FINAL PERFORMANCE REPORT

FEDERAL AID GRANT NO. T-34-P-1

SUBREGIONAL MAPPING OF THE TALLGRASS PRAIRIE CWCS REGION

OKLAHOMA DEPARTMENT OF WILDLIFE CONSERVATION

June 1, 2006 through August 31, 2009

FINAL PERFORMANCE REPORT

State: Oklahoma **Grant Number:** T-34-P-1

Grant Program: State Wildlife Grants Program

Grant Title: Subregional Mapping of the Tallgrass Prairie CWCS Region.

Grant Period: 1 June 2006 – 31 August 2009

Principal Investigator: Bruce Hoagland

ABSTRACT

The integration of regional habitat and vegetation maps with geospatial databases is an important tool for conservation biologists and wildlife managers. The objective of this project was to map the current distribution of tallgrass prairie, riparian/bottomland forest, and wetland habitats in the TPR as defined by the Oklahoma CWCS. To achieve this objective, we employed a three phase approach; 1) acquisition and processing of existing spatial data, 2) field verification, and 3) editing and completion of the TPR geospatial database. Existing digital data sources used included the Oklahoma GAP Analysis vegetation layer, the Nature Conservancy's Untilled Landscapes (UTL) map, Digital Orthophoto Quarter Quads (DOQQ) and National Agriculture Imagery Program (NAIP) County Mosaic. Of the habitat types mapped, tallgrass had the greatest spatial extent (917,573 acres) followed by the bottomland forest (60,667 acres) and wetlands (9,725 acres). Although large contiguous patches of tallgrass prairie occur in the western portion of the region, grasslands in the southeast were highly fragmented into small parcels. Bottomland forests were most extensive in the eastern portion of the study area and emergent wetlands were scattered throughout. The most significant challenge presented to this effort was segregating tall fescue (*Festuca arundinacea)* pastures from native tallgrass. Tall fescue is an introduced species that can be found throughout northeast Oklahoma.

Objective

To map the current distribution of tallgrass prairie, riparian/bottomland forest, and wetland habitats in the TPR as defined by the Oklahoma CWCS.

Introduction

The integration of regional habitat and vegetation maps with geospatial databases is an important tool for conservation biologists and wildlife managers. The rapid development of geospatial technologies has enhanced the capacity of conservation planners to devise state-level conservation actions through the analysis of species ranges in conjunction with landcover data. The resulting maps, generated from "layers" of spatial data residing in a Geographic Information System (GIS), can also be used depict and analyze the change in remnant native habitats over time.

Of particular relevance to conservation planners in Oklahoma, is the decline of tallgrass prairie and wetland (forested and emergent) habitats since European settlement of North America. In this study, we mapped the distribution of remnant tallgrass and wetlands habitats within the Tallgrass Prairie Region (TPR) of the State Wildlife Action Plan (SWAP) using a combination of GIS, digital imagery, and ground verification. Targeted habitats were tallgrass prairie, bottomland forest, and wetlands. Portions of the TPR have experienced extensive loss of tallgrass prairie habitat, the matrix forming vegetation type in this region, but resulting fragmentation has not been documented. Likewise, there has been a profound decline in the total acreage of wetland habitats in Oklahoma. These vegetation types are important habitat for a variety of Species of Greatest Conservation Need, including the Eastern Spotted Skunk, Northern Bobwhite, Greater Prairie Chicken, Snowy Plover, American Woodcock, Barn Owl, Loggerhead Shrike, and Bell's Vireo. The results of this project will provide wildlife managers with a dynamic tool for analyzing past habitat conditions and developing management plans for conservation of species of greatest conservation need.

Methods

Data collection

The process of mapping remnant habitats in the TPR was accomplished in three phases; 1) acquisition and processing of existing spatial data, 2) field verification, and 3) editing and completion of the TPR geospatial database. The goal of Phase 1 was to identify areas within the TPR with a high probability of containing target habitats. In this phase, landcover data mapped at small spatial scales was evaluated, such as the Oklahoma GAP Analysis (OKGap) project and the Nature Conservancy's Untilled Landscapes (UTL) maps. Both were selected because of their small scale, coarse resolution; OKGap pixel resolution of 30x30 meters) and UTL mapped tracts greater than 2,000 acres.

Once the analysis of the TPR with these digital products was completed, Digital Orthophoto Quarter Quads (DOQQ) and National Agriculture Imagery Program (NAIP) County Mosaic images were used to identify and precisely map habitats. The image resolution of this data source is 1 meter^2 pixel and is best suited for locating habitat patches of 40 acres or greater. Habitats patches identified on the NAIP images were then hand digitized into the preliminary TGP geospatial database.

The primary challenge for mapping native tallgrass prairie, even with large-scale data such as NAIP, is distinguishing native grasslands remnants from tame or non-native pastures. The UTL dataset simply discriminates between tilled and untilled landscape features within the Great Plains and adjacent Interior Lowlands with limited habitat classification. The OKGap vegetation layer, on the other hand, contains classified polygons of habitat types. Of greatest utility for this study was the categories tallgrass prairie and cool season pasture. In the TPR, cool season pastures were once native tallgrass prairie that have been converted to tall fescue (*Festuca arundinacea* Schreb.) pastures. Thus the OKGap vegetation layer was useful for segregating tallgrass prairie habitats from tall fescue pastures.

The NAIP images were "leaf-on" and in color, which allowed for the further discrimination of habitat types. When using color imagery for habitat mapping, vegetation types are represented by specific colors and textures. For example, tallgrass prairie remnants are blue-green in color with a "smooth" texture. Forested wetlands have dark green canopies with a "rough" texture. For example, if a parcel or patch of land is identified as tallgrass prairie in OKGap, the same polygon could be evaluated using the NAIP to verify whether it was tallgrass prairie or actually consisted of multiple habitat occurrences. If the NAIP image signature matched that of tallgrass prairie habitat then that patch was digitized as a polygon in the TPR geospatial database. This process was used for all three habitat types analyzed in this study; tallgrass prairie, bottomland forest, and wetlands. Each habitat type was digitized on-screen using ArcGIS 9.2 (ESRI, Redlands, Calif.). The final product of Phase 1 was a draft map TPR that was used for field verification.

The focus of Phase 2 was ground verification and validation of the draft TPR map. Visitation of field sites was prioritized based on land ownership. Thus, habitat patches identified as occurring on public land (i.e., Oklahoma Department of Wildlife Conservation Wildlife Management Areas, Oklahoma Department of Tourism installations, U.S. Army Corp of Engineers lands, U.S. Fish and Wildlife Service National Wildlife Refuges, etc.) were scheduled for evaluation first. Sites located on privately owned property were visited second. This strategy was based on the assumption that we could get permission to visit public owned land more quickly then private land. If polygons of interest occurred on private property, we consulted the county tax assessor's office for landowner contact information. Permission to visit the site was then requested from private landowners. If a landowner declined our request, the polygon was removed from the field verification process.

During a field visit, the polygon was first evaluated and a determination made whether the polygon did represent the habitat type as classified. In addition, notes were recorded regarding the quality of habitat patch and associated land management practices. These notes were used when editing the geospatial database.

Once a site was deemed as positive for the habitat type as mapped in Phase 1, the latitude and longitude (in decimal degrees) was recorded using a Global Positioning System (GPS) device. The GPS points were used in an iterative process involving field verification, editing spatial layers in the geospatial database, followed by additional field verification. This process was repeated until as many field sites were visited as possible. How this process expedited geospatial database development can be illustrated with a hypothetical example for bottomland forests. If 15 locations in Mayes County were mapped as bottomland forest in Phase 1 and five were determined to be pecan groves during field verification, GPS points entered for the pecan grove polygons could be compared with sites as yet unvisited in the TRP geospatial database. Thus, when color and texture analysis were done for the remaining bottomland forest sites in Mayes County, sites previously identified as forested wetlands that were actually pecan groves were removed from field verification.

When ground-truthing commenced in the second and subsequent field seasons, a random subsample of polygons was selected from the edited geospatial database. Approximately 20 percent of the digitized polygons were verified in this manner. Discrepancies between polygons digitized into the habitat layers and ground observations were noted and final edits completed. Phase 2 ended with a recheck of the NAIP images against ground-truth data to assure maximal accuracy of all digitized polygons.

Phase 3 consisted of quality control operations to assure accuracy and completion of the digital habitat layer. Metadata for the TGP Geospatial Database was also written in Phase 3.

Deviations from the project statement

There were limited procedural deviations from those proposed in the project statement, but all deviations enhanced the quality of the project. For example, the project statement called for the use of Digital Orthophoto Quarter Quads (DOQQs) for the image interpretation. Although we attempted to use this data source, it become obvious that tall fescue pastures could not be differentiated from native tallgrass prairie remnants using black-and-white imagery. The color NAIP data were more useful for distinguishing habitat types based on color signatures, which, as noted above, was instrumental in separating tall fescue from tallgrass prairie remnants.

It was realized that the protocol for 40 acre-grid blocks, as used by the Kansas Biological Survey, of intact prairie to be digitized was not attainable. Most habitat remnants, particularly tallgrass prairie, are not uniform. As a result, using the 40-acre grid protocol would result in an over estimate of some habitats and under estimates of others. This method would have been more appropriate for a raster based GIS data layer, not the vector based GIS approached used in this study.

The deviations from the patch sizes made in the project statement were based mainly on land-use practices. Tallgrass prairie habitat is used for either pastureland or annually mowed hay meadows. Interpreting polygons based on land-use practices proved to be the most meaningful to identify tallgrass prairie habitat. For example, grazing by livestock maintained large patches of tallgrass prairie whereas small patches were maintained by annual mowing.

Summary

Of the three habitat types mapped, tallgrass prairie occupied the greatest total area and number of patches in the study area (Table 1). There are two patterns to note regarding the distribution of tallgrass prairie. First is the large and contiguous tallgrass prairie in Kay and Osage counties (Figure 2) in the western lobe of the TPR and in Craig, Nowata, and Washington counties to the east (Figure 3). The large patch of tallgrass in Rogers County is significant due to its proximity to the Nowata and Washington County sites. However, most of Rogers County exemplifies the second pattern of note; that the south and east potions of the eastern lobe of the TPR are highly fragmented, small patch occurrences of remnant tallgrass prairies (Figure 4). These remnants are often referred to as prairie haymeadows. They differ in management regime from the large patches to the northwest, where large livestock operations utilize the native grasses. On the other hand, the grasses in haymeadows are typically cut for hay in July, which is baled and utilized off site. Prairie haymeadows tend to have a great abundance and diversity of forbs relative to large ranching operations. Nonetheless, areas mapped as large, contiguous tracts of tallgrass prairie may have prairie haymeadows embedded within them. This was observed in Craig and Nowata counties.

Bottomland forests were most prominent in the eastern lobe of the TPR along Caney, Verdigris, Neosho, and Arkansas Rivers, including large tributaries of these streams (Figure 4). Washington and Rogers counties had the greatest number of bottomland forest patches, but the largest mean patch size occurred in Nowata County (Table 3). The bottomland forests of Nowata County are pin oak dominated stands along the Verdigris River.

The distribution of wetlands in the area also corresponds with major streams (Figure 5). The greatest number of wetland patches occurred in Washington County, but by far the largest mean patch size and greatest total area of wetlands was in Nowata County (Table 4). The prominent patch of wetland vegetation in southern Nowata County is associated with Lake Oolagah. Wetlands mapped in the TPR geospatial database are emergent and in some cases aquatic beds. It should be noted that these classes of wetlands occur at fine spatial scales and often merge into adjacent vegetation types in remotely sensed data. Also many areas that appear to be wetlands occur on private land in the TPR, so opportunities for ground verification were limited.

Conclusion

Accuracy of the TGP geospatial database was improved by ground-truthing. The combination of field visits, collection of GPS data, and iterative mapping assured maximal accuracy for the project. This proved to be true for bottomland forests as well as tallgrass prairie. The bottomland forests were useful in identifying the location of wetlands because they were in close proximity to one another. Difficulty in digitizing bottomland forests arose in delineating them from upland forests and often the riparian transition to upland was very gradually turn into cross-timbers.

Segregating tall fescue pastures and remnant tallgrass prairie was a continuous challenge. This was particularly true when using black and white data sources. Color digital images facilitated better detection of tallgrass prairie remnants and field verification increased our confidence in the final product. Digital imagery that employs multi-season color imagery could further separate hay-meadows from tall fescue. Tall fescue is a cool season grass and flowers in the spring. By the time warm season grasses flower in the tallgrass prairie remnants, tall fescue inflorescences have begun to senesce and brown. This gives tall fescue pastures a distinctive color and texture separate from tallgrass prairie remnants. In this project, we could not include multi-temporal data in the budget.

Table 1: Occurrences and area occupied by habitat types of concern in the Tallgrass Prairie State Wildlife Action Plan region.

Habitat type	Number of Patches	Mean Patch Size (acres)	Median Patch Size (acres)	Total Landscape Area (acres)
Tallgrass Prairie	1,374	667.8	45.9	917,572.9
Bottomland Forests	551	110.1	53.5	60,667.1
Wetlands	113	86.1	28.2	9,724.7

Table 2: Occurrences and area occupied by tallgrass prairie remnants in the Tallgrass Prairie State Wildlife Action Plan region.

County	Number of Patches	Mean Patch Size (acres)	Median Patch Size (acres)	Total Landscape Area (Acres)
Craig	218	315.8	48.6	68845.9
Creek	2	203.9	203.9	407.9
Delaware	27	57.2	50.4	1544.8
Kay	50	1609.3	43.4	80463.8
Mayes	145	68.8	39.3	9973.1
McIntosh	17	38.7	36.9	657.2
Muskogee	96	96.5	37.4	9265.2
Noble	5	55.9	29.4	279.8
Nowata	151	671.8	38.6	101449.6
Okmulgee	40	102.6	53.2	4102.8
Osage	75	6750.5	72.0	506287.5
Ottawa	80	65.4	44.9	5235.1
Pawnee	107	151.3	40.4	16193.4
Payne	13	75.9	40.8	987.8
Rogers	154	174.9	42.5	26927.8

County	Number of Patches	Mean Patch Size (acres)	Median Patch Size (acres)	Total Landscape Area (Acres)
Tulsa	42	137.6	53.9	5780.1
Wagoner	108	61.7	47.0	6664.1
Washington	102	705.2	50.8	71935.5

Table 3: Area occupied and landscape metrics for bottomland forests in the Tallgrass Prairie State Wildlife Action Plan region.

County	Number of Patches	Mean Patch Size (acres)	Median Patch Size (acres)	Total Landscape Area (Acres)
Craig	36	75.7	61.9	2724.8
Creek	3	38.2	18.7	114.7
Mayes	78	121.8	52.4	9501.7
McIntosh	15	52.9	33.9	793.7
Muskogee	36	64.5	52.9	2323.4
Nowata	55	186.9	99.7	10280.2
Osage	34	35.9	24.9	1221.7
Ottawa	40	136.7	86.9	5466.4
Rogers	88	138.6	59.8	12195.8
Tulsa	72	45.3	30.1	3258.9
Wagoner	55	114.3	72.8	6288.2
Washington	91	71.3	38.5	6486.9

Table 4: Occurrences and area occupied by county of wetlands in the Tallgrass Prairie State Wildlife Action Plan region.

County	No. of Patches	Mean Patch Size (acres)	Median Patch Size (acres)	Total Landscape Area (Acres)
Craig	9	29.8	11.3	268.4
Delaware	2	16.8	16.8	33.7
Mayes	6	39.6	24.6	237.7
Mcintosh	4	37.5	33.5	149.9
Muskogee	18	19.9	17.3	359.9
Nowata	18	321.6	45.3	5788.8
Osage	4	19.3	24.4	77.2
Ottawa	5	44.8	24.7	224.1
Rogers	15	28.4	27.7	425.2
Tulsa	13	38.2	30.2	496.2
Washington	35	47.5	28.7	1663.7

Approved by:

Alan Peoples,
Chief of Wildlife Division
Oklahoma Department of Wildlife Conservation

John D. Stafford,
Federal Aid Coordinator
Oklahoma Department of Wildlife Conservation

Figure 1: Location of the Tallgrass Prairie State Wildlife Action Plan region with mapped remnants of tallgrass prairie, bottomland forest, and wetland habitats.

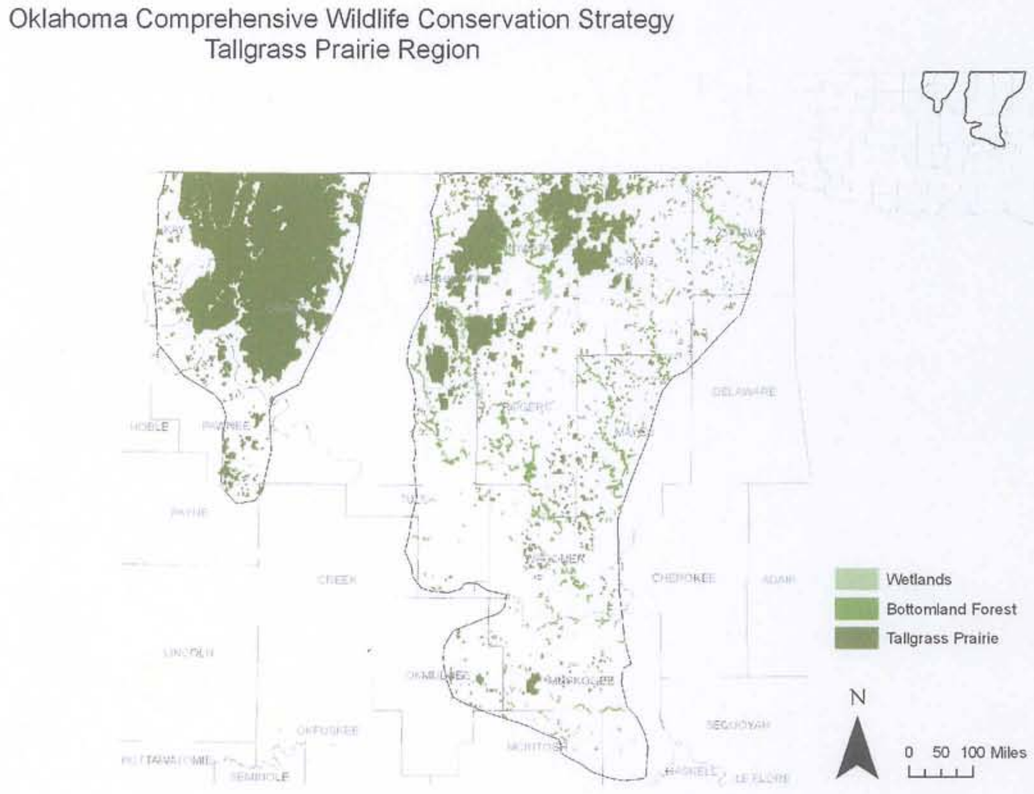

Figure 2: Distribution of tallgrass prairie remnants in the western portion of the Tallgrass Prairie State Wildlife Action Plan region.

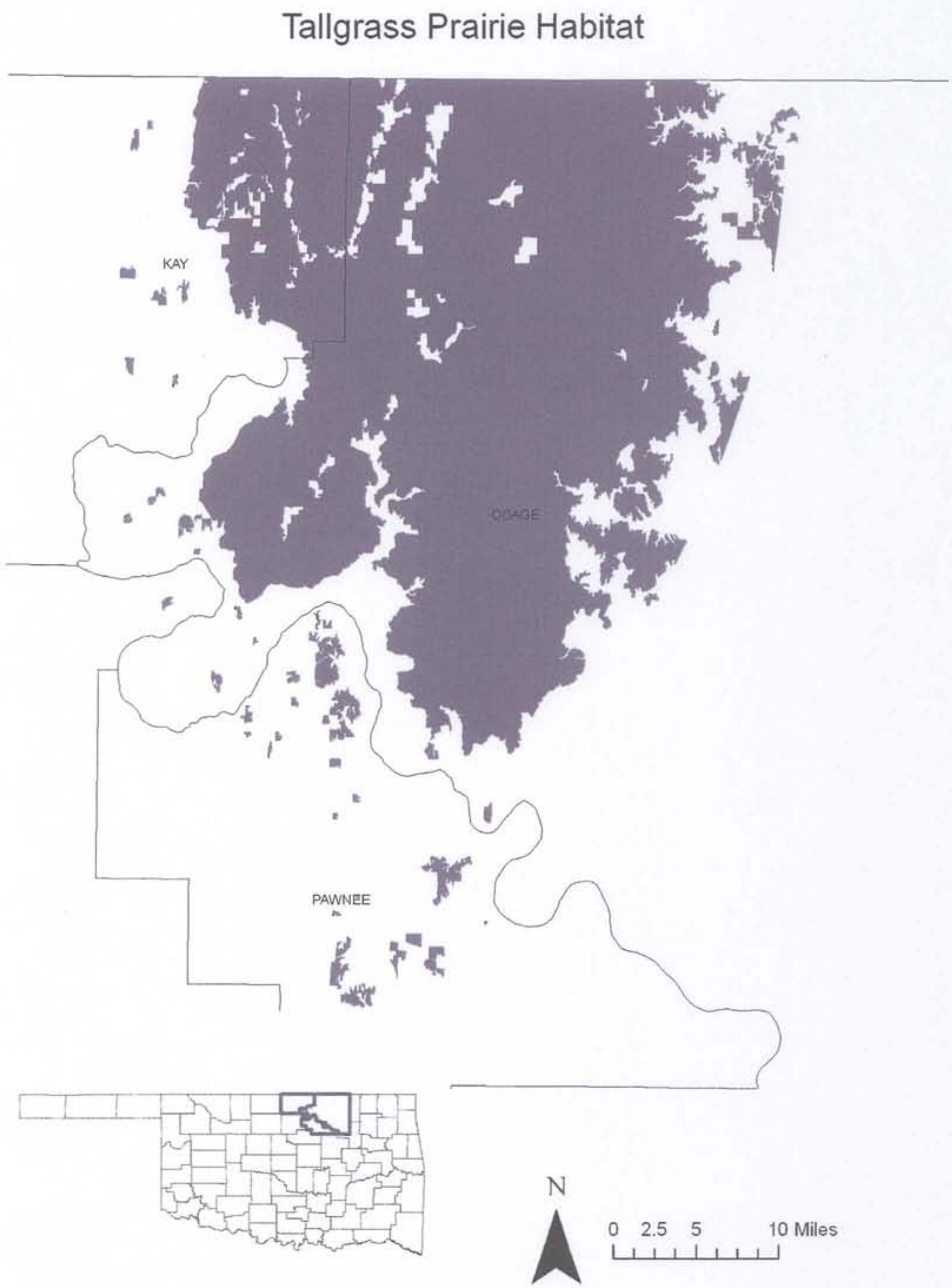

Figure 3: Distribution of tallgrass prairie remnants in the eastern portion of the Tallgrass Prairie State Wildlife ActionPlan region.

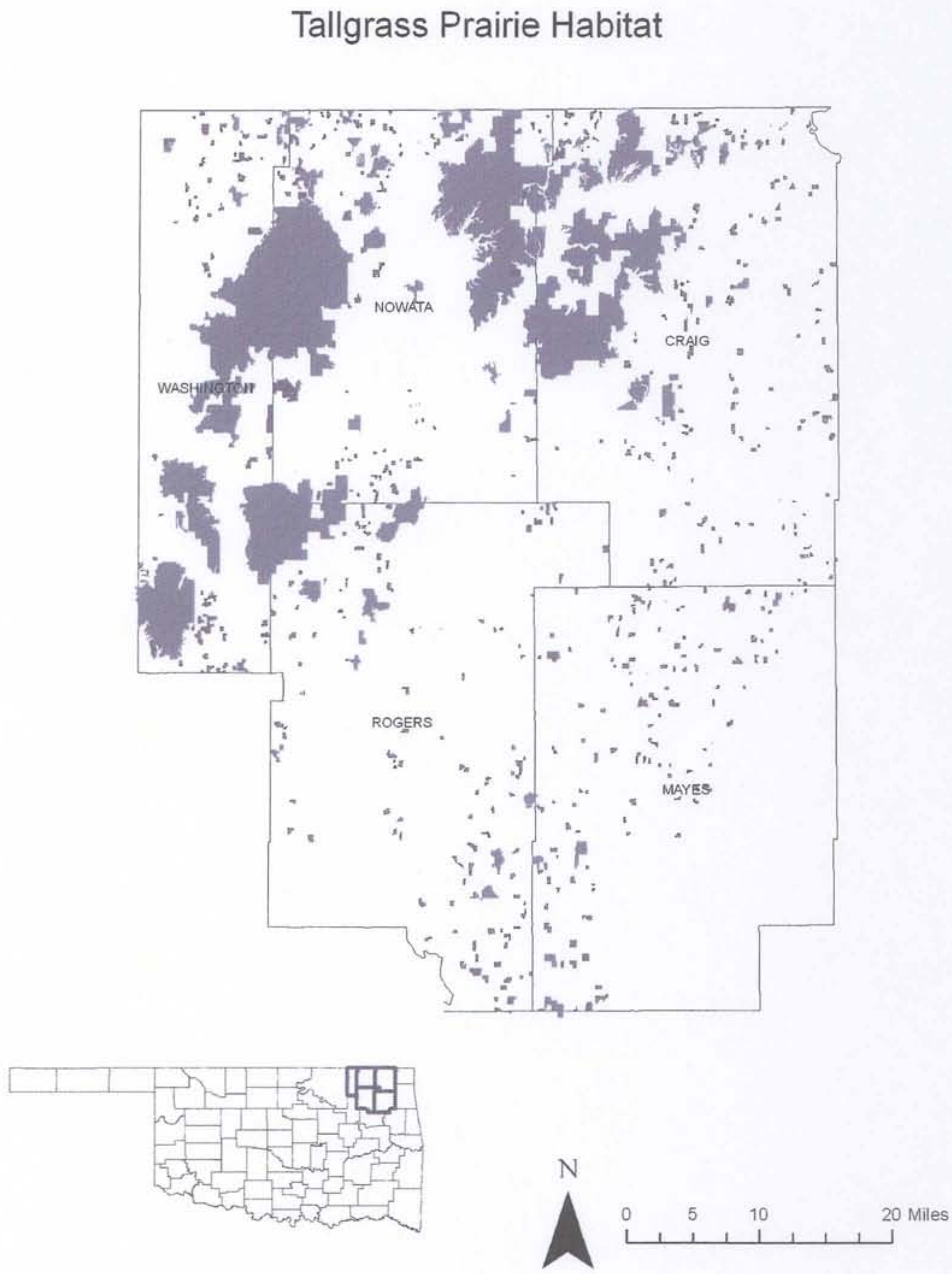

Figure 4: Distribution of bottomland forest in the Tallgrass Prairie State Wildlife Action Plan region.

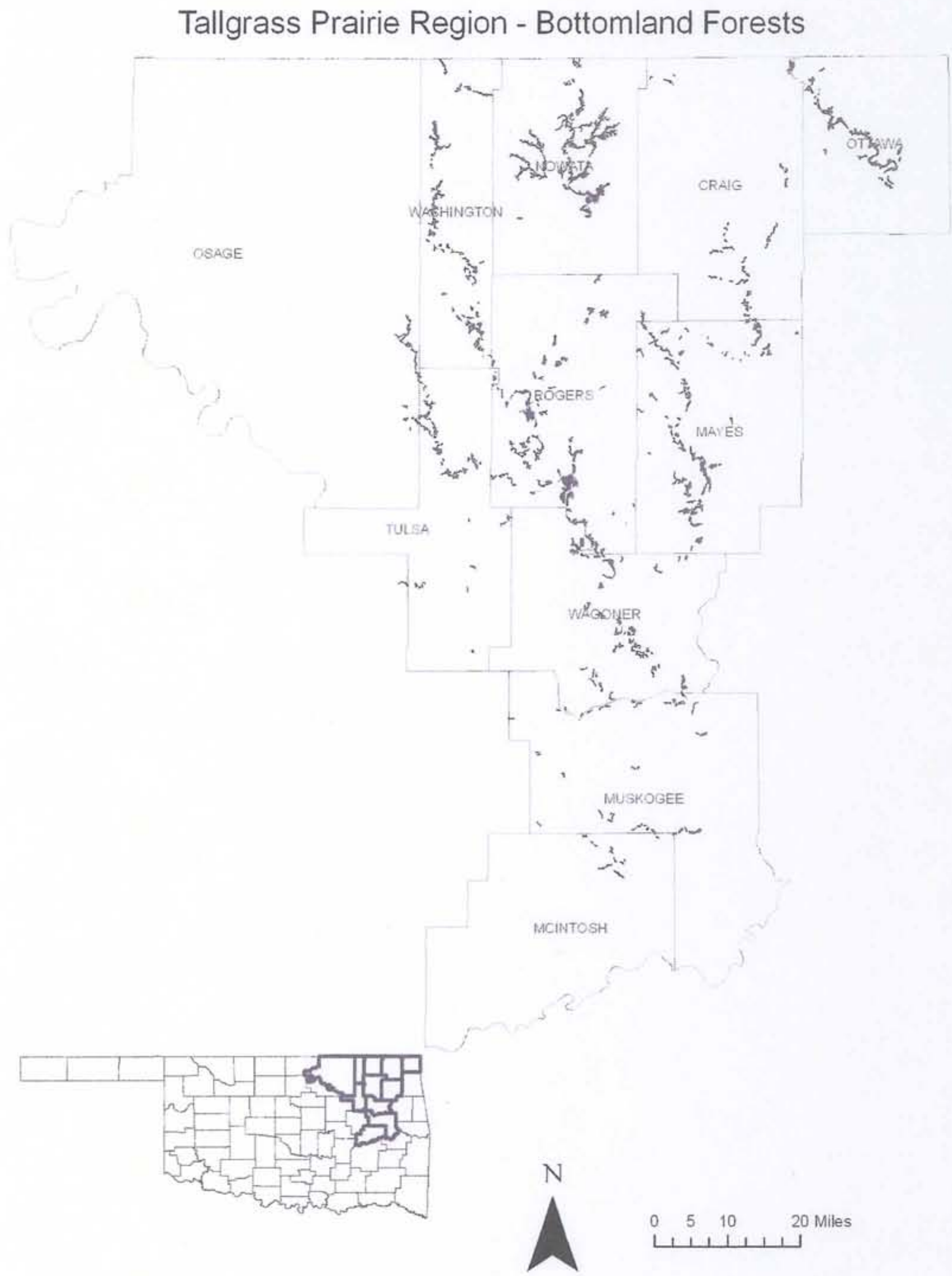

Figure 5: Distribution of wetland in Tallgrass Prairie State Wildlife Action Plan region.

Tallgrass Prairie Region - Wetlands

Significant Deviations: None

Principal Investigator: Dr. Bruce Hoagland
Oklahoma Biological Survey

Prepared by: Bruce Hoagland and Melissa A. Hinten
Oklahoma Biological Survey

Date: 14 October, 2009