae

Swamp Smartweed (*Polygonum hydropiperoides*)
Spotted Smartweed (*Polygonum* (*Persicaria*) *maculatum* (*persicaria*))
Pennsylvania Smartweed (*Polygonum pennsylvanicum*)
Water Smartweed (*Polygonum punctatum*)
Curly Dock (*Rumex crispus*)

Portulacaceae

Virginia Spring Beauty (*Claytonia virginica*)

Ranunculaceae

Carolina Anemone (*Anemone caroliniana*)
Carolina Larkspur (*Delphinium carolinianum*)
Buttercup (*Ranunculus* species)

Rosaceae

White Avens (*Geum canadense*)
Indian Physic (*Porteranthus stipulatus*)
Common Cinquefoil (*Potentilla simplex*)

Rubiaceae

Poorjoe Buttonweed (*Diodia teres*)
Bedstraw (*Galium* species)
Tiny Bluet (*Houstonia pusilla*)

Saururaceae

Lizard's Tail (*Saururus cernuus*)

Scrophulariaceae

Entireleaf Indian Paintbrush (*Castilleja indivisa*)
Violet Blue-eyed Mary (*Collinsia violacea*)

False Pimpernell (*Lindernia dubia*)
Sharpwinged Monkeyflower (*Mimulus alatus*)
Texas Toadflax (*Nuttallanthus texanus*)
Loose-flowered Penstemon (*Penstemon laxiflorus*)
Oklahoma Penstemon (*Penstemon oklahomensis*)
White Wand Penstemon (*Penstemon tubiflorus*)
Common Mullein (*Verbascum thapsus*)

Solanaceae
Longleaf Ground Cherry (*Physalis longifolia*)
Carolina Nightshade (*Solanum carolinense*)
Silverleaf Nightshade (*Solanum elaeagnifolium*)

Urticaceae
Heartleaf Nettle (*Urtica chamaedryoides*)

Valerianaceae
Beaked Cornsalad (*Valerianella radiata*)

Verbenaceae
Rose Verbena (*Glandularia canadensis*)
Lanceleaf Fogfruit (*Phyla lanceolata*)
Bigbract Verbena (*Verbena bracteata*)
White Vervain (*Verbena urticifolia*)

Violaceae
Field Pansy (*Viola bicolor*)
Missouri Blue Violet (*Viola missouriensis*)
Three-lobed Violet (*Viola palmata*)

Woody Plants:

Cupressaceae
Eastern Redcedar (*Juniperus virginiana*)

Aceraceae
Boxelder (*Acer negundo*)

Anacardiacea
Fragrant Sumac (*Rhus aromatica*)
Winged Sumac (*Rhus copallina*)
Poison Ivy (*Toxicodendron radicans*)

Aquifoliaceae
Deciduous Holly *(Ilex decidua*)

Betulaceae
River Birch (*Betula nigra*)

Bignoniaceae
Trumpetvine (*Campsis radicans*)

Caprifoliaceae
Japanese Honeysuckle (*Lonicera japonica*)
Coral Honeysuckle (*Lonicera sempervirens*)
Elderberry (*Sambucus canadensis*)
Buckbrush (*Symphoricarpos occidentalis*)
Rusty Blackhaw (*Viburnum rufidulum*)

Cornaceaae
Roughleaf Dogwood (*Cornus drummondii*)

Ebenaceae
Common Persimmon (*Diospyros virginiana*)

Ericaceae
Farkleberry (*Vaccinium arboreum*)
Blue Ridge Blueberry (*Vaccinium pallidum*)

Fabaceae
Swamp False Indigo (*Amorpha fruticosa*)
Redbud (*Cercis canadensis*)
Honey Locust (*Gleditsia triacanthos*)
Kentucky Coffeetree (*Gymnocladus dioicus*)

Fagaceae
Bur Oak (*Quercus macrocarpa*)
Blackjack Oak (*Quercus marilandica*)
Pin Oak (*Quercus palustris*)
Post Oak (*Quercus stellata*)
Black Oak (*Quercus velutina*)

Juglandaceae
Pecan (*Carya illinoinensis*)
Black Hickory (*Carya texana*)
Black Walnut (*Juglans nigra*)

Moraceae
Red Mulberry (*Morus rubra*)

Nyssaceae
Black Gum (*Nyssa sylvatica*)

Oleaceae
Swamp Privet (*Forestiera acuminata*)
White Ash (*Fraxinus americana*)
Green Ash (*Fraxinus pennsylvanica*)
Chinese Privet (*Ligustrum sinense*)

Platanaceae
Sycamore (*Platanus occidentalis*)

Rosaceae
Downy Serviceberry (*Amelanchier arborea*)
Green Hawthorn (*Crataegus viridis*)
Chickasaw Plum (*Prunus angustifolia*)
Oklahoma Plum (*Prunus gracilis*)
Mexican Plum (*Prunus mexicana*)
Black Cherry (*Prunus serotina*)
Pink Carolina Rose (*Rosa carolina*)
White Prairie Rose (*Rosa foliolosa*)
Sawtooth Blackberry (*Rubus argutus*)
Southern Dewberry (*Rubus trivialis*)

Rubiaceae
Common Buttonbush (*Cephalanthus occidentalis*)

Salicaceae
Eastern Cottonwood (*Populus deltoides*)
Black Willow (*Salix nigra*)

Sapotaceae
Chittamwood (*Sideroxylon* (*Bumelia*) *lanuginosa*)
Ulmaceae
Sugarberry (*Celtis laevigata*)
Winged Elm (*Ulmus alata*)
American Elm (*Ulmus americana*)
Slippery Elm (*Ulmus rubra*)
Vitaceae
Peppervine (*Ampelopsis arborea*)
Virginia Creeper (*Parthenocissus quinquefolia*)
Wild Grape (*Vitis* sp.)

COOKSON WILDLIFE MANAGEMENT AREA

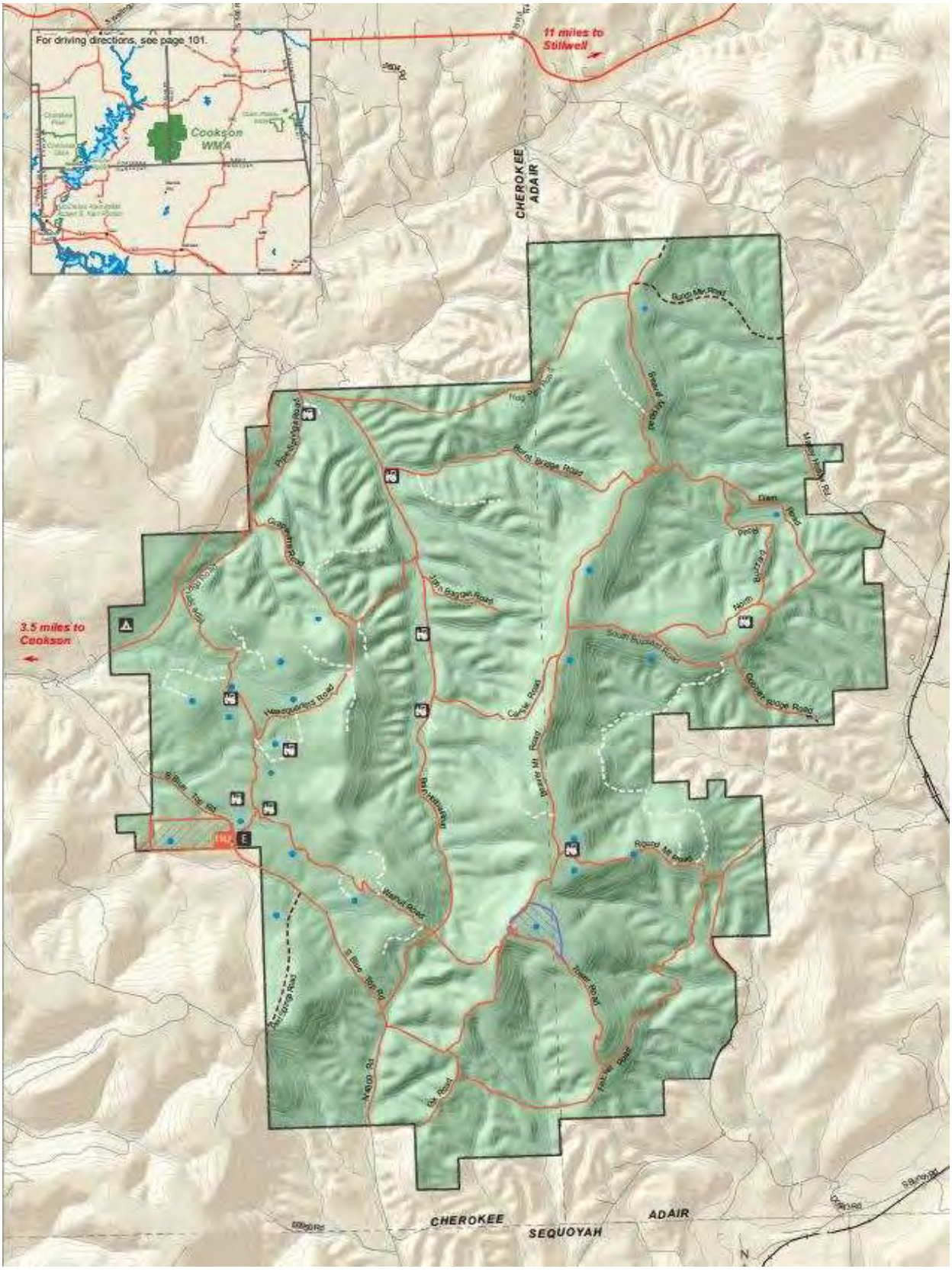
We conducted a series of biological surveys on the Cookson Wildlife Management Area in collaboration with Curt Allen and Colby Farquhar, the biologist and biological technician for the area, respectively. The authors owe a great debt of appreciation to Curt and Colby who gave us access to Cookson WMA, participated in the surveys for each of the taxonomic groups that were covered, helped us identify representative habitats across the WMA and tracked incidental species that they observed on the area but that we were unable to detect during the survey.

Cookson WMA is approximately 14,700 acres in size and lies on the county line between Adair and Cherokee counties immediately north of their junction with Sequoyah County (Figure 1). The topography of the area is rugged and encompasses many hills and ravines as well as Beaver Mountain which is a ridge that is oriented north to south along the Adair/Cherokee county line. The wildlife management area overlies the interface between the Springfield Plateau (a limestone formation) and the Boston Mountains (a sandstone formation), and its rocky hills are comprised of layers of sandstone and limestone. The soils over the area are part of the Clarksville series and are a cherty limestone/clay loam. Cookson WMA encompasses portions of three watersheds. The western quarter of the area lies within the Elk Creek watershed and a small, perennial reach of the stream flows near the western boundary of the area behind the headquarters. The central portion of the area lies within the Dry Creek watershed and an approximately four-mile long headwaters reach of the stream flows through the area. Both Elk Creek and Dry Creek are tributaries of the Illinois River. The eastern and southern portions of the WMA drain into approximately half a dozen intermittent tributaries of Sallisaw Creek which is a tributary of the Arkansas River. At least 20 small ponds occur on the area. Many of these are seasonal, fishless pools that serve as good breeding ponds for several species of salamanders, toads and frogs.

More than ninety percent of Cookson WMA is forested. Most of the forest and woodland stands are dominated by oaks, hickories and ashes. Sugar Maple (*Acer saccharum*) is a common mid-story species on slopes. Mixed stands of Shortleaf Pine (*Pinus echinata*) and oaks grow along several dry ridge tops and ravines. Common deciduous canopy trees include Post Oak (*Quercus stellata*), White Oak (*Quercus alba*), Northern Red Oak (*Quercus rubra*), Black Oak (*Quercus velutina*), Mockernut Hickory (*Carya alba*), Shagbark Hickory (*Carya ovata*), Black Hickory (*Carya texana*), White Ash (*Fraxinus americana*), Winged Elm (*Ulmus alata*), and Sugar Maple. Mesic hardwood and riparian forests occur along the intermittent and perennial streams on the WMA. These sites contain such species as American Basswood (*Tilia americana*), Sycamore (*Platanus occidentalus*), River Birch (*Betula nigra*), Hop Hornbeam (*Ostrya virginiana*), and Northern Spicebush (*Lindera benzoin*). A more complete list of woody and herbaceous plants found on Cookson WMA is shown in Table 8.

The non-forested portions of Cookson WMA consist of several mowed and/or burned openings and a few small food plots. These openings have been planted with a mix of exotic and native grasses and forbs to provide forage for the area's American Elk population. These are generally located in relatively level sites along WMA roads in valleys between hills or on the ridge line of Beaver Mountain. Also on the ridge of Beaver Mountain is a long, narrow oak-dominated woodland/savannah that is maintained by prescribed fire. Until recently, most of this area was closed-canopy forest because of years of fire suppression; however, drought in the early 2000s facilitated an outbreak of hypoxylon canker that killed many of the trees and restored this to a more site-appropriate condition as an oak woodland. Several rocky, limestone glades occur on the east and south sides of Beaver Mountain and on several hillsides on the western half of the area.

Figure 1. Map of Cookson Wildlife Management Area



The primary project personnel for the surveys were Curtis Tackett, Mark Howery, Curt Allen, Colby Farquhar, Jena Donnell, and Matt Fullerton. Brenda Smith (University of Oklahoma), Tony Rodger, and Trevor Stark (latter two ODWC) each assisted with one survey. During both winter bird surveys, we had help from the Oklahoma City Zoo's staff – Jordan Long, Brett Bartek, Christine Zbtowsky, and Lynnette Waugh in 2015, and Brett Bartek, Holly Ray, Stacey Sekscienski, Erik Calen and Jennifer Gaddy in 2016. We conducted 12 short-duration surveys on the area as follows:

14 December 2014
2, 3, and 4 February 2015
24, 25, and 26 March 2015
22, 23, and 24 June 2015
18, 19, and 20 November 2015
2, 3, and 4 February 2016
22, 23, and 24 March 2016
21 and 22 April 2016
24, 25, and 26 May 2016
5, 6, and 7 July 2016
16 and 17 November 2016
16 March 2017

Our techniques varied between surveys based upon the focal taxa for that season. The most commonly used technique was the timed search in which observers walked through specific habitats for a predetermined length of time (typically for 30 to 60 minutes at a time) and recorded every vertebrate that was seen or heard (in the case of birds and anurans). This was a very effective technique for surveying birds but was moderately successful for surveying the other terrestrial vertebrate groups. During timed-searches in March and April, we searched under rocks and fallen logs to find amphibians and reptiles; this is the period of peak activity for many salamanders, lizards and small snakes. During most of the surveys, we searched small ponds with dip nets to capture amphibian larvae and adults. We used dip nets to sample stream fish populations in the headwaters of three streams on the WMA. To assess the small mammal community, we used Sherman live traps baited with chicken scratch and rolled oats to capture, record, and release rodents. Small mammal trapping occurred in June 2015, November 2015, July 2016, and November 2016. During the June 2015 and May 2016 surveys (early summer) we conducted a series of 5-minute point counts along the WMA roads to assess the breeding bird community.

Each survey trip was planned with a focus on one or more species groups, and the focus shifted with the seasons as different taxa become more active. The foci for the November surveys were small mammals (accomplished through live trapping) and salamanders (accomplished by checking ponds for evidence of Ringed Salamander breeding). The February survey efforts were directed toward quantifying the wintering bird community, although we also checked several ponds and two springs for fish and amphibians and two small caves on Beaver Mountain for bats and salamanders. The emphasis during the March and April surveys was conducting timed-searches for salamanders, lizard and small snakes in rocky, forested habitats and glades. Assessing the breeding bird community was the focus of the late May and June surveys, although some effort was placed into conducting timed-searches for reptiles and amphibians. The July survey was organized around small mammal trapping and surveys for fish. Evening surveys for calling anurans were conducted in March, April, May, and June to encompass the range of breeding times for frog and toad species. During all surveys, we recorded incidental observations of birds, mammals, and reptiles. The level of search effort expended during the twelve survey trips to Cookson WMA totaled 33.5 hours of timed-searches within streams and riparian areas at eleven sites; 27.5 hours of timed-searches in and around 11 ponds (most were searched twice); 9.5 hours of road-based timed-searches at night listening for calling amphibians; 32.5 hours of timed-searches on foot in upland habitat (forests and glades); 11.0 hours of road-based timed searches along roads looking for reptiles; 380 trap nights using Sherman live-traps at 13 locations; 50.0 hours of timed-searches for wintering birds, and 96 five-minute point-counts for breeding birds (some sites were surveyed twice).

Although we recorded all vertebrates observed or heard during our surveys, the surveys were designed with a special emphasis on species of greatest conservation need (SGCN) as defined by the Oklahoma Comprehensive Wildlife Conservation Strategy. Prior to the survey, we identified 20 SGCN

that might occur on Cookson WMA including: Stippled Darter (*E. mihileze*), Wedgespot Shiner (*Notropis greeni*), Oklahoma Salamander (*Eurycea tynerensis*), Ozark Zigzag Salamander (*Plethodon angusticlavius*), Cave Salamander (*Eurycea lucifuga*), Grotto Salamander (*Eurycea spelaea*), Ringed Salamander (*Ambystoma annulatum*), Ouachita Map Turtle (*Graptemys ouachitensis*), Bald Eagle (*Haliaeetus leucocephalus*), American Woodcock (*Scolopax minor*), Red-headed Woodpecker (*Melanerpes erythrocephalus*), Wood Thrush (*Hylocichla mustelina*), Prothonotary Warbler (*Protonotaria citrea*), Louisiana Waterthrush (*Parkesia motacilla*), Kentucky Warbler (*Geothlypis formosa*), Worm-eating Warbler (*Helmitheros vermivora*), Rusty Blackbird (*Euphaga carolina*), LeConte's Sparrow (*Ammodramus leconteii*), Northern Long-eared Bat (*Myotis septentrionalis*) and Ozark Big-eared Bat (*Corynorhinus townsendii ingens*). During this inventory, we detected fourteen of these species - Stippled Darter, Oklahoma Salamander, Cave Salamander, Ozark Zigzag Salamander, Ringed Salamander, Bald Eagle, American Woodcock, Red-headed Woodpecker, Louisiana Waterthrush, Kentucky Warbler, Worm-eating Warbler, Rusty Blackbird, LeConte's Sparrow and Ozark Big-eared Bat, plus Ozark Emerald (*Somatochlora ozarkensis*).

Fish

We added to the fish community sampling that we conducted in 2015 by revisiting sites along the South Fork of Dry Creek (in Bolin Hollow) and the spring at the headwaters of Hastings Hollow. We also sampled along a reach of Elk Creek approximately one mile north of our 2015 sampling location. We sampled the fish communities at these sites by conducting timed searches using dip nets. All of our sampling occurred in headwater streams – Dry Creek is a headwater tributary to Caney Creek; Hastings Hollow is a headwater tributary to Sallisaw Creek, and our sampling sites on Elk Creek were in that stream's upper-most reach. The fish communities in these streams appear to be typical of springs and headwaters in the southern Ozark Region (Table 1). The streams were dominated by Southern Redbelly Dace (*Phoxinus erythrogaster*) and a few species of minnows and darters. Although the fish community diversity is small, one of these species, the Stippled Darter (now recognized as the Sunburst Darter (*Etheostoma mihileze*)) is an Oklahoma species of greatest conservation need and was found in all three streams.

In addition to these streams, we sampled eleven ponds on the WMA and found fish populations in three of them. One pond supported populations of Bluegill (*Lepomis macrochirus*) and Green Sunfish (*Lepomis cyanellus*), one pond appeared to contain mostly Common Goldfish (*Carassius auratus*) and the third pond contained a large population of Bullhead Minnows (*Pimephales vigilax*). Using two minnow traps, we caught and released 134 Bullhead Minnows from the last pond, but no other fish were caught.

Table 1. Fish Species Documented in Cookson WMA Streams.

Common Name	**Elk Creek**		**Dry Creek**		**Hastings Hollow**	
	2015	2016	2015	2016	2015	2016
Highland Stoneroller (*Campostoma spadiceum*)	80	7	8	30	20	0
S. Redbelly Dace (*Phoxinus erythrogaster*)	0	125	243	397	59	80
Creek Chub (*Semotilus atromaculatus*)	0	6	9	2	2	0
Slender Madtom (*Noturus exilis*)	0	0	0	2	0	1
Banded Sculpin (*Cottus carolinae*)	2	0	7	7	0	0
Green Sunfish (*Lepomis cyanellus*)	28	0	0	0	0	0
Orangethroat Darter (*Etheostoma spectabile*)	22	13	21	20	25	7
Sunburst (Stippled) Darter (*E. mihileze*)	2	1	2	2	2	0

Amphibians and Reptiles

We detected 17 of 23 possible amphibian species and 18 of 38 possible reptile species on Cookson WMA. The results of those surveys for amphibians are summarized in Table 2 and the results for reptiles are shown in Table 3. Weather conditions during each of the spring surveys were cool and wet, which were nearly ideal for detecting many amphibians and smaller forest reptiles. Additionally, Curt and Colby reported six reptile species to us that they had observed on Cookson WMA during the 2015-2016 survey period but that we did not find during our formal surveys. These species were Eastern Collared Lizard (*Crotaphytus collaris*) (an individual basking in a glade on the north end of Beaver Mountain), Black Ratsnake (*Elaphe obsoletus*), Eastern Hognose Snake (*Heterodon platirhinos*), Speckled Kingsnake (*Lampropeltis getula*), Copperhead (*Agkistrodon contortrix*) and Western Diamond-backed Rattlesnake (*Crotalus atrox*).

Table 2. Summary of Amphibian Detections on Cookson WMA.

Common Name	**Diurnal Timed Searches**	**Nocturnal Timed Searches**	**Notes**
Central Newt (*Notophthalmus viridescens*)	114	38	includes larvae & one eft
Ringed Salamander (*Ambystoma annulatum*)		2	453+ larvae
Spotted Salamander (*Ambystoma maculatum*)			10+ egg masses
Dark-sided Salamander (*Eurycea longicauda melanopleura*)	31		
Cave Salamander (*Eurycea lucifuga*)	13		
Oklahoma Salamander (*Eurycea tynerensis*)	202	31	(includes larvae)
Ozark Zigzag Salamander (*Plethodon angusticlavius*)	42		
Western Slimy Salamander (*Plethodon albagula*)	17		
Dwarf American Toad (*Bufo americanus charlesmithi*)	34	93	1,000s tadpoles
Blanchard's Cricket Frog (*Acris blanchardi*)	47	29	
Cajun Chorus Frog (*Pseudacris fouquettei*)	1	25	
Spring Peeper (*Pseudacris crucifer*)	9	57	
Gray & Cope's Gray Treefrog (*Hyla chrysoscelis & Hyla versicolor*)	21	42	
American Bullfrog (*Lithobates catesbeiana*)		1	
Green Frog (*Lithobates clamitans*)	2	5	
Pickerel Frog (*Rana palustris*)	2	2	
Southern Leopard Frog (*Rana sphenocephala utricularia*)	24	27	311+ tadpoles

Table 3. Summary of Reptile Detections on Cookson WMA.

Common Name	Diurnal Timed Searches
Eastern Snapping Turtle (*Chelydra serpentina*)	1
Three-toed Box Turtle (*Terrapene carolina*)	3
Prairie (Fence) Lizard (*Sceloporus consobrinus*)	15
Five-lined Skink (*Plestiodon fasciatus*)	19
Broad-headed Skink (*Plestiodon laticeps*)	2
Brown Skink (*Scincella lateralis*)	29
Western Wormsnake (*Carphophis vermis*)	1
Ring-necked Snake (*Diadophis punctatus*)	8
Red Milksnake (*Lampropeltis triangulum syspila*)	4
Coachwhip (*Masticophis flagellum*)	1
Plain-bellied Watersnake (*Nerodia erythrogaster flavigaster*)	6
Rough Greensnake (*Opheodrys aestivus*)	2
Great Plains Ratsnake (*Patherophis emoryi*)	1
Brown Snake (*Storeria dekayi texana*)	2
Flathead Snake (*Tantilla gracilis*)	6
Eastern Gartersnake (*Thamnophis sirtalis sirtalis*)	2
Rough Earthsnake (*Virginia striatula*)	4
Timber Rattlesnake (*Crotalus horridus*)	3

Our amphibian and reptile surveys documented four species that are species of greatest conservation need in Oklahoma: Ringed Salamander (*Ambystoma annulatum*), Oklahoma Salamander (*Eurycea tynerensis*), Cave Salamander, and Ozark Zigzag Salamander. All of these were found during timed-searches. The Ringed Salamander is a relatively large burrowing species that breeds in seasonal ponds during the fall. We located single adult Ringed Salamanders on two occasions in separate seasonal ponds. One was at a pond on the ridgeline of Beaver Mountain during the November 2015 survey and the other was in a pond near the southern base of Saddle Mountain during the February 2015 survey. We found hundreds of larval salamanders in eight ponds during the November, February, March, and April surveys. The Oklahoma Salamander is a small, primarily aquatic salamander that was detected during most of our stream surveys (e.g. Dry Creek, Elk Creek, Frank Lee Spring, and Hastings Hollow Spring) in February, March, and April, but was not found during the other months of the year. This species appears to be very common in rocky streams and ravines in the late winter and spring but appears to move into the gravel substrate as the weather becomes warmer and drier. We documented 233 Oklahoma Salamanders; these were a mix of adults and larvae. The Cave Salamander has an aquatic larval stage and is a terrestrial species as an adult. We found thirteen adult Cave Salamanders, five were under rocks and leaf litter near springs and the other eight were found in the small caves on Beaver Mountain. The Ozark Zigzag Salamander is a terrestrial forest salamander that undergoes its larval development while in a terrestrial egg. We found 42 Ozark Zigzag Salamanders in over a dozen mesic forested locations. Most of these were found by lifting rocks and logs in the early spring (March and April).

Most amphibians and reptiles were found during timed-searches, although some of the Prairie Lizards (*Sceloporus consobrinus*) and larger snakes were found while driving WMA roads. The months of March and April were by far the most productive months for finding salamanders, anurans, skinks, and

small snakes. Our survey results were based upon 33.5 hours of timed-searches within streams and riparian areas, 27.5 hours of timed-searches in and around ponds, 9.5 hours of road-based timed-searches at night listening for calling amphibians, 32.5 hours of timed-searches on foot in upland habitats, and incidental observations during 11.0 hours of road-based timed searches along roads looking for reptiles, mammals and birds. Cookson WMA contains an abundance of ground-level cover for amphibians and small reptiles in the form of rocks and logs. Because of this, we did not attempt to place any cover boards on the area. In forested habitats, we conducted timed searches during which we looked under loose rocks, logs and leaf litter. We successfully located Western Slimy Salamanders, Ozark Zigzag Salamanders, Five-lined Skinks (*Plestiodon fasciatus*), Brown Skinks (*Scincella lateralis*), Ring-necked Snakes, Flathead Snakes Rough Earth Snakes and Rough Greensnakes. Similar timed-searches in glades revealed Five-lined Skinks (*Plestiodon fasciatus*), Brown Skinks (*Scincella lateralis*), Red Milksnakes, Flathead Snakes, and one each of Rough Earthsnake and Western Worm Snake. Most of our encounters with larger snakes were opportunistic. For example, the Coachwhip (*Masticophis flagellum*), one of the Eastern Gartersnakes (*Thamnophis sirtalis sirtalis*), the Great Plains Ratsnake (*Patherophis emoryi*) and one of the Timber Rattlesnakes (*Crotalus horridus*) were encountered along roads while scouting or conducting point counts for breeding birds.

The WMA contains nearly two dozen small ponds, most of which are less than a quarter of an acre in size, shallow, and fishless; therefore, these were ideal breeding sites for many amphibians. We conducted winter-time and early spring surveys at twelve ponds. Nearly every pond contained Central Newts, Dwarf American Toads, Cricket Frogs, and Southern Leopard Frogs. Ringed Salamander larvae were found in nine ponds and Spotted Salamander egg masses were found in three ponds (two of which also supported Ringed Salamander larvae). Spring Peepers, Cajun Chorus Frogs, Southern Leopard Frogs and Dwarf American Toads were heard calling around ponds in February and March. Blanchard's Cricket Frogs, Gray Treefrogs, Green Frogs and Dwarf American Toads were heard calling around ponds in April and May. Gray Treefrogs and Blanchard's Cricket Frogs were the only species heard during surveys in June and July. We found only a few adult Pickerel Frogs and did not find any obvious breeding ponds. In all cases, we found only single adults and these were distributed in a range of locations including a tributary to Elk Creek, two small ponds, and a small cave on Beaver Mountain.

Mammals

We documented 20 species of native mammals on Cookson WMA 2016 (Table 4). Most of these mammals were encountered opportunistically while conducting timed searches for birds, reptiles and amphibians; however, 52 rodents of five species were trapped during 380 trap nights at nine locations (average trap success 13.7%).

One Nine-banded Armadillo (*Dasypus novemcinctus*), ten Eastern Cottontails (*Sylvilagus floridanus*), 12 Fox Squirrels (*Sciurus niger*), 27 Gray Squirrels (*Sciurus carolinensis*), 11 Eastern Chipmunks (*Tamias striatus*), one White-footed Mouse (*Peromyscus leucopus*), one Hispid Cotton Rat (*Sigmodon hispidus*), one Woodland Vole (*Microtus pinetorum*) and one Coyote (*Canis latrans*) were encountered incidentally during diurnal surveys for wintering and breeding birds, and timed-searches for amphibians and reptiles. Two Nine-banded Armadillos, ten unidentified bats, three Eastern Cottontails, and three Striped Skunks (*Mephitis mephitis*) were observed during nocturnal surveys for calling anurans during the March, May, and July surveys. Additionally, we observed many White-tailed Deer (*Odocoileus virginianus*) and American Elk (*Cervus elaphus*) incidentally during our surveys but did not track these species closely because the populations for both species are monitored closely by Curt Allen and Colby Farquhar and with much greater precision than we could hope to accomplish through this project. The presence of Virginia Opossum (*Didelphis virginiana*), Eastern Mole (*Scalopus aquaticus*), Raccoon (*Procyon lotor*) and Bobcat (*Felis rufa*) were confirmed through the observation of tracks and signs.

During multiple visits to two caves on Beaver Mountain in February and November, we observed a single roosting Tri-colored Bat (*Perimyotis subflavus*) on one occasion and single roosting Ozark Big-eared Bats (*Corynorhinus townsendii ingens*) on two occasions. These were the only bat species that we could confirm during the survey. We did not attempt to set up mist-nets for bats on Cookson WMA because of the presence of federally endangered species. Fortunately, the Southeastern Bat Working Group held a Bat BioBlitz in northeastern Oklahoma in August of 2013, and mist-netted bats at five locations on Cookson WMA. During the Bat BioBlitz, 239 bats of seven species were captured on the WMA as follows: 155 Eastern Red Bats (*Lasiurus borealis*) were captured at five locations; 45 Evening Bats (*Nycticeius humeralis*) were captured at five locations, 12 Northern Long-eared Bats (*Myotis septentrionalis*) were captured at five locations, 9 Big Brown Bats (*Eptesicus fuscus*) were captured at four locations, 9 Tri-colored Bats were captured at four locations, seven Gray Bats (*Myotis grisescens*) were captured at one location (on Dry Creek), and one Hoary Bat (*Lasiurus cinereus*) was captured at one location. The identities of the ten bats that we observed during our nocturnal amphibian calling surveys are uncertain, but the two most common species in this region are the Eastern Red Bat and the Evening Bat and we suspect that one or both of these species comprised those unidentified bats.

We used Sherman live-traps as our primary method for detecting rodents. We set Sherman live traps in lines at thirteen sites with a total trap effort of 380 trap nights. Trapping occurred on the surveys in June 2015, November 2015, July 2016 and November 2016. Trapping success was low in June and July, but high during both November surveys. Our overall trapping success was only 13.7%, but 39 out of 52 rodents were trapped in the November attemps compared to 13 rodents trapped in the June and July attemps. We trapped 52 rodents of five species: 17 White-footed Mice (Peromyscus leucopus), five Fulvous Harvest Mice (*Reithrodontomys fulvescens*), 23 Hispid Cotton Rats (Sigmodon hispidus), five Eastern Woodrats (*Neotoma floridana*), and two Woodland Voles (*Microtus pinetorum*). Based upon existing museum records from the Oklahoma portion of the Ozark Highlands, it appears that only two other rodent species are likely to occur on the area – Texas Brush Mouse (*Peromyscus attwateri*) and North American Deer Mouse (*Peromyscus maniculatus*). The Texas Brush Mouse is often found in rocky forested or brushy habitats, so it should be present on Cookson WMA. The North American Deer Mouse is most often associated with grasslands so it is unlikely to occur on the area in substantial numbers.

Colby Farquhar and Curt Allen reported observations of Southern Flying Squirrel (*Glaucomys volans*), Elliot's Short-tailed Shrew (*Blarina hylophaga*), Gray Fox (*Urocyon cinereoargenteus*) and American Black Bear (*Ursus americanus*) on Cookson WMA to confirm the presence of these species. In addition to the native mammals that we observed/documented, we saw at least 16 Feral Hogs (*Sus scrofa*) and numerous signs of wallowing and foraging pigs.

Table 4. Summary of Mammals Detected on Cookson WMA

Common Name	**Diurnal Timed Searches**	**Nocturnal Timed Searches**	**Live Traps**
Virginia Opossum	Multiple Track Lines		
Eastern Mole	Multiple Tunnels		
Tri-colored Bat	1		
Ozark Big-eared Bat	2		
unidentified bat		10	
Nine-banded Armadillo	1	2	
Eastern Cottontail	10	3	
Fox Squirrel	12		
Gray Squirrel	27		
Eastern Chipmunk	11		

White-footed Mouse	1		17
Fulvous Harvest Mouse			5
Hispid Cotton Rat	1		23
Eastern Woodrat			5
Woodland Vole	1		2
Coyote	1 (plus tracks)	5	
Raccoon	Multiple Track Lines		
Striped Skunk	Multiple Track Lines	3	
Bobcat	One Track Line		
White-tailed Deer	15	10	
American Elk	33	21	

Birds

Birds are the largest group of vertebrates in Oklahoma and they represented nearly 70% of the vertebrate species that we documented. The results below are divided into two sections: Wintering Season (based primarily upon data from two surveys in February 2015 and February 2016) and Breeding Season (based primarily upon data collected during two series of point counts conducted in June 2015 and late May 2016). Incidental bird observations were recorded during all other surveys and we examined these observations during the November, March, and April surveys, when the annual fall and spring migrations were occurring, to assess the presence of migrants between seasons. Most most of the birds that were observed during the migration months were year-round residents, lingering winter residents or early-arriving breeding species. All but four of the avian species that were observed during the fall and spring months were recorded during the winter and/or summer months as well. The only species that were detected only during the migration seasons were five species that we considered to be seasonal migrants – two Blue-headed Vireos (*Vireo solitarius*), three Swainson's Thrushes (*Catharus ustulatus*), a Nashville Warbler (*Oreothlypis ruficapilla*), three Orange-crowned Warblers (*Oreothlypis celata*) and two Yellow Warblers (*Setophaga petechia*).

Cumulatively (2015 and 2016 surveys combined), 97 species of birds were detected on the management area during our surveys. These included the five migrants listed above, 61 species that occurred on the area during the breeding season (including year-round residents) and 31 species that were present on the area only during the winter months. Seven of the species that we considered to be winter residents on the WMA - Bald Eagle (*Haliaeetus leucocephalus*), American Kestrel (*Falco sparverius*), Northern Flicker (*Colaptes auratus*), Brown Thrasher (*Toxostoma rufum*), Eastern Meadowlark (*Sturnella magna*), Red-winged Blackbird (*Agelaius phoeniceus*), and House Finch (*Carpodacus mexicanus*) - are known to nest elsewhere in northeastern Oklahoma; however, we did not find any evidence to indicate that they occurred on the WMA during their breeding seasons. The breeding-season birds that we documented included 55 species detected at one or more point-count stops, plus six other species observed incidentally during the summer months.

Wintering Bird Community

The wintering bird community on Cookson WMA was measured through a series of timed searches that were conducted by teams of three or four observers each on 2, 3 and 4 February 2016. During these surveys, the teams walked prescribed areas and drove WMA interior roads recording every bird that they could identify by sight and/or sound. Forty-eight species of wintering birds were recorded during this survey; please see Table 4 for the complete list including citations to scientific names). An additional six species of wintering birds were observed incidentally during the November 2015 survey and are listed as a supplement to the official winter bird survey below Table 5. For comparison, the

results of the 2015 winter bird survey (39 species) also are shown in Table 4. The 2016 winter bird survey includes an unidentified shorebird (probably a Wilson's Snipe (*Gallinago gallinago*)) that was flushed from a grassy field on Pipe Springs Road while searching for LeConte's Sparrows. We are confident that this was a shorebird, but the speed of the bird and the lighting prevented a positive identification. By far the most abundantly encountered species in 2016 were the White-throated Sparrow (809) and the Dark-eyed Junco (446) - both of which were encountered in flocks foraging in the herbaceous vegetation along the WMA's roads. Other common species were the Song Sparrow, Northern Cardinal, Tufted Titmouse, Carolina Chickadee, Carolina Wren, Fox Sparrow, Red-bellied Woodpecker and White-breasted Nuthatch. Noteworthy observations, because of their rarity and/or secretive behavior, were five Winter Wrens, five Hermit Thrushes, a single Brown Thrasher and five Swamp Sparrows. For the second year in a row, we observed an unexpected flock of American Pipits foraging in the grassy fields near the WMA entrance. Also for the second year in a row we observed an unexpected Golden Eagle, which was confirmed with a photograph. Five avian Species of Greatest Conservation Need were documented: Golden Eagle (a single individual observed at close-range soaring over the WMA), Bald Eagle (two individual birds observed soaring over the WMA), American Woodcock (four birds flushed from a wet glade during the November survey), Red-headed Woodpecker (27 birds found in woodland habitats and forest edges at multiple locations throughout the WMA), and LeConte's Sparrow (two birds flushed from dense grass in a field along Pipe Springs Road).

Comparing the results of 2015 and 2016, the relative abundances for most of the wintering birds were similar between years. Slightly more species were observed in 2016 and this was probably the result of increased search time. We had a sufficient number of observers in 2016 that we were able to split into three teams on February 3rd and search the area more thoroughly. The most striking differences between the two years were in the numbers of Red-headed Woodpeckers, Yellow-bellied Sapsuckers, and American Robins. Each of these birds is considered to be somewhat eruptive, meaning that their winter distributions change from year to year in response to changes in food availability or weather conditions. In the case of the Red-headed Woodpeckers, birds often winter in areas with high abundances of acorns and that was likely to be the case in 2016. American Robins often shift their distribution to track fruiting trees such as Eastern Redcedar; the reduced number of robins in 2016 suggests a regionally reduced fruit crop. Purple Finches also are an eruptive species and we saw a modest increase in 2016 that may reflect an abundant seed crop by the ashes, Boxelders, and/or River Birches.

Table 5. Summary of Winter Bird Community on Cookson WMA (Based on 27.5 Hours of Timed Searches in 2016 and 22.5 Hours in 2014/2015.)

Common Name	**# Seen/Heard February 2016 (27.5 hours)**	**# Seen/Heard Dec. 2014 & Feb. 2015 (22.5 hours)**
Wild Turkey (*Meleagris gallopavo*)	3	0
Turkey Vulture (*Cathartes aura*)	17	15
Black Vulture (*Coragyps atratus*)	5	0
Sharp-shinned Hawk (*Accipiter striatus*)	1	1
Cooper's Hawk (*Accipiter cooperii*)	0	1
Red-shouldered Hawk (*Buteo lineatus*)	3	2
Red-tailed Hawk (*Buteo jamaicensis*)	9	5
Golden Eagle (*Aquila chrysaetos*)	1	1
Bald Eagle (*Haliaeetus leucocephalus*)	2	6
unid. Shorebird	1	0
Mourning Dove (*Zenaida macroura*)	0	1
Barred Owl (*Strix varia*)	1	0
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	27	3

Red-bellied Woodpecker (*Melanerpes carolinus*)	25	29
Yellow-bellied Sapsucker (*Sphyrapicus varius*)	23	8
Downy Woodpecker (*Picoides pubescens*)	19	25
Northern Flicker (*Colaptes auratus*)	31	14
Pileated Woodpecker (*Dryocopus pileatus*)	5	7
Eastern Phoebe (*Sayornis phoebe*)	3	1
American Crow (*Corvus brachyrhynchos*)	21	15
Blue Jay (*Cyanocitta cristata*)	17	13
Carolina Chickadee (*Poecile carolinensis*)	37	44
Tufted Titmouse (*Baeolophus bicolor*)	51	57
White-breasted Nuthatch (*Sitta carolinensis*)	21	23
Brown Creeper (*Certhia americana*)	1	3
Carolina Wren (*Thryothorus ludovicianus*)	37	43
Winter Wren (*Troglodytes troglodytes*)	5	1
Brown Thrasher (*Toxostoma rufum*)	1	0
Ruby-crowned Kinglet (*Regulus calendula*)	8	0
Golden-crowned Kinglet (*Regulus satrapa*)	8	6
Eastern Bluebird (*Sialia sialis*)	10	26
American Robin (*Turdus migratorius*)	14	93
Hermit Thrush (*Catharus guttatus*)	5	2
American Pipit (*Anthus rubescens*)	24	14
Yellow-rumped Warbler (*Setophaga coronata*)	0	1
Northern Cardinal (*Cardinalis cardinalis*)	59	68
LeConte's Sparrow (*Ammodramus leconteii*)	2	0
Dark-eyed Junco (*Junco hyemalis*)	446	297
Field Sparrow (*Spizella pusilla*)	16	4
Chipping Sparrow (*Spizella passerina*)	2	20
Savannah Sparrow (*Passerculus sandwichensis*)	4	0
Fox Sparrow (*Passerella iliaca*)	27	12
Song Sparrow (*Melospiza melodia*)	61	39
Lincoln's Sparrow (*Melospiza lincolnii*)	4	1
Swamp Sparrow (*Melospiza georgiana*)	5	0
White-crowned Sparrow (*Zonotrichia leucophrys*)	3	0
White-throated Sparrow (*Zonotrichia albicollis*)	809	226
Eastern Meadowlark (*Sturnella magna*)	13	0
Red-winged Blackbird (*Agelaius phoeniceus*)	4	0
Purple Finch (*Carpodacus purpureus*)	13	3
American Goldfinch (*Carduelis tristis*)	4	16
Pine Siskin (*Carduelis pinus*)	0	3

In addition to the birds that were recorded during the two winter bird surveys in February 2015 and February 2016, we observed six species of birds during our November 2015 survey that were likely to be wintering species on the WMA. These were:

American Woodcock (*Scolopax minor*) - four flushed from a wet glade
American Kestrel (*Falco sparverius*) – two observed in fields
Cedar Waxwings (*Bombycilla cedrorum*) - three flocks totaling 57 birds feeding on redcedar, persimmon and greenbriar fruits
Eastern Towhee ((*Pipilo erythrophthalmus*) - one flushed from a thicket on Beaver Mt.
Rusty Blackbird (*Euphagus carolinus*) - flock of 11 seen near headquarters
House Finch (*Carpodacus mexicanus*) - one seen and heard around the headquarters

Breeding Bird Community

We used road-based, five-minute point counts as our primary tool for assessing the relative abundance and composition of the Cookson WMA breeding bird community. We identified and recorded every bird that was seen or heard during a five-minute period at 43 locations on May 25 and 26, 2016. The point count locations were placed along WMA roads and were spaced at intervals of 0.4 miles to maximize the number of stops that could be made while minimizing the potential for double-recording birds. We conducted the point counts between 6:10 am (approximately 25 minutes after first light) and 10:45 am. Because we did not begin the point counts until shortly after sunrise, therefore, we did not detect any nocturnal birds such as Chuck-wills-widows, which appear to be common in forested habitats on the WMA based upon the numbers that we heard during our evening amphibian surveys. We ended our surveys between 10:30 am and 10:45 am because of declining bird activity as the ambient temperature increased. We attempted to sample the different habitat types on the area in proportion to their abundance; however, riparian habitats were slightly under-sampled because Bolin Hollow Road was the only road that passed near this habitat type and woodland/glade habitat was under-sampled because they occurred at only a few locations adjacent to roads.

The habitat surrounding most of the survey stops was deciduous forest with varying degrees of canopy cover, understory vegetation density and dominant tree species composition. The breeding bird community reflects this habitat condition in that nearly all of the bird species are typical for deciduous forests. Eleven species of warblers, three species of vireos, both tanagers and all of the forest flycatchers in northeastern Oklahoma were detected during the survey. In contrast, no grassland birds were detected and only a few savannah/shrubland species were seen or heard (e.g. Yellow-breasted Chat, Orchard Oriole, American Goldfinch, Blue Grosbeak, and Field Sparrow). The combined results of the 2016 breeding bird point counts are shown in Table 6. To provide a comparison, the results of the point counts that were conducted in 2015 are shown in this table as well. Differences between the results of the two years are not meant to imply any annual variation in population size of any species. The point count locations between the two years were different, and there was a difference in the number of counts. In 2015, we were able to complete 53 point counts in two mornings; however, in 2016 we were able to conduct only 43 because of a rainfall event during the first morning (we did not conduct point counts in the rain) and because recent heavy rains had rendered some roads on the area temporarily inaccessible. Through the point counts, we identified 51 species in 2016 and 48 species in 2015 that are likely to nest on the area (Table 5). Additionally, we incidentally encountered four other species in 2016 and five species in 2015 that are likely to nest on the WMA in small numbers. These incidental encounters occurred along WMA roads between breeding bird point count stops or during timed searches for amphibians and reptiles around ponds and in riparian areas.

We believe that point counts are a very effective technique for measuring the occurrence and relative abundances of most songbirds, but they are less effective for detecting rare species. The relative abundances and habitat associations for the common species on the WMA were very similar between 2016 and 2015. The only notable differences between years were in the detections of a few relatively rare species that were recorded in only one year (e.g. American Redstart, Pine Warbler, Eastern Towhee, and Orchard Oriole), but the point count results were consistent with the conclusion that these species have a low relative abundance. Point counts work well for songbirds and other species that sing or call to make themselves or the boundaries of their nesting territories known, but they tend to underestimate the relative abundances of non-singing birds (e.g. Wild Turkeys and most raptors appear to be less common than they actually are). Combining the results of both years, we documented 61 bird species during the summer nesting season. It is likely that a few other species nest on Cookson WMA but were missed on our surveys due to their rarity or secretiveness including Eastern Screech-Owl (*Otus asio*), Great Horned Owl (*Bubo virginianus*), Whip-poor-will (*Antrostomus vociferus*) , Wood Thrush (*Hylocichla mustelina*), Prairie Warbler (*Setophaga discolor*), and Prothonotary Warbler (*Protonotaria citrea*).

Of the 61 species that were documented in the breeding bird community, four are considered to be species of greatest conservation need in Oklahoma: Red-headed Woodpecker, Worm-eating Warbler, Louisiana Waterthrush, and Kentucky Warbler. The Red-headed Woodpecker is an uncommon nesting species, although it is a common wintering species in some years. During the summer months we found this species only in open, oak-dominated woodlands around glades and on the ridge of Beaver Mountain where the combination of drought, hypoxylon canker (a fungal disease of oaks) and fire had reduced canopy cover and created open conditions with standing dead trees. Small numbers of Worm-eating Warblers were found in mesic forest sites where there were tall, mature deciduous trees with an understory of dogwoods, viburnums and hydrangeas. Louisiana Waterthrushes were found along all of the streams on the WMA including Dry Creek, Elm Creek, and the streams flowing from Frank Lee Spring and Hastings Hollow Spring. The Kentucky Warbler was the most common of the avian SGCN on the area, and we found it at 13 of the 43 point-count locations in 2016. Kentucky Warblers were most often found in mature, deciduous forest stands that had an abundance of understory shrubs, such as occur in ravines, hollows, and the lower slopes of hills.

The most commonly detected breeding birds were the Red-eyed Vireo, Indigo Bunting, Tufted Titmouse, Carolina Wren, and Summer Tanager each of which was detected at 70% or more of the point-count stops. Each of these species is a forest generalist and occurred in comparable numbers in stands of upland deciduous forest, riparian forest, mesic forest, and mixed oak/pine forest. Other forest generalists included Yellow-billed Cuckoo, Red-bellied Woodpecker, Eastern Wood Pewee, Great Crested Flycatcher, Carolina Chickadee, White-breasted Nuthatch, Blue-gray Gnatcatcher, Black and White Warbler, Scarlet Tanager, and Northern Cardinal. No species was restricted to the upland oak/hickory forest habitat type, although this is the habitat in which the Eastern Wood Pewee and the Summer Tanager were encountered most frequently. Species associated with clearings, glades, and open woodlands were Mourning Dove, Red-headed Woodpecker, Scissor-tailed Flycatcher, Eastern Bluebird, Yellow-breasted Chat, Blue Grosbeak, Chipping Sparrow, Field Sparrow, and Orchard Oriole. These species were generally uncommon on the WMA because the acreage of their preferred habitats is limited. Only two Pine Warblers were heard on the point counts and, not surprisingly, both of these were heard in mixed stands of Shortleaf Pine and oaks on ridge tops. Low-elevation riparian/mesic forest stands within valleys, hollows, and the lower slopes of hills supported the majority of the Acadian Flycatchers, White-eyed Vireos, Yellow-throated Vireos, Northern Parulas, Yellow-throated Warblers, Worm-eating Warblers, Louisiana Waterthrushes, and Kentucky Warblers. We detected three Ovenbirds and a single American Redstart; each of these birds was heard in mature mesic forest in Bolin Hollow.

Table 6. **Summary of 5-minute Point Counts for Assessing Breeding Birds on Cookson WMA. (Point counts were conducted at 43 locations in 2016 and at 53 locations in 2015.)**

Common Name	**Number of Birds Detected in 2016**	**Number of Birds Detected 2015**
Wild Turkey (*Meleagris gallopavo*)	1	0
Turkey Vulture (*Cathartes aura*)	6	9
Black Vulture (*Coragyps atratus*)	1	0
Cooper's Hawk (*Accipiter cooperii*)	0	1
Broad-winged Hawk (*Buteo platypterus*)	1	4
Red-shouldered Hawk (*Buteo lineatus*)	1	1
Red-tailed Hawk (*Buteo jamaicensis*)	1	1
Mourning Dove (*Zenaida macroura*)	8	6
Yellow-billed Cuckoo (*Coccyzus americanus*)	11	18
Barred Owl (*Strix varia*)	0	1
Chimney Swift (*Chaetura pelagica*)	3	7

Ruby-throated Hummingbird (*Archiochus colubris*)	3	1
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	2	0
Red-bellied Woodpecker (*Melanerpes carolinus*)	19	25
Hairy Woodpecker (*Picoides villosus*)	1	0
Downy Woodpecker (*Picoides pubescens*)	5	6
Pileated Woodpecker (*Dryocopus pileatus*)	3	4
Eastern Wood Pewee (*Contopus virens*)	36	28
Acadian Flycatcher (*Empidonax virescens*)	12	9
Great Crested Flycatcher (*Myiarchus crinitus*)	23	9
Scissor-tailed Flycatcher (*Tyrannus forficatus*)	1	1
White-eyed Vireo (*Vireo griseus*)	13	14
Red-eyed Vireo (*Vireo olivaceus*)	72	105
Yellow-throated Vireo (*Vireo flavifrons*)	2	2
American Crow (*Corvus brachyrhynchos*)	6	12
Fish Crow (*Corvus ossifragus*)	0	1
Blue Jay (*Cyanocitta cristata*)	7	5
Carolina Chickadee (*Poecile carolinensis*)	9	12
Tufted Titmouse (*Baeolophus bicolor*)	43	84
White-breasted Nuthatch (*Sitta carolinensis*)	14	14
Carolina Wren (*Thryothorus ludovicianus*)	47	60
Blue-gray Gnatcatcher (*Polioptila caerulea*)	36	30
Eastern Bluebird (*Sialia sialis*)	1	3
Northern Parula (*Setophaga americana*)	25	20
Black and White Warbler (*Mniotilta varia*)	13	3
Yellow-throated Warbler (*Setophaga dominica*)	5	6
Pine Warbler (*Setophaga pinus*)	2	0
American Redstart (*Setophaga ruticilla*)	1	0
Worm-eating Warbler (*Helmitheros vermivora*)	3	3
Louisiana Waterthrush (*Parkesia motacilla*)	4	2
Ovenbird (*Seiurus aurocapillus*)	1	2
Kentucky Warbler (*Geothlypis formosa*)	16	16
Common Yellowthroat (*Geothlypis trichas*)	1	1
Yellow-breasted Chat (*Icteria virens*)	6	8
Scarlet Tanager (*Piranga olivacea*)	11	15
Summer Tanager (*Piranga rubra*)	41	54
Northern Cardinal (*Cardinalis cardinalis*)	26	25
Blue Grosbeak (*Guiraca caerulea*)	6	8
Indigo Bunting (*Passerina cyanea*)	67	95
Eastern Towhee (*Pipilo erythrophthalmus*)	0	1
Chipping Sparrow (*Spizella passerina*)	5	2
Field Sparrow (*Spizella pusilla*)	1	1
Brown-headed Cowbird (*Molothrus ater*)	4	11
Orchard Oriole (*Icterus spurius*)	1	0
American Goldfinch (*Carduelis tristis*)	9	9

Seen Incidentally in 2016

Great Blue Heron (*Ardea herodias*)	2 seen incidentally & small rookery
Wood Duck (*Aix sponsa*)	2 seen incidentally
Chuck-will's Widow (*Antrostomus carolinensis*)	4 heard incidentally
Eastern Phoebe (*Sayornis phoebe*)	2 seen incidentally

American Robin (*Turdus migratorius*)	2 seen incidentally at headquarters
House Sparrow (*Passer domesticus*)	4 seen incidentally at headquarters

Seen Incidentally in 2015

Black Vulture (*Coragyps atratus*)	2 seen incidentally
Chuck-wills-widow (*Antrostomus carolinensis*)	3 heard incidentally
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	1 seen incidentally
Eastern Phoebe (*Sayornis phoebe*)	1 seen incidentally on Dry Creek
Pine Warbler (*Setophaga pinus*)	1 heard incidentally

Invertebrates

We did not place an emphasis on invertebrate surveys at Cookson WMA; however, we maintained an incidental list for the butterfly species that were encountered during our vertebrate surveys. Thirty species were observed on the area and these are listed in Table 7. While the diversity of butterflies is high, none of the species that we documented are species of greatest conservation need. We documented several roadside skippers but could not confirm that any of them were Linda's Roadside Skipper (*Amblyscirtes linda*).

Colby Farquhar identified many of the dragonflies and damselflies that we encountered during our timed searches and a partial list is included below in Table 7. During the July survey, we were joined by Brenda Smith, who is the state's leading expert on Odonates. She and Colby documented several dragonfly species including nine individuals of the Ozark Emerald (*Somatochlora ozarkensis*), which is a species of greatest conservation need and was recently petitioned for consideration for a federal listing under the Endangered Species Act. They witnessed six males and three females displaying, foraging, and ovipositing in the spring in Hastings Hollow on the south side of the WMA. They collected two voucher specimens, which were the first confirmed records of Ozark Emeralds in Cherokee County and in the Oklahoma portion of the Ozarks.

We placed minnow traps in Dry Creek and several ponds to document the crayfish species on the area and these are included in Table 7 as well. In the WMA streams, the Ringed Crayfish (*Orconectes neglectus*) appears to be the dominant crayfish species, but we found small numbers of the Western Plains Crayfish (*Orconectes causeyi*) as well. In the ponds that we searched, the Western Plains Crayfish appears to be the dominant species and was the only species that we documented.

Table 7. **Butterfly, Odonate and Crayfish Species Observed Incidentally on Cookson WMA**

Common Name / (Scientific Name)

Lepidoptera

Pipevine Swallowtail (*Battus philenor*)
Giant Swallowtail (*Papilio cresphontes*)
Eastern Tiger Swallowtail (*Papilio glaucus*)
Spicebush Swallowtail (*Papilio troilus*)
Checkered White (*Pontia protodice*)
Falcate Orangetip (*Anthocharis midea*)
Giant Cloudless Sulphur (*Phoebis sennae*)
Common Sulphur (*Colias philodice*)
Orange Sulphur (*Colias eurytheme*)
Southern Dogface (*Colias cesonia*)
Little Yellow (*Eurema lisa*)
Dainty Sulphur (*Nathalis iole*)
Banded Hairstreak (*Satryium calanus*)
Henry's Elfin (*Callophrys henrici*)
Red-banded Hairstreak (*Calycopis cecrops*)
Eastern Tailed Blue (*Everes comyntas*)
Reakirt's Blue (*Hemiargus isola*)
Spring Azure (*Celastrina neglecta*)
Summer Azure (*Celastrina ladon*)
American Snout (*Libytheana carinenta*)
Variegated Fritillary (*Euptoieta claudia*)
Great Spangled Fritillary (*Speyeria cybele*)
Pearl Crescent (*Phyciodes tharos*)
Silvery Checkerspot (*Chlosyne nycteis*)

Goatweed Leafwing (*Anaea andria*)
Mourning Cloak (*Nymphalis antiopa*)
Question Mark (*Polygonia interrogationis*)
American Painted Lady (*Vanessa virginiensis*)
Red Admiral (*Vanessa atalanta*)
Common Buckeye (*Junonia coenia*)
Red Spotted Purple (*Limenitis arthemis*)
Hackberry Emperor (*Asterocampa celtis*)
Northern Pearly-eye (*Enodia anthedon*)
Gemmed Satyr (*Cyllopsis gemma*)
Carolina Satyr (*Hermeuptychia sosybius*)
Little Wood Satyr (*Megisto cymela*)
Silver-spotted Skipper (*Epargyreus ciarus*)
Hoary Edge (*Achalarus lyciades*)
Southern Cloudywing(*Thorybes bathyllus*)
Scalloped Sootywing (*Staphylus hayhurstii*)
Sleepy Duskywing (*Erynnis brizo*)
Juvenal's Duskywing (*Erynnis juvenalis*)
Funreal Duskywing (*Erynnis funeralis*)
Horace's Duskywing (*Erynnis horatius*)
Wild Indigo Duskywing (*Erynnis baptisiae*)
Comm. Checkered Skipper (*Pyrgus communis*)
S. Broken-dash Skipper (*Wallengrenia otho*)
Sachem Skipper (*Atalopedes campestris*)
Delaware Skipper (*Anatrytone logan*)
Dun Skipper (*Euphyes vestris*)
Roadside Skipper species (*Amblyscirtes* sp.)

Odonata

Ebony Jewelwing (*Calopteryx maculata*)
American Rubyspot (*Hetaerina americana*)
Southern Spreadwing Damselfly (*Lestes australis*)
Azure Bluet (*Enallagma aspersum*)
Fragile Forktail (*Ischnura posita*)
Dusky Dancer (*Argia translata*)
Green Darner (*Anax junius*)
Comet Darner (*Anax longipes*)
Interior Least Clubtail (*Stylogomphus sigmastylus*)
Stillwater Clubtail (*Arigomphus lentulus*)
Ozark Emerald (*Somatochlora ozarkensis*)
Slender Baskettail (*Epitheca costalis*)
Common Whitetail (*Plathemis subornata*)
Slaty Skimmer (*Libellula incesta*)
Widow Skimmer (*Libellula luctuosa*)
Blue-faced Meadowhawk (*Sympetrum ambiguum*)
Blue Dasher (*Pachydiplax longipennis*)
Carolina Saddlebags (*Tramea carolina*)

Cambaridae

Western Plains Crayfish (*Orconectes causeyi*)
Ringed Crayfish (*Orconectes neglectus*)

Plants

To the best of our ability, we tried to document the plant species on Cookson Wildlife Management Area. The list shown in Table 8 does not represent an exhaustive survey effort, but instead it provides an indication of the more common plants on the area.

Table 8. Plant Species, Arranged by Family, Documented on Cookson WMA.

Herbaceous Plants

Aspleniaceae

Ebony Spleenwort (*Asplenium platyneuron*)
Maidenhair Spleenwort (*Asplenium trichomanes*)
Walking Fern (*Asplenium rhizophyllum*)
Northern Maidenhair Fern (*Adiantum pedatum*)
Purple Cliffbrake Fern (*Pellaea atropurpurea*)
Christmas Fern (*Polystichum acrostichoides*)
Bluntlobe Cliff Fern (*Woodsia obtusa*)

Dennstaedtiaceae

Western Bracken Fern (*Pteridium aquilinum*)

Equisetaceae

Field Horsetail (*Equisetum hyemale*)

Amaryllidaceae

Yellow Star Grass (*Hypoxis hirsuta*)

Agavaceae

False Aloe (*Manfreda virginica*)
Soapweed Yucca (*Yucca glauca*)

Araceae

Green Dragon (*Arisaema dracontium*)
Jack-in-the-Pulpit (*Arisaema triphyllum*)

Commelinaceae

Slender Day-Flower (*Commelina erecta*)
Woodland Spiderwort (*Tradescantia ernestiana*)
Ohio Spiderwort (*Tradescantia ohiensis*)
Iridaceae
Blue-eyed Grass (*Sisyrinchium* sp)
Liliaceae
Wild Onion (*Allium canadense*)
Pink Prairie Onion (*Allium stellatum*)
Eastern Wild Hyacinth (*Camassia scilloides*)
White Dogstooth Lilly (*Erythronium albidum*)
Yellow Trout Lilly (*Erythronium rostratum*)
False Garlic (*Nothoscordum bivalve*)
Solomon's Seal (*Polygonatum biflorum*)
Saw Greenbriar (*Smilax bona-nox*)
Tapertip Wake Robin (*Trillium viridescens*)
Death Camas (*Zigadenus nuttallii*)
Poaceae
Big Bluestem (*Andropogon gerardii*)
Broomsedge Bluestem (*Andropogon virginicus*)
Broadleaf Woodoats (*Chasmanthium latifolium*)
Poverty Oatgrass (*Dianthonia spicata*)
Scribner's Panicgrass (*Dichanthelium oligosanthes*)
Switchgrass (*Panicum virgatum*)
Thin Paspalum (*Paspalum setaceum*)
Little Bluestem (*Schizachyrium scoparium*)
Indian Grass (*Sorghastrum nutans*)
Purpletop Tridens (*Tridens flavus*)
Acanthaceae
American Water-willow (*Justica americana*)
Smooth Wild Petunia (*Ruellia humilis*)
Limestone Wild Petunia (*Ruellia strepens*)
Apiaceae
Hairy Angelica (*Angelica venenosa*)
Hairyfruit Chervil (*Chaerophyllum taintureri*)
Queen Anne's Lace (*Daucus carota*)
Harbinger of Spring (*Erigenia bulbosa*)
Rattlesnake Master (*Eryngium yuccifolium*)
Lace Bishopwed (*Ptilimnium nuttallii*)
Yellow Pimpernel (*Taenidia integerrima*)
Hedge Parsley (*Torilis arvensis*)
Golden Alexanders (*Zizia aurea*)
Aristolochiaceae
Woolly Pipevine (*Aristolochia tomentosa*)
Apocynaceae
Eastern Bluestar (*Amsonia taernaemontana*)
Prairie Dogbane (*Apocynum cannabinum*)
Asclepiadaceae
Four-leaf Milkweed (*Asclepias quadrifolia*)
Butterfly Milkweed (*Asclepias tuberosa*)
Whorled Milkweed (*Asclepias verticillata*)
Green Milkweed (*Asclepias viridis*)
Climbing Milkvine (*Matelea baldwyniana*)
Asteraceae
Yarrow (*Achillea millefolium*)
Common Ragweed (*Ambrosia artemesifolia*)
Giant Ragweed (*Ambrosia trifida*)
Parlin's Pussytoes (*Antennaria parlini*)
Plantainleaf Pussytoes (*Antennaria plantaginifolia*)
Western Daisy (*Astranthium integrifolium*)
Coreopsis Beggarticks (*Bidens aristosa*)
Prairie Plantain (*Cacalia plantaginea*)
Least Daisy (*Chaetopappa asteroides*)
Tall Thistle (*Cirsium altissimum*)
Bull Thistle (*Cirsium vulgare*)
Blue Mist Flower (*Conoclinium coelestinum*)
Mare's Tail (*Conyza canadensis*)
Finger Coreopsis (*Coreopsis palmate*)
Plains Coreopsis (*Coreopsis tinctorium*)
Tall Coreopsis (*Coreopsis triptera*)
Clasping Coneflower (*Dracopis amplexicaulis*)
Pale Coneflower (*Echinacea pallida*)
Purple Coneflower (*Echinacea pupurea*)?
Elephant's Foot (*Elephantopus carolinianus*)
American Burnweed (*Erechtites hieraciifolia*)
Annual Daisy Fleabane (*Erigeron annuus*)
Robin's Fleabane (*Erigeron pulchellus*)
Daisy Fleabane (*Erigeron strigosus*)
Late Thoroughwort (*Eupatorium serotinum*)
Spinytooth Gumweed (*Grindelia lanceolata*)
Bitter Sneezeweed (*Helenium amarum*)
Sawtooth Sunflower (*Helianthus grosseserratus*)
Rough Sunflower (*Helianthus hirsutus*)
Stiff Sunflower (*Helianthus pauciflorus*)?
Jerusalem Artichoke (*Helianthus tuberosus*)
Ox-eye False Sunflower (*Heliopsis helianthoides*)
Hawkweed species (*Hieracium* sp.)
Woolly-White (*Hymenopappus scabiosaeus*)
Wild Lettuce (*Lactuca canadensis*)
Woodland Lettuce (*Lactuca floridana*)
Oxeye Daisy (*Leucanthemum vulgare*)
Roundleaf Ragwort (*Packera obovata*)
White-flower Leafcup (*Polymnia canadensis*)
False Dandelion (*Pyrrhopappus carolinianus*)
Grayhead Coneflower (*Ratibida pinnata*)
Black-eyed Susan (*Rudbeckia hirta*)
Brown-eyed Susan (*Rudbeckia triloba*)
Cup Rosinweed (*Silphium perfoliatum*)
Downy Goldenrod (*Solidago petiolaris*)

Elmleaf Goldenrod (*Solidago ulmifolia*)
Late Purple Aster (*Symphyotrichum patens*)
Stiff Greenthread (*Thelesperma filifolium*)
Goatsbeard (*Tragopogon pratensis*)
Yellow Ironweed (*Verbisina alternifolia*)
Frostweed (*Verbisina virginica*)
Baldwin Ironweed (*Vernonia baldwinii*)

Berberidaceae

Mayapple (*Podophyllum peltatum*)

Boraginaceae

Beggars Lice (*Hackelia virginiana*)
Softhair Marbleseed (*Onosmodium molle*)

Brassicaceae

Smooth Rock Cress (*Arabis laevigata*)
Spring Bittercress (*Cardamine bulbosa*)
Cutleaf Toothwort (*Cardamine concatenata*)
Whitlow Draba (*Draba cuneifolia*)
Pepperweed species (*Lepidium* sp.)
Water Cress (*Rorippa nasturtium-aquaticum*)

Cactaceae

Prickly Pear Cactus (*Opuntia humifusa*)

Cabombaceae

Water Shield (*Brasenia schreberi*)

Campanulaceae

American Bellflower (*Campanula americana*)
Cardinal Flower (*Lobelia cardinalis*)
Pale Spike Lobelia (*Lobelia spicata*)
Clasping Venus Looking-glass (*Triodanis perfoliata*)

Capparaceae

Roughseed Clammyweed (*Polanisia dodecandra*)

Caryophyllaceae

Deptford Pink (*Dianthus armeria*)
Glade Sandwort (*Minurtia patula*)
Starry (Fringed) Catchfly (*Silene stellata*)
Fire Pink (*Silene virginica*)
Common Chickweed (*Stellaria media*)

Clusiaceae

St. Andrew's Cross (*Hypericum hypericoides*)
Shrubby St. Johnswort (*Hypericum prolificum*)
Spotted St. Johnswort (*Hypericum punctatum*)

Convolvulaceae

Wild Potato Vine (*Ipomoea pandurata*)

Crassulaceae

Pink Widow's Cross (*Sedum pulchellum*)

Fabaceae

Prairie Acacia (*Acaciella angustissima*)
Blue Wild Indigo (*Baptisia australis*)
Longbract Wild Indigo (*Baptisia bracteata*)
Partridge Pea (*Chamaecrista fasciulata*)
Butterfly Pea (*Clitoria mariana*)
Crown Vetch (*Coronilla varia*)
Illinois Bundleflower (*Desmanthus illinoensis*)
Tick Trefoil (*Desmodium* species)
Bush Clover (*Lespedeza* species)
Black Medic (*Medicago lupulina*)
Yellow Sweet Clover (*Melilotus officinalis*)
Nuttall's Sensitive Briar (*Mimosa nuttallii*)
Sampsons Snakeroot (*Orbexilum pedunculatum*)
Purple Prairie Clover (*Petalostemon purpureum*)
Slim-flowered Scurfpea (*Psoralidium tenuiflora*)
Broadleaf Snoutbean (*Rhynchosia latifolia*)
Wild Climbing Bean (*Strophostyles helvola*)
Goat's Rue (*Tephrosia virginiana*)
Red Clover (*Trifolium pratense*)
White Clover (*Trifolium repens*)
Carolina Wood Vetch (*Vicia caroliniana*)
Pygmyflower Vetch (*Vicia minutiflora*)
Smooth Vetch (*Vicia sativa*)

Fumariaceae

Pale Corydalis (*Corydalis flavula*)
Smallflower Fumewort (*Corydalis micrantha*)
Dutchman's Breeches (*Dicentra cucullaria*)

Gentianaceae

Squarestem Rose-Gentian (*Sabatia angularis*)
Prairie Rose-Gentian (*Sabatia campestris*)

Geraniaceae

Carolina Cranesbill (*Geranium carolinianum*)
Wild Geranium (*Geranium maculatum*)

Hydrophyllaceae

Hairy Phacelia (*Phacelia hirsuta*)

Lamiaceae

Giant Hyssop (*Agastache nepetoides*)
Common Dittany (*Cunila origanoides*)
Henbit (*Lamium amplexicaule*)
Purple Dead Nettle (*Lamium purpureum*)
Spotted Beebalm (*Monarda bradburiana*)
Wild Beebalm (*Monarda fistulosa*)
Beefsteak Plant (*Perilla frutescens*)
Self-Heal (*Prunella vulgaris*)
Narrowleaf Mountain Mint (*Pycnanthemum tenuifolium*)
Lyreleaf Sage (*Salvia lyrata*)
Eggleaf Skullcap (*Scutellaria ovata*)
Slenderleaf Betony (*Stachys tenuifolia*) ?
Woodland Germander (*Teucrium canadense*)

Lentibulariaceae

Humped Bladderwort (*Utricularia gibba*)

Lythraceae

Blue Waxweed (*Cuphea viscosissima*)

Malvaceae

Bush's Poppymallow (*Callirhoe bushii*)
Fringed Poppy Mallow (*Callirhoe digitata*)
Melastomataceae
Meadow Beauty (*Rhexia mariana*)
Menispermaceae
Carolina Coralbead (*Cocculus carolinus*)
Molluginaceae
Green Carpetweed (*Mollugo verticillata*)
Onagraceae
Tall Gaura (*Gaura longiflora*)
Bushy Water Primrose (*Ludwigia alternifolia*)
Cutleaf Evening Primrose (*Oenothera laciniata*)
Showy Evening Primrose (*Oenothera speciosa*)
Stemless Evening Primrose (*Oenothera triloba*)
Oxalidaceae
Yellow Wood Sorrel (*Oxalis stricta*)
Violet Wood Sorrel (*Oxalis violacea*)
Papaveraceae
Bloodroot (*Sanguinaria canadensis*)
Passifloraceae
Purple Passionflower (*Passiflora incarnata*)
Phytolaccaceae
Pokeweed (*Phytolacca americana*)
Plantaginaceae
Largebracted Plantain (*Plantago aristata*)
Rugel's Plantain (*Plantago rugelii*)
Dwarf Plantain (*Plantago virginica*)
Polemoniaceae
Woodland Phlox (*Phlox divaricata*)
Prairie Phlox (*Phlox pilosa*)
Jacob's Ladder (*Polemonium reptans*)
Polygonaceae
Pennsylvania Smartweed (*Polygonum pennsylvanicum*)
Water Smartweed (*Polygonum punctatum*)
Pale Dock (*Rumex altissimus*)
Portulacaceae
Virginia Spring Beauty (*Claytonia virginica*)
Primulaceae
Seaside Brookweed (*Samolus valerandi*)
Ranunculaceae
Carolina Anemone (*Anemone caroliniana*)
Rue Anemone (*Anemonella thalictroides*)
Wild Columbine (*Aquilegia canadensis*)
Pale Clematis (*Clematis versicolor*)
Carolina Larkspur (*Delphinium carolinianum*)
Dwarf Larkspur (*Delphinium tricorne*)
False Rue Anenome (*Enemion biternatum*)
Early Buttercup (*Ranunculus fascicularis*)
Buttercup (*Ranunculus* species)
Purple Meadow-rue (*Thalictrum dasycarpum*)
Rosaceae
White Avens (*Geum canadense*)
Indian Physic (*Porteranthus stipulatus*)
Common Cinquefoil (*Potentilla simplex*)
Rubiaceae
Bedstraw (*Galium* species)
Prairie Bluet (*Hedyotis nigricans*)
Longleaf Bluet (*Houstonia longifolia*)
Tiny Bluet (*Houstonia pusilla*)
Saururaceae
Lizard's Tail (*Saururus cernuus*)
Saxifragaceae
American Coralbell (*Heuchera americana*)
Scrophulariaceae
Clammy Hedgehyssop (*Gratiola neglecta*)
False Pimpernell (*Lindernia dubia*)
Canadian Toadflax (*Nuttallanthus canadensis*)
Canadian Lousewort (*Pedicularis canadensis*)
Smooth Penstemon (*Penstemon digitalis*)
White Wand Penstemon (*Penstemon tubiflorus*)
Moth Mullein (*Verbascum blattaria*)
Common Mullein (*Verbascum thapsus*)
Solanaceae
Carolina Nightshade (*Solanum carolinense*)
Silverleaf Nightshade (*Solanum elaeagnifolium*)
Urticaceae
Smallspike False Nettle (*Boehmeria cylindrica*)
Heartleaf Nettle (*Urtica chamaedryoides*)
Valerianaceae
Beaked Cornsalad (*Valerianella radiata*)
Verbenaceae
Rose Verbena (*Glandularia canadensis*)
Narrowleaf Vervain (*Verbena simplex*)
Hoary Vervain (*Verbena stricta*)
White Vervain (*Verbena urticifolia*)
Violaceae
Field Pansy (*Viola bicolor*)
Birdsfoot Violet (*Viola pedata*)
Missouri Blue Violet (*Viola sororia*)
Three-lobed Violet (*Viola triloba*)

Woody Plants:
Pinaceae
Shortleaf Pine (*Pinus echinata*)
Cupressaceae
Eastern Redcedar (*Juniperus virginiana*)
Aceraceae
Boxelder (*Acer negundo*)

Red Maple (*Acer rubrum*)
Sugar Maple (*Acer saccharum*)
Anacardiacea
Fragrant Sumac (*Rhus aromatica*)
Winged Sumac (*Rhus copallina*)
Poison Ivy (*Toxicodendron radicans*)
Aquifoliaceae
Deciduous Holly *(Ilex decidua*)
Betulaceae
River Birch (*Betula nigra*)
Hop Hornbeam (*Ostrya virginiana*)
Bignoniaceae
Trumpetvine (*Campsis radicans*)
Southern Catalpa (*Catalpa bignonioides*)
Caprifoliaceae
Coral Honeysuckle (*Lonicera flava*)
Elderberry (*Sambucus canadensis*)
Buckbrush (*Symphoricarpos occidentalis*)
Rusty Blackhaw (*Viburnum rufidulum*)
Celastraceae
Eastern Wahoo (*Euonymus atropurpurea*)
Cornaceaae
Roughleaf Dogwood (*Cornus drummondii*)
Flowering Dogwood (*Cornus florida*)
Silky Dogwood (*Cornus obliqua*)
Ebenaceae
Common Persimmon (*Diospyros virginiana*)
Ericaceae
Farkleberry (*Vaccinium arboreum*)
Blue Ridge Blueberry (*Vaccinium pallidum*)
Deerberry (*Vaccinium stamineum*)
Fabaceae
Swamp False Indigo (*Amorpha fruticosa*)
Redbud (*Cercis canadensis*)
Honey Locust (*Gleditsia triacanthos*)
Kentucky Coffeetree (*Gymnocladus dioicus*)
Fagaceae
Ozark Chinkapin (*Castanea pumila*)
White Oak (*Quercus alba*)
Bur Oak (*Quercus macrocarpa*)
Blackjack Oak (*Quercus marilandica*)
Chinkapin Oak (*Quercus muehlenbergii*)
Northern Red Oak (*Quercus rubra*)
Shumard Oak (*Quercus shumardii*)
Post Oak (*Quercus stellata*)
Black Oak (*Quercus velutina*)
Hydrangeaceae
Wild Hydrangea (*Hydrangea arborescens*)
Hoary Mock Orange (*Philadelphus pubescens*)
Juglandaceae
Mockernut Hickory (*Carya alba*)
Red Hickory (*Carya ovalis*)
Shagbark Hickory (*Carya ovata*)
Black Hickory (*Carya texana*)
Black Walnut (*Juglans nigra*)
Lauraceae
Northern Spicebush (*Lindera benzoin*)
Sassafras (*Sassafras albidum*)
Moraceae
Red Mulberry (*Morus rubra*)
Nyssaceae
Black Gum (*Nyssa sylvatica*)
Oleaceae
White Ash (*Fraxinus americana*)
Green Ash (*Fraxinus pennsylvanica*)
Platanaceae
Sycamore (*Platanus occidentalus*)
Rhamnaceae
Shrub New Jersey Tea (*Ceanothus americanus*)
Carolina Buckthorn (*Frangula caroliniana*)
Rosaceae
Downy Serviceberry (*Amelanchier arborea*)
Cockspur Hawthorn (*Crataegus crus-galli*)
Mexican Plum (*Prunus mexicana*)
Black Cherry (*Prunus serotina*)
Carolina Rose (*Rosa carolina*)
Southern Dewberry (*Rubus trivialis*)
Rubiaceae
Common Buttonbush (*Cephalanthus occidentalis*)
Salicaceae
Eastern Cottonwood (*Populus deltoides*)
Black Willow (*Salix nigra*)
Sapotaceae
Chittamwood (*Sideroxylon* (*Bumelia*) *lanuginosa*)
Simaroubaceae
Tree-of-Heaven (*Ailanthus altissima*)
Tiliaceae
American Basswood (*Tilia americana*)
Ulmaceae
Sugarberry (*Celtis laevigata*)
Winged Elm (*Ulmus alata*)
American Elm (*Ulmus americana*)
Verbenaceae
American Beautyberry (*Callicarpa americana*)
Vitaceae
Peppervine (*Ampelopsis arborea*)
Heartleaf Peppervine (*Ampelopsis cordata*)
Virginia Creeper (*Parthenocissus quinquefolia*)
Wild Grape (*Vitis* sp.)

CROSS TIMBERS WILDLIFE MANAGEMENT AREA

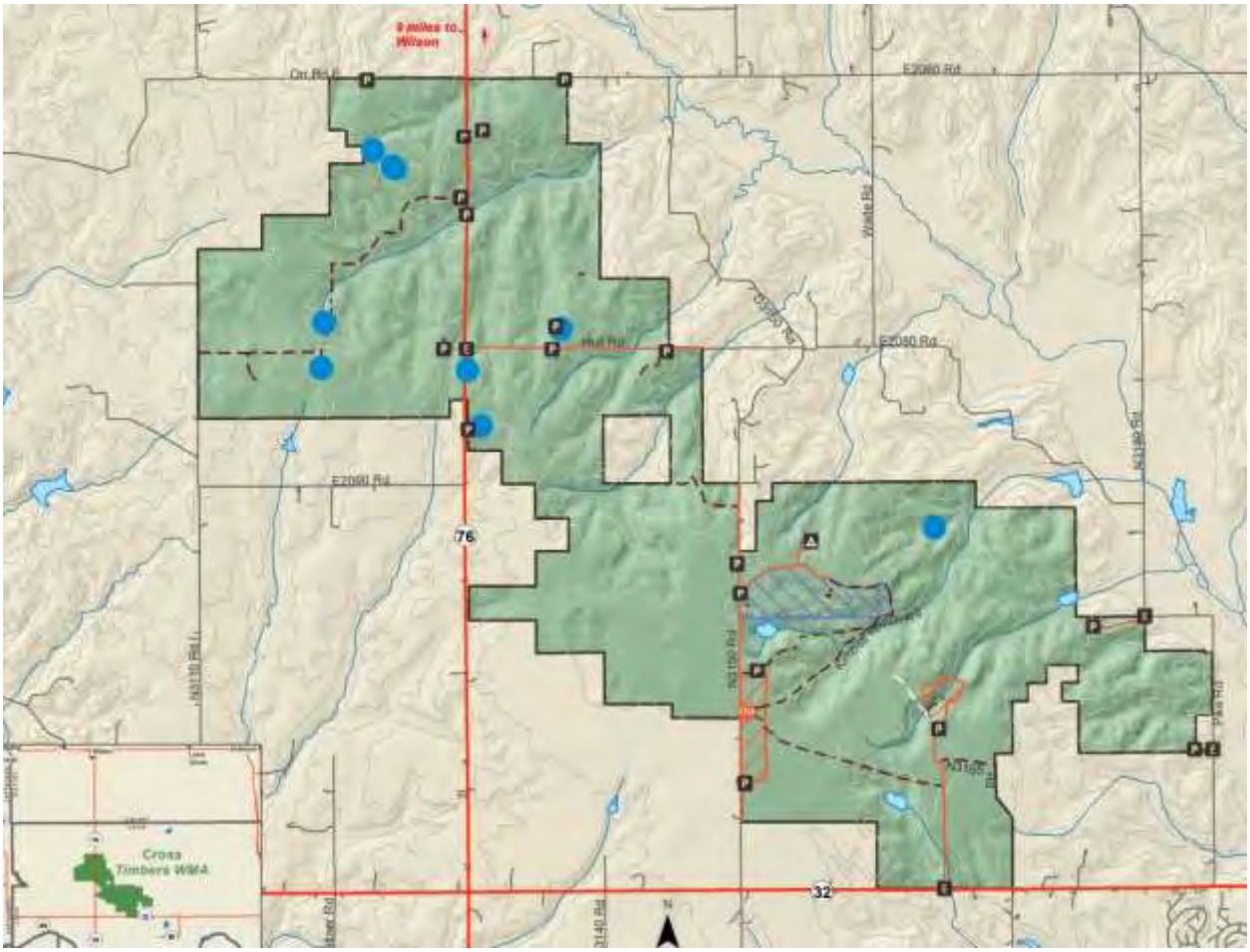
During the first segment of the project, we conducted biological surveys on the Cross Timbers WMA to develop an inventory of vertebrate species with an emphasis on species of greatest conservation need. The Cross Timbers WMA is approximately 8,200 acres in size and lies in western Love County, Oklahoma approximately 8 miles north of the Red River and 14 miles west of Interstate 35 (Figure 1). The area lies on sandy soil, much of which appears to be low, rolling stabilized dunes. Based upon the soils and the condition of the landscape surrounding the wildlife management area, the region was historically dominated by open oak woodlands. The area appears to be underlain with limestone, but this bedrock is covered by deep sands that were wind-deposited from the Red River flood plain over many millennia. As a result of many years of wind deposition, sand has completely covered the underlying clay and rock such that this limestone has little to no influence over the plant community or habitats available to wildlife. There are no rock outcrops or exposed cuts on the area. There are over a dozen man-made ponds on the WMA, but there are no perennial streams. The intermittent streams and drainages on the WMA drain toward the south (in the direction of the Red River) or toward the northeast toward Simon Creek. Simon Creek is a perennial tributary to the Red River but its channel lies one to two miles east of the eastern boundary of the WMA.

The two most common habitat types on Cross Timbers WMA are oak woodlands and non-native grasslands. The oak woodlands are dominated by Post Oak (*Quercus stellata*), Blackjack Oak (*Quercus marilandica*), Black Hickory (*Carya texana*) and Cedar Elm (*Ulmus crassifolia*), with Black Willow (*Salix nigra*) and Pecan (*Carya illinoensis*) occurring in low drainages. Other woody components to the woodland community are Chittamwood (*Bumelia lanuginosa*), Sugarberry (*Celtis laevigata*), Netleaf Hackberry (*Celtis reticulata*), Winged Elm (*Ulmus alata*), American Elm (*Ulmus americana*), Texas Hercules-Club (*Zanthoxylum hirsutum*), Eastern Redcedar (*Juniperus virginiana*), Red Mulberry (*Morus rubra*) Bur Oak (*Quercus macrocarpa*), Black Walnut (*Juglans nigra*), Texas (Ohio) Buckeye (*Aesculus glabra*) , Sycamore (*Platanus occidentalis*), and Honey Locust (*Gleditsia triacanthos*) were found in small numbers within a few stands. Most woodland tracts have a diverse understory and we kept a running list of some of the more common plants that we encountered: this information is shown in Table 9.

Oak woodland dominated the eastern and northern portions of the WMA (primarily east of Stockton Road and north of Hull Road respectively). In the western portion of the WMA (primarily along Cabin Road and to the west of Stockton Road), there were large tracts of grasslands. These were dominated by Weeping Lovegrass (*Eragrostis curvula*) and to a lesser extent Bermuda grass (Cynodon dactylon), wire grass (*Aristida* species) and Windmill Grass (*Chloris verticillata*).

We conducted surveys during February, March, April, May, June, July, and September of 2014. Each of these surveys occurred during a two or three-day period, but three single-day surveys were conducted in May and June. In addition to these surveys, this report includes some data that were collected outside of this grant during a pilot study in 2013. In 2013, we conducted surveys on Cross Timbers WMA in February, April, May, and July. These data are included for completeness, but the time and expenses associated with their collection were not charged to this grant. The primary project personnel for the surveys were Curtis Tackett, Buck Ray, Mark Howery, Jena Donnell, Matt Fullerton, Kelly Adams, Melynda Hickman, Marli Claytor, and Jeff Tibbits. We had additional help on individual surveys by Rachel Bradley, Ricky Lehrter, Rori Buresch, Jennifer Drooby, Alex Rizzo, Jennifer Everson, Amanda Thomas, Corey Jager, Stephanie Clark, Eric Kalen, Andrea Brenner, Brett Barteck, Alicia Hahn, Nadine Varner, and Don Alm. We wish to especially acknowledge the assistance of the Central Region staff that assisted us with this project and allowed us access to the WMA - Brandon Baker, Tom Wyatt, and Jeff Pennington.

Figure 1. Map of Cross Timbers Wildlife Management Area



We used a handful of survey techniques during this project. The most commonly used technique was the timed search in which observers walked through specific habitats for a predetermined length of time (typically 45 to 90 minutes) and recorded every vertebrate that was seen or heard (in the case of birds and anurans). This was a very effective technique for surveying birds but was only partially successful for surveying the other terrestrial vertebrate groups. We used cover boards at five locations in an attempt to draw to the surface reptiles and amphibians that would normally burrow under leaf litter or the ground during the daylight hours. To assess the small mammal community, we used Sherman live traps baited with chicken scratch and rolled oats to capture, record, and release rodents. We used hoop-net turtle traps set in ponds to capture aquatic turtles and assess that community's composition. During the early summer we conducted a series of 5-minute point counts along the WMA roads to assess the breeding bird community.

Each survey trip had a slightly different focus that targeted different species groups. The February survey was focused primarily on wintering birds and we placed out 20 cover boards that were made from 48" by 48" squares of plywood. We recorded birds during all of the remaining surveys, but greater emphasis was placed on timed searches for amphibians and reptiles and we live-trapped small mammals during the March, April, May, and July surveys. We conducted nocturnal searches for amphibians and aquatic reptiles in March, April, May, and July with an emphasis on calling male frogs and toads. During the June and July surveys we conducted a series of roadside, five-minute point counts

for breeding birds, and during the July and September surveys we drove portions of the roads on and near the WMA after dark searching for basking reptiles.

Although we recorded all vertebrates that we observed or heard during our surveys, the surveys were designed with a special emphasis on Species of Greatest Conservation Need (SGCN) as defined by the Oklahoma Comprehensive Wildlife Conservation Strategy. We identified 12 SGCN that we believed were likely to occur on Cross Timbers WMA based upon the existing habitat. These were the Texas Horned Lizard, Northern Scarlet Snake, Western Chicken Turtle, Swainson's Hawk, Northern Bobwhite, Solitary Sandpiper, Red-headed Woodpecker, Bell's Vireo, Prothonotary Warbler, Kentucky Warbler, LeConte's Sparrow and Harris's Sparrow. Of these, we detected eight species - all of them birds.

Amphibians and Reptiles

Based upon existing museum data, we suspected that as many as 14 species of amphibians and 41 species of reptiles might be present on Cross Timbers WMA. The potential amphibian community included one species of salamander, Smallmouth Salamander (*Ambystoma texanum*), and thirteen species of anurans. The potential reptile community included up to seven species of aquatic turtles, the Three-toed and Ornate Box Turtles (*Terrapene carolina triunguis* and *T. ornata*), nine species of lizards and as many as 23 species of snakes.

During the course of our surveys, we conducted 31.5 hours of timed-searches during daylight hours, 7.25 hours of nocturnal timed-searches around wetlands, set aquatic turtle traps out for six nights at five ponds and covered 37 miles in four one-hour night-time road searches. The results of those surveys are summarized below (Table 1). We detected 8 or 9 of the 14 possible amphibian species and 16 of 41 possible reptile species. We could not reliably differentiate between the two species of closely-related treefrogs by their calls.

Weather conditions affect the success of all biological surveys, but they are especially influential during surveys for amphibians and reptiles because they directly affect their activity patterns. During all seasons, dry weather reduces the activity of most amphibians and many of the small, fossorial lizards and snakes. Cool weather in the spring can reduce the activity of larger lizards and snakes, while unusually warm weather conditions during the summer will reduce activity for most species and may cause many snakes to become more nocturnal. The winter and spring of 2014 were unusually dry and less than 35% of the normal rainfall fell between January and May. This may have negatively affected the activity of some early-spring breeding amphibians such as chorus frogs, toads and the Smallmouth Salamander (*Ambystoma texanum*). Despite survey effort in March and April, we had limited success in locating early season amphibians, although we were able to document Strecker's Chorus Frogs (*Pseudacris streckeri*) at two small ponds. These Strecker's Chorus Frogs were noteworthy in that they represented new county records for Love County. In contrast to the spring, the summer rainfall (June and July) was above average and we had no difficulty detecting summer-breeding species such as Great Plains Narrowmouth Toad (*Gastrophryne olivacea*), Gray Treefrog (*Hyla versicolor* and *Hyla chrysoscelis*) and Blanchard's Cricket Frog (*Acris blanchardi*). Most anurans were detected during nocturnal surveys when we listened for calling males or searched for animals around the margins of breeding ponds (Table 1). Although our surveys failed to detect Smallmouth Salamander and Great Plains Toad (*Anaxyrus cognatus*), we believe that both species are likely to occur on Cross Timbers WMA. Additional surveys will be needed to document these spring-breeding amphibians.

Hoop-net traps proved to be an effective survey technique for documenting aquatic turtles and we captured five Common Snapping Turtles (Chelydra serpentine) and 51 Red-eared Sliders (*Trachemys scripta elegans*) in two trap nights of effort at each of two ponds (four trap nights total). Overall, the turtle diversity that we documented was low and the absence of any perennial streams on the area was probably a contributing factor. The existing habitats for aquatic turtles were somewhat isolated, man-

made ponds. Several of these ponds, especially the smaller ones, were not reliably perennial and went dry during the regional drought of 2011 and 2012. If perennial streams flowed through Cross Timbers WMA, it is likely that Ouachita Map Turtle (*Graptemys ouachitensis*), Eastern River Cooter (*Pseudemys concinna*), Smooth Softshell (*Apalone mutica*), and Spiny Softshell (*Apalone spinifera*) would be more common and more likely to have colonized ponds on the area. Additional search effort is needed for these species as well as two other aquatic turtles, Mississippi Mud Turtle (*Kinosternon subrubrum*) and Western Chicken Turtle (*Deirochelys reticularia miaria*) that have the potential to occur on the WMA. We located two Ornate Box Turtles during our surveys but did not detect any Three-toed Box Turtles. Box turtles in general appear to be rare in this area and we are not certain what the cause is for this.

One of the species that we had hoped to find on Cross Timbers WMA was the Texas Horned Lizard (*Phrynosoma cornutum*). Nearly half of our diurnal timed-searches were conducted in areas that appeared to be suitable habitats for this species, but we were unable to locate any. We haven't fully researched the history of the Cross Timbers WMA (former Kimball Ranch), but perhaps the historic landscape was too forested to support Texas Horned Lizards or past land uses were not compatible with healthy horned lizard populations and the ants on which they feed. The Prairie Racerunner (*Cnemidophorus sexlineatus viridis*) is a species that commonly co-occurs with Texas Horned Lizards in central and western Oklahoma. We found 22 racerunners during our timed search, but their populations appear to be patchy on the WMA because all of these lizards were found in only two grassland sites. Interestingly, we did not detect any Texas Spotted Whiptails (*Cnemidophorus gularis*) on the WMA. This is another species that co-occurs with Texas Horned Lizards in portions of southern Oklahoma and is another indication that local habitat conditions or historic conditions may not have been a suitable for these grassland species as we assumed. Texas Spotted Whiptails are often found in rocky grasslands and the deep, sandy soils on the WMA may not be suitable for them. The two most common lizards on Cross Timbers WMA appear to be the Prairie Lizard (aka Fence Lizard) (*Sceloporus consobrinus*) and the Brown Skink (*Scincella lateralis*). Despite the abundance of woodland habitat, we only found one Five-lined Skink (*Plestiodon fasciatus*) during our timed searches. The lack of rocky habitat and suitable cover objects made it more difficult for us to find Five-lined Skinks and also may have rendered the WMA unsuitable for Eastern Collared Lizards (*Crotaphytus collaris*) which are locally common elsewhere in the state where rocky habitats exist. We suspect that the Southern Prairie Skink (*Plestiodon septentrionalis*) occurs on the area, but this fossorial lizard is difficult to detect even during its peak period of activity in the spring. Also, Western Slender Glass Lizard (*Ophisaurus attenuatus*) is likely to be documented in the future with additional spring season search effort.

One of the difficulties that we had in surveying Cross Timbers WMA is the scarcity of cover objects under which reptiles and amphibians can seek shelter. We found very few rocks on the area and none with a diameter greater than five inches. To compensate for this scarcity of cover objects, we placed 20 plywood cover boards on the area to try and lure reptiles and amphibians to use them; however, we had limited success. The boards were used frequently by Brown Skinks, but the only other reptile that we documented under the cover boards was a single Prairie Lizard. In addition to the Southern Prairie Skink mentioned above, we suspect that there are as many as seven species of small, fossorial snakes that may occur on Cross Timbers WMA (e.g. Ring-necked Snake (*Diadophus punctatus*), Texas Brown Snake (*Storeria dekayi*), Variable Groundsnake (*Sonora semiannulata*) and Rough Earthsnake (*Virginia striatula*)). The only small species of snake that we documented was the Flathead Snake (*Tantilla gracilis*), which is a common and widespread species in central and eastern Oklahoma. Larger snake species are often a challenge to locate because many of them occur at low densities and remain hidden in burrows when they are not actively foraging (which they may do only a day or two every two weeks). We documented only seven of the 15 larger species of snakes that we anticipated on the area; however, most of those were documented multiple times which suggests that they are the most common snake species on Cross Timbers WMA (e.g. Eastern Racer (*Coluber constrictor*), Black Ratsnake (*Pantherophis obsoletus*), Plain-bellied Watersnake (*Nerodia erythrogaster*) and Timber Rattlesnake (*Crotalus horridus*)). In addition to these species, we suspect that Eastern Hog-nosed Snake (*Heterodon*

platirhinos), Prairie Kingsnake (*Lampropeltis calligaster*), Speckled Kingsnake (*Lampropeltis holbrooki*), Rough Green Snake (*Opheodrys aestivus*) and Bullsnake (*Pituophis catenifer sayi*) also occur on the WMA in small numbers. Nocturnal searches for snakes along roads were fairly effective on Cross Timbers WMA, particularly on the paved roads and we documented Black Ratsnakes and all three venomous species using this method.

Table 1. Summary of Amphibian and Reptile Detections on Cross Timbers WMA.

Common Name	Diurnal Timed Searches	Nocturnal Timed Searches	Other Techniques**
Dwarf American Toad (*Anaxyrus americanus charlesmithi*)	5	4	
Woodhouse's Toad (*Anaxyrus woodhousii*)	1	1	
Great Plains Narrowmouth (*Gastrophryne olivacea*)	3	6	
Blanchard's Cricket Frog* (*Acris blanchardii*)	61	195	
Strecker's Chorus Frog (*Pseudacris streckeri*)		5	
Gray & Cope's Treefrog* (*Hyla chrysoscelis & H. versicolor*)	4	173	
S. Leopard Frog* (*Lithobates sphenocephala utricularia*)	2	38	
American Bullfrog (*Lithobates catesbeiana*)		2	
Eastern Snapping Turtle (*Chelydra serpintina*)	1	1	5
Red-eared Slider (*Trachemys scripta elegans*)	17	13	51
Ornate Box Turtle (*Terrapene ornata*)	2		
Prairie (Fence) Lizard (*Sceloporus consobrinus*)	38		1
Six-lined Racerunner (*Cnemidophorus sexlineatus*)	22		
Five-lined Skink (*Plestiodon fasciatus*)	1		
Brown Skink (*Scincella lateralis*)	29		8
Eastern Racer (*Coluber constrictor*)	3		
Black Ratsnake (*Pantherophis obsoletus*)	2		2
Coachwhip (*Masticophis flagellum*)	3		
Plain-bellied Watersnake (*Nerodia erythrogaster*)	2	8	
Western Ribbonsnake (*Thamnophis proximus*)	1	5	
Flat-headed Snake (*Tantilla gracilis*)	2		
Copperhead (*Agkistrodon contortrix*)	1		1
Timber Rattlesnake (*Crotalus horridus*)	2		4
Western Pygmy Rattlesnake (*Sistrurus miliarius*)			1

* These numbers do not include tadpoles or larval stages of amphibians, but do include recently metamorphosed individuals

** Other Techniques were: aquatic turtle traps; cover boards; nocturnal road searches

Mammals

Based upon available museum records published in the book "Mammals of Oklahoma," we anticipated that as many as 31 species of native mammals might be present on Cross Timbers WMA including four species of bats, 13 species of rodents and six species of carnivores. We documented 20 to 22 species of native mammals (two species are suspect), plus feral pigs, on the WMA. These records were obtained through 510 trap nights using Sherman live traps, and incidental observations made during 31.5 hours of diurnal and 7.25 hours of nocturnal timed-searches for other taxa and 54 cover board checks (Table 2).

Sherman live traps were our primary method for detecting rodents and other small mammals. We trapped and released 98 rodents in 510 trap nights for a trapping success of 19.2%. By far the two most common rodents on the WMA were the White-footed Mouse (*Peromyscus leucopus*) and the Hispid Cotton Rat (*Sigmodon hispidus*). Despite the capture of 75 White-footed Mice, we did not capture a single Deer Mouse (*Peromyscus maniculatus*), which is a common species across much of Oklahoma. We trapped one mouse that had an orange-tinted band of fur along each of its sides; we believe that this mouse was a Texas Brush Mouse (*Peromyscus attwateri*) or a hybrid between a Texas Brush Mouse and a White-footed Mouse. We found potential new county records for Woodland Vole (*Microtus pinetorum*) (a single animal located under debris during a timed search), Hispid Pocket Mouse (*Chaetodipus hispidus*) (two individuals live-trapped in prairie remnants) and Fulvous Harvest Mouse (*Reithrodontomys fulvescens*) (one individual live-trapped in a second-growth oak woodland). During our timed-searches, we recorded the presence of mammal tracks as a way of detecting their presence. We found tracks of most of the carnivore species that were expected to occur on the area including the presence of Mink (*Mustela vison*) tracks at two pond sites. We observed four bats during our nocturnal surveys.

Although we did not capture any of these bats, we suspect that these were one Silver-haired Bat (*Lasionycteris noctivagans*) and three Eastern Red Bats (*Lasiurus borealis*) based upon their size, coloration and the time of year. During the late summer, a survey trip was made specifically to mist-net bats. Four bats were captured over ponds during three nights of netting - two Eastern Red Bats and two Evening Bats (*Nycticeius humeralis*). Other common mammals on the area were Nine-banded Armadillo (*Dasypus novemcinctus*), Fox Squirrel (*Sciurus niger*), Eastern Cottontail (*Sylvilagus floridanus*), Striped Skunk (*Mephitis mephitis*) and Opossum (*Didelphis virginiana*). We documented most of the mammal species that we suspected of occurring on the wildlife management area; however, we believe that Least Shrew (*Cryptotis parva*), Elliot's Short-tailed Shrew (*Blarina hylophaga*), and Plains Harvest Mouse (*Reithrodontomys montanus*) may be documented with additional search effort.

Table 2. Summary of Mammals Detected on Cross Timbers WMA.

Common Name	Diurnal Searches	Nocturnal Searches	Live Traps	Cover Boards	Nets
Virginia Opossum (*Didelphis virginiana*)	2 + Tracks	2			
Eastern Red Bat (*Lasiurus borealis*)		3 (suspected)			2
Silver-haired Bat (*Lasionycteris noctivagans*)		1 (suspected)			
Evening Bat (*Nycticeius humeralis*)					2
Nine-banded Armadillo (*Dasypus novemcinctus*)	3	4			
Eastern Cottontail (*Sylvilagus floridanus*)	26	11			
Fox Squirrel (*Sciurus niger*),	7				
Plains Pocket Gopher (*Geomys bursarius*)	Mounds				
Hispid Pocket Mouse (*Chaetodipus hispidus*)			2		
Fulvous Harvest Mouse (*Reithrodontomys fulvescens*)			1		
White-footed Mouse	6		75	10	

(*Peromyscus leucopus*)			
Texas Brush Mouse (or hybrid) (*Peromyscus attwateri*)			1
Hispid Cotton Rat (*Sigmodon hispidus*)	7	1	16
Eastern Woodrat (*Neotoma floridana*)	1		3
Woodland Vole (*Microtus pinetorum*)	1		
Coyote (*Canis latrans*)	Tracks		
Gray Fox (*Urocyon cinereoargenteus*)	Tracks		
Raccoon (*Procyon lotor*)	Tracks	2	
Mink (*Mustela vison*)	Tracks		
Striped Skunk (*Mephitis mephitis*)	4 + Tracks	3	
Bobcat (*Felis rufus*)	Tracks		
White-tailed Deer (*Odocoileus virginianus*)	14 + Tracks	22	
Feral Hog (*Sus scrofa*)	9		

Birds

Birds are the largest group of vertebrates in Oklahoma and represented more than 80% of the vertebrates that we documented. The results below are divided into three sections: Wintering Season (based upon February surveys); Spring Transition (based upon March, April, and May surveys), and Breeding Season (based upon June and July surveys). Cumulatively, 130 species were detected on the management area during the course of our surveys including 61 breeding species, 37 wintering species, and 32 species that were only documented during the transitional period between winter and summer when many species are migrating. Of these last 32 species, at least eight are potentially nesting on the Cross Timbers WMA but were not documented in June or July surveys - Wood Duck (*Aix sponsa*), Great Horned Owl (*Bubo virginianus*), Barred Owl (*Strix varia*), Western Kingbird (*Tyrranus verticalis*), Brown Thrasher (*Toxostoma rufum*), Black-and-White Warbler (*Mniotilta varia*), Prothonotary Warbler (*Protonotaria citrea*) and Red-winged Blackbird (*Agelaius phoeniceus*). For example, we found a singing male Prothonotary Warbler in riparian trees bordering a small pond and wetland during our May survey; because this species normally returns to Oklahoma in early April and initiates nesting in late April and early May, we suspect that this bird was a nesting summer resident.

The wintering bird community on Cross Timbers WMA was measured through a series of timed searches that were conducted as part of the grant in February of 2014 and outside of the grant in February of 2013. In these surveys, two teams of two to four birders walked prescribed areas and recorded all the birds that were seen or heard in a specified time period. The results are presented side-by-side for an inter-year comparison (Table 3). In total, 62 species of wintering birds were recorded during at least one of the two surveys and 40 species were detected in both years. Noteworthy, because they are species of greatest conservation need, were the Harris's Sparrow (*Zonotrichia querula*), LeConte's Sparrow (*Ammodramus leconteii*), Red-headed Woodpecker (*Melanerpes erythrocephalus*), and Canvasback (*Aythya valisineria*). Harris's Sparrows were a commonly-encountered species in brushy and woodland habitats. LeConte's Sparrows were found in stands of native tallgrass and appear to be fairly common on

the area. LeConte's Sparrow is a secretive species and the only effective way to detect them is to walk through suitable habitat and watch for them as they are flushed from the grass. Red-headed Woodpeckers were rare but found in open, mature oak woodlands. The Canvasbacks were probably transient birds that used the shallow ponds on the WMA as foraging sites. The winter bird community is somewhat typical of what is found elsewhere in Central Oklahoma, but we encountered greater numbers of Spotted Towhees (*Pipio maculatus*), Fox Sparrows (*Passerella iliaca*), Field Sparrows (*Spizella pusilla*), Song Sparrows (*Melospiza melodia*), Harris's Sparrows, Hermit Thrushes (*Catharus guttatus*), and Brown Thrashers than we expected to find. The February 2014 survey represents 17 hours of timed-searches by a party of four observers. The February 2013 results area based upon 18 hours of timed-searches.

Table 3. Summary of Winter Bird Community on Cross Timbers WMA Based on Two Surveys.

Common Name	# February 2014	# February 2013
Wild Turkey (*Meleagris gallopavo*)	1	
Northern Bobwhite (*Colinus virginianus*)		21
Mallard (*Anas platyrhynchos*)	23	3
Gadwall (*Anas strepera*)	2	6
Northern Shoveler (*Anas clypeata*)		2
Green-winged Teal (*Anas crecca*)	7	
Ring-necked Duck (*Aythya collaris*)	9	
Canvasback (*Aythya valisineria*)	2	
Turkey Vulture (*Cathartes aura*)	8	32
Black Vulture (*Coragyps atratus*)		2
Northern Harrier (*Circus cyaneus*)	3	
Red-shouldered Hawk (*Buteo lineatus*)	1	4
Red-tailed Hawk (*Buteo jamaicensis*)	5	4
American Kestrel (*Falco sparverius*)	4	3
Greater Yellowlegs (*Tringa melanoleuca*)		1
Ring-billed Gull (*Larus delawarensis*)	1	
Mourning Dove (*Zenaida macroura*)	4	10
Greater Roadrunner (*Geococcyx californianus*)	1	3
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	2	
Red-bellied Woodpecker (*Melanerpes carolinus*)	10	11
Yellow-bellied Sapsucker (*Sphyrapicus varius*)	4	
Downy Woodpecker (*Picoides pubescens*)	6	7
Northern Flicker (*Colaptes auratus*)	6	5
Eastern Phoebe (*Sayornis phoebe*)	1	1
Loggerhead Shrike (*Lanius ludovicianus*)		1
American Crow (*Corvus brachyrhynchos*)	21	36
Blue Jay (*Cyanocitta cristata*)	24	61
Carolina Chickadee (*Poecile carolinensis*)	22	42
Tufted Titmouse (*Baeolophus bicolor*)	11	17
Carolina Wren (*Thryothorus ludovicianus*)	13	14
Bewick's Wren (*Thryomanes bewickii*)	3	5
Golden-crowned Kinglet (*Regulus satrapa*)		3
Ruby-crowned Kinglet (*Regulus calendula*)		8
Eastern Bluebird (*Sialia sialis*)	18	18
Hermit Thrush (*Catharus guttatus*)	4	1
American Robin (*Turdus migratorius*)	81	288
Northern Mockingbird (*Mimus polyglottos*)	14	9
Brown Thrasher (*Toxostoma rufum*)	6	2
Cedar Waxwing (*Bombycilla cedrorum*)	138	107

Yellow-rumped Warbler (*Setophaga coronata*)	14	13
Northern Cardinal (*Cardinalis cardinalis*)	91	73
Spotted Towhee (*Pipilo maculatus*)	25	20
Eastern Towhee (*Pipilo erythropthalmus*)	2	
Savannah Sparrow (*Passerculus sandwichensis*)	84	
Vesper Sparrow (*Pooecetes gramineus*)	14	2
LeConte's Sparrow (*Ammodramus leconteii*)	5	1
Dark-eyed Junco (*Junco hyemalis*)	198	66
Field Sparrow (*Spizella pusilla*)	15	74
Fox Sparrow (*Passerella iliaca*)	6	16
Song Sparrow (*Melospiza melodia*)	44	18
Swamp Sparrow (*Melospiza georgiana*)	1	
Lincoln's Sparrow (*Melospiza lincolnii*)	4	1
Harris's Sparrow (*Zonotrichia querula*)	49	41
White-crowned Sparrow (*Zonotrichia leucophrys*)		2
White-throated Sparrow (*Zonotrichia albicollis*)	8	19
meadowlark species (most Eastern)	69	26
Eastern Meadowlark (*Sturnella magna*)	14	12
Western Meadowlark (*Sturnella neglecta*)		1
Red-winged Blackbird (*Agelaius phoeniceus*)	2	30
Brown-headed Cowbird (*Molothrus ater*)		70
House Finch (*Carpodacus mexicanus*)	1	5
American Goldfinch (*Carduelis tristis*)	7	17
Pine Siskin (*Carduelis pinus*)		1

Spring Migration/Transition

The bird community during the prolonged spring season was assessed through a series of timed searches in March, April and May. These surveys picked up a mix of year-round resident birds, late winter visitors, early-arriving Neotropical migrants and species that are truly migrants through Oklahoma. These numbers were based upon 22.5 hours of timed-searches on foot and approximately 2.5 hours of counts made from vehicles along 28 miles of roadsides. In total, 120 species were identified during the spring surveys. Only common names are provided in the table because of space concerns, but common names follow the standard American Ornithologist Union taxonomy. The species shown in *italics* are those that are present on the Cross Timbers WMA only during their spring and/or fall migrations. Although 32 species were only observed during the spring transition months, our knowledge of the breeding and wintering biology of these species suggests that only the 22 species shown in italics were migrants and that the remaining ten species were rare wintering or nesting birds (e.g. Barred Owl (*Strix varia*) and Prothonotary Warbler (*Protonotaria citrea*)).

Table 4. Birds Observed on Cross Timbers WMA during the Transition from the Wintering Community to the Breeding Community (aka Spring Migration Period)

Common Name			
Wild Turkey	14	Mallard	2
Northern Bobwhite	51	Gadwall	34
Great Blue Heron	4	Green-winged Teal	17
Great Egret	4	*Blue-winged Teal*	*8*
Snowy Egret	8	Redhead	1
Green Heron	2	Turkey Vulture	28
Canada Goose	2	Black Vulture	7
Wood Duck	2	Mississippi Kite	6

Sharp-shinned Hawk	1
Cooper's Hawk	1
Northern Harrier	1
Broad-winged Hawk	3
Red-shouldered Hawk	10
Red-tailed Hawk	7
Swainson's Hawk	17*
American Kestrel	2
Killdeer	4
Greater Yellowlegs	*4*
Lesser Yellowlegs	*1*
Solitary Sandpiper	*1*
Upland Sandpiper	*3*
Spotted Sandpiper	*2*
Baird's Sandpiper	*19*
White-rumped Sandpiper	*11*
Ring-billed Gull	15
Franklin's Gull	*130*
Mourning Dove	76
Yellow-billed Cuckoo	36
Greater Roadrunner	1
Great Horned Owl	2
Barred Owl	2
Chuck-wills-widow	11
Common Nighthawk	2
Chimney Swift	3
Ruby-throated Hummingbird	1
Belted Kingfisher	1
Red-headed Woodpecker	1
Red-bellied Woodpecker	22
Yellow-bellied Sapsucker	1
Downy Woodpecker	8
Northern Flicker	9
Pileated Woodpecker	2
Eastern Phoebe	19
Least Flycatcher	*3*
Great Crested Flycatcher	4
Scissor-tailed Flycatcher	41
Western Kingbird	2
Bell's Vireo	11
White-eyed Vireo	29
Red-eyed Vireo	7
Warbling Vireo	2
Loggerhead Shrike	1
Northern Rough-winged Swallow	1
Barn Swallow	10
Cliff Swallow	16
Tree Swallow	*3*
Blue Jay	26
American Crow	11
Carolina Chickadee	40
Tufted Titmouse	77
White-breasted Nuthatch	1
Carolina Wren	57
Bewick's Wren	16
Ruby-crowned Kinglet	1
Blue-gray Gnatcatcher	67
Eastern Bluebird	31
American Robin	15
Swainson's Thrush	*2*
Hermit Thrush	2
Northern Mockingbird	35
Brown Thrasher	9
Gray Catbird	*1*
Cedar Waxwing	312
Orange-crowned Warbler	*9*
Nashville Warbler	*1*
Tennessee Warbler	*1*
Black-and-White Warbler	11
Prothonotary Warbler	1
Yellow Warbler	*8*
Yellow-rumped Warbler	4
Blackpoll	*1*
American Redstart	*1*
Yellow-breasted Chat	1
Summer Tanager	18
Northern Cardinal	226
Blue Grosbeak	5
Spotted Towhee	23
Indigo Bunting	22
Lazuli Bunting	*1*
Painted Bunting	57
Dickcissel	54
Grasshopper Sparrow	11
LeConte's Sparrow	1
Lark Sparrow	29
Savannah Sparrow	41
Vesper Sparrow	9
Dark-eyed Junco	11
Field Sparrow	66
Chipping Sparrow	57
Clay-colored Sparrow	*29*
Fox Sparrow	4
Song Sparrow	16
Lincoln's Sparrow	7
Harris's Sparrow	53
White-crowned Sparrow	9
White-throated Sparrow	4
Bobolink	*23*
Red-winged Blackbird	20
Eastern Meadowlark	38
Brown-headed Cowbird	14

Common Grackle	1	American Goldfinch	4
House Finch	3		

* the Swainson's Hawk data represent a migrating group; however, this species was present also during the summer

Breeding Bird Community

We used road-based, five-minute point-counts as our primary tool for assessing the relative abundance and composition of the Cross Timbers WMA breeding bird community. We identified and recorded every bird that was seen or heard during a five-minute period at 41 locations. The point-count locations were placed along existing county and WMA roads and were spaced at intervals of 0.4 to 0.5 miles to minimize the potential for double-recording birds. We conducted the point counts between sunrise and 10:30 am each morning. Because we did not start until sunrise, we did not detect the Chuck-wills-widow (*Caprimulgus carolinensis*) although it is a common woodland species on the WMA. We ended our surveys at 10:30 because of declining bird activity as the morning hours progressed. Because there was greater accessibility to the oak woodland (Cross Timbers woodland) habitat type on the WMA, this habitat was over-sampled in proportion to its abundance on the WMA. Similarly, grassland habitat was over-sampled in proportion to its abundance. Table 5 provides a summary of the combined data from all 41 point-count stations. These stations were distributed across three general habitat types as follows: grassland – 7 sites; early succession oak woodland or scrub – 10; mature oak woodland or forest – 24. Our point-count data identified 55 species that are likely to be breeding on Cross Timbers WMA (Table 5). We encountered seven other species incidentally (not at point-count stations) that are likely to be breeding on the WMA. We observed two White-winged Doves (*Zenaida asiatica*), one Yellow-throated Warbler (*Setophaga dominica*), and one Green Heron (*Butorides virescens*) on the area in July while traveling between point count stations, but they were not detected on any of our point counts. We also heard and/or saw Chuck-wills-widows (*Caprimulgus carolinensis*), Common Nighthawk (*Chordeiles minor*) and Eastern Screech Owl (*Otus asio*) during our nocturnal surveys for calling amphibians. Point counts are a very effective technique for measuring the occurrence of songbirds, but are less effective for detecting rare species. It is likely that other nesting species occur on the area that were missed due to their rarity or secretiveness including the Wood Duck, Barred Owl, Great Horned Owl, and Prothonotary Warbler as mentioned above. Early-nesting species such as the Black-and White Warbler are less likely to be detected during our surveys because their vocal frequency declines rapidly after their nesting activity has ended.

The most commonly detected breeding birds were the Northern Cardinal (*Cardinalis cardinalis*) and Painted Bunting (*Passerina ciris*), which were found in nearly all of the sites with some woody cover. Mourning Dove (*Zenaida macroura*), Field Sparrow (*Spizella pusilla*), and Northern Bobwhite (*Colinus virginianus*) were found in a wide range of habitat conditions from grassland to open oak woodland. Common birds in the oak woodland sites were the Carolina Wren (*Thryothorus ludovicianus*), Tufted Titmouse (*Baeolophus bicolor*), Blue-gray Gnatcatcher (*Polioptila caerulea*), Summer Tanager (*Piranga rubra*), and Yellow-billed Cuckoo (*Coccyzus americanus*). Common birds in grassland and shrubland sites were Dickcissel (*Spiza americana*), Lark Sparrow (*Chondestes grammacus*), Eastern Bluebird (*Sialia sialis*), and Northern Mockingbird (*Mimus polyglottos*). Of special interest because of their status as species of greatest conservation need were the Bell's Vireo (*Vireo bellii*), Swainson's Hawk (*Buteo swainsonii*), Painted Bunting, and Northern Bobwhite. Bell's Vireos were almost always found in Chickasaw Plum thickets in grassland and shrubland habitats. The WMA appears to support one to three pairs of Swainson's Hawks, which occur in the open grassland sites.

Table 5. Summary of 41 Breeding Season, 5-minute Point-Counts on the Cross Timbers WMA

Common Name	Number of Birds Detected
Wild Turkey (*Meleagris gallopavo*)	6
Northern Bobwhite (*Colinus virginianus*)	30
Great Egret (*Ardea alba*)	1
Little Blue Heron (*Egretta caerulea*)	2
Cattle Egret (*Bubulcus ibis*)	4
Black-bellied Whistling Duck (*Dendrocygnus autumnalis*)	2
Turkey Vulture (*Cathartes aura*)	7
Black Vulture (*Coragyps atratus*)	2
Mississippi Kite (*Ictinia mississippiensis*)	10
Broad-winged Hawk (*Buteo platypterus*)	1
Red-shouldered Hawk (*Buteo lineatus*)	2
Red-tailed Hawk (*Buteo jamaicensis*)	1
Swainson's Hawk (*Buteo swainsonii*)	1
Killdeer (*Charadrius vociferous*)	2
Mourning Dove (*Zenaida macroura*)	34
Yellow-billed Cuckoo (*Coccyzus americanus*)	33
Greater Roadrunner (*Geococcyx californianus*)	1
Chimney Swift (*Chaetura pelagica*)	1
Ruby-throated Hummingbird (*Archiochus colubris*)	1
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	1
Red-bellied Woodpecker (*Melanerpes carolinus*)	11
Downy Woodpecker (*Picoides pubescens*)	10
Pileated Woodpecker (*Dryocopus pileatus*)	1
Eastern Phoebe (*Sayornis phoebe*)	3
Great Crested Flycatcher (*Myiarchus crinitus*)	6
Scissor-tailed Flycatcher (*Tyrannus forficatus*)	13
Purple Martin (*Progne subis*)	5
N. Rough-winged Swallow (*Stelgidopteryx serripennis*)	7
Barn Swallow (*Hirundo rustica*)	2
Cliff Swallow (*Perochelidon pyrrhonota*)	7
Bell's Vireo (*Vireo bellii*)	5
White-eyed Vireo (*Vireo griseus*)	10
Red-eyed Vireo (*Vireo olivaceus*)	6
American Crow (*Corvus brachyrhynchos*)	19
Blue Jay (*Cyanocitta cristata*)	3
Carolina Chickadee (*Poecile carolinensis*)	13
Tufted Titmouse (*Baeolophus bicolor*)	37
White-breasted Nuthatch (*Sitta carolinensis*)	1
Carolina Wren (*Thryothorus ludovicianus*)	41
Bewick's Wren (*Thryomanes bewickii*)	8
Blue-gray Gnatcatcher (*Polioptila caerulea*)	26
Eastern Bluebird (*Sialia sialis*)	13
Northern Mockingbird (*Mimus polyglottos*)	18
Yellow-breasted Chat (*Icteria virens*)	3
Summer Tanager (*Piranga rubra*)	21
Northern Cardinal (*Cardinalis cardinalis*)	117
Blue Grosbeak (*Guiraca caerulea*)	10
Indigo Bunting (*Passerina cyanea*)	12

Painted Bunting (*Passerina ciris*)	74
Dickcissel (*Spiza americana*)	28
Grasshopper Sparrow (*Ammodramus savannarum*)	2
Lark Sparrow (*Chondestes grammacus*)	11
Field Sparrow (*Spizella pusilla*)	31
Eastern Meadowlark (*Sturnella magna*)	8
Brown-headed Cowbird (*Molothrus ater*)	18
Green Heron (*Butorides virescens*)	1 seen incidentally
White-winged Dove (*Zenaida asiatica*)	2 seen incidentally
Eastern Screech Owl (*Otus asio*)	1 heard incidentally
Chuck-wills-widow (*Caprimulgus carolinensis*)	11 heard incidentally
Common Nighthawk (*Chordeiles minor*)	2 heard incidentally
Yellow-throated Warbler (*Setophaga dominica*)	1 seen incidentally

Invertebrates and Plants

We did not place an emphasis on invertebrate surveys on the Cross Timbers WMA because the Arogos Skipper (*Atrytone arogos*) is the only invertebrate species of greatest conservation need with the potential to occur on the area. The Arogos Skipper is associated with tallgrass prairie habitat and uses Big Bluestem (*Andropogon gerardii*) as the forage species for its larvae. While Big Bluestem is present on Cross Timbers WMA, it occurs in small prairie patches and as an understory in open oak woodlands. All of the large tracts of grassland on the WMA are dominated by exotic grasses and not suitable as Arogos Skipper habitat; therefore, we did not conduct surveys for this specific species. We did, however, maintain an incidental list for butterfly species that we encountered during our vertebrate surveys. Thirty-one species were observed on the area and these are listed in Table 6.

Table 6. Butterfly Species Observed Incidentally on Cross Timbers WMA

Common Name	Common Name
Pipevine Swallowtail (*Battus philenor*)	American Painted Lady (*Vanessa virginiensis*)
Eastern Tiger Swallowtail (*Papilio glaucus*)	Red Admiral (*Vanessa atalanta*)
Black Swallowtail (*Papilio polyxenes*)	Viceroy (*Limenitis archippus*)
Checkered White (*Pontia protodice*)	Gulf Fritillary (*Agraulis vanilla*)
Falcate Orangetip (*Anthocharis midea*)	Variegated Fritillary (*Euptoieta claudia*)
Giant Cloudless Sulphur (*Phoebis sennae*)	Pearl Crescent (*Phyciodes tharos*)
Orange (Alfalfa) Sulphur (*Colias eurytheme*)	Hackberry Emperor (*Asterocampa celtis*)
Sleepy Orange (*Eurema nicippe*)	Common Buckeye (*Junonia coenia*)
Little Yellow (*Eurema lisa*)	Common Wood Nymph (*Cercyonis pegala*)
Dainty Sulphur (*Nathalis iole*)	Little Wood Satyr (*Megisto cymela*)
Eastern Tailed Blue (*Everes comyntas*)	Cloudywing sp. (*Thorybes* sp.)
Reakirt's Blue (*Hemiargus isola*)	Hoary Edge (*Achalarus lyciades*)
Monarch (*Danaus plexippus*)	Funereal Duskywing (*Erynnis funeralis*)
Goatweed Leafwing (*Anaea andria*)	Com. Checkered Skipper (*Pyrgus communis*)
Mourning Cloak (*Nymphalis antiopa*)	Sachem Skipper (*Atalopedes campestris*)
Question Mark (*Polygonia interrogationis*)	

Plants

To the best of our ability, we tried to document the plant species on Cross Timbers Wildlife Management Area. The list shown in Table 7 is not a complete list but provides an indication of some of the more common plants on the area.

Table 7. Plant Species Documented on Cross Timbers WMA.

Herbaceous Plants

Aspleniaceae
Blunt-lobbed Cliff Fern (*Woodsia obtusa*)

Commelinaceae
Slender Day-Flower (*Commelina erecta*)
Prairie Spiderwort (*Tradescantia occidentalis*)
Ohio Spiderwort (*Tradescantia ohiensis*)

Iridaceae
Prairie Lilly (*Nemastylis geminiflora*)
Blue-eyed Grass (*Sisyrinchium* sp)

Liliaceae
Wild Onion (*Allium canadense*)
False Garlic (*Nothoscordum bivalve*)
White Dogstooth Lilly (*Erythronium albidum*)

Smilacaceae
Greenbriar (*Smilax bona-nox*)

Agavaceae
Soapweed Yucca (*Yucca glauca*)

Poaceae
Big Bluestem (*Andropogon gerardii*)
Bushy Bluestem (*Andropogon glomeratus*)
Purple Threeawn Grass (*Aristida purpurea*)
Silver Bluestem (*Bothriochloa laguroides*)
Sideoats Grama (*Bouteloua curtipendula*)
Broadleaf Woodoats (*Chasmanthium latifolium*)
Rattail Grass (*Coelorachis cylindrica*)
Canada Wildrye (*Elymus canadensis*)
Fall Witchgrass (*Leptoloma cognatum*)
Scribner's Panicgrass (*Panicum oligosanthes*)
Switchgrass (*Panicum virgatum*)
Little Bluestem (*Schizachyrium scoparium*)
Indian Grass (*Sorghastrum nutans*)
Purpletop Greasegrass (*Tridens flavus*)

Acanthaceae
Smooth Wild Petunia (*Ruellia humilis*)

Amaranthaceae
Slender Snake-Cotton (*Froelichia gracilis*)

Apiaceae
American Wild Carrot (*Daucus pusillus*)

Apocyanaceae
Fringed Blue-Star (*Amsonia ciliata*)
Prairie Dogbane (*Apocynum cannabinum*)

Aristolochiaceae
Woolly Pipevine (*Aristolochia tomentosa*)

Asclepiadaceae
Butterfly Milkweed (*Asclepias tuberosa*)
Green Milkweed (*Asclepias viridis*)
Climbing Milkweed (*Matelea cynanchoides*)

Asteraceae
Yarrow (*Achillea millefolium*)
Western Ragweed (*Ambrosia psilostachya*)
Giant Ragweed (*Ambrosia trifida*)
Lazy Daisy (*Aphanostephus skirrhobasis*)
Greeneyes (*Berlandiera lyrata*)
Least Daisy (*Chaetopappa asteroides*)
Soft Golden Aster (*Chrysopsis pilosa*)
Mare's Tail (*Conyza canadensis*)
Largeflower Coreopsis (*Coreopsis grandiflora*)
Plains Coreopsis (*Coreopsis tinctorium*)
Prairie Purple Coneflower (*Echinacea angustifolia*)
Engelmann's Daisy (*Engelmannia pinnatifida*)
Prairie Daisy Fleabane (*Erigeron strigosus*)
Summer Gaillardia (*Gaillardia aestivalis*)
Rose-ring Indian Blanket (*Gaillardia pulchella*)
Spanish Gold Gumweed (*Grindelia papposa*)
Bitter Sneezeweed (*Helenium amarum*)
Prairie Sunflower (*Helianthus petiolaris*)
Woolly-White (*Hymenopappus scabiosaeus*)
Wild Lettuce (*Lactuca canadensis*)
Dotted Blazing Star (*Liatris punctata*)
Skeletonweed (*Lygodesmia* sp.)
Sweetscent (*Pluchea odorata*)
False Dandelion (*Pyrrhopappus* sp.)
Upright Prairie Coneflower (*Ratibida columnifera*)
Black-eyed Susan (*Rudbeckia hirta*)
Drummond's Aster (*Symphyotrichum drummondii*)
Fineleaf Yellow Daisy (*Tetraneuris linearifolia*)
Greenthread (*Thelesperma filifolium*)
Winged Crownbeard (*Verbisina helianthoides*)

Golden Crownbeard (*Verbisina encelioides*)
Baldwin Ironweed (*Vernonia baldwinii*)
Sleepy Daisy (*Xanthisma texanum*)
Boraginaceae
Pasture Heliotrope (*Heliotropium tenellum*)
Narrowleaf Puccoon (*Lithospermum incisum*)
Cactaceae
Prickly Pear Cactus (*Opuntia humifusa*)
Campanulaceae
Venus Looking-glass (*Triodanis* sp)
Caryophyllaceae
Texas Sandwort (*Arenaria stricta*)
Convolvulaceae
Texas Bindweed (*Convolvulus equitans*)
Cucurbitaceae
Buffalo Gourd (*Cucurbitia foetidissima*)
Euphorbiaceae
Bull Nettle (*Cnidoscolus texanus*)
Woolly Croton (*Croton capitatus*)
Tropical Croton (*Croton glandulosus*)
Texas Croton (*Croton texensis*)
Queen's Delight (*Stillingia sylvatica*)
Nettleleaf Noseburn (*Tragia* sp)
Fabaceae
Prairie Acacia (*Acacia angustissima*)
Hog Peanut (*Amphicarpaea bracteata*)
Blue False Indigo (*Baptisia australis*)
Largebracted False Indigo (*Baptisia leucophaea*)
Showy Partridge Pea (*Chamaecrista fasciulata*)
Butterfly Pea (*Centrosema virginianum*)
Rattlebox (*Crotalaria sagittalis*)
Black Dalea (*Dalea frutescens*)
Illinois Bundleflower (*Desmanthus ilinoensis*)
Tick Trefoil (*Desmodium marilandicum*)
Scarlet Indigo (*Indigofera miniata*)
Roundhead Bush Clover (*Lespedeza capitata*)
Catclaw Sensitive Briar (*Mimosa nuttallii*)
Yellow Neptune (*Neptunia lutea*)
Purple Prairie Clover (*Petalostemon purpureum*)
White Prairie Clover (*Petalostemon candidum*)
Slim-flowered Scurfpea (*Psoralidium tenuiflora*)
Broadleaf Snoutbean (*Rhynchosia latifolia*)
Bladderpod (*Sesbania vesicaria*)
Wild Climbing Bean (*Strophostyles* sp)
Goat's Rue (*Tephrosia virginiana*)
Red Clover (*Trifolium pratense*)
Smooth Vetch (*Vicia sativa*)
Gentianaceae
Mountain Pink (*Centaurium beyrichii*)
Prairie Rose-Gentian (*Sabatia campestris*)
Geraniaceae
Carolina Cranesbill (*Geranium carolinianum*)
Krameriaceae
Trailing Ratany (*Krameria lanceolata*)
Lamiaceae
Lemon Beebalm (*Monarda citriodora*)
Azure Sage (*Salvia azurea*)
Woodland Germander (*Teucrium canadense*)
Linaceae
Meadow Flax (*Linum pretense*)
Stiffstem Flax (*Linum rigidum*)
Grooved Flax (*Linum sulcatum*)
Loranthaceae
Mistletoe (*Phoradendron serotinum*)
Malvaceae
Pink Poppy Mallow (*Callirhoe alcaeoides*)
Rose Poppy Mallow (*Callirhoe involucrata*)
Menispermaceae
Carolina Snailseed (*Cocculus carolinus*)
Molluginaceae
Green Carpetweed (*Mollugo verticillata*)
Onagraceae
Tall Gaura (*Gaura longiflora*)
Woolly Gaura (*Gaura villosa*)
False Gaura (*Stenosiphon linifolius*)
Water Primrose (*Ludwigia repens*)
Cutleaf Evening Primrose (*Oenothera laciniata*)
Four-point Evening Primrose (*Oenothera rhobipetala*)
Showy Evening Primrose (*Oenothera speciosa*)
Half-shrub Evening Primrose (*Calylophus* sp.)
Oxalidaceae
Yellow Wood Sorrel (*Oxalis stricta*)
Violet Wood Sorrel (*Oxalis violacea*)
Pappaveraceae
Prickly Poppy (*Argemone polyanthemos*)
Phytolaccaceae
Pokeweed (*Phytolacca americana*)
Plantaginaceae
Woolly Plantain (*Plantago patagonica*)
Redseed Plantain (*Plantago rhodosperma*)
Polygalaceae
White Milkwort (*Polygala alba*)
Pink Milkwort (*Polygala incarnata*)
Polygonaceae
Annual Buckwheat (*Eriogonum annuum*)
Pale Dock (*Rumex altissimus*)
Portulacaceae
Spring Beauty (*Claytonia virginica*)
Ranunculaceae
Carolina Anemone (*Anemone caroliniana*)

Carolina Larkspur (*Delphinium carolinianum*)
Rubiaceae
Rough Buttonweed (*Diodia teres*)
Bluet (*Hedyotis nigricans*)
Scrophulariaceae
Indian Paintbrush (*Castilleja coccinea*)
Canada Toadflax (*Nuttallanthus canadensis*)
Loose-flowered Penstemon (*Penstemon laxiflorus*)
Common Mullein (*Verbascum thapsus*)
Solanaceae
Indian Datura (*Datura innoxia*)
Ground Cherry (*Physalis* sp)
Carolina Nightshade (*Solanum carolinense*)
Buffalo Bur (*Solanum cornutum*)
Silverleaf Nightshade (*Solanum elaeagnifolium*)
Verbenaceae
Dakota Verbena (*Glandularia bipinnatifida*)
Slender Vervain (*Verbena halei*)
Blue Vervain (*Verbena hastata*)
White Vervain (*Verbena urticifolia*)
Violaceae
Field Pansy (*Viola bicolor*)
Missouri Blue Violet (*Viola sororia*)
Zygophyllaceae
Goathead Puncture Vine (*Tribulus terrestris*)

Woody Plants:
Cupressaceae
Eastern Redcedar (*Juniperus virginiana*)
Anacardiaceae
Winged Sumac (*Rhus copallina*)
Poison Ivy (*Toxicodendron radicans*)
Aquifoliaceae
Deciduous Holly *(Ilex decidua*)
Bignoniaceae
Trumpetvine (*Campsis radicans*)
Caprifoliaceae
Buckbrush (*Symphoricarpos occidentalis*)
Rusty Blackhaw (*Viburnum rufidulum*)
Elderberry (*Sambucus canadensis*)
Cornaceae
Roughleaf Dogwood (*Cornus drummondii*)
Ebenaceae
Common Persimmon (*Diospyros virginiana*)
Fabaceae
Redbud (*Cercis canadensis*)
Honey Locust (*Gleditsia triacanthos*)
False Indigo (*Amorpha fruticosa*)
Fagaceae
Bur Oak (*Quercus macrocarpa*)
Blackjack Oak (*Quercus marilandica*)
Shumard Oak (*Quercus shumardii*)
Post Oak (*Quercus stellata*)
Hippocastanaceae
Texas (Ohio) Buckeye (*Aesculus glabra*)
Juglandaceae
Pecan (*Carya illinoensis*)
Black Hickory (*Carya texana*)
Black Walnut (*Juglans nigra*)
Moraceae
Red Mulberry (*Morus rubra*)
Platanaceae
Sycamore (*Platanus occidentalus*)
Rhamnaceae
Carolina Buckthorn (*Rhamnus caroliniana*)
Rosaceae
Green Hawthorn (*Crataegus viridis*)
Mexican Plum (*Prunus mexicana*)
Oklahoma Plum (*Prunus gracilis*)
Chickasaw (Sand) Plum (*Prunus angustifolia*)
Southern Dewberry (*Rubus trivialis*)
Rutaceae
Texas Hercules Club (*Zanthoxylum hirsutum*)
Salicaceae
Plains Cottonwood (*Populus deltoides*)
Black Willow (*Salix nigra*)
Sapotaceae
Chittamwood (*Bumelia lanuginosa*)
Ulmaceae
Sugarberry (*Celtis laevigata*)
Netleaf Hackberry (*Celtis reticulata*)
Winged Elm (*Ulmus alata*)
American Elm (*Ulmus americana*)
Cedar Elm (*Ulmus crassifolia*)
Verbenaceae
American Beautyberry (*Callicarpa americana*)
Vitaceae
Peppervine (*Ampelopsis arborea*)
Virginia Creeper (*Parthenocissus quinquefolia*)
Wild Grape (*Vitis* sp.)

SIGNIFICANT DEVIATIONS:
There were no significant deviations associated with this grant.

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