FINAL REPORT
CONSERVATION PRIORITY OF 11-DIGIT HYDROLOGIC UNITS IN OKLAHOMA

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TABLE OF CONTENTS

Chapter 1. Aquatic stratification regions for the state of Oklahoma 5
Introduction..... 5
Methods..... 6
Study area..... 6
Analysis..... 6
Results..... 7
Discussion..... 9
Literature cited..... 12
Chapter 2. Hydrologic units of conservation priority in Oklahoma. 25
Introduction..... 25
Methods..... 29
Study area..... 29
Prioritizing streams 29
Results..... 31
Discussion..... 35

LIST OF TABLES

CHAPTER 1

Table 1. Descriptive statistics and comparison of environmental factors between level 5 clusters 15
Table 2. Relative abundances and species comparisons between level 5 clusters. 17
Table 3. General descriptions of Oklahoma aquatic stratification regions. 21

LIST OF FIGURES

CHAPTER 1

Figure 1. The Arkansas and Red River basins in Oklahoma 22
Figure 2. Level 5 clusters and Aquatic Stratification Regions for Oklahoma 23
Figure 3. Dendrogram of Oklahoma stratification regions 24

CHAPTER 2

Figure 1. The Arkansas and Red River basins in Oklahoma 42
Figure 2. Condition, conservation and overall ranks of 11-digit hydrologic units in the High Plains of Oklahoma 43
Figure 3. Condition, conservation and overall ranks of 11-digit hydrologic units in the Central Prairies of Oklahoma 44
Figure 4. Condition, conservation and overall ranks of 11-digit hydrologic units in the Ozarks of Oklahoma 45
Figure 5. Condition, conservation and overall ranks of 11-digit hydrologic units in the Ouachita Mountains of Oklahoma 46
Figure 6. Overall ranks of all hydrologic units in Oklahoma. Darker colors indicate higher rankings 47

CHAPTER 1. AQUATIC STRATIFICATION REGIONS FOR THE STATE OF OKLAHOMA

Introduction

The relationship between aquatic ecosystem structure and landscape scale patterns, including physical and zoogeographic influences, has been well documented (Frissell et al 1986, Richards et al. 1996, Imhof et al. 1996, Nichols 1928, Leopold 1994). At a landscape scale geology, topography and climate control the physical structure of streams. Surficial geology influences stream ecosystem structure by controlling substrate composition, morphology (Leopold 1994, Richards et al 1996), and riparian zone composition (Richards et al. 1996). Geology, topology and climate affect a stream's hydrology and structure. Streamflow quantity and timing, which are directly related to precipitation patterns and relief, are correlated with water temperature, channel morphology and habitat diversity (Richards et al. 1996, Poff et al. 1997, Leopold 1994).

In addition to physical characteristics, zoogeographic history also has a strong influence over stream ecosystem structure (Frissell et al. 1986). The available fauna in a stream ecosystem is the product of a whole series of historical zoogeographies that have succeeded one another in time and resulted in the present pattern (Davies 1961).

Ecoregions are commonly used to summarize landscape scale patterns and provide a stratification tool for both research and management efforts (Woods et al. 2005, Bailey 1995, Hughes et al. 1987, Frissell et al. 1986). Many efforts have been made to stratify Oklahoma by landscape scale physiographic and faunal patterns. Most of these efforts have been directed at terrestrial ecosystems and are based primarily on vegetation (Blair and Hubbell 1938, Duck and Fletcher 1944). Webb (1950) focused on the zoogeography of mammals. The most recent attempts are based on a combination of vegetation, geology and climate with a far lesser

emphasis on zoogeography (Bailey 1995, Woods et al. 2005). Some have even focused on aquatic ecosystems, but from such a broad scale that their utility is limited (Abell et al. 2000).

In this study, I will develop aquatic stratification regions to broadly group similar streams, not just by physical factors, but also by zoogeographic patterns in fishes. By doing this, I can stratify future analyses, and give all streams due consideration based on their stream potential, comparing similar streams to similar streams.

Methods

Study area

Oklahoma encompasses large portions of two major river systems: the Arkansas River and the Red River (figure 1). The Arkansas River originates near Leadville, Colorado in the Rocky Mountains, crossing the high plains, tallgrass prairie and the interior highlands before its ultimate confluence with the Mississippi River in eastern Arkansas. The Red River originates in eastern New Mexico and flows easterly across the high plains, crosstimbers, Ouachita Mountains and gulf coastal plains before its confluence with the Atchafalayah and Mississippi Rivers in western Louisiana. Our analysis encompasses the portions of these watersheds in the state of Oklahoma.

Analysis

Aquatic stratification regions were delineated relative to the distribution of 175 species of fish using collection data (Oklahoma Department of Environmental Quality pers. comm., Oklahoma Conservation Commission pers. comm.). Collection data was used for medium sized streams (stream order 4-6). Exotic species were excluded from all analyses.

Stratification regions were delineated using a Ward's minimum variance cluster analysis (Jongman et al. 1995, SAS Institute Inc 2002). A Wards cluster analysis groups observations in a dataset hierarchically. The distance between two clusters is the ANOVA sum of squares between

the two clusters added up over all the variables. Two observations are clustered into a pair in each iteration, and cluster statistics are generated. I used the pseudo t^2 statistic to determine the number and strength of clusters in the dataset (SAS Institute Inc 2002).

Landscape scale influences driving the stratification regions were examined using an analysis of variance on ranked data, and specific differences between individual stratification regions were examined using multiple comparisons with Bonferroni (Dunn) corrections (p=.01, SAS Institute Inc 2002, Steele et al. 1997). I examined geologic composition (percents of limestone, igneous rocks, alluvium, and older sands and gravel), mean annual rainfall, topographic relief (mean elevation and standard deviation of elevation), and land cover (percent forest, grassland and shrubland).

To gain a better understanding how species are arranged among ecoregions, I used an analysis of variance on ranked relative abundance data. To limit the list of species examined, and evaluate only the dominant species in an assemblage, I selected only those species that made up more than 5% of a community, on average (table 2).

Results

The cluster analysis revealed a strong relationship between 5 groups. Four of these groups were roughly equivalent to the High Plains, Central Prairies, Ozarks and Ouachita Mountains (figure 2). One group of miscellaneous sites was spread throughout Oklahoma.

When examining the relationships between the spatial layout of the regions and the environmental factors that drive them, I found that all environmental variables except the percentage of igneous rock had significant differences between regions (table 1).

Precipitation formed three groups. The Ouachita Mountains were unique, while the Ozarks and miscellaneous streams grouped together and the Central Prairies and High Plains grouped together.

The elevation variables showed many differences between regions. With mean elevation, the Ozarks, Central Prairies and High Plains were all unique. The Ouachita Mountains and miscellaneous sites grouped together and had the lowest mean elevation. With relief (standard deviation of elevation) each region was again unique with the exception of the High Plains and miscellaneous sites, which grouped together. The Ouachita Mountains had the highest relief, with the Ozarks closely second. The High Plains and miscellaneous sites had a moderate degree of relief.

Land cover variables, generally speaking, split the regions into interior highlands and plains regions. The percent forest broke into two major groups, with the Ozarks and Ouachita Mountains grouping together with the highest percent forest, and the Central Prairies and High Plains grouping together with the least. The miscellaneous sites were separate from all other groups with a moderate amount of forest. With percent grassland, only Central Prairies and High plains grouped together with the highest amount. All other regions were separate, with the Ozarks having the least amount of grassland. Percent shrubland formed two groups: Central Prairies and High Plains with the largest percentage of shrubland, and Ozarks and miscellaneous sites having a moderate amount. The Ouachita Mountains had the lowest percent shrubland.

The percent limestone was similar across all regions with the exception of the Ozarks, which was unique with the greatest amount of limestone. The percent of mixed limestone and sedimentary rock formed a gradient across the regions. The Ouachita Mountains, Central Prairies and High Plains grouped together, and the Central Prairies, High Plains and miscellaneous sites

grouped together. The Ozarks remained separate, with the most mixed rocks. Igneous rocks were scarce throughout the study area, and all regions were similar. Percent sand and gravel was similar across all regions, with the exception of the High Plains, which had the highest amount.

To assess zoogeographic patterns, I examined dominant species across Oklahoma. Twenty-nine species made up, on average, over 5% in the assemblages of which they were a part (table 2). Twenty of these species were Cyprinids, two were Fundulids, two were Centrarchids and three were Percids. Many species were endemic to certain regions, which will be discussed in depth in the discussion. Several species were ubiquitous across the state of Oklahoma including the bullhead minnow (*Pimephales vigilax*), brook silverside (*Labidesthes sicculus*), western mosquitofish (*Gambusia affinis*) and longear sunfish (*Lepomis megalotis*).

Discussion

Geology, topography, vegetation and climate were commonly regarded as fundamental variables along which both terrestrial and aquatic biodiversity arrange themselves. In addition to these, zoogeography played a role (Frissell et al 1986, Richards et al. 1996, Imhof et al. 1996, Nichols 1928, Leopold 1994). I translated the five clusters into four regions (figures 2 and 3, table 3). As I looked back at the groupings of sites along environmental gradients, I began to understand which gradients caused shifts in aquatic stratification regions across Oklahoma.

The Ozarks and the Ouachita Mountains often referred to collectively as the Interior Highlands. These regions were differentiated from each other by precipitation, topography, geology and vegetation. The Ozarks had slightly less rainfall that the Ouachita Mountains. Both regions had high relief, though the Ouachita Mountains were more rugged. While three of the geologic variables were not significant, the percents of limestone, mixed rock and sedimentary rocks were. The Ozarks were predominately limestone and mixed rocks, where the Ouachita

Mountains were nearly entirely sedimentary rocks. While both of these regions were dominated by forest, vegetation differences were primarily in shrublands and grasslands, which were a minor component of both regions. On the ground, these influences are readily apparent. The Mississippian limestone that formed the majority of the Ozarks formed a Karst landscape with gravel bottomed, spring fed streams. The Ouachita streams were higher gradient, bedrock controlled, rainfall dominated streams. Both stream types had forested watersheds. The fish assemblages in these regions had many species in common: central stoneroller (*Campostoma anomalum*), bigeye shiner (*Notropis boops*) and orangethroated darter (*Etheostoma spectabile*) These regions also had key differences. The Ozark sites were dominated by the cardinal shiner (*Luxilus cardinalis*), Ozark minnow (*Notropis nubilis*), and southern redbelly dace (*Phoxinus erythrogaster*), while the Ouachita Mountains were inhabited by the blacktail shiner (*Cyprinella venusta*), Kiamichi shiner (*Notropis ortenburgeri*), redfin shiner (*Lythrurus umbratilis*) and orangebelly darter (*Etheostoma radiosum*, table 2).

The break between the Ouachita Mountains and Central Prairies was defined by precipitation, topography, geology and vegetation. Precipitation was lower in the Central Prairies than in the Ouachita Mountains. While mean elevation was higher in the Central Prairies, relief was much less. Geology was similar between the regions, with the exception of alluvium. The Central Prairies had more alluvium than the Ouachita Mountains, in connection with the wide alluvial streams in western Oklahoma. While forest dominated the Ouachita Mountains, the Central Prairies was dominated by grasslands, with forest and shrublands making up a smaller proportion. These regions have few fish species in common, other than the species that are ubiquitous across Oklahoma. The Ouachita Mountains assemblages included the Kiamichi shiner, blacktail shiner, redfin shiner and orangebelly darter. Central Prairie assemblages

included emerald shiner (*Notropis atherinoides*) and the ghost shiner (*Notropis buchanani*, table 2).

The boundary between the Ozarks and Central Prairies was defined by precipitation, relief, geology and vegetation. Precipitation was much lower in the Central Prairies compared to the Ozarks. While the mean elevation was higher in the Central Prairies, again, the relief was much less. While the Ozarks were predominantly limestone the Central Prairies consisted of sedimentary and mixed rocks, with a higher percentage of alluvium. The Ozarks were mostly forested, but the Central Prairies were mostly grasslands with lesser amounts of forest and shrublands. The Ozark assemblages contained the cardinal shiner, Ozark minnow, and southern redbelly dace, while the Central Prairie stream species included emerald shiner and the ghost shiner. As between the Ouachita Mountains and the Central Prairies, this was also a stark boundary, with few key species being shared between regions (table 2).

The last boundary, between the Central Prairies and High Plains, was driven by topography and geology. Precipitation and vegetation did not vary between regions, and therefore did not seem to be major driving factors. Both mean elevation and relief was greater in the High Plains than the Central Prairies. The percentage of sedimentary rocks was less in the High Plains, which had more sand and gravel. The High Plains generally overlie the Ogallala formation, while the Central Prairies overlie more cohesive sedimentary rocks. The fish assemblages in these two regions had much in common. Both regions have red shiner (*Cyprinella lutrensis*), plains minnow (*Hybognathus placitus*), Red River shiner (*Notropis bairdi*), sand shiner (*Notropis stramineus*), fathead minnow (*Pimephales promelas*) and plains killifish (*Fundulus zebrinus*). The Central Prairies had emerald shiner and ghost shiner, while the High plains were populated by the Arkansas darter (*Etheostoma craigini*, table 2).

Overall, geology and topography played the largest role in driving regional faunal diversity shifts. This is presumably due to the roles they play in controlling stream structure and hydrologic regime. Each region had a unique geologic and topographic makeup. Precipitation seemed to be most important in differentiating between plains and interior highland regions. While it can be useful to examine vegetation to provide context as it does appear to have some correlation with regions, it should be interpreted with caution. Vegetation patterns were highly correlative with precipitation, with precipitation alone explaining as much as 73% of variation in forest and grassland. Its significance across regions may have been more due to this direct relationship than any role in shaping stream ecosystem processes and fish assemblage structure.

This study provided the broadest look at landscape influences on stream ecosystem structure, to provide a regionalization to facilitate the management of aquatic resources. More work needs to be done in Oklahoma and surrounding areas to further quantify these relationships and improve the understanding of the linkages between landscape scale factors and their effect on reach level features and biotic patterns. A better understanding of zoogeographic patterns within major fish regions would also be of benefit, to better understand the effect of local gradients on fish assemblage structure.

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Table 1. Descriptive statistics and comparison of environmental factors between level 5 clusters

Level 5 cluster	Ozarks	Ouachita Mountains	Central Prairies	High Plains	Miscell-aneous
N	99	160	136	188	74
Precipitation (p<.01)					
Mean	44.9	46.8	30.5	29.5	40.8
Range	42.0-49.5	21.0-57.5	19.0-46.0	15.0-53.0	22.0-57.5
Similarity	a		b	b	a
Mean elevation (p<.01)					
Mean	271.2	211.2	364.2	510.9	231.4
Range	162.5-341.3	92.4-757.8	238.0-821.2	91.8–1425.6	96.2-643.8
Similarity		a			a
Relief (Standard deviation of elevation) (p<.01)					
Mean	26.4	26.8	8.8	13.4	12.2
Range	15.8-49.1	2.64-89.94	0.22-38.8	0.15-62.43	0.84-91.3
Similarity				a	a
Average Forest (p<.01)					
Mean	61.0	58.2	10.6	14.3	31.6
Range	22.2-92.5	0-98.5	0-66.3	0-90.2	0.3-97.2
Similarity	a	a	b	b	
Average grassland content (p<.01)					
Mean	0	6.2	32.1	45.5	14.2
Range	0-1.2	0-92.1	0-96.3	0-99.5	0-58.9
Similarity			a	a	
Percent shrublands (p<.01)					
Mean	0.9	0.66	4.4	4.5	2.1
Range	0-7.9	0-20.4	0-32.8	0-56.0	0-21.4
Similarity	b		a	a	b
Percent sedimentary (p<.01)					
Mean	19.7	92.2	81.1	67.7	69.8
Range	0-100	0-100	0-100	0-100	0-100
Similarity		a	ab	c	bc
Percent Limestone (p<.01)					
Mean	44.2	2.0	0.5	4.0	5.5
Range	0-100	0-100	0-72.4	0-100	0-100
Similarity		a	a	a	a

Table 1 continued. Descriptive statistics and comparison of environmental factors between level 5 clusters

Level 5 cluster	Ozarks	Ouachita Mountains	Central Prairies	High Plains	Miscell-aneous
Percent mixed (p<.01)					
Mean	36.0	0.9	5.8	6.4	11.6
Range	0-100	0-97.8	0-100	0-100	0-100
Similarity		b	ab	ab	a
Percent igneous					
Mean	0.0	1.9	0.4	0.5	0.3
Range	0-0.8	0-79.1	0-29.7	0-37.6	0-20.9
Similarity	a	a	a	a	a
Percent alluvium (p<.01)					
Mean	0	2.5	12.0	14.2	11.6
Range	0-0	0-96.8	0-100	0-100	0-100
Similarity	c	bc	a	a	ab
Percent sand and gravel (p<.01)					
Mean	0	0.4	0.1	7.3	1.3
Range	0-0	0-32.8	0-7.6	0-100	0-79.9
Similarity	a	a	a		a

Table 2. Relative abundances and species comparisons between level 5 clusters.

Species	Ozarks	Ouachita Mountains	Miscell-aneous	Central Prairies	High Plains
Central stoneroller					
Campostoma anomalum					
Mean	0.111	0.067	0.054	0.006	0.021
Range	0-0.768	0-0.452	0-0.448	0-0.145	0-0.500
Similarity		a	a	b	b
Red shiner					
Cyprinella lutrensis					
Mean	0	0.031	0.231	0.443	0.291
Range	0-0.003	0-0.826	0-0.764	0-0.980	0-0.969
Similarity	b	b	a		a
Blacktail shiner					
Cyprinella venusta					
Mean	0	0.028	0.010	0.005	0.019
Range	0-0	0-0.600	0-0.526	0-0.261	0-0.931
Similarity	b	a	a	b	b
Steelcolor shiner					
Cyprinella whipplei					
Mean	0.012	0.056	0.017	0.003	0.006
Range	0-0.338	0-0.549	0-0.174	0-0.398	0-0.400
Similarity	a		a	b	b
Plains minnow					
Hybognathus placitus					
Mean	0	0	0.009	0.014	0.024
Range	0-0	0-0	0-0.199	0-0.241	0-1.000
Similarity	b	b	a	a	a
Cardinal shiner					
Luxilus cardinalis					
Mean	0.199	0	0	0	0.003
Range	0-0.790	0-0.18	0-0.020	0-0	0-0.250
Similarity		a	a	a	a
Ouachita shiner					
Lythrurus snelsoni					
Mean	0	0.001	0	0	0
Range	0-0	0-0.180	0-0.011	0-0	0-0
Similarity	a	a	a	a	a
Redfin shiner					
Lythrurus umbratilis					
Mean	0.002	0.067	0.018	0	0.005
Range	0-0.062	0-0.687	0-0.172	0-0.036	0-0.737
Similarity	b	a	a	b	b

Table 2 continued. Relative abundances and species comparisons between level 5 clusters.

Species	Ozarks	Ouachita Mountains	Miscell-aneous	Central Prairie	High Plains
Emerald shiner					
Notropis atherinoides					
Mean	0.001	0.018	0.027	0.023	0.010
Range	0-0.028	0-0.471	0-0.604	0-0.388	0-0.500
Similarity	a	a			a
Red River shiner					
Notropis bairdi					
Mean	0	0	0.001	0.008	0.015
Range	0-0	0-0	0-0.055	0-0.313	0-0.325
Similarity	bc	c	bc	ab	a
Bigeye shiner					
Notropis boops					
Mean	0.043	0.138	0.018	0	0.018
Range	0-0.867	0-0.775	0-0.326	0-0.003	0-0.885
Similarity				a	a
Ghost shiner					
Notropis buchanani					
Mean	0	0	0.016	0.041	0.002
Range	0-0.003	0-0.021	0-0.392	0-0.800	0-0.297
Similarity	a	a			a
Ozark minnow					
Notropis nubilus					
Mean	0.070	0.001	0	0	0.003
Range	0-0.466	0-0.092	0-0	0-0	0-0.548
Similarity		a	a	a	a
Kiamichi shiner					
Notropis ortenburgeri					
Mean	0	0.016	0.003	0	0
Range	0-0	0-0.470	0-0.099	0-0	0-0
Similarity	b	a	a	b	b
Sand shiner					
Notropis stramineus					
Mean	0	0.002	0.010	0.042	0.090
Range	0-0	0-0.354	0-0.141	0-0.450	0-0.667
Similarity	b	b		a	a
Southern redbelly dace					
Phoxinus erythrogaster					
Mean	0.011	0	0	0	0.011
Range	0-0.261	0-0	0-0.009	0-0	0-0.856
Similarity		a	a	a	a

Table 2 continued. Relative abundances and species comparisons between level 5 clusters.

Species	Ozarks	Ouachita Mountains	Miscell-aneous	Central Prairie	High plains
Fathead minnow					
Pimephales promelas					
Mean	0	0.002	0.007	0.023	0.040
Range	0-0.004	0-0.286	0-0.114	0-4.18	0-0.706
Smilarity	b	b		a	a
Bullhead minnow					
Pimephales vigilax					
Mean	0.001	0.008	0.023	0.111	0.027
Range	0-0.022	0-0.188	0-0.183	0-0.856	0-0.600
Similarity	b	ab			a
Brook silversides					
Labidesthes sicculus					
Mean	0.016	0.059	0.045	0.002	0.006
Range	0-0.469	0-0.476	0-0.584	0-0.069	0-1.000
Similarity		a	a	b	b
Western mosquitofish					
Gambusia affinis					
Mean	0.028	0.063	0.060	0.072	0.121
Range	0-0.177	0-0.753	0-0.470	0-0.624	0-0.900
Similarity	bc	c	a	ab	ab
Plains killifish					
Fundulus zebrinus					
Mean	0	0	0.006	0.021	0.039
Range	0-0	0-0	0-0.187	0-0.601	0-0.500
Similarity	b	b	a	a	a
Longear sunfish					
Lepomis megalotis					
Mean	0.028	0.083	0.039	0.035	0.026
Range	0-0.317	0-0.434	0-0.377	0-0.435	0-1
Similarity	a		a	a	
Arkansas darter					
Etheostoma craigini					
Mean	0	0	0	0	0.011
Range	0-0	0-0	0-0	0-0	0-0.490
Similarity	a	a	a	a	
Orangebelly darter					
Etheostoma radiosum					
Mean	0	0.038	0.006	0	0.002
Range	0-0	0-0.351	0-0.115	0-0	0-0.298
Similarity	a			a	a

Table 2 continued. Relative abundances and species comparisons between level 5 clusters.

Species	Ozarks	Ouachita Mountains	Miscell-aneous	Central Prairies	High Plains
Orangethroated darter					
Etheostoma spectabile					
Mean	0.058	0.013	0.014	0.001	0.015
Range	0-0.446	0-0.320	0-0.218	0-0.037	0-0.511
Similarity				a	a

Table 3. General descriptions of Oklahoma aquatic stratification regions.

Region	Ozark Plateau	Ouachita Mountains	Central Prairies	High plains
Precipitation (30 year average)	44 inches of rain per year	Wettest region in Oklahoma 46 inches of rain per year	Moderate amounts of rainfall 32 inches of rain per year	Moderate amounts of rainfall 18 inches of rain per year
Geology	High relief Mississippian limestone	High relief shale mountains with sandstone valleys. Sands in the Red River valley	Sedimentary rocks with alluvial deposits along major rivers	Ogallala sand and gravels
Vegetation	Oak – pine forest	Pine forest	Crosstimbers forest and tallgrass and mixedgrass prairie	Shortgrass prairie and sandsage shrublands
Stream types	Gravel bottomed spring-fed streams	Bedrock dominated high gradient streams with flashy rainfall flows	Silty low gradient prairie streams	Wide, sandy plains streams
Zoogeography	Dominant species: cardinal shiner, central stoneroller and Ozark minnow Other species: Southern redbelly dace bigeye shiner orangethroated darter	Dominant species: bigeye shiner, central stoneroller, redfin shiner Other species: blacktail shiner, Kiamichi shiner, flier, orangebelly darter and orangethroated darter	Dominant species: red shiner, ghost shiner, sand shiner Other species: emerald shiner, fathead minnow, plains minnow, Red River shiner and plains killifish	Dominant species: red shiner, sand shiner, northern plains killifish Other species: fathead minnow, plains killifish, plains minnow, Red River shiner, Arkansas darter

Figure 1. The Arkansas and Red River basins in Oklahoma

Figure 2. Level 5 clusters and Aquatic Stratification Regions for Oklahoma

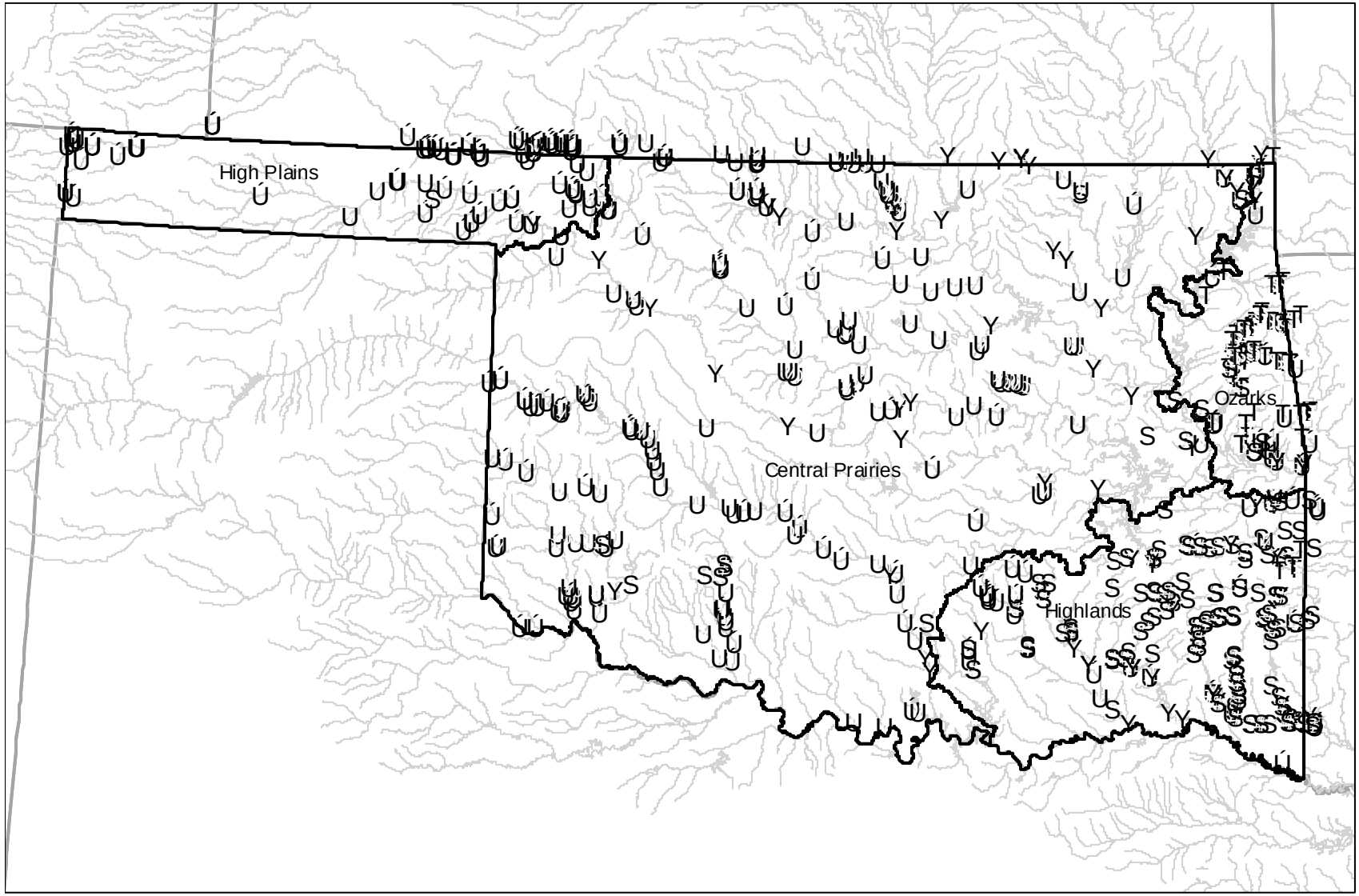
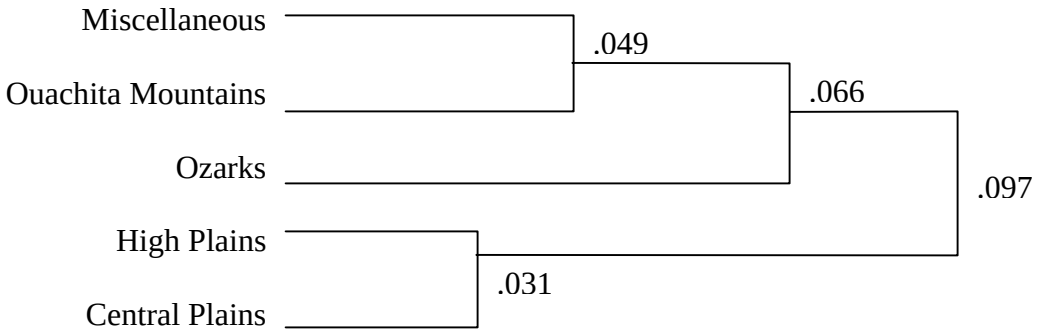


Figure 3. Dendrogram of Oklahoma stratification regions



CHAPTER 2. HYDROLOGIC UNITS OF CONSERVATION PRIORITY IN OKLAHOMA.

Introduction

Aquatic resource managers have long struggled with developing stream conservation and restoration priorities, and many methods have been used, ranging from fieldwork intensive (Patton 1997) to geographic information system (GIS) based (Higgins et al. 2005). These approaches find some measure or estimate of the condition of the stream ecosystem and place some value on the fauna that inhabit that system. The contribution of fauna to the conservation value of a stream ecosystem is commonly based on species richness, and rare species richness. Recently, efforts have been made to develop techniques to determine the uniqueness of an ecosystem taken as a whole, providing an opportunity to prioritize rare stream types over those that are more common (Higgins et al. 2005) .

Environmental variables acting at multiple scales influence the expression of a stream ecosystem. As discussed in the previous chapter, landscape scale processes such as geology and precipitation determine a stream's shape, substrate type, and hydrologic regime (Richards et al. 1996, Frissell et al. 1986). Zoogeographic patterns influence a stream by providing the available fauna forming the assemblage. At a local scale, stream condition and habitat configuration are controlled by land use, land cover, reservoirs and point sources of pollution.

Watershed land use changes due to agriculture and silviculture reduce woody debris and other structural components in streams, resulting in large expanses of stream with shallow, simple habitat structure. Other activities associated with these practices such as road construction and channelization further compound impacts to streams (Schlosser 1991). Land use activities also shift the trophic structure, by decreasing allochthonous inputs of energy and increasing autochthonous inputs. This shifts the main energy input into a stream from fall to spring. Finally, changes in land use increase the rate at which water and sediment enters a stream in the form of

runoff after a rain event, accentuating high and low flow events (Poff et al. 1997, Schlosser 1991, Rutherford 1992).

Rutherford et al. (1992) examined the effect of timber management on fish assemblages in the Little River drainage of southeast Oklahoma. They found that clear cutting associated with silviculture management increased streamflow, sedimentation and water temperature and decreased allochthonous inputs resulting in local short-term shifts in the fish assemblage. In the first three years following a clear cut, the abundance of r-selected fish species like minnows and darters decreased. In years 3-6, k-selected species, like bass and sunfish showed declines. The r-selected species with short life spans and high reproduction appeared to recover more quickly, while the k-selected species with longer life spans and low reproductive rates took longer. They attributed these impacts to increased sedimentation immediately following clear cutting activities and long term impacts of increased water temperature and streamflow.

Impervious surfaces affect both the hydrology (Alberti et al. 2006) and geomorphology of a stream ecosystem (Kang and Marsten 2006, Miltner et al. 2004). Urbanization changes the type and magnitude of runoff processes through the creation of impervious surfaces (Alberti et al. 2006, Kang and Marsten 2006, Miltner et al. 2004). Impervious surfaces decrease infiltration and increase runoff adding more water to streams during a rainfall event than pre-urbanization times and increasing flood peaks (Kang and Marsten 2006). In addition, storm drains are designed to carry rain water to streams as quickly as possible (Alberti et al. 2006). Miltner et al. (2004) examined the effect of urbanization on the biotic integrity of streams with respect to Clean Water Act standards. They found significant declines in biotic integrity in hydrologic units with 13.8% impervious surfaces and total loss of aquatic life use at 27.1%. They also found that allied stressors such as sewer overflows, wastewater discharges, landfills, accidental spills,

intentional dumping and stream dredging and filling reduced these thresholds further. This echoes the conclusions of Karr and Chu (2000) who found that biological systems become grossly impaired when impervious surfaces within a watershed reach 8-20% and irreparably damaged from 25-60%, referring to minimum water quality standards. Geomorphic effects of urbanization are the result of changes in the hydrologic regime (Kang, R.S. and R.A. Marsten. 2006), but also include the channelization and lining of streams with concrete to move water faster (Alberti et al. 2006).

It has been well established that reservoirs have both upstream and downstream effects on stream ecosystems. Downstream reaches are affected by changes in hydrologic, temperature and sediment regimes. High flow pulses are trapped by a reservoir, and diverted for water supply or released over time, increasing the base flows of streams during dry seasons, and decreasing base flow during wetter seasons (Poff et al. 1997, Hubbs and Pigg 1976, Luttrell et al 1999, Vaughn and Taylor 1999). These releases are often made from the hypolimnion, at the bottom of a reservoir where temperatures are cold, effecting the temperature regime in downstream portions of the river (Vaughn and Taylor 1999). Sediment, an important stream flow component, settles out as stream water slows upon entering the reservoir. The clear water releases from reservoirs in turn entrain sediment, resulting in excessive scouring in tailwater streams (Hubbs and Pigg 1976, Leopold 1994, Vaughn and Taylor 1999).

Vaughn and Taylor (1999) documented the result of these effects on mussels in the Little River in southeastern Oklahoma. They related the composition of the mussel assemblage with distance from reservoirs. They found that mussels did not begin to recover until 20 km downstream of Pine Creek Lake, and increased linearly in number of both individuals and species after that, peaking at 58 km. They suggested that 1) because mussels are slow moving,

they cannot seek refugia fast enough with the increased rise and fall rates for flow, 2) the decreased temperatures due to hypolimnetic releases decrease mussels metabolic rate, hindering growth in summer months and 3) the erosion and subsequent stream destabilization further degrade mussel habitat.

Upstream effects of reservoirs include the disruption of source/sink dynamics, fragmentation of free-flowing habitats, and the introduction of predator species (Gido et al 2002, Luttrell et al. 1999). Luttrell et al. (1999) documented these effects while examining the decline of the speckled chub (*Macrhybopsis aestivalis*) complex in Oklahoma. The speckled chub complex spawns semibouyant eggs during flood events, which float downstream as they hatch and develop into larvae. Adults must disperse upstream. Because of the harsh, unpredictable nature of plains streams, these species rely on source/sink relationships with more reliable streams to provide stock after major drought events. The speckled chub complex, because of both eggs entering reservoirs and disruption of source/sink relationships by reservoirs, has seen major declines. The shoal chub (*M. hyostoma*) has been extirpated from 55% of its historic range while the Arkansas River Speckled chub (*M. tetranema)* has been extirpated from 90% of its historic range. The threatened Arkansas River shiner (*Notropis girardi*) displays a similar life history, and has also shown decreases due to both competition with bait species and habitat fragmentation. It was historically distributed throughout the western portions of the Arkansas River drainage in Oklahoma, Kansas, New Mexico and Texas, and is now restricted to the Canadian River in west central Oklahoma (USFWS 1998).

In the previous chapter I developed aquatic stratification regions to stratify our analyses. This study will examine the local features that influence a stream's potential capacity and

condition, and the fauna that make up a stream ecosystem, then rate the streams in Oklahoma looking for those in the best condition, and highest in priority for preservation.

Methods

Study area

Oklahoma encompasses large portions of two major river systems: the Arkansas River and the Red River (figure 1). The Arkansas River originates near Leadville, Colorado in the Rocky Mountains, crossing the high plains, tallgrass prairie and the interior highlands before its ultimate confluence with the Mississippi River in eastern Arkansas. The Red River originates in eastern New Mexico and flows easterly across the high plains, crosstimbers, Ouachita Mountains and gulf coastal plains before its confluence with the Atchafalayah and Mississippi Rivers in western Louisiana. Our analysis encompasses the portions of these watersheds in the state of Oklahoma.

Prioritizing streams

This study was meant to compliment the Unified Watershed Assessment (UWA), which used 11-digit hydrologic units as analysis areas. These are the units that I used to rank stream segments. I chose to exclude sliver polygons, defined as having an area of less than 39,000 acres, as they did not have enough area to allow a robust assessment. To reduce the possibility of spatial or ecoregional bias in or analysis, I stratified the analysis using the stratification regions described in the previous chapter.

The condition of each hydrologic unit was examined using land use, urbanization, reservoir impacts and point sources. Land use was examined using the 2001 National Land Cover Database (NLCD, Homer et al. 2004). I quantified the percent of the hydrologic unit that was converted from native vegetation to agricultural uses, as the sum of improved forage, forest plantation (classified as pine forest), and row crops. The degree of urbanization was measured as

the percent impervious surfaces in each hydrologic unit, using the impervious surfaces layer of the NLCD (Yang et al 2002). Reservoir impacts were measured by quantifying the percent of land mass that has been inundated by reservoirs in each hydrologic unit. Point source impacts were measured by counting the number of point sources registered with the Environmental Protection Agency (USEPA) in each hydrologic unit (USEPA 1998a, USEPA1998b, USEPA 1998c).

The ecosystem value of each hydrologic unit was determined using species richness, the species of interest richness, the uniqueness of the stream ecosystem, and whether or not the hydrologic unit is in The Nature Conservancy aquatic portfolio. Species richness is defined as the total number of species that reside in an hydrologic unit. Species of interest were defined as species that were listed, declining or endemic. Richness indices were calculated using fish collection data provided by the Oklahoma Conservation Commission (pers. comm.) and Oklahoma Department of Environmental Quality (pers. comm.). I chose to use fish only, because there is a great deal of information available on the community composition of fishes in Oklahoma, as compared to other taxonomic groups, where data is spotty and inconsistently recorded. The uniqueness of an ecosystem was determined first by assigning a stream type to all stream reaches with a link magnitude of 10 or above. Stream types were based on surficial geology, gradient, size and flow permanence of the stream reach. Stream types were compared to species assemblages to ensure compatibility (appendix A). Stream types were assigned to hydrologic units by assigning the stream type of the largest reach to the unit. Uniqueness was measured as the number of similar unit types within a region. The Nature Conservancy (TNC) aquatic portfolio was compiled for the purpose of identifying the most biologically significant streams in the Arkansas and Red Rivers, and was a multi-agency effort. This dataset also

encompasses critical habitat for listed species. A hydrologic unit was determined to be in the TNC portfolio if the largest stream reach was in the portfolio.

To determine the conservation priority of hydrologic units in Oklahoma, I ranked each site based on each condition and ecosystem value criterion. The ranks of each ecosystem value criteria were averaged to develop a conservation ranking. Likewise, the ranks of each of the condition criteria were averaged to develop a condition ranking. Finally, the mean rank over all criteria was calculated, giving an overall priority ranking for each hydrologic unit. All rankings were stratified by aquatic stratification region.

Results

The High Plains encompassed 31 hydrologic units in the panhandle of Oklahoma. This region had eight system types. Two stream types occurred only once, while the most common stream types occurred eight times. Eight hydrologic units were a part of the TNC aquatic portfolio. Those units were mostly along the Cimarron River. Species richness averaged 8.2. The minimum species richness was zero, while the maximum was 29. The number of species of conservation interest per unit ranged from zero to seven, with the mean being 1.7 species. The conservation ranking of high plains hydrologic units was highest along the Cimarron River, and was low throughout Beaver River watershed (figure 2, appendix B). Turning to the condition variables, point source inputs of pollution ranged from zero to three. Eight hydrologic units had point sources, and those were mostly associated with the Beaver River. The High Plains were largely rural; the percent of impervious surfaces was very low ranging from .03% to 0.98%. The conversion of native vegetation to agriculture averaged at about 23.8% and ranged from <1% to 65%. Reservoir impacts in the High Plains were minimal, topping out at 2.6 %. The conservation rankings of High Plains hydrologic units were evenly spread throughout the region, but were

generally lowest along the Beaver River (figure 2, appendix C). When looking at all criteria together, the highest ranked hydrologic units are 1) the western most portion of the Cimarron River in Oklahoma (11040002010), 2) the Cimarron River just downstream (11040002040), 3) the Cimarron River at Buffalo Creek (11050001020), and 4) the Cimarron River at its re-entry into Oklahoma (11040006060, figure 2, appendices B and C).

The Central Prairies region was the largest region assessed, and contained 248 hydrologic units. There are 40 different stream types in the central plains. Nine stream types occurred once, and the most common stream type occurred 41 times. Seventy of the hydrologic units were in the TNC aquatic portfolio, including the Canadian River, the Cimarron River, the Red River, Deep Fork Creek, the headwaters of the Washita River and Cache Creek. Species richness ranged from zero to 63, and averaged around 21 species. Species richness was somewhat higher in the Arkansas River areas of the region, and lower as one moved west. The richness of species of conservation interest, on the other hand, was evenly distributed throughout the region. The average richness of species of interest was three, with some hydrologic units having as many as eleven. The conservation ranking of hydrologic units was highest along the Arkansas River and its tributaries. The downstream portions of the Washita River, Red River and Canadian River were all ranked lower (figure 2, appendix B). Point sources ranged from zero to ninety, with the highest concentrations of point sources corresponding to the Tulsa and Oklahoma City metropolitan areas. Similarly, impervious surfaces were highest near Tulsa and Oklahoma City (35.6%), but in rural areas were as low as 0.03%. Conversion occurred in two bands: in the wheat belt west of Oklahoma City, and in the prairies east of Tulsa. In these areas, improved vegetation made up to 82% of the hydrologic unit. Elsewhere, conversion was as low as 1%. Reservoirs were ubiquitous in this region. The central prairie contained over forty major

reservoirs including Lake Texoma and Lake Eufaula. The amount of hydrologic unit inundated by reservoirs ranged from zero to 18%. Condition ranks were higher in the western, less populated portions of the Central Prairies. Hydrologic units were also rated high in the Flint Hills of Osage County (figure 3, appendix C). Overall ranks followed this same pattern. The four highest ranking hydrologic units were 1) the headwaters of Hominy Creek (11070107020), 2) the headwaters of the Caney River (11070106020), 3) the Arkansas River below Salt Creek (11060006100) and 4) the westernmost part of Elm Fork of the Red River in Oklahoma (11120304030, figure 3, appendices B and C).

The Ozarks in northeastern Oklahoma encompassed ten stream systems. Four stream types occurred only once, and the most common system occurred nine times, along the Arkansas River Navigation System. Five hydrologic units were in the TNC aquatic portfolio, specifically Lee Creek, two on the Illinois River, Baron Fork Creek, and Spring River. Species richness was high in this region, ranging from 18 to 103. The highest species richness was in the Illinois River and Spring River hydrologic units. The richness of species of conservation interest was also high, ranging from five on the Neosho River to 29 in the Illinois River. The conservation ranking for the Ozarks, similar to its component parts, was highest throughout the Illinois River watershed and on the Spring River (figure 4, appendix B). Looking at the condition ranks, the number of point sources ranged from zero to 18, and was evenly spread throughout the region. The percent impervious surfaces was uniform across the region, and ranged from 0.12% to 3.51%. The percent of hydrologic unit converted to improved vegetation ranged from 12% to 61%, and was ubiquitous across the region. The percent inundation by reservoirs ranged from zero to 19.8%. This included the Arkansas River Navigation System, and three major reservoirs: Tenkiller, Eucha, and Spavinaw. The condition ranks were the highest in hydrologic units with headwaters,

on Lee Creek, and on Greenleaf Creek (figure 4, appendix C). When looking at the overall rank, Lee Creek ranked the highest, followed by the Illinois River. The four highest ranked hydrologic units were: 1) the Lee Creek headwaters (11110104070), 2) Illinois River mainstem (11110103110), 3) Greenleaf Creek (11110102020) and 4) the Illinois River above Baron Fork (11110103060, figure 4, appendices B and C).

The Ouachita Mountains in southeastern Oklahoma encompassed fourteen system types. Five system types occurred once, while the most common stream type occurred twelve times. Twenty one of the hydrologic units were in the TNC aquatic portfolio including the Mountain Fork Creek, Glover River, Kiamichi River, Little River, Red River, Blue River and Poteau River. Species Richness was high in this region, averaging 46 species per hydrologic unit, and ranging from zero to 107 species. Species richness was lower in hydrologic units in the Washita River watershed, compared to elsewhere in the region. The number of species of conservation interest per hydrologic unit averaged at seven, and ranged from zero to 26. The conservation ranking of hydrologic units was fairly evenly spread throughout the region, with downstream units ranking higher (figure 5, appendix B). Point sources were relatively scarce, with many hydrologic units having none. However, near the Red River and Poteau River, they were quite dense; the highest number in one hydrologic unit being eight. The percent of impervious surfaces in this area were low, ranging from 0.06% to 1.12%. The percent of hydrologic unit converted to improved vegetation ranged from 16% to 67%, and was higher in the eastern forested areas than in the grasslands of the Clear and Muddy Boggies and the Blue River. This region had many large reservoirs, including Lake Texoma and Broken Bow Reservoir. Percent inundation ranged from zero to 27%. Condition rankings were generally higher in the western parts of the region, with both the Blue River and Muddy Boggy ranking high (figure 5, appendix C). Overall, The Blue

River, Kiamichi River and Muddy Boggy ranked high. The top four hydrologic units were: 1) the central part of the Blue River (11140102020), 2) the Muddy Boggy above the confluence with the Clear Boggy (11140103050), 3) the Little River at the state line (11140109170), and 4) the Cedar Creek tributary of the Kiamichi River (11140109170, figure 5, appendices B and C)

Discussion

The High Plains were predominately rural, and land use was mostly wheat and small grains. These crops were irrigated with groundwater from the Ogallala aquifer and alluvial aquifers associated with the Beaver River. These alluvial aquifer withdrawals have led to the dewatering of portions of the Beaver River (US Fish and Wildlife Service 1998). The Cimarron River valley, on the other hand, is more rugged and remains in native vegetation. This area had a naturally depauperate fish assemblage, but included the Arkansas darter (*Etheostoma craigini*), a species of concern, that persists in the Cimarron River in the High Plains of Oklahoma and Kansas (Oklahoma Department of Environmental Quality pers. comm.).

The Central Prairies for the most part overlaid shale and sandstone. Land use in this region was a mixture of cattle grazing on native rangeland and crop production. Wheat production and associated stream impacts affected small streams in the central and eastern part of this region. Metropolitan areas had high amounts of both impervious surfaces and point source inputs. Small streams in the Central Prairies were silty and had few species of interest. The large rivers were more sandy and wide, with a greater number of rare and endemic species. Like the High Plains, some streams in this region were affected by dewatering, especially in the western portions, but many were also affected by the construction of reservoirs. All of these cumulative impacts had an effect on the biota in these streams, including the extirpation of many species from their historic ranges. The Arkansas River shiner was restricted to the Canadian River (USFWS 2004)

and the Arkansas River speckled chub has been extirpated from Oklahoma altogether (Luttrell et al. 1999). However, there were still some good examples of Central Plains rivers, including the Canadian River in western Oklahoma, the Elm Fork of the Red River, and the headwater streams draining the Flint Hills.

The Ozarks were predominately rural, but were under pressure of development, especially along state-designated Scenic Rivers like the Illinois River. Oak-pine forests were converted to improved pasture for cattle grazing, predominately in stream valleys. The fish assemblages in these streams had a high degree of endemism, and a number of listed species including the Neosho mucket (*Lampsilis rafinesqueana*) and Arkansas darter, which are federal species of concern. The Neosho madtom (*Noturus placidus*), a federally threatened species historically occurred in the Illinois, Neosho and Spring Rivers, but was extirpated from these rivers in Oklahoma (Wenke and Eberle 1991). The Illinois River had the most diverse fish assemblage relative to any other stream in the Ozarks. It also had the last remaining viable population of the Neosho mucket in Oklahoma (Mather 2006, USFWS 2005). Lee Creek was a good example of a Boston Mountains stream and hosted many rare species, including the longnose darter (*Percina nasuta*, Wagner et al 1985).

The Ouachita Mountains included large areas of pine forest and pine plantations. Silviculture was a major land use, and had a tremendous impact on stream condition and water quality. These streams were further impacted by reservoirs, including a hydroelectric plant on Mountain Fork Creek. Like the Ozarks, the Ouachita Mountains had a high level of endemism in both fishes and mussels, and a number of rare and listed species. The leopard darter (*Percina pantherina*), a federally threatened species, occurred in the Mountain Fork, Glover and Little Rivers (Jones 1984). The Little River and Kiamichi River were also home to the endangered

Ouachita rock pocketbook (*Arkansia wheeleri*, Martinez 1994) and the scaleshell (*Leptodea leptodon*, US Fish and Wildlife 2004). The Blue River, which ranked first in the Ouachita Mountains, was a unique stream, with a number of rare and disjunct species including the seaside alder (*Alnus maritima*), southern redbelly dace (*Phoxinus erythrogaster*) and least darter (*Etheostoma microperca*, Erwin and Tejan 2004).

It cannot be denied that there are a number of anthropogenic effects that have taken their toll on the aquatic biodiversity of Oklahoma. Of 172 fish species in Oklahoma, 52 were at risk and four were listed; of the 24 mussel species in Oklahoma, all 24 were at risk and three are listed (Oklahoma Department of Wildlife Conservation 2005). That said, there were still many rivers that retained their full assemblages of fishes and mussels and were in relatively good condition. This ranking was meant to identify those streams of highest value, so that conservation and restoration efforts could be spent where they may do the most good. It may be more effective to work in those areas where there are clusters of hydrologic units in good condition such as the Elm Fork of the Red River, the Cimarron River in the High Plains and adjacent areas, the Blue River, the Kiamichi River and the Illinois River (figure 6). Some of the hydrologic units that ranked highly in this study also ranked highly in the Unified Watershed Assessment. The overlap in these two prioritizations could enable the selection of streams whose conservation will serve both the needs of biodiversity and society, such as the Illinois River, Muddy Boggy and Kiamichi River.

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Figure 1. The Arkansas and Red River basins in Oklahoma

Figure 2. Condition, conservation and overall ranks of 11-digit hydrologic units in the High Plains of Oklahoma. Lower numbers indicate higher value.

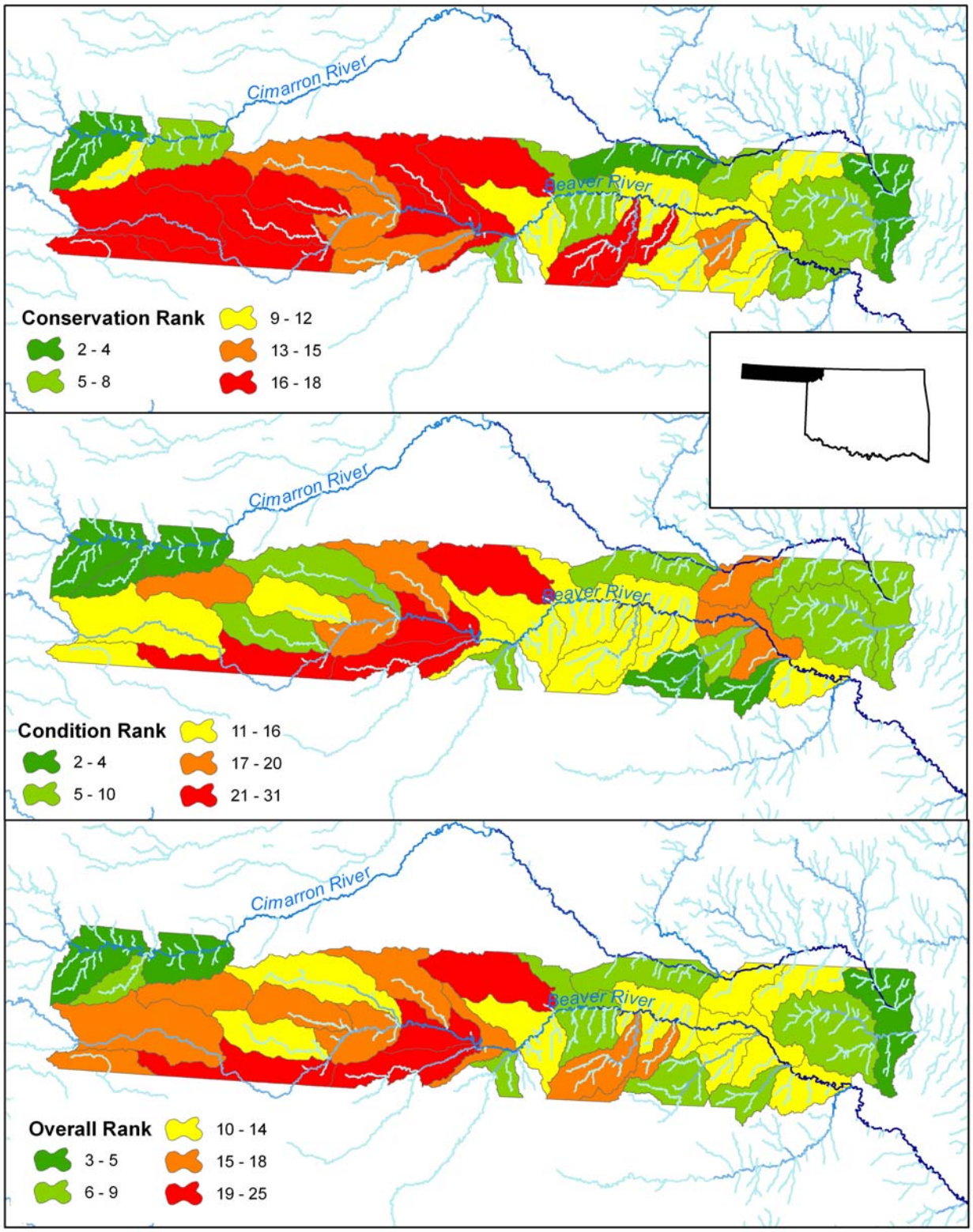


Figure 3. Condition, conservation and overall ranks of 11-digit hydrologic units in the Central Prairies of Oklahoma. Lower numbers indicate higher value.

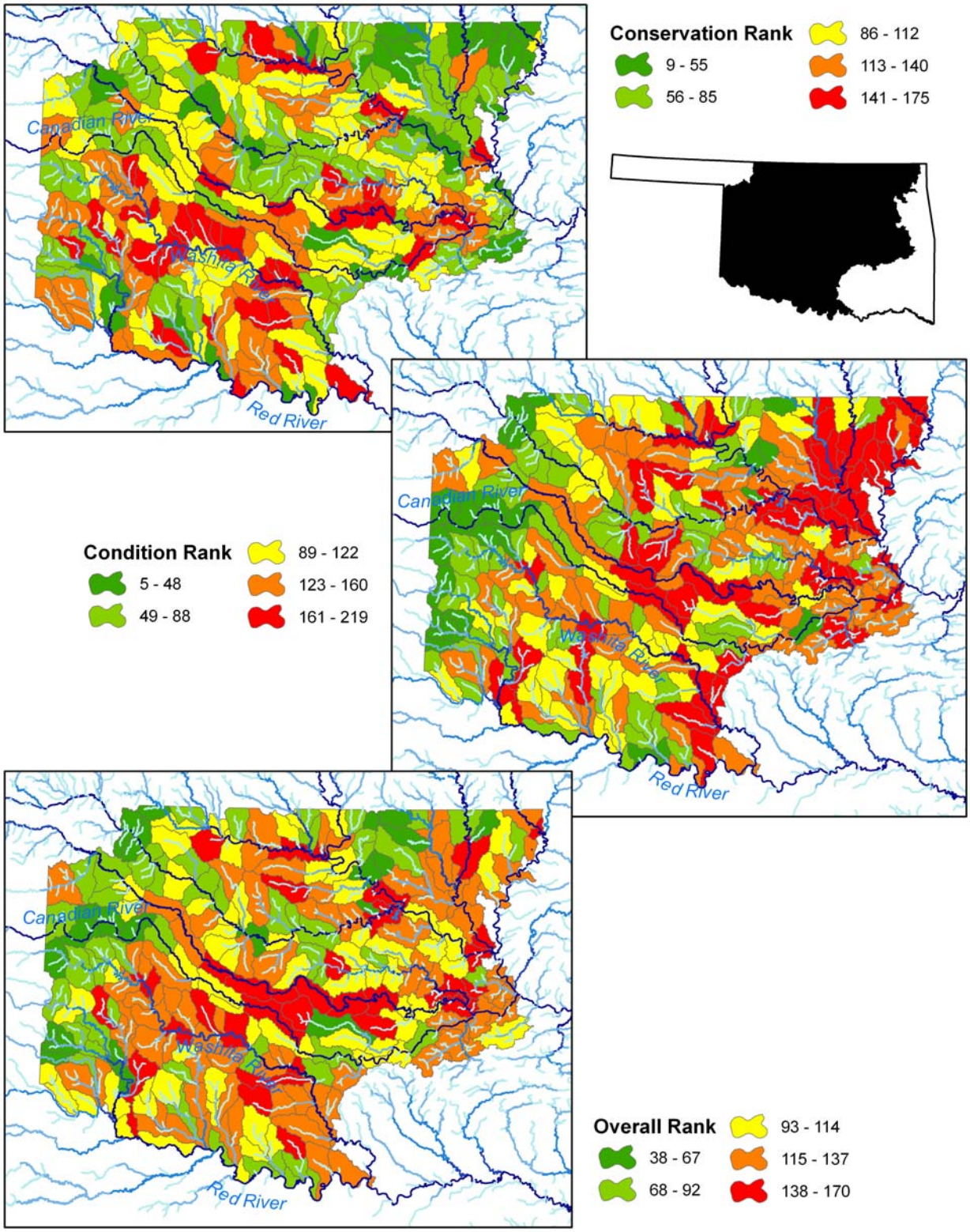


Figure 4. Condition, conservation and overall ranks of 11-digit hydrologic units in the Ozarks of Oklahoma. Lower numbers indicate higher value.

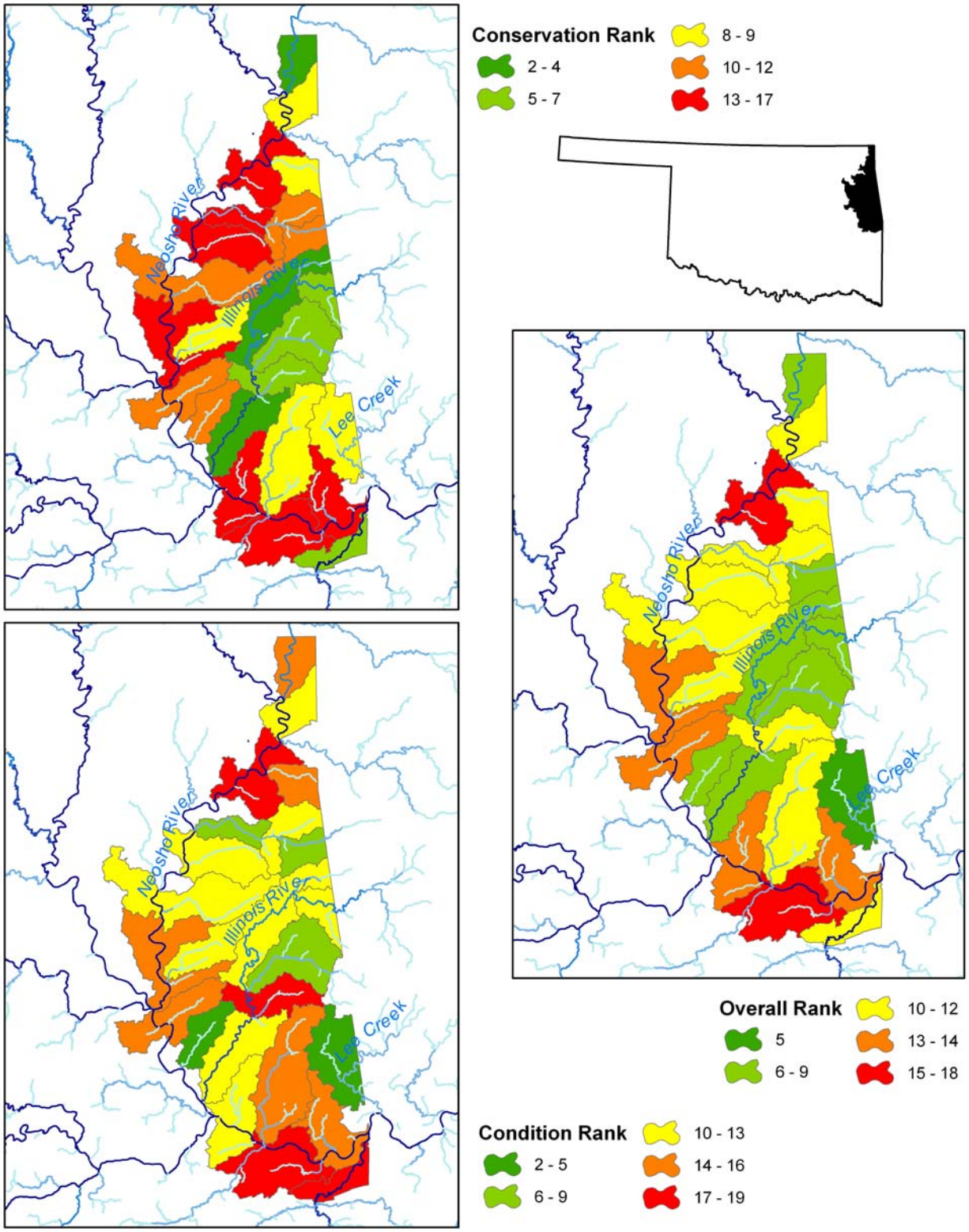


Figure 5. Condition, conservation and overall ranks of 11-digit hydrologic units in the Ouachita Mountains of Oklahoma. Lower numbers indicate higher value.

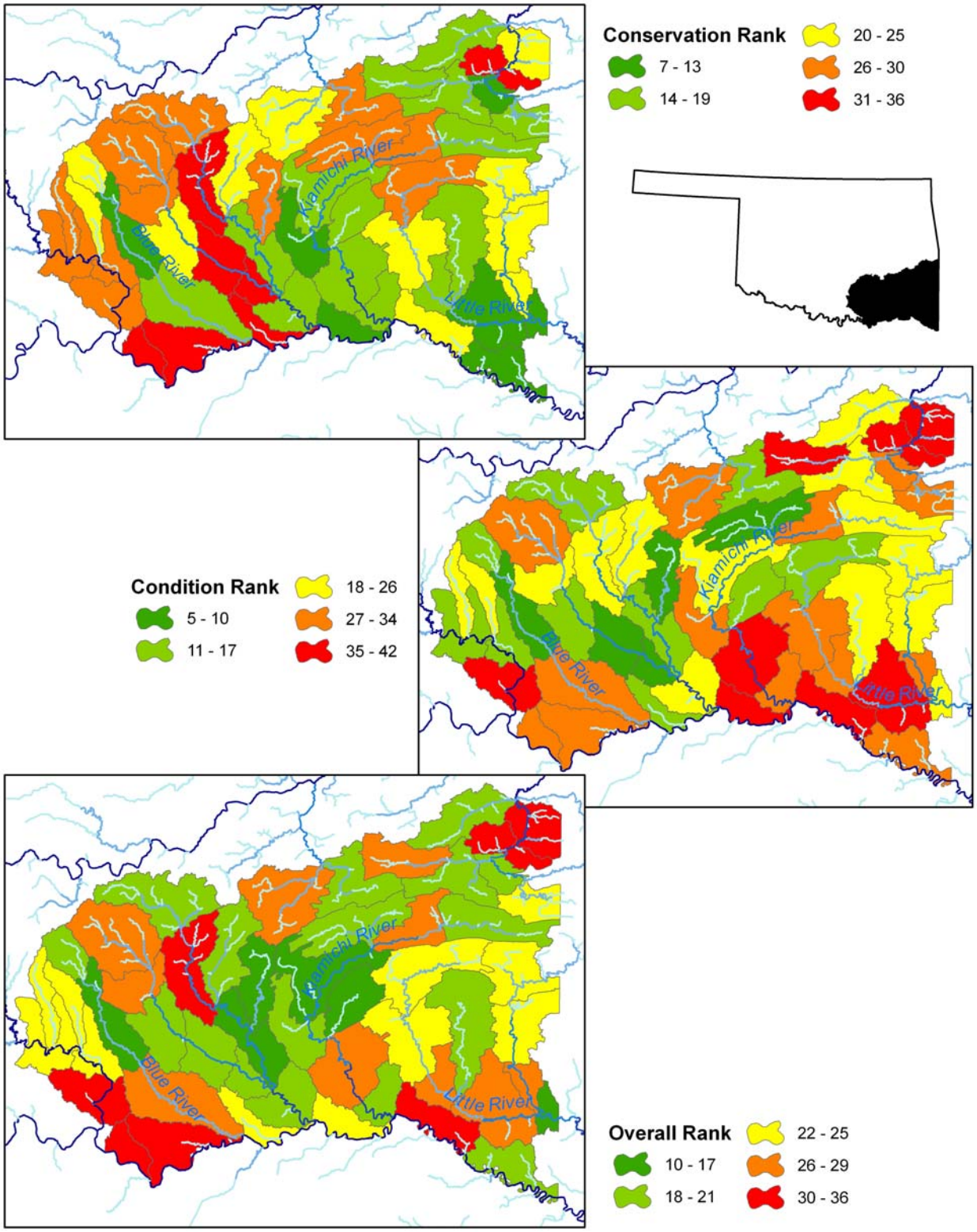
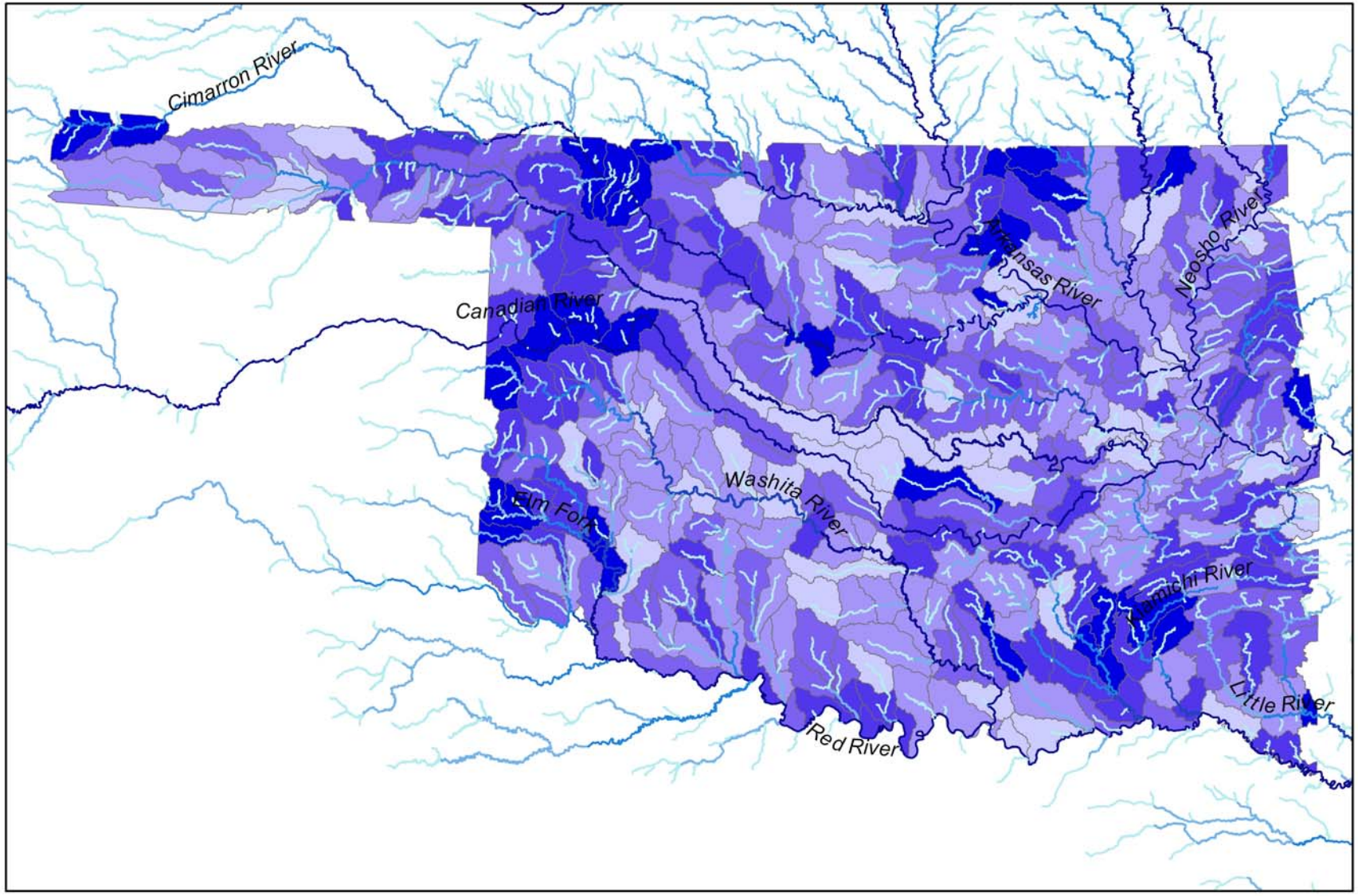


Figure 6. Overall ranks of all hydrologic units in Oklahoma. Darker colors indicate higher rankings.



Appendix A. Stream type descriptions

Stream Type	Name	Fish Assemblage	Description
2_1	Flint Hills and Plains Creeks	Red shiner and bullhead minnow with sand shiner and central stoneroller	Intermittent, low gradient creeks with moderate and high gradient headwaters, flowing over a mixture of sedimentary rocks and limestone
2_10	Southern Prairie Limestone Creeks	Sand shiner and central stoneroller	Intermittent, low gradient creeks with moderate and high gradient headwaters, flowing over a mixture of sedimentary rocks and limestone
2_11	Boston Mountains Creeks	Central stoneroller, bluntnose minnow, ribbon shiner and Ozark minnow	Perennial, medium gradient creeks on sandstone with high gradient tributaries
2_12	Arkansas Valley Shale Creeks	Red shiner and redfin shiner, with lesser numbers of golden shiner and common carp	Perennial, low gradient creeks (with low gradient headwaters) with silty substrates, flowing across shale
2_13	Springfield Plateau Creeks	Cardinal shiner, central stoneroller, Ozark minnow	Perennial, gravel bottomed spring-fed creeks with low-gradient mainstems and high gradient headwaters on limestone
2_14	Verdigris River Creeks	Suckermouth minnow, red shiner and bullhead minnow, with central stoneroller	Intermittent, low gradient creeks with moderate and high gradient headwaters, flowing over a mixture of sedimentary rocks and limestone
2_17	Upper Red River Tributaries	Golden shiner and red shiner	Perennial, low gradient creeks flowing across bands of shale and sandstone
2_2	Plains Creeks	Red shiner and bluntnose minnow. Sand Creek and Bird Creek have disjunct populations of Kiamichi Shiner	Low gradient creeks with moderate to high gradient headwaters on shale

Appendix A continued. Stream type descriptions

Stream Type	Name	Fish Assemblage	Description
2_20	Disjunct Limestone Creeks	Disjunct populations of Ozark fishes with headwaters populated by southern redbelly dace and central stoneroller	Low gradient creeks on dolomite and granite. Bedrock dominated substrates with travertine deposits on granite in Ouachita example. High gradient tributaries on dolomite and granite with bedrock and boulder substrates in Central Plains example
2_22	Black Kettle Creeks	Species data not available	Perennial creeks with intermittent moderate gradient tributaries, low gradient mainstem, originating in coarse sandstone, flowing into fine sandstone and alluvium.
2_25	Red River Mixedgrass Prairie Creeks	Red shiner, central stoneroller, with sand shiner	Low gradient creeks on alluvium with low to moderate gradient tributaries on shale
2_3	Plains Loess Creeks	Red shiner and suckermouth minnow, with sand shiner and bullhead minnow	Intermittent small creeks on shale becoming perennial in some cases in lower reach. All intermittent tributaries, low gradient mainstem, moderate gradient tributaries
2_36	Ogallala Creeks	Red shiner, plains killifish and sand shiner with bullhead minnow	Ephemeral washes on unconsolidated Ogallala sand
2_4	Mixedgrass Prairie Creeks	Red shiner with some sand shiner	Perennial small creeks with intermittent tributaries, low, moderate and high gradient, in fine sandstone, evaporate andshale
2_44	Red River Chloride Creeks	Red River pupfish and plains killifish with red shiner, sand shiner	Low gradient creeks on alluvium, high chloride content, with low to moderate gradient tributaries on shale

Appendix A continued. Stream type descriptions

Stream Type	Name	Fish Assemblage	Description
2_5	Cimarron Mesquite Badlands Creeks	Red shiner and plains killifish with sand shiner and plains minnow	Intermittent, small creeks, low to high gradient, in evaporite
2_60	Ogallala Sandstone Creeks	Fish data not available	Low gradient intermittent creeks on Ogallala sands and gravels with downstream reaches on sandstone
2_8	Little River Watershed Creeks.	Central stoneroller and bigeye shiner	Perennial low gradient creeks with high and medium gradient tributaries on sandstone and bedrock/boulder dominated substrates
3_10	Elk Prairie Streams	Red shiner and bullhead minnow, with suckermouth minnow, central stoneroller and sand shiner	Low gradient streams with moderate tributaries and few high gradient headwaters on shale
3_11	High Plains Streams	Red shiner, suckermouth minnow and sand shiner. Plains killifish also present	Low to moderate gradient streams on Ogallala sand and gravel
3_13	Disjunct Limestone Streams	Striped shiner, bigeye shiner and stoneroller. Disjunct species include: redspot chub, black redhorse, least darter and southern redbelly dace	Low gradient stream with top half on dolomite and granite, and bottom half on sand. Bedrock dominated substrates with travertine deposits on granite
3_14	Red River Mixedgrass Prairie Streams	Red shiner, suckermouth minnow and bullhead shiner with Red River shiner and Red River pupfish	Perennial medium streams, low gradient with moderate to high gradient intermittent tributaries in fine sandstone, shale, and some alluvium
3_16	Flint Hills Streams	Red shiner, bullhead minnow and suckermouth minnow	Perennial low gradient streams flowing across a mixture of sedimentary rocks and limestone

Appendix A continued. Stream type descriptions

Stream Type	Name	Fish Assemblage	Description
3_17	Kansas Loess Streams	Fish data not available	Perennial medium streams, low gradient with low to moderate gradient intermittent tributaries in alluvium, some sand
3_18	Washita and Prairie Streams	Red shiner, sand shiner and bullhead minnow	Low gradient streams on variable geology, but predominately from sandstone, alluvium, and mixtures of sedimentary rocks and limestone .
3_19	Cimarron Valley Streams	Red shiner, plains killifish, with sand shiner and emerald shiner	Perennial streams, low gradient with moderate to high gradient intermittent tributaries in fine sandstone, evaporite/shale, and some alluvium
3_28	Oklahoma Badlands Streams	Plains killifish, red shiner, with an introduced population of Red River shiner	Perennial medium streams, low gradient with moderate to high gradient intermittent tributaries in evaporite
3_3	Ozark Streams	Cardinal shiner, central stoneroller, Ozark minnow with carmine shiner in lesser abundance	Perennial Karst streams on limestone with low gradient mainstems and high gradient tributaries, gravel substrates
3_4	Canadian Hills Streams	Fish data not available	Perennial streams with silty substrates, flowing across shale. Low gradient mainstems with moderate gradient tributaries
3_6	Northern Arkansas Basin Streams	Redfin and bigeye shiner. Central stoneroller at all sites but in small numbers, ribbon shiner in Brazil Creek and northward	Perennial low-gradient streams on shale with moderate to high gradient headwaters

Appendix A continued. Stream type descriptions

Stream Type	Name	Fish Assemblage	Description
3_9	Central OK Red River streams	Golden and redfin shiners	Low gradient streams flowing over shale, with silt/clay substrate. Rocky riffles, possibly slightly turbid
4_1	Illinois River	Ozark minnow, and carmine shiner. Species only in Illinois River, include the spotfin shiner and ozark shiner	Large perennial Karst streams with gravel bottomed, low gradient mainstems and moderate gradient tributaries in the northern Illinois River watershed. High gradient tributaries in the southern Illinois River and Baron Fork watersheds
4_10	Prairie Tablelands Large Streams	Red shiner and sand shiner	Perennial low gradient large streams flowing across a mixture of sedimentary rocks and limestone
4_12	Canadian Hills Streams	Fish data not available	Perennial large streams with silty substrates, flowing across shale. Low gradient mainstems with low to moderate gradient tributaries.
4_15	Grand Prairie Rivers	Red shiner with bullhead minnow and sand shiner.	Large streams in clays/marls and a mixture of sedimentary rocks and limestone of the Grand Prairie
4_17	Elk Prairie Large Streams	Fish data not available	Perennial low gradient large streams with gravel substrate, flowing across shale, tributaries moderate gradient with pockets of high gradient headwaters along western ridges
4_19	Boggies and Blue River	Blacktail shiner red shiner and bullhead minnow, with redfin and ribbon shiners in smaller numbers.	Low gradient, large streams flowing across sand and a mixture of sedimentary rocks and limestone

Appendix A continued. Stream type descriptions

Stream Type	Name	Fish Assemblage	Description
4_2	Springfield large streams	Fish data not available	Perennial Karst large streams, gravel bottomed, low gradient mainstems with high gradient tributaries
4_20	Salty forks of the Red River	Red river shiner and plains killifish with red shiner and Red River shiner	Low gradient large streams flowing across evaporite and shale
4_21	Washita River	Red shiner with sand shiner and bullhead minnow	Low gradient large streams originating in Ogallala sand and gravel, flowing across bands of shale
4_25	Ogallala streams	Fish data not available	Dry and ephemeral washes In Ogallala sand and gravel
4_3	Spring River large streams	Red shiner with bullhead shiner and central stoneroller in fewer numbers	Large low-gradient streams with medium gradient tributaries. West-flowing tributaries originate on limestone, east-flowing tributaries originate on shale
4_31	Ogallala sandstone streams	Fish data not available	Perennial, low gradient streams on Ogallala sand and gravel and Permian sandstones
4_4	Boston Mountains large streams	Fish data not available	Low gradient large streams with high gradient tributaries, originating on shale
4_6	Ouachita Mountain large streams	Steelcolor and blacktail shiner, with redfin shiner and central stoneroller	Perennial large streams on shale, originating on sandstone. Boulder, bedrock dominated substrates
4_7	Arkansas Basin large streams	Red shiner and redfin shiner, with emerald and steelcolor shiners	Perennial low-gradient large streams with high gradient tributaries flowing across shale

Appendix A continued. Stream type descriptions

Stream Type	Name	Fish Assemblage	Description
4_8	Interior Plains Large Streams	Red shiner, with sand shiner, bullhead shiner and suckermouth minnow	Perennial low gradient large streams with moderate gradient tributaries on moderately calcareous geology
5_1	Lower Arkansas River	Fish data not available	Large low gradient rivers on alluvial deposits. Most has been severely impacted by channelization and reservoir construction for navigation
5_10	Muddy Boggy	Red shiner and blacktail shiner with emerald shiner	Low gradient tributary to the Red River, flowing across limestone and sand
5_11	Washita River	Red shiner, with sand shiner and bullhead minnow	Large, low gradient Red River tributaries originating in shale, flowing through quaternary alluvium on sand and mud
5_16	Chloride Red River	Plains minnow, red shiner, with Red River shiner and Red River pupfish	Large river on alluvial deposits with sandy substrate. Salt deposits from Permian deposits create high chloride concentrations in rivers
5_19	Salty Arkansas Rivers	Fish data not available	
5_2	Kansas Loess Rivers	Fish data not available	Large low gradient intermittent rivers on dune sands. Sandy substrate
5_3	Osage Large Rivers	Fish data not available	Large low gradient rivers on alluvial deposits, running through bands of sandstone and limestone
5_4	Illinois River	No native fishery, trout fishery in tailrace	Almost completely inundated by Lake Tenkiller with hypolimnetic release
5_5	Poteau River	Red shiner, bullhead minnow, emerald shiner	

Appendix A continued. Stream type descriptions

Stream Type	Name	Fish Assemblage	Description
5_6	High Plains Rivers	Arkansas River shiner, sand shiner, flathead chub	Large river flowing across Ogallala sands. Intermittently flowing due to dewatering
5_7	Crosstimbers Rivers	Fish data not available	Large sandy river flowing across sedimentary rocks
5_8	Ouachita Red River Tributaries	Steelcolor shiner, blacktail shiner	South-flowing large tributaries of the Red River with silty substrates. Flowing across mud and clay
5_9	Red River	Red shiner and blacktail shiner dominate with emerald shiner	Large river on alluvial deposits. Low gradient river with sandy substrate. Oxbows form in abandoned reaches

Appendix B. Conservation ranks for 11-digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Stream Type	Uniqueness		Priority Stream			Species Richness		Species of Interest		Conservation Rank
			Value	Rank	Value	Score	Rank	Value	Rank	Value	Rank	
11050001030	Central Prairie	5_19	12	142	CF	3	1	16	147	3	78	92
11050001040	Central Prairie	5_19	12	142	CF	3	1	18	123	4	53	79.75
11050001050	Central Prairie	5_19	12	142	CF	3	1	21	100	5	29	68
11050001060	Central Prairie	5_19	12	142	CF	3	1	18	123	4	53	79.75
11050001070	Central Prairie	2_5	2	13	No	0	80	14	161	2	116	92.5
11050001080	Central Prairie	3_17	1	1	No	0	80	19	114	5	29	56
11050001090	Central Prairie	5_19	12	142	CF	3	1	15	153	2	116	103
11050002010	Central Prairie	5_19	12	142	CF	3	1	39	28	9	6	44.25
11050002020	Central Prairie	2_4	30	178	No	0	80	21	100	4	53	102.75
11050002030	Central Prairie	2_4	30	178	No	0	80	18	123	4	53	108.5
11050002040	Central Prairie	5_19	12	142	CF	3	1	34	43	7	17	50.75
11050002050	Central Prairie	5_19	12	142	CF	3	1	0	219	0	194	139
11050002060	Central Prairie	2_4	30	178	No	0	80	16	147	2	116	130.25
11050002070	Central Prairie	2_4	30	178	No	0	80	24	84	4	53	98.75
11050002080	Central Prairie	3_19	5	40	No	0	80	27	70	3	78	67
11050002090	Central Prairie	2_4	30	178	No	0	80	12	173	2	116	136.75
11050002100	Central Prairie	2_4	30	178	No	0	80	13	168	2	116	135.5
11050002110	Central Prairie	3_19	5	40	No	0	80	22	95	4	53	67
11050002120	Central Prairie	5_19	12	142	CF	3	1	42	24	8	9	44
11050002130	Central Prairie	4_10	6	75	No	0	80	33	51	5	29	58.75
11050002140	Central Prairie	4_10	6	75	No	0	80	18	123	2	116	98.5
11050002150	Central Prairie	4_10	6	75	No	0	80	28	66	3	78	74.75
11050002160	Central Prairie	5_7	41	208	No	0	80	49	18	8	9	78.75
11050003010	Central Prairie	2_3	5	40	No	0	80	9	197	2	116	108.25
11050003020	Central Prairie	5_7	41	208	No	0	80	49	18	7	17	80.75
11050003030	Central Prairie	2_3	5	40	No	0	80	10	191	0	194	126.25
11050003040	Central Prairie	4_8	12	142	No	0	80	26	72	3	78	93
11050003050	Central Prairie	5_7	41	208	No	0	80	24	84	5	29	100.25
11050003060	Central Prairie	2_1	5	40	No	0	80	18	123	2	116	89.75

Appendix B continued. Conservation ranks for 11-digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Stream Type	Uniqueness		Priority Stream			Species Richness		Species of Interest		Conservation Rank
			Value	Rank	Value	Score	Rank	Value	Rank	Value	Rank	
11050003070	Central Prairie	2_1	5	40	No	0	80	24	84	2	116	80
11050003080	Central Prairie	5_7	41	208	No	0	80	23	92	2	116	124
11060001030	Central Prairie	3_16	5	40	No	0	80	24	84	3	78	70.5
11060001040	Central Prairie	5_7	41	208	No	0	80	33	51	3	78	104.25
11060001050	Central Prairie	5_7	41	208	No	0	80	50	13	8	9	77.5
11060002030	Central Prairie	4_10	6	75	CF	3	1	11	181	3	78	83.75
11060002040	Central Prairie	4_10	6	75	C	1	48	12	173	2	116	103
11060003030	Central Prairie	3_28	2	13	No	0	80	17	137	3	78	77
11060004030	Central Prairie	5_19	12	142	No	0	80	21	100	2	116	109.5
11060004040	Central Prairie	2_4	30	178	No	0	80	8	201	2	116	143.75
11060004050	Central Prairie	3_28	2	13	No	0	80	18	123	3	78	73.5
11060004060	Central Prairie	5_19	12	142	No	0	80	50	13	10	2	59.25
11060004070	Central Prairie	5_19	12	142	No	0	80	18	123	2	116	115.25
11060004080	Central Prairie	2_4	30	178	No	0	80	12	173	1	165	149
11060004090	Central Prairie	2_4	30	178	No	0	80	17	137	2	116	127.75
11060004100	Central Prairie	2_3	5	40	No	0	80	18	123	4	53	74
11060004110	Central Prairie	5_7	41	208	No	0	80	0	219	0	194	175.25
11060005060	Central Prairie	5_2	2	13	CF	3	1	43	21	8	9	11
11060005070	Central Prairie	2_3	5	40	No	0	80	18	123	3	78	80.25
11060005080	Central Prairie	5_2	2	13	CF	3	1	52	11	8	9	8.5
11060006010	Central Prairie	3_19	5	40	No	0	80	9	197	2	116	108.25
11060006020	Central Prairie	4_10	6	75	No	0	80	20	109	3	78	85.5
11060006030	Central Prairie	5_7	41	208	No	0	80	25	78	2	116	120.5
11060006040	Central Prairie	2_1	5	40	No	0	80	24	84	4	53	64.25
11060006050	Central Prairie	2_1	5	40	C	1	48	20	109	3	78	68.75
11060006060	Central Prairie	2_1	5	40	C	1	48	35	39	4	53	45
11060006070	Central Prairie	3_19	5	40	No	0	80	12	173	1	165	114.5
11060006080	Central Prairie	4_8	12	142	No	0	80	12	173	2	116	127.75
11060006090	Central Prairie	4_8	12	142	No	0	80	31	55	3	78	88.75

Appendix B continued. Conservation ranks for 11-digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Stream Type	Uniqueness		Priority Stream			Species Richness		Species of Interest		Conservation Rank
			Value	Rank	Value	Score	Rank	Value	Rank	Value	Rank	
11060006100	Central Prairie	5_7	41	208	No	0	80	63	1	10	2	72.75
11060006110	Central Prairie	5_7	41	208	No	0	80	5	213	0	194	173.75
11070103030	Central Prairie	5_3	9	101	F	2	47	39	28	5	29	51.25
11070103040	Central Prairie	2_14	1	1	C	1	48	30	59	3	78	46.5
11070103050	Central Prairie	5_3	9	101	No	0	80	14	161	1	165	126.75
11070105010	Central Prairie	5_3	9	101	No	0	80	53	9	4	53	60.75
11070105020	Central Prairie	2_12	5	40	No	0	80	32	54	3	78	63
11070105030	Central Prairie	5_3	9	101	No	0	80	50	13	3	78	68
11070105040	Central Prairie	5_3	9	101	No	0	80	0	219	0	194	148.5
11070106020	Central Prairie	4_17	3	23	No	0	80	30	59	5	29	47.75
11070106030	Central Prairie	4_17	3	23	No	0	80	40	26	5	29	39.5
11070106050	Central Prairie	4_17	3	23	No	0	80	17	137	2	116	89
11070106060	Central Prairie	2_2	3	23	CF	3	1	43	21	6	21	16.5
11070106070	Central Prairie	5_3	9	101	No	0	80	26	72	4	53	76.5
11070106080	Central Prairie	5_3	9	101	No	0	80	29	62	4	53	74
11070107010	Central Prairie	2_2	3	23	CF	3	1	34	43	4	53	30
11070107020	Central Prairie	2_2	3	23	No	0	80	25	78	3	78	64.75
11070107030	Central Prairie	4_8	12	142	No	0	80	23	92	2	116	107.5
11070107040	Central Prairie	4_8	12	142	No	0	80	55	5	5	29	64
11070206010	Central Prairie	5_3	9	101	CF	3	1	51	12	7	17	32.75
11070206020	Central Prairie	5_3	9	101	CF	3	1	25	78	1	165	86.25
11070206050	Central Prairie	2_12	5	40	No	0	80	37	35	9	6	40.25
11070209010	Central Prairie	2_12	5	40	CF	3	1	35	39	5	29	27.25
11070209020	Central Prairie	2_12	5	40	CF	3	1	38	31	4	53	31.25
11070209030	Central Prairie	5_1	6	75	No	0	80	29	62	6	21	59.5
11070209080	Central Prairie	2_12	5	40	No	0	80	37	35	3	78	58.25
11070209090	Central Prairie	5_1	6	75	No	0	80	39	28	5	29	53
11090201010	Central Prairie	5_7	41	208	CF	3	1	10	191	2	116	129
11090201020	Central Prairie	5_7	41	208	CF	3	1	15	153	5	29	97.75

Appendix B continued. Conservation ranks for 11-digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Stream Type	Uniqueness		Priority Stream			Species Richness		Species of Interest		Conservation Rank
			Value	Rank	Value	Score	Rank	Value	Rank	Value	Rank	
11090201030	Central Prairie	5_7	41	208	CF	3	1	22	95	5	29	83.25
11090201040	Central Prairie	5_7	41	208	CF	3	1	22	95	5	29	83.25
11090201050	Central Prairie	5_7	41	208	CF	3	1	21	100	5	29	84.5
11090201060	Central Prairie	3_18	11	120	No	0	80	21	100	4	53	88.25
11090201070	Central Prairie	5_7	41	208	CF	3	1	18	123	2	116	112
11090202010	Central Prairie	5_7	41	208	CF	3	1	34	43	5	29	70.25
11090202020	Central Prairie	2_4	30	178	No	0	80	16	147	2	116	130.25
11090202030	Central Prairie	2_4	30	178	C	1	48	24	84	4	53	90.75
11090202040	Central Prairie	5_7	41	208	CF	3	1	11	181	3	78	117
11090202050	Central Prairie	5_7	41	208	CF	3	1	17	137	1	165	127.75
11090202060	Central Prairie	5_7	41	208	CF	3	1	17	137	3	78	106
11090202070	Central Prairie	3_16	5	40	No	0	80	19	114	3	78	78
11090202080	Central Prairie	5_7	41	208	CF	3	1	55	5	9	6	55
11090203010	Central Prairie	2_4	30	178	No	0	80	19	114	1	165	134.25
11090203020	Central Prairie	3_16	5	40	No	0	80	43	21	6	21	40.5
11090203030	Central Prairie	2_10	1	1	No	0	80	8	201	2	116	99.5
11090203040	Central Prairie	4_8	12	142	No	0	80	25	78	3	78	94.5
11090204030	Central Prairie	3_4	4	32	C	1	48	12	173	0	194	111.75
11090204040	Central Prairie	4_12	3	23	No	0	80	24	84	2	116	75.75
11090204050	Central Prairie	5_7	41	208	CF	3	1	0	219	0	194	155.5
11090204060	Central Prairie	5_7	41	208	C	1	48	28	66	1	165	121.75
11090204070	Central Prairie	5_7	41	208	No	0	80	25	78	0	194	140
11090204080	Central Prairie	5_7	41	208	No	0	80	50	13	5	29	82.5
11100203020	Central Prairie	2_36	1	1	No	0	80	10	191	2	116	97
11100203030	Central Prairie	4_25	1	1	C	1	48	27	70	2	116	58.75
11100301010	Central Prairie	5_6	1	1	No	0	80	36	38	5	29	37
11100301020	Central Prairie	2_5	2	13	No	0	80	15	153	3	78	81
11100301030	Central Prairie	3_18	11	120	No	0	80	6	211	2	116	131.75
11100301040	Central Prairie	5_7	41	208	No	0	80	15	153	2	116	139.25

Appendix B continued. Conservation ranks for 11-digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Stream Type	Uniqueness		Priority Stream			Species Richness		Species of Interest		Conservation Rank
			Value	Rank	Value	Score	Rank	Value	Rank	Value	Rank	
11100301050	Central Prairie	5_7	41	208	No	0	80	29	62	4	53	100.75
11100301060	Central Prairie	5_7	41	208	No	0	80	33	51	4	53	98
11100301070	Central Prairie	5_7	41	208	No	0	80	0	219	0	194	175.25
11100301080	Central Prairie	5_7	41	208	No	0	80	35	39	6	21	87
11100302010	Central Prairie	5_7	41	208	No	0	80	14	161	1	165	153.5
11100302020	Central Prairie	5_7	41	208	No	0	80	40	26	4	53	91.75
11100302030	Central Prairie	5_7	41	208	No	0	80	18	123	1	165	144
11100302040	Central Prairie	5_7	41	208	No	0	80	0	219	0	194	175.25
11100302050	Central Prairie	2_4	30	178	No	0	80	26	72	5	29	89.75
11100302060	Central Prairie	2_4	30	178	No	0	80	37	35	3	78	92.75
11100302070	Central Prairie	5_7	41	208	No	0	80	46	20	6	21	82.25
11100302080	Central Prairie	5_7	41	208	No	0	80	31	55	2	116	114.75
11100302090	Central Prairie	5_7	41	208	No	0	80	0	219	0	194	175.25
11100303010	Central Prairie	3_19	5	40	No	0	80	31	55	3	78	63.25
11100303020	Central Prairie	4_8	12	142	C	1	48	34	43	4	53	71.5
11100303030	Central Prairie	2_3	5	40	No	0	80	15	153	2	116	97.25
11100303040	Central Prairie	4_8	12	142	C	1	48	0	219	0	194	150.75
11100303050	Central Prairie	4_8	12	142	C	1	48	18	123	1	165	119.5
11100303060	Central Prairie	3_16	5	40	C	1	48	17	137	2	116	85.25
11100303070	Central Prairie	4_8	12	142	C	1	48	6	211	0	194	148.75
11100303080	Central Prairie	3_10	1	1	C	1	48	19	114	2	116	69.75
11100303090	Central Prairie	5_7	41	208	CF	3	1	19	114	1	165	122
11100303100	Central Prairie	4_8	12	142	No	0	80	34	43	3	78	85.75
11100303110	Central Prairie	5_7	41	208	CF	3	1	29	62	2	116	96.75
11100303120	Central Prairie	5_7	41	208	CF	3	1	19	114	3	78	100.25
11100303130	Central Prairie	5_7	41	208	C	1	48	26	72	0	194	130.5
11110101010	Central Prairie	4_8	12	142	No	0	80	38	31	4	53	76.5
11110101020	Central Prairie	5_1	6	75	CF	3	1	58	4	8	9	22.25
11110101030	Central Prairie	3_16	5	40	No	0	80	25	78	1	165	90.75

Appendix B continued. Conservation ranks for 11-digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Stream Type	Uniqueness		Priority Stream			Species Richness		Species of Interest		Conservation Rank
			Value	Rank	Value	Score	Rank	Value	Rank	Value	Rank	
11110101040	Central Prairie	5_1	6	75	CF	3	1	53	9	6	21	26.5
11110101050	Central Prairie	3_4	4	32	No	0	80	28	66	2	116	73.5
11110101060	Central Prairie	5_1	6	75	CF	3	1	0	219	0	194	122.25
11110102030	Central Prairie	3_4	4	32	C	1	48	8	201	0	194	118.75
11110102040	Central Prairie	3_4	4	32	C	1	48	23	92	0	194	91.5
11110102050	Central Prairie	4_12	3	23	No	0	80	19	114	0	194	102.75
11110102060	Central Prairie	4_12	3	23	No	0	80	38	31	1	165	74.75
11110102070	Central Prairie	5_1	6	75	No	0	80	61	2	11	1	39.5
11110104010	Central Prairie	4_7	1	1	No	0	80	34	43	3	78	50.5
11120202040	Central Prairie	4_20	11	120	No	0	80	22	95	5	29	81
11120202050	Central Prairie	4_20	11	120	No	0	80	34	43	5	29	68
11120202060	Central Prairie	3_14	10	110	No	0	80	12	173	1	165	132
11120202070	Central Prairie	4_20	11	120	No	0	80	18	123	2	116	109.75
11120302040	Central Prairie	3_11	1	1	No	0	80	15	153	4	53	71.75
11120302060	Central Prairie	4_20	11	120	No	0	80	5	213	2	116	132.25
11120302070	Central Prairie	4_20	11	120	No	0	80	11	181	2	116	124.25
11120302080	Central Prairie	4_20	11	120	No	0	80	30	59	5	29	72
11120303010	Central Prairie	5_16	5	40	No	0	80	24	84	5	29	58.25
11120303020	Central Prairie	3_14	10	110	No	0	80	7	206	0	194	147.5
11120303030	Central Prairie	2_22	2	13	No	0	80	16	147	2	116	89
11120303040	Central Prairie	4_20	11	120	No	0	80	0	219	0	194	153.25
11120303050	Central Prairie	2_22	2	13	No	0	80	13	168	0	194	113.75
11120303060	Central Prairie	4_20	11	120	No	0	80	11	181	1	165	136.5
11120303070	Central Prairie	5_16	5	40	No	0	80	41	25	7	17	40.5
11120303080	Central Prairie	3_14	10	110	No	0	80	17	137	1	165	123
11120303090	Central Prairie	5_16	5	40	No	0	80	34	43	6	21	46
11120304030	Central Prairie	3_14	10	110	C	1	48	16	147	5	29	83.5
11120304040	Central Prairie	4_20	11	120	CF	3	1	18	123	3	78	80.5
11120304050	Central Prairie	3_14	10	110	No	0	80	0	219	0	194	150.75

Appendix B continued. Conservation ranks for 11-digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Stream Type	Uniqueness		Priority Stream			Species Richness		Species of Interest		Conservation Rank
			Value	Rank	Value	Score	Rank	Value	Rank	Value	Rank	
11120304060	Central Prairie	4_20	11	120	CF	3	1	28	66	6	21	52
11130101030	Central Prairie	2_44	1	1	No	0	80	3	217	0	194	123
11130101040	Central Prairie	3_14	10	110	No	0	80	7	206	3	78	118.5
11130101060	Central Prairie	4_20	11	120	CF	3	1	0	219	0	194	133.5
11130102010	Central Prairie	5_16	5	40	C	1	48	0	219	0	194	125.25
11130102020	Central Prairie	2_25	4	32	No	0	80	10	191	1	165	117
11130102030	Central Prairie	5_16	5	40	C	1	48	0	219	0	194	125.25
11130201010	Central Prairie	5_9	7	87	No	0	80	50	13	8	9	47.25
11130201020	Central Prairie	5_9	7	87	No	0	80	7	206	0	194	141.75
11130201030	Central Prairie	5_9	7	87	No	0	80	17	137	0	194	124.5
11130201040	Central Prairie	2_17	2	13	No	0	80	0	219	0	194	126.5
11130201050	Central Prairie	2_17	2	13	No	0	80	0	219	0	194	126.5
11130201060	Central Prairie	3_18	11	120	C	1	48	9	197	0	194	139.75
11130201070	Central Prairie	3_18	11	120	C	1	48	17	137	1	165	117.5
11130201080	Central Prairie	2_4	30	178	No	0	80	0	219	0	194	167.75
11130201090	Central Prairie	3_18	11	120	No	0	80	17	137	3	78	103.75
11130201100	Central Prairie	5_9	7	87	No	0	80	55	5	10	2	43.5
11130201100	Central Prairie	5_9	7	87	No	0	80	55	5	10	2	43.5
11130202010	Central Prairie	3_18	11	120	C	1	48	13	168	1	165	125.25
11130202020	Central Prairie	4_15	5	40	CF	3	1	20	109	0	194	86
11130202030	Central Prairie	2_20	1	1	C	1	48	20	109	2	116	68.5
11130202040	Central Prairie	4_15	5	40	CF	3	1	22	95	1	165	75.25
11130202050	Central Prairie	4_15	5	40	CF	3	1	11	181	1	165	96.75
11130203020	Central Prairie	2_25	4	32	CF	3	1	0	219	0	194	111.5
11130203030	Central Prairie	3_14	10	110	No	0	80	0	219	0	194	150.75
11130203040	Central Prairie	2_25	4	32	CF	3	1	1	218	0	194	111.25
11130203050	Central Prairie	3_14	10	110	No	0	80	7	206	0	194	147.5
11130203060	Central Prairie	3_13	1	1	CF	3	1	16	147	1	165	78.5
11130203070	Central Prairie	4_15	5	40	CF	3	1	35	39	3	78	39.5

Appendix B continued. Conservation ranks for 11-digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Stream Type	Uniqueness		Priority Stream			Species Richness		Species of Interest		Conservation Rank
			Value	Rank	Value	Score	Rank	Value	Rank	Value	Rank	
11130203010	Central Prairie	2_25	4	32	No	0	80	0	219	0	194	131.25
11130208010	Central Prairie	3_14	10	110	C	1	48	13	168	2	116	110.5
11130208020	Central Prairie	3_14	10	110	C	1	48	0	219	0	194	142.75
11130208030	Central Prairie	2_4	30	178	No	0	80	14	161	2	116	133.75
11130208040	Central Prairie	2_4	30	178	No	0	80	31	55	5	29	85.5
11130208050	Central Prairie	4_15	5	40	No	0	80	0	219	0	194	133.25
11130210010	Central Prairie	5_9	7	87	No	0	80	26	72	2	116	88.75
11130210020	Central Prairie	5_9	7	87	No	0	80	0	219	0	194	145
11130301030	Central Prairie	4_21	7	87	C	1	48	21	100	3	78	78.25
11130301040	Central Prairie	4_21	7	87	C	1	48	21	100	4	53	72
11130301050	Central Prairie	4_21	7	87	C	1	48	13	168	2	116	104.75
11130301060	Central Prairie	4_21	7	87	C	1	48	12	173	1	165	118.25
11130301070	Central Prairie	4_21	7	87	C	1	48	10	191	1	165	122.75
11130302010	Central Prairie	4_21	7	87	No	0	80	8	201	2	116	121
11130302020	Central Prairie	2_4	30	178	No	0	80	0	219	0	194	167.75
11130302030	Central Prairie	4_21	7	87	C	1	48	9	197	0	194	131.5
11130302040	Central Prairie	2_4	30	178	No	0	80	14	161	1	165	146
11130302050	Central Prairie	5_11	12	142	No	0	80	15	153	3	78	113.25
11130302060	Central Prairie	3_18	11	120	No	0	80	0	219	0	194	153.25
11130302070	Central Prairie	5_11	12	142	No	0	80	10	191	0	194	151.75
11130302080	Central Prairie	5_11	12	142	No	0	80	19	114	3	78	103.5
11130302090	Central Prairie	3_18	11	120	No	0	80	0	219	0	194	153.25
11130302100	Central Prairie	2_4	30	178	No	0	80	0	219	0	194	167.75
11130302110	Central Prairie	5_11	12	142	No	0	80	8	201	0	194	154.25
11130302120	Central Prairie	2_4	30	178	No	0	80	14	161	2	116	133.75
11130302130	Central Prairie	2_4	30	178	No	0	80	15	153	1	165	144
11130302140	Central Prairie	2_4	30	178	No	0	80	11	181	0	194	158.25
11130302150	Central Prairie	5_11	12	142	No	0	80	19	114	3	78	103.5
11130302160	Central Prairie	2_4	30	178	No	0	80	5	213	1	165	159

Appendix B continued. Conservation ranks for 11-digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Stream Type	Uniqueness		Priority Stream			Species Richness		Species of Interest		Conservation Rank
			Value	Rank	Value	Score	Rank	Value	Rank	Value	Rank	
11130302170	Central Prairie	2_4	30	178	No	0	80	11	181	2	116	138.75
11130302180	Central Prairie	3_18	11	120	No	0	80	20	109	3	78	96.75
11130302190	Central Prairie	5_11	12	142	No	0	80	7	206	0	194	155.5
11130303010	Central Prairie	5_11	12	142	No	0	80	26	72	3	78	93
11130303020	Central Prairie	5_11	12	142	No	0	80	11	181	1	165	142
11130303030	Central Prairie	2_4	30	178	No	0	80	0	219	0	194	167.75
11130303040	Central Prairie	2_4	30	178	No	0	80	0	219	0	194	167.75
11130303050	Central Prairie	5_11	12	142	No	0	80	11	181	0	194	149.25
11130303060	Central Prairie	5_11	12	142	No	0	80	38	31	4	53	76.5
11130303070	Central Prairie	2_4	30	178	No	0	80	11	181	2	116	138.75
11130303080	Central Prairie	2_4	30	178	No	0	80	0	219	0	194	167.75
11130303090	Central Prairie	2_4	30	178	No	0	80	5	213	0	194	166.25
11130303100	Central Prairie	3_18	11	120	No	0	80	14	161	1	165	131.5
11130303110	Central Prairie	5_11	12	142	No	0	80	21	100	4	53	93.75
11130303120	Central Prairie	3_18	11	120	No	0	80	21	100	2	116	104
11130303130	Central Prairie	5_11	12	142	No	0	80	59	3	8	9	58.5
11040002010	High Plains	4_31	2	3	CF	3	1	20	4	5	2	2.5
11040002020	High Plains	2_60	1	1	No	0	9	2	20	1	15	11.25
11040002040	High Plains	4_31	2	3	CF	3	1	9	14	2	10	7
11040006060	High Plains	5_6	5	8	CF	3	1	17	6	5	2	4.25
11040008010	High Plains	5_19	3	5	CF	3	1	9	14	2	10	7.5
11040008060	High Plains	5_19	3	5	CF	3	1	6	19	0	18	10.75
11050001010	High Plains	4_10	1	1	C	1	7	15	7	4	5	5
11050001020	High Plains	5_19	3	5	CF	3	1	29	1	7	1	2
11100101040	High Plains	4_25	8	25	No	0	9	0	21	0	18	18.25
11100101050	High Plains	4_25	8	25	No	0	9	0	21	0	18	18.25
11100101060	High Plains	2_36	7	18	No	0	9	0	21	0	18	16.5
11100101070	High Plains	2_36	7	18	No	0	9	0	21	0	18	16.5
11100101080	High Plains	4_25	8	25	No	0	9	8	16	2	10	15

Appendix B continued. Conservation ranks for 11-digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Stream Type	Uniqueness		Priority Stream			Species Richness		Species of Interest		Conservation Rank
			Value	Rank	Value	Score	Rank	Value	Rank	Value	Rank	
11100101090	High Plains	2_36	7	18	No	0	9	0	21	0	18	16.5
11100101100	High Plains	3_11	5	8	No	0	9	0	21	0	18	14
11100102010	High Plains	2_36	7	18	No	0	9	0	21	0	18	16.5
11100102020	High Plains	4_25	8	25	No	0	9	0	21	0	18	18.25
11100102030	High Plains	4_25	8	25	No	0	9	0	21	0	18	18.25
11100102040	High Plains	2_36	7	18	No	0	9	0	21	0	18	16.5
11100102050	High Plains	4_25	8	25	No	0	9	20	4	5	2	10
11100102060	High Plains	5_6	5	8	No	0	9	24	3	4	5	6.25
11100103020	High Plains	2_36	7	18	No	0	9	0	21	0	18	16.5
11100103050	High Plains	3_11	5	8	No	0	9	0	21	0	18	14
11100104070	High Plains	3_11	5	8	No	0	9	15	7	3	8	8
11100201010	High Plains	4_25	8	25	No	0	9	10	13	0	18	16.25
11100201020	High Plains	2_36	7	18	No	0	9	7	17	0	18	15.5
11100201030	High Plains	5_6	5	8	No	0	9	7	17	1	15	12.25
11100201050	High Plains	3_11	5	8	No	0	9	15	7	2	10	8.5
11100201060	High Plains	4_25	8	25	No	0	9	14	10	2	10	13.5
11100201070	High Plains	5_6	5	8	No	0	9	14	10	3	8	8.75
11100201080	High Plains	3_11	5	8	C	1	7	11	12	1	15	10.5
11100201090	High Plains	5_6	5	8	No	0	9	28	2	4	5	6
11090204010	Ouachita Mountains	4_12	1	1	C	1	21	37	35	3	36	23.25
11090204020	Ouachita Mountains	4_7	4	17	No	0	22	45	26	2	45	27.5
11110105030	Ouachita Mountains	4_7	4	17	F	2	11	44	27	8	18	18.25
11110105040	Ouachita Mountains	3_6	1	1	No	0	22	49	22	8	18	15.75
11110105050	Ouachita Mountains	4_7	4	17	No	0	22	59	13	8	18	17.5
11110105060	Ouachita Mountains	5_5	3	8	F	2	11	73	4	14	4	6.75
11110105070	Ouachita Mountains	5_5	3	8	No	0	22	13	49	1	49	32
11110105080	Ouachita Mountains	5_5	3	8	No	0	22	39	32	4	31	23.25
11110105090	Ouachita Mountains	4_7	4	17	No	0	22	64	11	9	17	16.75
11130304010	Ouachita Mountains	2_20	3	8	No	0	22	26	41	3	36	26.75

Appendix B continued. Conservation ranks for 11-digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Stream Type	Uniqueness Value	Uniqueness Rank	Priority Stream Value	Priority Stream Score	Priority Stream Rank	Species Richness Value	Species Richness Rank	Species of Interest Value	Species of Interest Rank	Conservation Rank
11130304020	Ouachita Mountains	2_20	3	8	CF	3	1	26	41	3	36	21.5
11130304030	Ouachita Mountains	5_11	3	8	No	0	22	23	44	2	45	29.75
11130304040	Ouachita Mountains	5_11	3	8	No	0	22	16	47	3	36	28.25
11130304050	Ouachita Mountains	5_11	3	8	No	0	22	27	40	3	36	26.5
11140101010	Ouachita Mountains	5_9	6	25	F	2	11	16	47	2	45	32
11140101020	Ouachita Mountains	5_9	6	25	F	2	11	0	50	0	50	34
11140101040	Ouachita Mountains	5_9	6	25	F	2	11	0	50	0	50	34
11140101060	Ouachita Mountains	5_9	6	25	F	2	11	70	6	14	4	11.5
11140102010	Ouachita Mountains	2_20	3	8	CF	3	1	18	46	4	31	21.5
11140102020	Ouachita Mountains	3_13	1	1	CF	3	1	49	22	10	13	9.25
11140102030	Ouachita Mountains	4_19	9	31	No	0	22	57	17	13	6	19
11140103010	Ouachita Mountains	4_19	9	31	No	0	22	39	32	8	18	25.75
11140103020	Ouachita Mountains	3_9	2	6	No	0	22	43	28	3	36	23
11140103030	Ouachita Mountains	4_19	9	31	No	0	22	22	45	2	45	35.75
11140103040	Ouachita Mountains	3_9	2	6	No	0	22	28	39	3	36	25.75
11140103050	Ouachita Mountains	4_19	9	31	No	0	22	79	3	16	3	14.75
11140103060	Ouachita Mountains	5_10	1	1	No	0	22	58	15	7	25	15.75
11140104010	Ouachita Mountains	4_19	9	31	No	0	22	43	28	5	30	27.75
11140104020	Ouachita Mountains	4_19	9	31	No	0	22	34	36	4	31	30
11140104030	Ouachita Mountains	4_19	9	31	No	0	22	52	18	7	25	24
11140104040	Ouachita Mountains	4_19	9	31	No	0	22	30	38	4	31	30.5
11140104050	Ouachita Mountains	4_19	9	31	No	0	22	24	43	3	36	33
11140105010	Ouachita Mountains	4_6	12	40	CF	3	1	52	18	11	11	17.5
11140105020	Ouachita Mountains	4_6	12	40	CF	3	1	38	34	4	31	26.5
11140105030	Ouachita Mountains	4_6	12	40	No	0	22	42	30	6	28	30
11140105040	Ouachita Mountains	4_6	12	40	CF	3	1	69	7	13	6	13.5
11140105050	Ouachita Mountains	2_8	1	1	CF	3	1	32	37	3	36	18.75
11140105060	Ouachita Mountains	5_8	4	17	CF	3	1	71	5	10	13	9
11140105070	Ouachita Mountains	5_8	4	17	No	0	22	59	13	8	18	17.5

Appendix B continued. Conservation ranks for 11-digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Stream Type	Uniqueness Value	Uniqueness Rank	Priority Stream Value	Priority Stream Score	Priority Stream Rank	Species Richness Value	Species Richness Rank	Species of Interest Value	Species of Interest Rank	Conservation Rank
11140105080	Ouachita Mountains	5_8	4	17	No	0	22	69	7	11	11	14.25
11140106020	Ouachita Mountains	5_9	6	25	F	2	11	46	24	7	25	21.25
11140106040	Ouachita Mountains	5_9	6	25	F	2	11	93	2	17	2	10
11140107010	Ouachita Mountains	4_6	12	40	No	0	22	46	24	6	28	28.5
11140107020	Ouachita Mountains	4_6	12	40	No	0	22	52	18	10	13	23.25
11140107030	Ouachita Mountains	4_6	12	40	No	0	22	69	7	13	6	18.75
11140107040	Ouachita Mountains	4_6	12	40	CF	3	1	58	15	12	9	16.25
11140107050	Ouachita Mountains	4_6	12	40	F	2	11	107	1	26	1	13.25
11140108040	Ouachita Mountains	4_6	12	40	F	2	11	42	30	8	18	24.75
11140108050	Ouachita Mountains	4_6	12	40	No	0	22	52	18	10	13	23.25
11140108060	Ouachita Mountains	4_6	12	40	No	0	22	67	10	8	18	22.5
11140109170	Ouachita Mountains	5_8	4	17	CF	3	1	62	12	12	9	9.75
11070206030	Ozarks	5_1	9	16	No	0	6	54	9	18	5	9
11070206040	Ozarks	2_13	2	5	No	0	6	51	12	13	9	8
11070206060	Ozarks	5_1	9	16	No	0	6	19	23	5	24	17.25
11070207190	Ozarks	4_3	1	1	CF	3	1	91	3	26	3	2
11070209040	Ozarks	3_3	2	5	No	0	6	20	22	11	12	11.25
11070209050	Ozarks	4_2	2	5	No	0	6	28	17	9	16	11
11070209060	Ozarks	4_2	2	5	No	0	6	18	24	8	19	13.5
11070209070	Ozarks	5_1	9	16	No	0	6	27	18	9	16	14
11070209100	Ozarks	5_1	9	16	No	0	6	52	10	14	8	10
11070209110	Ozarks	2_13	2	5	No	0	6	46	15	13	9	8.75
11070209120	Ozarks	5_1	9	16	No	0	6	27	18	10	14	13.5
11110102010	Ozarks	5_1	9	16	No	0	6	60	8	9	16	11.5
11110102020	Ozarks	2_11	1	1	No	0	6	31	16	8	19	10.5
11110103050	Ozarks	4_1	3	13	CF	3	1	87	4	24	4	5.5
11110103060	Ozarks	4_1	3	13	CF	3	1	103	1	27	2	4.25
11110103090	Ozarks	4_1	3	13	C	1	5	71	5	18	5	7
11110103100	Ozarks	5_4	2	5	No	0	6	69	6	16	7	6

Appendix B continued. Conservation ranks for 11-digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Stream Type	Uniqueness		Priority Stream			Species Richness		Species of Interest		Conservation Rank
			Value	Rank	Value	Score	Rank	Value	Rank	Value	Rank	
11110103110	Ozarks	5_4	2	5	No	0	6	102	2	29	1	3.5
11110104020	Ozarks	5_1	9	16	No	0	6	27	18	8	19	14.75
11110104030	Ozarks	3_3	2	5	No	0	6	52	10	11	12	8.25
11110104040	Ozarks	5_1	9	16	No	0	6	48	14	6	23	14.75
11110104050	Ozarks	5_1	9	16	No	0	6	50	13	7	22	14.25
11110104070	Ozarks	4_4	1	1	CF	3	1	25	21	10	14	9.25
11110105110	Ozarks	5_5	1	1	No	0	6	68	7	12	11	6.25

Appendix C. Condition Ranks for 11 digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Point sources		urbanization		conversion		reservoirs		UWA	Conser-vation	Condi-tion	Comb-ined
		Value	Rank	Value	Rank	Value	Rank	Value	Rank	Rank	Rank	Rank	Rank
11050001030	Central Prairie	1	73	0.18	37	14.31	48	0.00	1	0	92	39.75	65.88
11050001040	Central Prairie	0	1	0.18	37	20.94	90	0.10	28	0	80	39.00	59.38
11050001050	Central Prairie	1	73	0.34	89	26.72	115	0.10	28	0	68	76.25	72.13
11050001060	Central Prairie	1	73	0.37	98	24.46	107	0.00	1	80	80	69.75	74.75
11050001070	Central Prairie	1	73	0.32	82	53.40	194	0.20	82	0	93	107.75	100.13
11050001080	Central Prairie	2	135	0.47	125	55.73	201	0.10	28	0	56	122.25	89.13
11050001090	Central Prairie	1	73	0.49	133	25.87	112	0.10	28	0	103	86.50	94.75
11050002010	Central Prairie	1	73	0.73	179	47.09	172	0.10	28	0	44	113.00	78.63
11050002020	Central Prairie	0	1	0.62	166	61.87	218	0.00	1	0	103	96.50	99.63
11050002030	Central Prairie	2	135	0.62	166	54.02	196	0.10	28	0	109	131.25	119.88
11050002040	Central Prairie	3	160	0.46	121	57.35	207	0.00	1	0	51	122.25	86.50
11050002050	Central Prairie	0	1	0.30	74	48.66	179	0.10	28	31	139	70.50	104.75
11050002060	Central Prairie	0	1	0.31	78	63.94	224	0.00	1	0	130	76.00	103.13
11050002070	Central Prairie	3	160	0.60	162	67.32	234	0.10	28	0	99	146.00	122.38
11050002080	Central Prairie	1	73	0.76	183	67.77	236	0.10	28	41	67	130.00	98.50
11050002090	Central Prairie	0	1	0.36	94	55.75	202	0.00	1	0	137	74.50	105.63
11050002100	Central Prairie	0	1	0.37	98	58.78	213	0.10	28	0	136	85.00	110.25
11050002110	Central Prairie	5	196	0.92	196	58.92	214	0.20	82	0	67	172.00	119.50
11050002120	Central Prairie	0	1	0.28	62	55.69	200	0.00	1	0	44	66.00	55.00
11050002130	Central Prairie	15	236	6.08	243	26.99	116	1.40	211	0	59	201.50	130.13
11050002140	Central Prairie	23	242	2.69	236	55.39	199	0.10	28	0	99	176.25	137.38
11050002150	Central Prairie	2	135	0.20	44	41.34	157	0.10	28	50	75	91.00	82.88
11050002160	Central Prairie	3	160	0.60	162	36.44	145	0.20	82	0	79	137.25	108.00
11050003010	Central Prairie	1	73	0.25	56	19.77	82	0.10	28	0	108	59.75	84.00
11050003020	Central Prairie	1	73	0.43	110	19.68	81	0.20	82	0	81	86.50	83.63
11050003030	Central Prairie	1	73	0.47	125	5.77	12	6.60	234	20	126	111.00	118.63
11050003040	Central Prairie	8	223	3.40	238	11.03	34	0.50	158	0	93	163.25	128.13
11050003050	Central Prairie	6	206	0.70	176	16.30	58	0.40	140	39	100	145.00	122.63
11050003060	Central Prairie	4	177	1.71	224	9.20	23	0.20	82	80	90	126.50	108.13

Appendix C. Condition ranks for 11 digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Point sources		urbanization		conversion		reservoirs		UWA	Conser-vation	Condi-tion	Comb-ined
		Value	Rank	Value	Rank	Value	Rank	Value	Rank	Rank	Rank	Rank	Rank
11050003070	Central Prairie	0	1	0.42	108	7.46	15	0.00	1	64	80	31.25	55.63
11050003080	Central Prairie	7	214	1.08	208	3.77	2	6.80	235	0	124	164.75	144.38
11060001030	Central Prairie	0	1	0.16	31	8.87	20	2.90	219	0	71	67.75	69.13
11060001040	Central Prairie	0	1	0.29	68	24.64	110	5.80	233	0	104	103.00	103.63
11060001050	Central Prairie	5	196	2.19	226	22.66	98	9.20	237	10	78	189.25	133.38
11060002030	Central Prairie	0	1	0.09	4	10.23	31	0.10	28	0	84	16.00	49.88
11060002040	Central Prairie	0	1	0.81	189	42.61	158	0.20	82	0	103	107.50	105.25
11060003030	Central Prairie	0	1	0.30	74	82.53	247	0.10	28	0	77	87.50	82.25
11060004030	Central Prairie	0	1	0.43	110	20.18	87	3.30	224	0	110	105.50	107.50
11060004040	Central Prairie	1	73	0.43	110	58.14	211	4.10	228	0	144	155.50	149.63
11060004050	Central Prairie	1	73	0.41	107	52.11	189	0.10	28	0	74	99.25	86.38
11060004060	Central Prairie	2	135	0.47	125	51.77	188	0.20	82	0	59	132.50	95.88
11060004070	Central Prairie	3	160	0.55	148	64.74	225	0.10	28	0	115	140.25	127.75
11060004080	Central Prairie	1	73	0.43	110	64.96	226	0.10	28	0	149	109.25	129.13
11060004090	Central Prairie	0	1	0.28	62	76.65	242	0.00	1	0	128	76.50	102.13
11060004100	Central Prairie	5	196	2.42	231	65.80	228	0.00	1	80	74	164.00	119.00
11060004110	Central Prairie	7	214	0.72	177	71.90	238	0.10	28	0	175	164.25	169.75
11060005060	Central Prairie	4	177	1.03	204	75.88	241	0.20	82	0	11	176.00	93.50
11060005070	Central Prairie	0	1	0.54	145	67.95	237	0.00	1	94	80	96.00	88.13
11060005080	Central Prairie	1	73	0.99	202	77.17	244	0.10	28	64	9	136.75	72.63
11060006010	Central Prairie	2	135	0.55	148	62.26	220	0.30	122	0	108	156.25	132.25
11060006020	Central Prairie	1	73	0.55	148	41.31	156	0.10	28	0	86	101.25	93.38
11060006030	Central Prairie	0	1	0.23	51	24.35	106	0.30	122	0	121	70.00	95.25
11060006040	Central Prairie	0	1	0.22	47	15.87	55	0.30	122	0	64	56.25	60.25
11060006050	Central Prairie	2	135	0.46	121	10.15	29	0.20	82	0	69	91.75	80.25
11060006060	Central Prairie	2	135	0.58	157	9.37	24	0.20	82	0	45	99.50	72.25
11060006070	Central Prairie	4	177	0.94	199	44.91	163	0.60	170	0	115	177.25	145.88
11060006080	Central Prairie	2	135	0.58	157	20.34	88	0.30	122	0	128	125.50	126.63
11060006090	Central Prairie	4	177	0.60	162	16.05	56	0.30	122	21	89	129.25	109.00

Appendix C continued. Condition Ranks for 11 digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Point sources		urbanization		conversion		reservoirs		UWA	Conser-vation	Condi-tion	Comb-ined
		Value	Rank	Value	Rank	Value	Rank	Value	Rank	Rank	Rank	Rank	Rank
11060006100	Central Prairie	0	1	0.22	47	10.13	28	0.00	1	64	73	19.25	46.00
11060006110	Central Prairie	5	196	0.78	185	3.86	4	9.70	239	22	174	156.00	164.88
11070103030	Central Prairie	1	73	0.31	78	53.07	192	0.20	82	0	51	106.25	78.75
11070103040	Central Prairie	0	1	0.13	17	52.65	191	0.20	82	0	47	72.75	59.63
11070103050	Central Prairie	14	234	0.53	141	36.31	144	13.90	245	1	127	191.00	158.88
11070105010	Central Prairie	16	237	2.72	237	36.98	147	0.70	187	0	61	202.00	131.38
11070105020	Central Prairie	13	233	2.37	228	33.49	131	0.80	195	57	63	196.75	129.88
11070105030	Central Prairie	7	214	1.52	219	47.71	175	0.50	158	0	68	191.50	129.75
11070105040	Central Prairie	9	226	1.48	218	49.97	182	0.40	140	0	149	191.50	170.00
11070106020	Central Prairie	0	1	0.11	13	11.79	37	0.20	82	0	48	33.25	40.50
11070106030	Central Prairie	1	73	0.21	45	25.76	111	4.00	227	0	40	114.00	76.75
11070106050	Central Prairie	2	135	0.81	189	45.57	167	5.10	231	0	89	180.50	134.75
11070106060	Central Prairie	6	206	0.43	110	12.12	38	0.20	82	73	17	109.00	62.75
11070106070	Central Prairie	9	226	2.41	229	35.94	140	0.60	170	0	77	191.25	133.88
11070106080	Central Prairie	6	206	0.98	201	40.21	153	0.50	158	0	74	179.50	126.75
11070107010	Central Prairie	5	196	0.50	135	5.78	13	1.00	201	27	30	136.25	83.13
11070107020	Central Prairie	0	1	0.16	31	5.29	10	0.00	1	64	65	10.75	37.75
11070107030	Central Prairie	6	206	0.54	145	9.55	25	0.40	140	16	108	129.00	118.25
11070107040	Central Prairie	90	248	10.81	246	18.82	75	0.50	158	7	64	181.75	122.88
11070206010	Central Prairie	11	229	2.51	232	74.72	239	0.50	158	0	33	214.50	123.63
11070206020	Central Prairie	2	135	1.58	220	77.81	245	1.50	212	94	86	203.00	144.63
11070206050	Central Prairie	2	135	1.14	212	60.88	216	10.00	240	23	40	200.75	120.50
11070209010	Central Prairie	7	214	0.65	170	63.35	223	0.20	82	0	27	172.25	99.75
11070209020	Central Prairie	2	135	0.56	152	78.66	246	0.10	28	0	31	140.25	85.75
11070209030	Central Prairie	4	177	0.50	135	61.04	217	1.00	201	0	60	182.50	121.00
11070209080	Central Prairie	3	160	0.79	188	58.58	212	0.20	82	0	58	160.50	109.38
11070209090	Central Prairie	23	242	2.41	229	48.58	177	0.60	170	0	53	204.50	128.75
11090201010	Central Prairie	0	1	0.13	17	10.02	27	0.10	28	0	129	18.25	73.63
11090201020	Central Prairie	0	1	0.07	2	6.17	14	0.00	1	0	98	4.50	51.13

Appendix C continued. Condition Ranks for 11 digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Point sources		urbanization		conversion		reservoirs		UWA Rank	Conser-vation Rank	Condi-tion Rank	Comb-ined Rank
		Value	Rank	Value	Rank	Value	Rank	Value	Rank				
11090201030	Central Prairie	0	1	0.14	22	14.85	51	0.00	1	64	83	18.75	51.00
11090201040	Central Prairie	0	1	0.17	34	33.36	130	0.00	1	50	83	41.50	62.38
11090201050	Central Prairie	1	73	0.35	92	36.18	143	0.00	1	50	85	77.25	80.88
11090201060	Central Prairie	4	177	1.04	205	62.66	221	0.00	1	50	88	151.00	119.63
11090201070	Central Prairie	0	1	0.23	51	47.96	176	0.20	82	0	112	77.50	94.75
11090202010	Central Prairie	1	73	0.54	145	45.42	166	0.20	82	0	70	116.50	93.38
11090202020	Central Prairie	1	73	0.56	152	32.84	129	0.10	28	62	130	95.50	112.88
11090202030	Central Prairie	3	160	0.99	202	20.05	86	0.20	82	0	91	132.50	111.63
11090202040	Central Prairie	19	241	4.55	240	34.66	137	0.20	82	0	117	175.00	146.00
11090202050	Central Prairie	1	73	0.48	131	34.38	136	0.10	28	64	128	92.00	109.88
11090202060	Central Prairie	1	73	0.28	62	17.33	71	0.10	28	0	106	58.50	82.25
11090202070	Central Prairie	11	229	1.66	223	19.97	84	0.40	140	0	78	169.00	123.50
11090202080	Central Prairie	4	177	0.45	118	16.43	60	0.80	195	0	55	137.50	96.25
11090203010	Central Prairie	9	226	3.83	239	5.68	11	5.20	232	13	134	177.00	155.63
11090203020	Central Prairie	1	73	0.33	86	8.08	18	0.80	195	0	41	93.00	66.75
11090203030	Central Prairie	1	73	0.30	74	7.94	16	0.70	187	104	100	87.50	93.50
11090203040	Central Prairie	2	135	0.45	118	16.81	64	0.60	170	61	95	121.75	108.13
11090204030	Central Prairie	5	196	0.85	193	23.10	100	0.20	82	0	112	142.75	127.25
11090204040	Central Prairie	6	206	0.81	189	21.35	92	9.20	237	0	76	181.00	128.38
11090204050	Central Prairie	0	1	0.06	1	14.15	47	0.00	1	0	156	12.50	84.00
11090204060	Central Prairie	2	135	0.30	74	17.27	69	13.40	243	0	122	130.25	126.00
11090204070	Central Prairie	1	73	0.37	98	23.87	104	16.30	246	0	140	130.25	135.13
11090204080	Central Prairie	5	196	0.49	133	46.97	171	0.60	170	0	83	167.50	125.00
11100203020	Central Prairie	1	73	0.37	98	2216.0	248	3.10	220	0	97	159.75	128.38
11100203030	Central Prairie	0	1	0.52	139	19.15	78	1.00	201	0	59	104.75	81.75
11100301010	Central Prairie	12	232	1.45	217	19.42	80	0.10	28	0	37	139.25	88.13
11100301020	Central Prairie	1	73	0.31	78	21.92	95	0.00	1	94	81	61.75	71.38
11100301030	Central Prairie	1	73	0.19	40	31.21	127	0.00	1	0	132	60.25	96.00
11100301040	Central Prairie	0	1	0.46	121	38.61	150	0.00	1	0	139	68.25	103.75

Appendix C continued. Condition Ranks for 11 digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Point sources		urbanization		conversion		reservoirs		UWA	Conser-vation	Condi-tion	Comb-ined
		Value	Rank	Value	Rank	Value	Rank	Value	Rank	Rank	Rank	Rank	Rank
11100301050	Central Prairie	1	73	0.53	141	43.13	160	4.40	229	0	101	150.75	125.75
11100301060	Central Prairie	4	177	0.73	179	54.16	197	0.10	28	0	98	145.25	121.63
11100301070	Central Prairie	1	73	0.59	159	66.79	231	0.10	28	0	175	122.75	149.00
11100301080	Central Prairie	27	244	5.97	242	48.61	178	1.60	213	37	87	219.25	153.13
11100302010	Central Prairie	75	246	35.55	248	3.77	2	0.20	82	0	154	144.50	149.00
11100302020	Central Prairie	14	234	2.56	234	17.59	72	1.00	201	0	92	185.25	138.50
11100302030	Central Prairie	16	237	2.55	233	26.99	116	0.20	82	0	144	167.00	155.50
11100302040	Central Prairie	4	177	0.45	118	23.84	103	0.30	122	0	175	130.00	152.63
11100302050	Central Prairie	7	214	1.20	213	27.50	120	1.30	210	0	90	189.25	139.50
11100302060	Central Prairie	3	160	0.26	58	26.21	114	0.70	187	110	93	129.75	111.25
11100302070	Central Prairie	1	73	0.55	148	27.32	119	0.60	170	11	82	127.50	104.88
11100302080	Central Prairie	7	214	0.28	62	17.12	67	0.10	28	83	115	92.75	103.75
11100302090	Central Prairie	1	73	0.64	169	19.10	77	16.70	247	0	175	141.50	158.38
11100303010	Central Prairie	18	239	10.26	245	4.49	7	0.30	122	0	63	153.25	108.25
11100303020	Central Prairie	1	73	0.27	61	9.13	22	0.40	140	0	72	74.00	72.75
11100303030	Central Prairie	2	135	0.51	137	8.93	21	0.10	28	0	97	80.25	88.75
11100303040	Central Prairie	4	177	0.66	171	11.61	35	0.50	158	0	151	135.25	143.00
11100303050	Central Prairie	1	73	0.42	108	12.78	41	1.60	213	0	120	108.75	114.13
11100303060	Central Prairie	5	196	0.57	155	13.32	43	0.60	170	0	85	141.00	113.13
11100303070	Central Prairie	0	1	0.22	47	9.58	26	0.60	170	0	149	61.00	104.88
11100303080	Central Prairie	0	1	0.59	159	11.64	36	0.90	199	0	70	98.75	84.25
11100303090	Central Prairie	0	1	0.15	26	19.38	79	0.70	187	0	122	73.25	97.63
11100303100	Central Prairie	4	177	0.61	165	14.88	52	0.50	158	78	86	138.00	111.88
11100303110	Central Prairie	4	177	0.47	125	28.19	121	1.10	208	0	97	157.75	127.25
11100303120	Central Prairie	8	223	1.25	215	30.46	125	0.20	82	0	100	161.25	130.75
11100303130	Central Prairie	7	214	0.82	192	25.95	113	11.00	241	0	131	190.00	160.25
11110101010	Central Prairie	29	245	2.66	235	12.80	42	0.60	170	0	77	173.00	124.75
11110101020	Central Prairie	87	247	13.84	247	10.36	32	0.50	158	25	22	171.00	96.63
11110101030	Central Prairie	1	73	0.53	141	36.94	146	0.10	28	0	91	97.00	93.88

Appendix C continued. Condition Ranks for 11 digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Point sources		urbanization		conversion		reservoirs		UWA	Conser-vation	Condi-tion	Comb-ined
		Value	Rank	Value	Rank	Value	Rank	Value	Rank	Rank	Rank	Rank	Rank
11110101040	Central Prairie	18	239	4.96	241	34.77	139	0.10	28	0	27	161.75	94.13
11110101050	Central Prairie	2	135	0.21	45	57.48	209	0.60	170	0	74	139.75	106.63
11110101060	Central Prairie	6	206	1.61	222	45.24	164	0.10	28	0	122	155.00	138.63
11110102030	Central Prairie	3	160	1.08	208	63.16	222	0.20	82	0	119	168.00	143.38
11110102040	Central Prairie	0	1	0.34	89	51.42	187	0.10	28	0	92	76.25	83.88
11110102050	Central Prairie	2	135	0.77	184	53.35	193	0.20	82	0	103	148.50	125.63
11110102060	Central Prairie	2	135	0.67	172	47.28	173	0.50	158	0	75	159.50	117.13
11110102070	Central Prairie	6	206	0.93	197	34.07	134	13.80	244	22	40	195.25	117.38
11110104010	Central Prairie	7	214	0.28	62	42.64	159	0.70	187	0	51	155.50	103.00
11120202040	Central Prairie	0	1	0.10	8	8.28	19	0.10	28	41	81	14.00	47.50
11120202050	Central Prairie	1	73	0.44	116	27.27	118	0.10	28	41	68	83.75	75.88
11120202060	Central Prairie	3	160	0.25	56	45.57	167	0.30	122	0	132	126.25	129.13
11120202070	Central Prairie	2	135	0.93	197	66.46	230	0.10	28	64	110	147.50	128.63
11120302040	Central Prairie	0	1	0.11	13	4.43	6	0.10	28	0	72	12.00	41.88
11120302060	Central Prairie	0	1	0.15	26	8.04	17	0.10	28	0	132	18.00	75.13
11120302070	Central Prairie	1	73	0.43	110	18.02	73	0.20	82	0	124	84.50	104.38
11120302080	Central Prairie	0	1	0.15	26	33.68	133	3.10	220	0	72	95.00	83.50
11120303010	Central Prairie	0	1	0.17	34	50.23	184	0.00	1	31	58	55.00	56.63
11120303020	Central Prairie	1	73	1.06	207	36.08	142	0.40	140	0	148	140.50	144.00
11120303030	Central Prairie	0	1	0.10	8	56.22	205	0.30	122	0	89	84.00	86.50
11120303040	Central Prairie	0	1	0.22	47	56.06	204	0.40	140	0	153	98.00	125.63
11120303050	Central Prairie	0	1	0.78	185	65.56	227	0.60	170	0	114	145.75	129.75
11120303060	Central Prairie	3	160	0.52	139	60.17	215	0.00	1	86	137	128.75	132.63
11120303070	Central Prairie	0	1	0.15	26	48.70	180	0.20	82	29	41	72.25	56.38
11120303080	Central Prairie	4	177	0.33	86	47.44	174	3.40	225	0	123	165.50	144.25
11120303090	Central Prairie	3	160	1.20	213	67.66	235	0.20	82	0	46	172.50	109.25
11120304030	Central Prairie	0	1	0.12	15	0.13	1	0.10	28	41	84	11.25	47.38
11120304040	Central Prairie	0	1	0.10	8	13.86	45	0.10	28	31	81	20.50	50.50
11120304050	Central Prairie	0	1	0.12	15	16.56	62	0.10	28	0	151	26.50	88.63

Appendix C continued. Condition Ranks for 11 digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Point sources		urbanization		conversion		reservoirs		UWA	Conser-vation	Condi-tion	Comb-ined
		Value	Rank	Value	Rank	Value	Rank	Value	Rank	Rank	Rank	Rank	Rank
11120304060	Central Prairie	1	73	0.34	89	40.86	155	0.10	28	86	52	86.25	69.13
11130101030	Central Prairie	0	1	0.46	121	49.97	182	0.00	1	0	123	76.25	99.63
11130101040	Central Prairie	1	73	0.29	68	52.46	190	0.10	28	94	119	89.75	104.13
11130101060	Central Prairie	1	73	0.29	68	32.83	128	0.20	82	0	134	87.75	110.63
11130102010	Central Prairie	1	73	0.32	82	65.92	229	0.10	28	50	125	103.00	114.13
11130102020	Central Prairie	3	160	1.04	205	76.89	243	0.30	122	0	117	182.50	149.75
11130102030	Central Prairie	0	1	0.36	94	57.96	210	0.10	28	31	125	83.25	104.25
11130201010	Central Prairie	1	73	0.29	68	33.62	132	0.50	158	39	47	107.75	77.50
11130201020	Central Prairie	1	73	0.26	58	34.10	135	0.00	1	73	142	66.75	104.25
11130201030	Central Prairie	0	1	0.09	4	18.41	74	0.10	28	0	125	26.75	75.63
11130201040	Central Prairie	2	135	0.10	8	13.97	46	0.40	140	0	127	82.25	104.38
11130201050	Central Prairie	1	73	0.35	92	22.08	96	0.10	28	0	127	72.25	99.38
11130201060	Central Prairie	0	1	0.09	4	23.02	99	0.30	122	31	140	56.50	98.13
11130201070	Central Prairie	0	1	0.13	17	23.75	101	0.10	28	0	118	36.75	77.13
11130201080	Central Prairie	5	196	0.97	200	14.32	49	0.20	82	0	168	131.75	149.75
11130201090	Central Prairie	0	1	0.28	62	16.42	59	0.30	122	0	104	61.00	82.38
11130201100	Central Prairie	1	73	0.67	172	67.18	232	0.20	82	0	44	139.75	91.63
11130201100	Central Prairie	1	73	0.67	172	67.18	232	0.20	82	0	44	139.75	91.63
11130202010	Central Prairie	1	73	0.17	34	40.20	152	0.10	28	0	125	71.75	98.50
11130202020	Central Prairie	2	135	0.75	182	28.32	123	4.50	230	0	86	167.50	126.75
11130202030	Central Prairie	1	73	0.47	125	4.06	5	3.10	220	0	69	105.75	87.13
11130202040	Central Prairie	8	223	6.24	244	21.37	93	0.30	122	0	75	170.50	122.88
11130202050	Central Prairie	2	135	0.57	155	45.36	165	0.40	140	0	97	148.75	122.75
11130203010	Central Prairie	0	1	0.33	86	15.85	54	2.40	218	0	131	89.75	110.50
11130203020	Central Prairie	2	135	0.26	58	45.97	170	0.20	82	0	112	111.25	111.38
11130203030	Central Prairie	0	1	0.23	51	49.28	181	0.70	187	0	151	105.00	127.88
11130203040	Central Prairie	1	73	0.72	177	56.99	206	0.20	82	0	111	134.50	122.88
11130203050	Central Prairie	0	1	0.32	82	53.45	195	0.20	82	0	148	90.00	118.75
11130203060	Central Prairie	4	177	0.40	104	12.35	39	0.40	140	0	79	115.00	96.75

Appendix C continued. Condition Ranks for 11 digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Point sources		urbanization		conversion		reservoirs		UWA	Conser-vation	Condi-tion	Comb-ined
		Value	Rank	Value	Rank	Value	Rank	Value	Rank	Rank	Rank	Rank	Rank
11130203070	Central Prairie	1	73	0.63	168	45.77	169	0.20	82	0	40	123.00	81.25
11130208010	Central Prairie	3	160	0.39	102	20.57	89	0.20	82	0	111	108.25	109.38
11130208020	Central Prairie	0	1	0.14	22	37.19	148	0.30	122	0	143	73.25	108.00
11130208030	Central Prairie	1	73	0.53	141	22.16	97	0.30	122	48	134	108.25	121.00
11130208040	Central Prairie	7	214	2.26	227	14.58	50	0.40	140	38	86	157.75	121.63
11130208050	Central Prairie	0	1	0.44	116	23.92	105	8.20	236	0	133	114.50	123.88
11130210010	Central Prairie	4	177	1.71	224	17.24	68	3.80	226	0	89	173.75	131.25
11130210020	Central Prairie	1	73	0.51	137	13.46	44	18.50	248	0	145	125.50	135.25
11130301030	Central Prairie	0	1	0.13	17	4.86	9	0.20	82	0	78	27.25	52.75
11130301040	Central Prairie	2	135	0.13	17	4.83	8	0.40	140	0	72	75.00	73.50
11130301050	Central Prairie	1	73	0.18	37	12.62	40	0.20	82	0	105	58.00	81.38
11130301060	Central Prairie	1	73	0.14	22	10.22	30	0.10	28	0	118	38.25	78.25
11130301070	Central Prairie	0	1	0.14	22	16.51	61	12.90	242	0	123	81.50	102.13
11130302010	Central Prairie	0	1	0.09	4	17.07	66	0.30	122	80	121	48.25	84.63
11130302020	Central Prairie	0	1	0.08	3	28.26	122	0.30	122	0	168	62.00	114.88
11130302030	Central Prairie	1	73	0.48	131	37.65	149	0.60	170	0	132	130.75	131.13
11130302040	Central Prairie	0	1	0.56	152	34.76	138	0.40	140	100	146	107.75	126.88
11130302050	Central Prairie	3	160	1.58	220	51.09	186	0.30	122	0	113	172.00	142.63
11130302060	Central Prairie	1	73	0.16	31	55.75	202	0.60	170	0	153	119.00	136.13
11130302070	Central Prairie	0	1	0.32	82	75.23	240	0.00	1	0	152	81.00	116.38
11130302080	Central Prairie	1	73	0.29	68	57.39	208	0.60	170	0	104	129.75	116.63
11130302090	Central Prairie	0	1	0.23	51	44.35	162	0.50	158	0	153	93.00	123.13
11130302100	Central Prairie	0	1	0.19	40	43.32	161	0.40	140	0	168	85.50	126.63
11130302110	Central Prairie	4	177	0.39	102	50.95	185	0.40	140	0	154	151.00	152.63
11130302120	Central Prairie	0	1	0.23	51	54.50	198	0.60	170	0	134	105.00	119.38
11130302130	Central Prairie	0	1	0.29	68	62.03	219	3.10	220	17	144	127.00	135.50
11130302140	Central Prairie	3	160	0.31	78	40.26	154	0.60	170	0	158	140.50	149.38
11130302150	Central Prairie	5	196	0.78	185	29.02	124	0.60	170	0	104	168.75	136.13
11130302160	Central Prairie	0	1	0.10	8	19.99	85	1.70	216	0	159	77.50	118.25

Appendix C continued. Condition Ranks for 11 digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Point sources		urbanization		conversion		reservoirs		UWA	Conser-vation	Condi-tion	Comb-ined
		Value	Rank	Value	Rank	Value	Rank	Value	Rank	Rank	Rank	Rank	Rank
11130302170	Central Prairie	0	1	0.40	104	21.03	91	0.10	28	0	139	56.00	97.38
11130302180	Central Prairie	3	160	0.69	175	18.87	76	0.40	140	79	97	137.75	117.25
11130302190	Central Prairie	11	229	1.25	215	36.01	141	0.10	28	0	156	153.25	154.38
11130303010	Central Prairie	1	73	0.19	40	15.28	53	0.80	195	0	93	90.25	91.63
11130303020	Central Prairie	1	73	0.59	159	24.49	108	0.40	140	0	142	120.00	131.00
11130303030	Central Prairie	1	73	0.15	26	21.55	94	1.00	201	0	168	98.50	133.13
11130303040	Central Prairie	0	1	0.19	40	30.92	126	1.00	201	0	168	92.00	129.88
11130303050	Central Prairie	4	177	0.87	194	38.76	151	0.90	199	89	149	180.25	164.75
11130303060	Central Prairie	0	1	0.36	94	23.77	102	1.20	209	92	77	101.50	89.00
11130303070	Central Prairie	3	160	0.74	181	17.30	70	0.70	187	101	139	149.50	144.13
11130303080	Central Prairie	1	73	0.40	104	16.68	63	2.30	217	63	168	114.25	141.00
11130303090	Central Prairie	0	1	0.36	94	10.88	33	0.50	158	0	166	71.50	118.88
11130303100	Central Prairie	2	135	0.47	125	16.08	57	0.40	140	0	132	114.25	122.88
11130303110	Central Prairie	4	177	1.09	210	24.60	109	0.70	187	0	94	170.75	132.25
11130303120	Central Prairie	6	206	0.91	195	16.91	65	1.00	201	0	104	166.75	135.38
11130303130	Central Prairie	4	177	1.12	211	19.83	83	1.60	213	0	59	171.00	114.75
11040002010	High Plains	0	1	0.03	1	0.31	1	0.10	10	58	3	3.25	2.88
11040002020	High Plains	0	1	0.04	2	5.33	3	0.00	1	0	11	1.75	6.50
11040002040	High Plains	0	1	0.11	3	2.52	2	0.00	1	0	7	1.75	4.38
11040006060	High Plains	0	1	0.17	4	18.40	12	0.10	10	0	4	6.75	5.50
11040008010	High Plains	0	1	0.21	10	35.62	28	1.10	30	0	8	17.25	12.38
11040008060	High Plains	0	1	0.17	4	33.03	26	0.10	10	0	11	10.25	10.50
11050001010	High Plains	0	1	0.23	16	21.39	16	0.00	1	73	5	8.50	6.75
11050001020	High Plains	0	1	0.17	4	12.14	9	0.20	18	0	2	8.00	5.00
11100101040	High Plains	0	1	0.32	23	26.59	19	0.20	18	50	18	15.25	16.75
11100101050	High Plains	1	25	0.32	23	27.07	22	0.40	28	0	18	24.50	21.38
11100101060	High Plains	0	1	0.21	10	21.32	15	0.10	10	0	17	9.00	12.75
11100101070	High Plains	0	1	0.24	19	26.91	21	0.30	23	0	17	16.00	16.25
11100101080	High Plains	2	31	0.78	31	14.34	11	0.00	1	104	15	18.50	16.75

Appendix C continued. Condition Ranks for 11 digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Point sources Value	Point sources Rank	urbanization Value	urbanization Rank	conversion Value	conversion Rank	reservoirs Value	reservoirs Rank	UWA Rank	Conser-vation Rank	Condi-tion Rank	Com-bined Rank
11100101090	High Plains	0	1	0.38	27	38.87	30	0.30	23	0	17	20.25	18.38
11100101100	High Plains	0	1	0.21	10	35.05	27	0.00	1	0	14	9.75	11.88
11100102010	High Plains	0	1	0.35	26	57.98	31	0.30	23	0	17	20.25	18.38
11100102020	High Plains	3	32	0.98	32	36.66	29	2.60	32	0	18	31.25	24.75
11100102030	High Plains	0	1	0.28	22	31.51	24	0.10	10	102	18	14.25	16.25
11100102040	High Plains	1	25	0.43	29	65.40	32	0.40	28	0	17	28.50	22.50
11100102050	High Plains	0	1	0.22	14	31.62	25	0.30	23	0	10	15.75	12.88
11100102060	High Plains	0	1	0.21	10	26.24	18	0.20	18	0	6	11.75	9.00
11100103020	High Plains	0	1	0.25	20	26.79	20	0.10	10	0	17	12.75	14.63
11100103050	High Plains	1	25	0.45	30	20.93	14	2.20	31	0	14	25.00	19.50
11100104070	High Plains	0	1	0.17	4	11.13	7	0.10	10	94	8	5.50	6.75
11100201010	High Plains	0	1	0.23	16	27.29	23	0.20	18	0	16	14.50	15.38
11100201020	High Plains	0	1	0.25	20	21.68	17	0.30	23	0	16	15.25	15.38
11100201030	High Plains	1	25	0.22	14	5.97	4	0.20	18	0	12	15.25	13.75
11100201050	High Plains	0	1	0.20	8	10.90	6	0.00	1	0	9	4.00	6.25
11100201060	High Plains	0	1	0.23	16	13.65	10	0.00	1	104	14	7.00	10.25
11100201070	High Plains	1	25	0.39	28	11.80	8	0.10	10	90	9	17.75	13.25
11100201080	High Plains	0	1	0.20	8	10.40	5	0.00	1	104	11	3.75	7.13
11100201090	High Plains	1	25	0.34	25	19.83	13	0.00	1	86	6	16.00	11.00
11090204010	Ouachita Mountains	6	46	0.59	44	30.42	17	0.50	29	0	23	34.00	28.63
11090204020	Ouachita Mountains	0	1	0.17	7	32.46	20	0.40	22	0	28	12.50	20.00
11110105030	Ouachita Mountains	2	29	0.35	29	61.77	50	0.20	14	0	18	30.50	24.38
11110105040	Ouachita Mountains	7	48	0.57	40	38.01	28	0.80	38	18	16	38.50	27.13
11110105050	Ouachita Mountains	0	1	0.22	12	38.98	29	4.90	46	0	18	22.00	19.75
11110105060	Ouachita Mountains	1	20	0.24	15	37.92	27	27.10	51	9	7	28.25	17.50
11110105070	Ouachita Mountains	7	48	0.57	40	42.17	34	0.60	34	0	32	39.00	35.50
11110105080	Ouachita Mountains	6	46	1.12	51	57.71	46	0.30	21	0	23	41.00	32.13
11110105090	Ouachita Mountains	4	40	0.21	10	38.99	30	0.20	14	0	17	23.50	20.13
11130304010	Ouachita Mountains	2	29	0.29	22	23.10	11	0.50	29	0	27	22.75	24.75

Appendix C continued. Condition Ranks for 11 digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Point sources		urbanization		conversion		reservoirs		UWA Rank	Conser-vation Rank	Condi-tion Rank	Com-bined Rank
		Value	Rank	Value	Rank	Value	Rank	Value	Rank				
11130304020	Ouachita Mountains	2	29	0.38	31	18.17	4	0.40	22	0	22	21.50	21.50
11130304030	Ouachita Mountains	0	1	0.35	29	21.88	9	0.50	29	0	30	17.00	23.38
11130304040	Ouachita Mountains	0	1	0.23	13	17.65	2	8.70	48	13	28	16.00	22.13
11130304050	Ouachita Mountains	7	48	0.95	50	18.11	3	14.20	50	0	27	37.75	32.13
11140101010	Ouachita Mountains	1	20	0.78	47	35.68	23	0.40	22	0	32	28.00	30.00
11140101020	Ouachita Mountains	2	29	0.34	27	39.02	31	0.60	34	0	34	30.25	32.13
11140101040	Ouachita Mountains	0	1	0.09	2	34.01	22	0.40	22	0	34	11.75	22.88
11140101060	Ouachita Mountains	1	20	0.67	45	66.79	51	0.50	29	0	12	36.25	23.88
11140102010	Ouachita Mountains	4	40	0.25	18	16.23	1	0.10	6	0	22	16.25	18.88
11140102020	Ouachita Mountains	1	20	0.18	8	21.37	7	0.10	6	0	9	10.25	9.75
11140102030	Ouachita Mountains	4	40	0.81	48	31.31	19	0.40	22	0	19	32.25	25.63
11140103010	Ouachita Mountains	2	29	0.21	10	19.51	5	0.10	6	0	26	12.50	19.13
11140103020	Ouachita Mountains	0	1	0.32	23	19.87	6	4.00	45	3	23	18.75	20.88
11140103030	Ouachita Mountains	2	29	0.49	37	24.66	14	0.40	22	0	36	25.50	30.63
11140103040	Ouachita Mountains	0	1	0.06	1	37.24	25	0.10	6	8	26	8.25	17.00
11140103050	Ouachita Mountains	2	29	0.14	4	26.14	15	0.20	14	0	15	15.50	15.13
11140103060	Ouachita Mountains	1	20	0.25	18	52.67	42	0.10	6	0	16	21.50	18.63
11140104010	Ouachita Mountains	3	38	0.55	38	22.26	10	0.80	38	0	28	31.00	29.38
11140104020	Ouachita Mountains	2	29	0.20	9	30.89	18	0.70	36	0	30	23.00	26.50
11140104030	Ouachita Mountains	0	1	0.23	13	23.83	13	0.90	42	0	24	17.25	20.63
11140104040	Ouachita Mountains	0	1	0.16	6	21.48	8	0.20	14	0	31	7.25	18.88
11140104050	Ouachita Mountains	0	1	0.15	5	23.29	12	0.20	14	0	33	8.00	20.50
11140105010	Ouachita Mountains	1	20	0.24	15	53.34	43	0.10	6	0	18	21.00	19.25
11140105020	Ouachita Mountains	2	29	0.38	31	33.72	21	0.50	29	18	27	27.50	27.00
11140105030	Ouachita Mountains	0	1	0.12	3	28.23	16	0.00	1	0	30	5.25	17.63
11140105040	Ouachita Mountains	1	20	0.25	18	46.41	38	0.10	6	0	14	20.50	17.00
11140105050	Ouachita Mountains	0	1	0.24	15	43.39	36	0.00	1	0	19	13.25	16.00
11140105060	Ouachita Mountains	4	40	0.48	36	39.70	32	0.40	22	0	9	32.50	20.75
11140105070	Ouachita Mountains	4	40	0.45	34	37.19	24	6.30	47	5	18	36.25	26.88

Appendix C continued. Condition Ranks for 11 digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Point sources Value	Point sources Rank	urbanization Value	urbanization Rank	conversion Value	conversion Rank	reservoirs Value	reservoirs Rank	UWA Rank	Conser-vation Rank	Condi-tion Rank	Com-bined Rank
11140105080	Ouachita Mountains	0	1	0.33	26	56.75	45	0.70	36	0	14	27.00	20.63
11140106020	Ouachita Mountains	4	40	0.58	42	61.03	49	0.80	38	0	21	42.25	31.75
11140106040	Ouachita Mountains	0	1	0.32	23	60.61	48	1.90	43	0	10	28.75	19.38
11140107010	Ouachita Mountains	0	1	0.28	21	43.23	35	0.00	1	0	29	14.50	21.50
11140107020	Ouachita Mountains	0	1	0.32	23	48.29	40	2.40	44	6	23	27.00	25.13
11140107030	Ouachita Mountains	3	38	0.71	46	51.43	41	0.10	6	0	19	32.75	25.75
11140107040	Ouachita Mountains	0	1	0.58	42	58.82	47	0.00	1	0	16	22.75	19.50
11140107050	Ouachita Mountains	8	51	0.91	49	54.04	44	0.20	14	0	13	39.50	26.38
11140108040	Ouachita Mountains	1	20	0.47	35	40.09	33	0.00	1	0	25	22.25	23.50
11140108050	Ouachita Mountains	0	1	0.34	27	37.60	26	9.80	49	1	23	25.75	24.50
11140108060	Ouachita Mountains	1	20	0.55	38	46.27	37	0.80	38	0	23	33.25	27.88
11140109170	Ouachita Mountains	0	1	0.41	33	46.72	39	0.20	14	0	10	21.75	15.75
11070206030	Ozarks	1	6	0.71	16	40.78	13	8.60	18	41	9	13.25	11.13
11070206040	Ozarks	1	6	0.66	15	55.83	22	3.30	16	12	8	14.75	11.38
11070206060	Ozarks	4	19	1.16	22	36.69	11	19.80	24	15	17	19.00	18.13
11070207190	Ozarks	3	15	0.82	17	55.50	20	0.70	8	64	2	15.00	8.50
11070209040	Ozarks	0	1	0.37	5	48.88	17	0.00	1	0	11	6.00	8.63
11070209050	Ozarks	2	10	0.39	6	40.82	14	1.20	11	0	11	10.25	10.63
11070209060	Ozarks	2	10	0.25	3	16.07	3	8.60	18	4	14	8.50	11.00
11070209070	Ozarks	2	10	0.48	8	33.76	7	6.90	17	0	14	10.50	12.25
11070209100	Ozarks	2	10	0.65	14	45.10	15	0.40	5	0	10	11.00	10.50
11070209110	Ozarks	0	1	0.36	4	56.55	23	2.30	14	0	9	10.50	9.63
11070209120	Ozarks	5	21	0.58	12	33.49	6	9.80	20	47	14	14.75	14.13
11110102010	Ozarks	18	24	3.51	24	38.53	12	0.40	5	0	12	16.25	13.88
11110102020	Ozarks	0	1	0.21	2	14.09	2	1.60	13	0	11	4.50	7.50
11110103050	Ozarks	0	1	0.59	13	49.97	18	0.90	9	26	6	10.25	7.88
11110103060	Ozarks	3	15	0.98	20	25.35	5	0.10	3	0	4	10.75	7.50
11110103090	Ozarks	3	15	0.40	7	36.45	10	0.00	1	0	7	8.25	7.63
11110103100	Ozarks	4	19	1.01	21	48.09	16	1.50	12	0	6	17.00	11.50

Appendix C continued. Condition Ranks for 11 digit hydrologic units in Oklahoma.

HUC 11	Aquatic Stratification Region	Point sources		urbanization		conversion		reservoirs		UWA	Conser-vation	Condi-tion	Com-bined
		Value	Rank	Value	Rank	Value	Rank	Value	Rank	Rank	Rank	Rank	Rank
11110103110	Ozarks	2	10	0.54	9	19.23	4	10.40	21	11	4	11.00	7.25
11110104020	Ozarks	1	6	0.54	9	36.43	9	16.30	23	29	15	11.75	13.25
11110104030	Ozarks	6	22	0.87	18	36.17	8	3.00	15	49	8	15.75	12.00
11110104040	Ozarks	10	23	0.54	9	55.57	21	11.20	22	41	15	18.75	16.75
11110104050	Ozarks	1	6	0.89	19	61.54	24	0.60	7	0	14	14.00	14.13
11110104070	Ozarks	0	1	0.14	1	12.93	1	0.10	3	0	9	1.50	5.38
11110105110	Ozarks	3	15	1.37	23	52.89	19	0.90	9	0	6	16.50	11.38