Development of Floristic Quality Index Approaches for Wetland Plant Communities in Oklahoma

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Final Report

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and

Oklahoma Conservation Commission
2800 N. Lincoln Blvd. Suite 160,
Oklahoma City, OK 73105

Prepared by:
Anne-Katherine Ewing[1] and Bruce Hoagland[1]

[1]Oklahoma Biological Survey and Department of Geography, University of Oklahoma
Norman, OK 73072

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Introduction

In order to assess the impact of anthropogenic changes on habitat integrity, wildlife and land managers, environmental agencies and researchers need a reliable tool that provides a standardized methodology for habitat assessment (Rentch and Anderson 2006). Qualitative descriptions of community integrity typically employ broad, poorly defined terminology; i.e., "low," “medium" and “high" or "poor," “good" and "excellent," and are subjective, thus diminishing repeatability between investigators (Wilhelm and Masters 1995; Freeman and Morse 2002; McAllister et al. 2009; Mortellaro et al. 2009). As a result, qualitative approaches are insufficient for assessing habitat quality and for making between site comparisons (Wilhelm and Masters 1995; Mortellaro et al. 2009). Incorporating quantitative measures provides objectivity and facilitates comparison of site conditions (Wilhelm 1977; Swink and Wilhelm 1979, 1994; Wilhelm and Masters 1995; Rooney and Rogers 2002; Andreas et al. 2004; Taft et al. 2007).

Conservation biologists and environmental managers in Oklahoma need effective techniques to assess the condition of wetland habitats. The degradation of wetland plant communities and functions has been particularly relentless. Wetlands have been drained, filled and converted to suit a variety of land uses such as growing crops, raising livestock and urban development (Rentch and Anderson 2006; Mitsch and Gosselink 2007; McAllister et al. 2009). Changes linked to anthropogenic activities continue to threaten the integrity or overall quality and health of ecosystem populations (Herman et al. 2001; Rentch and Anderson 2006; Rocchio 2007; Mortellaro et al. 2009).

Numerous techniques rely on ecological or biological indicators for assessing ecosystem condition (Mack 2004, Niemi and McDonald 2004). An ecological indicator is defined as a quantifiable characteristic of the structure, composition or function of an ecological system. Typically, biological organisms are employed to assess conditions, hence the term biological indicators. Recently devised techniques have utilized vascular plants as indicators of habitat condition. Gerould Wilhelm developed a practical, yet ecologically significant quantitative method for assessing habitat condition--the Natural Areas Rating

Index (NARI), which was revised and now termed the Floristic Quality Assessment (FQA) (Wilhelm 1977, 1978; Swink and Wilhelm 1979, 1994). Floristic Quality Assessment (FQA) is a habitat assessment methodology that uses plants because they are sensitive indicators of environmental change (Carignan and Villard 2001; Niemi and McDonald 2004).

The FQA approach assumes that habitat condition can be evaluated by the analysis of the constituent flora, since the "naturalness" of a habitat is a reflection of the constituent flora (Freeman and Morse 2002; Bourdaghs et al. 2006). The FQA originally was used to assess prairies in Illinois (Swink and Wilhelm 1979, 1994; Taft et al. 1997). FQA has been applied across the Midwest and northeast United States, but not in Oklahoma.

Although the FQA relies on presence-absence data, the data themselves can be collected using a suite of vegetation sampling techniques. It has been demonstrated that any person with a basic knowledge of field botany can implement this assessment approach successfully. The FQA approach is flexible, and regardless of a community's size and/or shape, floristic quality assessments may be executed in any habitat, including both wetlands and uplands. Environmental agencies such as the U.S. EPA are interested in developing methods for the assessment of wetland condition based on quantitative measures; thus, this present study focuses on assessing wetland condition.

The FQA approach to assess wetland habitat condition has been used in 14 states (Taft et al. 1997; Herman et al. 2001; Milburn et al. 2001; Mushet et al. 2002; Bernthal 2003; Andreas et al. 2004; Cohen et al. 2004; Nichols et al. 2006; Herman et al. 2006; Rentch and Anderson 2006; Rocchio 2007; Wardrop et al. 2007; Allain et al. 2009; Steinauer and Rolfsmeier 2010), and in the Great Lakes Region (Bourdaghs et al. 2006).

The FQA has floristic and site level components. The floristic component consists of assigning a Coefficient of Conservatism (CC) to each wetland and aquatic plant within the state, region, or ecoregion of study and calculating the mean Coefficient of Conservatism (mCC). The Coefficient of Conservatism (CC) is a numerical value ranging from 0 to 10. CCs are independent of plant community type, size and shape, and can be generated for any

given geographical area. CC values are whole integers and rank plant species with respect to all other taxa in a region's flora (Andreas and Lichvar 1995).

Generating the CC score is the most consequential portion of the FQA process, and at the core of this process is the concept of "species conservatism." Species conservatism states that plant species differ in their responses to disturbance and exhibit varying levels of "fidelity" (Swink and Wilhelm 1994; Rocchio 2007; McAllister et al. 2009). Fidelity is defined in the literature as a characteristic lacking in generalist species (McAllister et al. 2009). Fidelity attempts to integrate a subjectively numerical value that captures a species capacity to tolerate anthropogenic alterations of wetland habitats (Swink and Wilhelm 1994; Wilhelm and Masters 1995; Andreas and Lichvar 1995; Freeman and Morse 2002; Bernthal 2003; Andreas et al. 2004). The presence of a species at a site with moderate to high fidelity is indicative of a high quality habitat. Species scoring a CC value of 10 are referred to as the most "conservative" because they exhibit high fidelity to conditions that best represent 'natural habitats' or areas that are most similar to the landscape prior to European settlement. Species scoring 0 are considered “generalist” and their presence represents sites heavily disturbed by anthropogenic activity or non-natural habitats. It is assumed that perturbation of high quality habitats will result in the loss of species with high CC scores. Thus, CC scores reflect the likelihood that a species can be found in remnant natural habitats (Wilhelm 1977, Swink and Wilhelm 1994, Freeman and Morse 2002, Taft et al. 1997).

The precursor to the FQA, NARI, weighted rare, threatened and endangered species very high, 15 and 20, respectively. Swink and Wilhelm (1979, 1994) realized that rarity and threatened or endangered status are not simply a result of habitat degradation. Several pioneers of the FQA have stressed that CC values are only to be applied to native plant species. Native and nonnative species have not evolved in parallel with one another, since nonnative species were not part of pre-settlement landscape, thus do not meet the assumptions of the FQA (Swink and Wilhelm 1979, 1994; Wilhelm and Masters 1995; Taft et al. 1997). Although, in more recent FQA studies, both native and nonnative species are

evaluated, but nonnative species are given a default CC value of zero (Freeman and Morse 2002; Milburn et al. 2007; Taft et al. 2007; McAllister et al. 2009; Mortellaro et al. 2009).

In the majority of FQA studies, the species level is the lowest taxonomic division assigned a CC value. Freeman and Morse (2002) explain that taxa that are at the genus or higher taxonomic level are not assigned CC values, since plant species within a genus could respond different to anthropogenic change and display varying degrees of fidelity to remnant natural habitats; however, they have suggested that CC values may be assigned to infraspecific taxa (subspecies and varieties) as well, which could be useful when two or more infraspecific taxa of a species occur within a state and differ in fidelity to native plant communities. Hybrids, naturally occurring or not, are not assigned CC values (Freeman and Morse 2002). Similar to nonnative species, hybrid plant species have not evolved alongside native species; thus, they do not meet the assumptions of the FQA and are not assigned CC values.

The site level component of a FQA is the floristic quality index (FQI_T) and is a calculation of site quality using the assigned CC values for vegetation at that site. The FQI_T uses the mean Coefficient of Conservatism (mCC_T) multiplied by the square root of the total number of both native and nonnative plant species, as shown in the equation below (Swink and Wilhelm 1994; Taft et al. 1997; Freeman and Morse 2002).

$$FQI_T = (mCC_T)(\sqrt{N_T}) \quad \text{(Equation 4)}$$

Where mCC_T is the average CC value for a site, and $\sqrt{N_T}$ is the square root of species richness of the site in question. This equation calculates the FQI_T with total species richness and mCC_T of all species, both native and nonnative (Freeman and Morse 2002).

Numerous state and federal agencies have been attempting to develop a comprehensive wetlands program for Oklahoma. This goal of this thesis is to develop a wetland assessment tool—Floristic Quality Assessment (FQA)—that can be used with other environmental data to monitor and evaluate wetlands throughout Oklahoma. The development of a FQA in Oklahoma could aid wetland managers and ecologists to prioritize conservation efforts,

compare wetland plant communities and identify reference sites for wetland assessment statewide. When this project is complete, Oklahoma will be the first state in EPA Region 6 to have a comprehensive FQA; furthermore, since Oklahoma shares ecoregions with all states in Region 6, this project will be applicable to those adjacent states and the CC values can be used as a tool for the National Wetland Condition Assessment and incorporation into the state wetlands monitoring and assessment program.

The objectives of this study are to develop 1) a FQA methodology for assessing habitat condition, 2) to create a comprehensive list of CC scores for wetland plants in Oklahoma, 3) to calibrate this list by conducting FQA for wetland habitats across ecoregions in the state of Oklahoma, and 4) to evaluate regional differences in floristic composition using a nonmetric multidimensional scaling ordination (NMDS). In addition to the FQI, the number of species or species richness, percent cover and Simpson's diversity index factors will be investigated as well and function as the 'other environmental data' to be collected.

METHODS

Study Area

Oklahoma is a diverse state, in terms of climate, terrain, vegetation, and ecosystems. The state's southeast to northwest gradient is the most diverse. For example, the western panhandle receives an average annual rainfall of 43 cm, and the southeastern portions of the state receive an average annual rainfall of approximately 142 cm. The length of the growing season, defined as the annual number of frost free days, maxes out at 225 to 230 days in the southern and southeastern most counties, while the northwestern panhandle of Oklahoma has only 175 frost free days annually. The average annual temperature increases from northwest to southeast; the southeastern part of the state has a mean annual temperature of 16.7°C (62°F), while the northwestern panhandle has an average annual temperature of 13.3°C (56°F).

The distribution of plant species largely reflects the gradients of temperature and rainfall in the state. Vegetation types transition from short grass prairies in the panhandle to

central mixed grass prairies to eastern oak-hickory forests (Hoagland 2000; Woods et al. 2005). A comparison of vegetation and environmental conditions between Cimarron County in the northwest and McCurtain County in the southeast further illustrates the magnitude of the gradient. The northwest corner of Cimarron County contains the only occurrences of piñyon pine and one-seed juniper in the state, a vegetation type that is very common in the Rocky Mountain front range. In Cimarron County, and the panhandle generally, elevations are among the highest in the state, annual rainfall tends to be low and variable and supports mainly short grass prairies, while southeastern Oklahoma, particularly McCurtain County, has some of the lowest elevations in the state, much higher and consistent rainfall and is inhabited by bottomland hardwood forests, oak-hickory-pine forests and bald cypress swamps (Woods et al. 2005). It is widely accepted that Oklahoma's diverse climate, topography, terrestrial and wetland plant communities contribute to the state's ecological diversity (Woods et al. 2005).

In this study, a total of 33 sites were sampled: seven lakes, ten emergent wetlands, eight riparian woodland sites, two oxbow lakes, two sloughs, two ponds, one seep/spring and one playa. There are 12 Level III EPA ecoregions in Oklahoma; the High Plains, Southwestern Tablelands, Central Great Plains, Flint Hills, Cross Timbers, East Central Texas Plains, South Central Plains, Ouachita Mountains, Arkansas Valley, Boston Mountains, Ozark Highlands, and the Central Irregular Plains (Woods et al. 2005). For the purposes of this study, however, some ecoregions were merged based on their ecological similarities in terms of climate, vegetation communities, geography, land use and land cover as well as wetland types. For example, the High Plains and Southwestern Tablelands were merged into one unit, as was the Flint Hills with the East Central Texas Plains and the Cross Timbers. The Boston Mountains, Central Irregular Plains and Ozark Highlands were merged into another unit. Table 1 lists dominant wetland types for each ecoregion in Oklahoma.

Ecoregion	Typical Wetland Type(s)
High Plains	Playa lakes, riparian forests, sand dunes
Southwestern Tablelands	Sand dunes, bottomland forests, riparian corridors
Central Great Plains	Salt flats, sand dunes, bottomland forests, closed depressions, riparian corridors
Flint Hills	Bottomland forests
East Central Texas Plains	Bottomland forests, oxbow lakes, riparian corridors
Cross Timbers (Central Oklahoma/Texas Plains)	Bottomland forests, oxbow lakes, riparian corridors
South Central Plains	Bald cypress swamps, marshes, seeps, forested wetlands, oxbow lakes, ponds and lakes
Ouachita Mountains	Bottomland forests
Arkansas Valley	Bottomland forests
Boston Mountains	Bottomland forests
Ozark Highlands	Bottomland forests
Central Irregular Plains	Forested wetlands

Table 1: Oklahoma's Ecoregions and Representative Wetland Habitats

Figure 1 shows the distribution of the 33 wetland study sites across nine of Oklahoma's ecoregions. Six sites were located in the High Plains/Southwestern Tablelands. Four sites were located in the Central Great Plains, the Ouachita Mountains and in the Arkansas Valley ecoregion. Five sites were located in the Cross Timbers, in the South Central Plains, and in the Ozark Highlands/Central Irregular Plains.

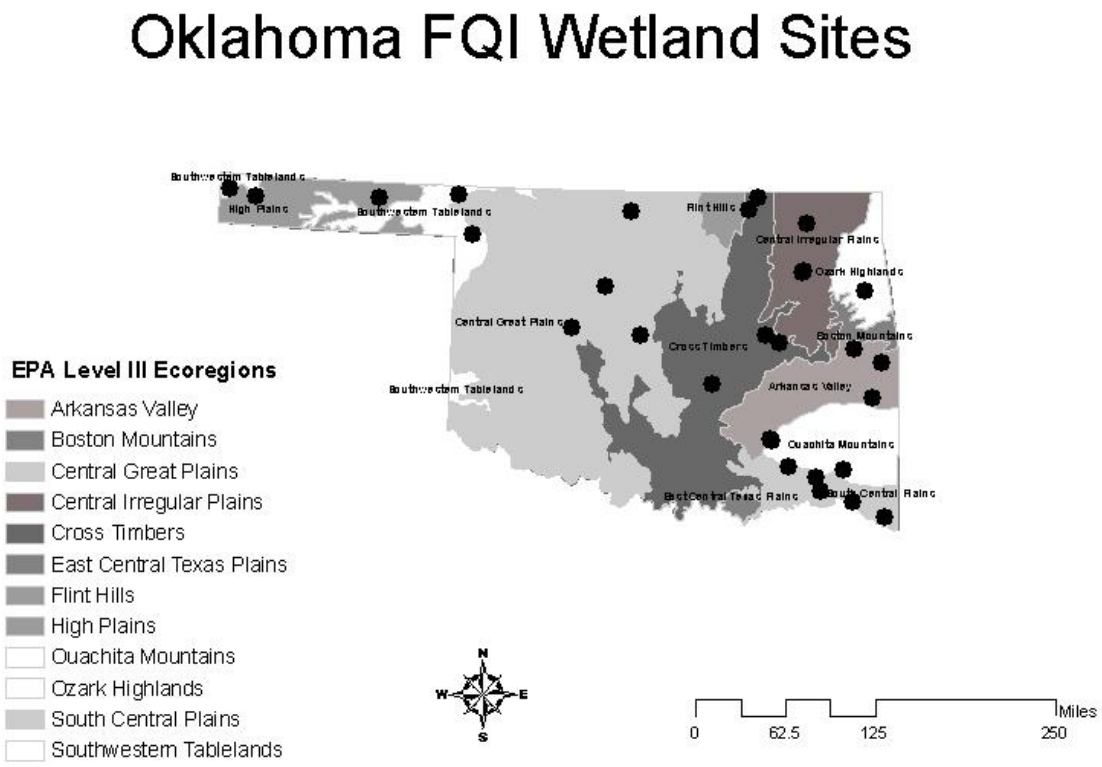

Figure 1: Map of the 33 wetland sites sampled for this project.

Ecoregions with the least amount of rainfall are located in the western part of the state. Parts of the Southwestern Tablelands receive the most variable and least amount of rainfall in the state ranging from 41 cm to 71 cm per year, while precipitation in the Ouachita Mountains toward the southeast ranges from 109 cm to 145 cm per year (Woods et al. 2005). The highest elevation in Oklahoma is Black Mesa, which is located in the northwestern section of the panhandle in the Southwestern Tablelands, at 1,516 meters. The lowest elevation, at 88 meters, is in the South Central Plains in the southeastern corner of the state (Woods et al. 2005). The broad environmental gradient from Oklahoma's eastern and western sides is apparent.

The largest ecoregion is the Central Great Plains with an area of 28,308 m^2. The largest ecoregion is also the most diverse, in terms of number of potential natural vegetation types, with 8. The smallest ecoregion is the East Central Texas Plains (Woods et al. 2005). The

Flint Hills region, which is located in the north central part of the state, and the Boston Mountains, located in the east central portion of state; both have only one vegetation type: tall grass prairie and oak-hickory forest, respectively (Woods et al. 2005). For more descriptive information about each of Oklahoma's 12 ecoregions, refer to Appendix A.

To ensure accuracy of the FQA in Oklahoma wetland communities, it is necessary to calibrate the FQI for the state or region(s). Oklahoma has a diverse assemblage of wetland vegetation types (Hoagland 2000, 2002) due to the state's broad longitudinal gradient producing numerous ecoregions (Woods et al. 2005). Due to the states numerous and diverse wetland ecosystems, calibrating the FQA for Oklahoma required collecting vegetation data in the majority of Level III ecoregions (Hoagland 2000, 2002).

Study Site Selection

The initial phase of the field study was locating suitable wetland sites for data collection. The primary resource for locating suitable sites was the Oklahoma Natural Heritage Inventory (ONHI) Database, which contains site-specific data for unique natural communities. The ONHI Database contains data from 186 wetlands sites from a project to locate wetlands of conservation significance (Hoagland et al. 1998, 2001a, 2001b). There were few wetland sites in the ONHI database for the Ouachita Mountains and South Central Plains, so USFWS National Wetland Inventory and U.S. Geological Survey (1,24,000) topographic maps were consulted.

Data Collection

Site location data collected at each, include latitude and longitude, date sampled and elevation, using a Garmin© eTrex GPS unit (Table 2). Table 3 includes more location information such as the county and ecoregion or group of merged ecoregions each site is located within.

Site ID	Latitude	Longitude	Elev.	Date Sampled	Wetland Type
OKM2901	35°31'11.80"N	95°56'06.62"W	1909'	6/14/2011	Emergent Wetland
OKM2902	35°34'07.23"N	96°05'47.06"W	265'	6/14/2011	Lacustrine Fringe
KIN2701	36°03'41.21"N	98°06'14.38"W	1077'	6/15/2011	Emergent Wetland
CIM2603	36°50'20.04"N	102°52'36.97"W	4316'	6/25/2011	Lacustrine Fringe
TEX2501	36°50'55.14"N	100°59'41.23"W	4315'	6/26/2011	Playa Lake
SEQ3705	35°26'14.64"N	94°59'55.14"W	449'	7/18/2011	Emergent Wetland
NOW4003	36°41'13.48"N	95°34'32.18"W	646'	7/19/2011	Emergent Wetland
CHE3901	36°01'45.87"N	94°50'28.14"W	1177'	7/20/2011	Pond
CHE3902	36°01'37.10"N	94°51'20.23"W	1164'	7/20/2011	Pond
SEM2903	35°05'34.55"N	96°45'28.63"W	853'	8/30/2011	Slough
BLA2702	35°37'47.04"N	98°30'20.82"W	1581'	8/30/2011	Lacustrine Fringe
CHO3501	34°08'58.41"N	95°28'41.02"W	403'	9/1/2011	Emergent Wetland
ATO3601	34°31'32.03"N	96°01'19.67"W	646'	9/2/2011	Lacustrine Fringe
ATO3602	34°32'29.29"N	96°02'21.88"W	547'	9/2/2011	Lacustrine Fringe
OSA2904	36°49'05.28"N	96°18'56.94"W	869'	9/6/2011	Seep/Spring
ROG4004	36°12'30.30"N	95°36'21.78"W	521'	9/8/2011	Oxbow Lake
ROG4005	36°12'13.68"N	95°37'03.24"W	547'	9/8/2011	Oxbow Lake
LEF3706	34°56'27.24"N	94°45'27.96"W	429'	9/30/2011	Lacustrine Fringe
MCC3503	33°44'54.18"N	94°38'25.08"W	318'	10/1/2011	Slough
MCC3504	33°54'38.40"N	95°01'31.14"W	360'	10/1/2011	Emergent Wetland
CHO3502	34°01'13.14"N	95°24'53.28"W	377'	10/1/2011	Lacustrine Fringe
GRA2704	36°47'15.38"N	97°47'07.51"W	1061'	7/27/2011	Riparian Woodland
MCC3604	34°13'43.11"N	95°06'43.99"W	461'	7/21/2011	Riparian Woodland
MCC3603	34°12'58.79"N	95°07'23.90"W	462'	7/20/2011	Riparian Woodland
ELL2606	36°31'20.04"N	99°47'12.20"W	2198'	7/14/2011	Emergent Wetland
OSA2905	36°56'30.42"N	96°11'14.05"W	750'	7/28/2011	Riparian Woodland
ATO3505	34°15'30.63''N	95°47'37.96''W	550'	9/1/2011	Riparian Woodland
CIM2502	36°47'03.30''N	102°32'07.89''W	4214'	8/17/2011	Emergent Wetland
HAR2605	36°54'56.53"N	99°59'00.43"W	2175'	8/16/2011	Emergent Wetland
LEF3707	35°17'08.99"N	94°38'47.58"W	416'	8/10/2011	Riparian Woodland
LEF3708	35°17'09.60"N	94°39'14.65"W	413'	8/11/2011	Riparian Woodland
HAR2604	36°54'50.42"N	99°59'30.62"W	2175'	7/13/2011	Emergent Wetland
OKL2703	35°34'02.06"N	97°39'10.88"W	1219'	6/30/2011	Riparian Woodland

Table 2: Site ID, date sampled, GPS location, and other physical information for Oklahoma's 33 FQI wetland sites.

Ecoregion/Merged Ecoregions	Site ID	County
High Plains (25) & Southwestern Tablelands (26)	TEX2501	Texas
	CIM2502	Cimarron
	CIM2603	Cimarron
	HAR2604	Harper
	HAR2605	Harper
	ELL2606	Ellis
Central Great Plains (27)	KIN2701	Kingfisher
	BLA2702	Blaine
	OKL2703	Oklahoma
	GRA2704	Grant
Cross Timbers (29), Flint Hills (28) & East Central Texas Plains (33)	OKM2901	Okmulgee
	OKM2902	Okmulgee
	SEM2903	Seminole
	OSA2904	Osage
	OSA2905	Osage
South Central Plains (35)	CHO3501	Choctaw
	CHO3502	Choctaw
	CHO3503	McCurtain
	CHO3504	McCurtain
	ATO3505	Atoka
Ouachita Mountains (36)	ATO3601	Atoka
	ATO3602	Atoka
	MCC3603	McCurtain
	MCC3604	McCurtain
Arkansas Valley (37)	SEQ3705	Sequoyah
	LEF3706	Leflore
	LEF3707	LeFlore
	LEF3708	LeFlore
Boston Mountains (38), Ozark Highlands (39) & Central Irregular Plains (40)	CHE3901	Cherokee
	CHE3902	Cherokee
	NOW4003	Nowata
	ROG4004	Rogers
	ROG4005	Rogers

Table 3: County and ecoregion that each of Oklahoma's 33 FQI wetland sites is located within.

Vegetation data were collected from a 10m x 10m plot with two 1m x 1m subplots, one in the southwest corner and the other in the northeast corner. Figure 2 illustrates the sample plot design used in this present FQI study.

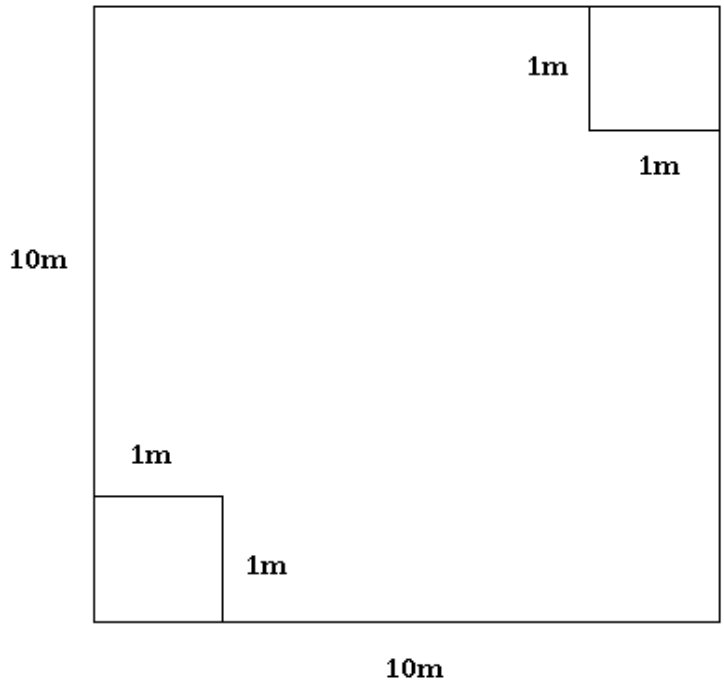

Figure 2: FQI Plot design for the 33 wetland sites.

All species present in the 10m x 10m plot were first recorded; percent cover of species present in the subplots was then visually estimated. The Daubenmire scale for visually estimating plant coverage was used within each plot. If trees are the dominant vegetation type, then trees with a diameter at breast height (DBH) over 2.0cm are recorded. A site may be sampled with more than 1 plot based on its size.

A voucher specimen was prepared for each species present and deposited in the Robert Bebb Herbarium at the University of Oklahoma. Plants were identified using *Aquatic and Wetland Plants of Southeastern United States: Dicotyledons* and *Aquatic and Wetland Plants of Southeastern United States: Monocotyledons* and *Illustrated Flora of East Texas*, and taxonomy follows USDA Plants (plants.usda.gov).

Assigning Coefficients of Conservatism (CC) for Oklahoma's wetland plants

This process began with the compilation of a list of wetland plants known to occur in Oklahoma. The resulting list was derived from the Region 6 list of plants known to occur in wetlands. We used Wetland Indicator Status (WIS), if available, to extract species with FACW- to OBL in to the list. Facultative Wetland (FACW) indicates that a species has a 67% to 99% probability of occurring in a wetland throughout its range, but may occasionally

found in more upland conditions (plants.usda.gov). The plus (+) and minus (-) sign is used with WIS to specify if a species is more (+) or less (-) likely to occur in wetlands. Obligate Wetland (OBL) denotes a 99% probability of a species occurring in wetlands throughout its range (plants.usda.gov).

A preliminary CC score was assigned based on a species capacity to tolerate anthropogenic change and fidelity to high quality wetland habitats. The CC score is a subjective numerical score and was based upon consultation of the available literature (such as the manuals cited above) and expert knowledge (Table 4).

Coefficient of Conservatism	Description
0	Nonnative taxa; plant species with a wide range of ecological tolerances. Native, ruderal plant species or those that occupy the most severely disturbed habitats. Opportunistic invaders that have rapid rates of growth, flowering and reproduction and have successful seed dispersal strategies.
1	Common, widespread plant species found in a variety of plant communities that are not typical of any specific community but abundant in non-natural areas. Ruderal plant species or those that occupy the most severely disturbed and newly disturbed habitats. Rapid rates of growth, flowering and reproduction and have successful seed dispersal strategies.
2	Ruderal-competitive plant species found in a variety of plant communities. Plant species that are tolerable of frequent and severe disturbances, Dominant, long lived species that are common, widespread and not typical of any specific habitat but abundant in non-natural areas.
3	Plant species with an intermediate range of ecological tolerances. Plant species that are tolerable of frequent and severe disturbances, Dominant, long lived species found in a variety of plant communities and abundant in non-natural areas.

4	Plant species with an intermediate range of ecological tolerances, typically associated with a specific plant community. Dominant or co-dominant plants species that can survive light to significant disturbances, intermittently. Occasionally found in non-natural areas but obligate to natural areas. If disturbance increases in intensity, frequency or duration, the species would decline.
5	Plant species with an intermediate range of ecological tolerances, typically associated with a specific plant community. Dominant or co-dominant plants species that can survive light to significant disturbances, intermittently. Occasionally found in non-natural areas but obligate to natural areas. If disturbance increases in intensity, frequency or duration, the species would decline.
6	Plant species with a narrow range of ecological tolerances, typically associated with a specific plant community. Dominant or co-dominant plants species that can survive significant to light disturbances, intermittently. Occasionally found in non-natural areas but obligate to natural areas. If disturbance increases in intensity, frequency or duration, the species would decline.
7	Plant species with a narrow range of ecological tolerances and that are closely associated with plant communities in advanced successional stages high quality natural habitats and exists only where minor degradation has occurred. Any increase in disturbance regimes usually decreases population size.
8	Plant species with a narrow range of ecological tolerances and those that are closely associated with plant communities in advanced successional stages high quality natural habitats and exists only where minor degradation has occurred. Any increase in disturbance regimes usually decreases population size.
9	Plant species that are highly sensitive to any anthropogenic disturbances;

	species that are obligate to natural areas but can sustain some minor habitat degradation. Very conservative plant species that are restricted to mostly intact, high quality natural communities.
10	Plant species that are highly sensitive to any anthropogenic disturbances and have very narrow habitat preferences. Most conservative plant species that are obligate to high-quality natural areas or restricted to mostly intact, high quality natural plant communities.

Table 4: Summarizes the characteristics of each coefficient of conservatism value, according to the FQA literature. Information synthesized from Andreas and Lichvar (1995), Taft et al. (1997), Freeman and Morse (2002), Bernthal (2003), Andreas et al. (2004), Cohen et al. (2004), Rentch and Anderson (2006), Rocchio (2008).

I compared the resulting CC values with those assigned to adjacent states, Colorado, Kansas, Louisiana, Missouri and Nebraska. We also addressed the question whether OBL species were more likely to receive higher CC values, on average, than the various FAC categories.

Data Analysis

Upon return to the lab, the corresponding CC value was added to the species list for each site. These species lists include only plants that could be identified to the species level and excludes those individuals that could not be identified to or below the genus level (Bourdaghs et al. 2006). The mean Coefficient of Conservatism (mCC_T) and the Floristic Quality Index (FQI_T) was then calculated for each site. The mCC_T was the averaged the CC value for all native plant species and calculated as (Swink and Wilhelm 1994; Taft et al. 1997; Freeman and Morse 2002).

$$mCC_T = \sum CC_T / N_T \text{ (Equation 5)}$$

Where, $\sum CC_T$ is the summation of CC values for both native and nonnative plant species for the site under evaluation, and N_T is the number of native and nonnative species present at the site. As noted above, nonnative species were included in this mCC_T calculation.

Species richness, defined as the total number of species at a site, was determined for each site as well. Average percent cover for each site was calculated using percent cover data collected from the northeast and southwest 1m x 1m subplots. Species diversity was calculated for each site using Simpson's diversity index (D):

$$\text{Simpson's diversity index} = D = 1 - \sum p_i^2 \quad \text{(Equation 6)}$$

Where p_i is the proportion of individuals in the ith species (Magurran 2004). Simpson's diversity index values range from 0 to 1, where 1 represents the highest level of diversity (Magurran 2004). The Simpson's diversity index was calculated using PC-ORD© with average percent cover values for species in the 1m x 1m subplots.

Given the geographic scope of this project, nonmetric multi-dimensional scaling (NMDS) ordination was used to detect regional differences in vegetation composition. A matrix was compiled using average percent cover values for species occurring in the 1m x 1m subplots at each site. A NMDS ordination is a useful tool for analysis of non-parametric datasets, a common characteristic of vegetation composition data (McCune and Grace 2002). The NMDS ordination in PC-ORD© version 5.0 software (Mather 1976; McCune and Grace 2002) was used to determine if sites within ecoregions showed greater similarity in composition than those in distant ecoregions. If so sites should cluster with co-occurring sites. The closer the sites are to one another in ordination space, the more similar they are in vegetation composition. Their distance in ordination space has no bearing on physical geographic location; however, it is assumed that the closer sites are geographically, the more likely they are to have the same species in common. The NMDS ordination used 6 axes with Sorenson's distance measure and a random starting configuration and 250 iterations of real data. This generated multiple runs for each axis. I ran the ordination again with 6 axes using Sorenson's distance measure, but I supplied the number of seeds, 1737, for consistency. The NMDS was run again with 1 run of real data and no runs of randomized data.

Results and Discussion

Oklahoma Wetland Plant List

The resulting Oklahoma wetland plant list consists of 698 species (Appendix B). Only species with a Region 6 WIS were included in this analysis, which included 346 OBL, 183 FACW species, 80 FACW- and 67 FACW+ species listed on the Oklahoma wetland plant list. All nonnative species were given zeros. Hybrids naturally occurring or not in Oklahoma were not assigned CC values. A CC value of 6 was the most common CC assigned (Figure 3).

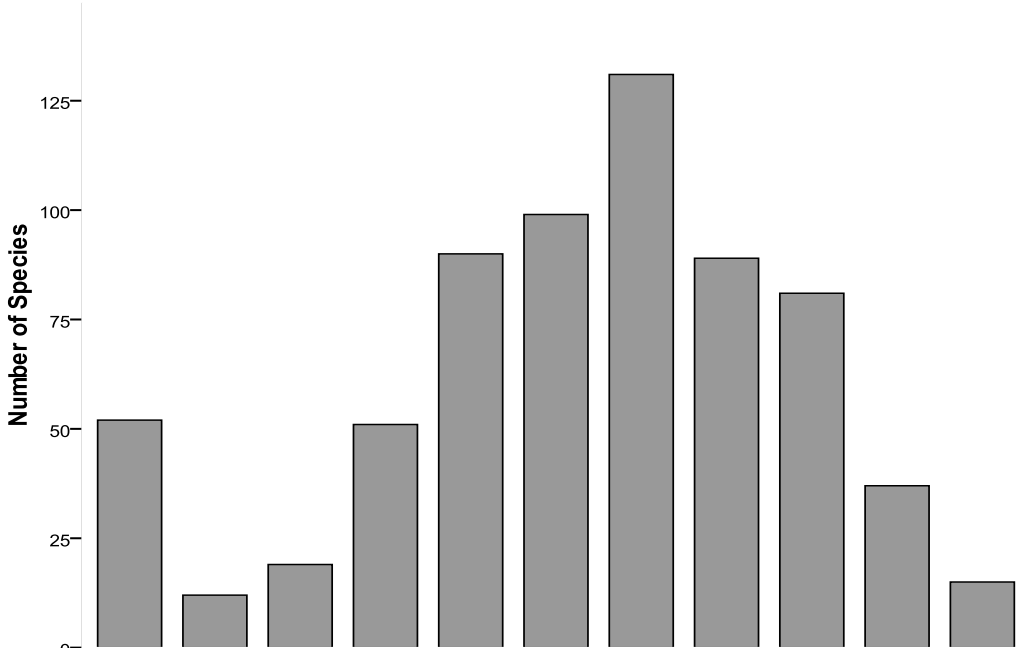

Figure 3: Histogram of the number of species for each CC value from 0 to 10. N = 676. This analysis used 676 plant species from the Oklahoma Wetland Plant List. Species that were not assigned CC values nor had a Region 6 WIS were removed from this analysis.

Species with a WIS of OBL were most likely to receive a high CC value (Figure 4). 51% of the species listed were designated as OBL, 11 of which were assigned a CC value of 10. FACW- species had the lowest average CC values at 4.04, followed by FACW (4.64) and FACW+ (4.91). FACW, FACW+ and OBL had CC values ranging from 0 to 10, while FACW-

species had CC values from 0 to 9. Only one FACW species was assigned a CC of 10, as were two FACW- species and three FACW+ species.

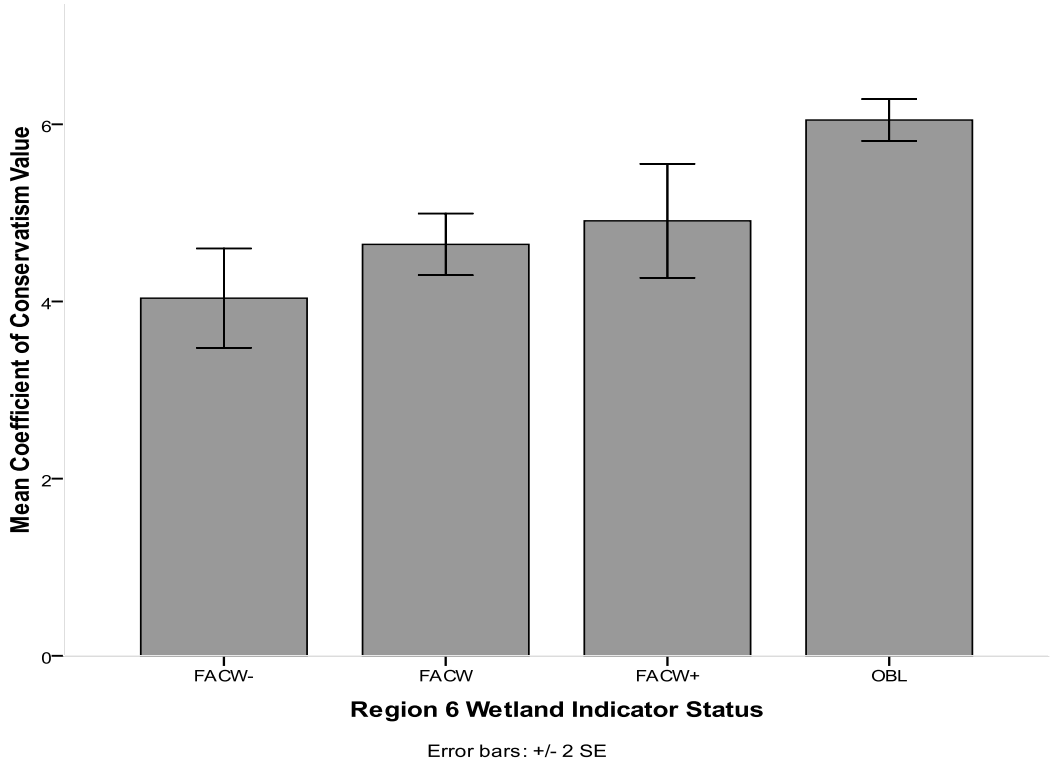

Figure 4: The bar graph below shows the average Coefficient of Conservatism (CC) value assigned to species of a certain Region 6 Wetland Indicator Status (WIS). N = 676. FACW (+/-) = Facultative Wetland; OBL = Obligate Wetland. See text for definitions of Region 6 WIS.

Site Analysis

A total of 409 taxa, 94% of which were identified to the species level, were encountered at 33 sites. There were 207 different species were encountered in the 33 wetland study sites (Table 5). Of those, 61% species had only one occurrence, while 19% species had two occurrences. *Polygonum hydropiperoides* Michx. (swamp smartweed), a native obligate perennial, was encountered the most frequently at 45% of the sites.

Species	Number of sites in which a species occurs
Acer negundo L.	1
Acer saccharinum L.	1
Agrostis hyemalis (Walter) Britton, Sterns & Poggenb.	1
Alopecurus carolinianus Walter	1
*Amaranthus blitoides** S. Watson	1
Amaranthus retroflexus L.	2
Amaranthus tuberculatus (Moq.) Sauer	2
Ambrosia artemisiifolia L.	1
Ambrosia grayi (A. Nelson) Shinners	1
Ambrosia psilostachya DC.	1
Ambrosia trifida L.	1
Ammannia coccinea Rottb.	1
Ammannia auriculata Willd.	2
Amorpha fruticosa L.	2
Ampelopsis arborea (L.) Koehne	3
Apios americana Medik.	1
Apocynum cannabinum L.	1
Azolla mexicana Schltdl. & Cham. ex C. Presl	1
*Bassia scoparia** (L.) A.J. Scott	2
Berchemia scandens (Hill) K. Koch	2
Betula nigra L.	2
Bidens frondosa L.	1
Boehmeria cylindrica (L.) Sw.	3
Boltonia diffusa Elliot	1
*Bromus arvensis** L.	1
*Bromus tectorum** L.	2
Brunnichia ovata (Walters) Shinners	1
Callicarpa americana L.	1
Campsis radicans (L.) Seem. ex Bureau	1
*Cardiospermum halicacabum** L.	4
Carex crus-corvi Shuttlw. ex Kunze	1
Carex gigantea Rudge	2
Carex hystericina Muhl. ex Willd.	1
Carya illinoinensis (Wangenh.) K. Koch	1
Celtis occidentalis L.	1
Cephalanthus occidentalis L.	9
Ceratophyllum demersum L.	2
Chamaesyce glyptosperma (Engelm.) Small	1

Species	Number of sites in which a species occurs
Chamaesyce maculata (L.) Small	3
Chasmanthium laxum (L.) Yates	1
Chenopodium berlandieri Moq.	1
Commelina erecta L.	2
Conoclinium coelestinum (L.) DC.	1
*Convolvulus arvensis** L.	1
Conyza canadensis (L.) Cronquist	4
Cuscuta cuspidata Engelm.	3
Cyperus erythrorhizos Muhl.	6
Cyperus esculentus L.	1
*Cyperus iria** L.	1
Cyperus odoratus L.	4
Cyperus psuedovegetus Steud.	1
Cyperus squarrosus L.	6
Dichanthelium acuminatum (Sw.) Gould & C.A. Clark	1
Dichanthelium scoparium	2
Dichanthelium sphaerocarpon (Elliott) Gould	1
Diospyros virginiana L.	2
*Echinochloa colona** (L.) Link	3
*Echinochloa crus-galli** (L.) Beauv.	3
*Echinochloa muricata** (P. Beauv.) Fernald	1
Echinodorus cordifolius (L.) Griseb	1
Eclipta prostrata (L.) L.	2
Eleocharis acicularis (L.) Roem. & Schult.	4
Eleocharis compressa Sull.	1
Eleocharis geniculata (L.) Roem. & Schult.	1
Eleocharis obtusa (Willd.) Schult.	3
Eleocharis palustris (L.) Roem. & Schult.	3
Eleocharis quadrangulata (Michx.) Roem. & Schult	2
Elephantopus carolinianus Raeusch.	1
Elephantopus tomentosus L.	1
*Eleusine indica** (L.) Gaertn.	1
Elodea nuttalli (Planch.) H. St. John	2
Elymus canadensis L.	2
Eragrosits hypnoides (Lam.) Britton, Sterns & Poggenb.	1
*Eragrostis japonica** (Thunb.) Trin.	1
Eryngium prostratum Nutt. ex DC.	1
Eupatorium perfoliatum L.	1

Species	Number of sites in which a species occurs
Festuca subverticillata (Pers.) Alexeev	1
Fimbristylis autumnalis (L.) Roem. & Schult.	2
Fimbristylis vahlii (Lam.) Link	8
Forestiera acuminata (Michx.) Poir.	1
Fragaria virginiana Duchesne	1
Fraxinus pennsylvanica Marsh.	4
Galactia volubilis (L.) Britton	1
Geum canadense Jacq.	1
Gratiola brevifolia Raf.	1
Gratiola neglecta Torr.	1
Helenium autumnale L.	1
Heliotropium curvassium L.	1
*Heliotropium indicum** L.	5
Heteranthera limosa (Sw.) Willd.	1
Hibiscus lasiocarpos Cav.	1
Hibiscus moscheutos L.	2
Hordeum jubatum L.	1
Hydrocotyle ranunculoides L. f.	1
Hydrolea ovata Nutt. ex Choisy	1
Hydrolea uniflora Raf.	1
Hypericum muticum L.	3
Ilex decidua Walter	2
*Ipomoea hederacea** Jacq.	2
Ipomoea nil (L.) Roth	2
Iva annua L.	1
Juncus coriaceous Mack.	2
Juncus effusus L.	4
Juncus secundus P. Beauv. ex Poir.	1
Juncus torreyi Coville	1
Justicia americana (L.) Vahl	1
Leersia oryzoides (L.) Sw.	5
Leersia virginica Willd.	1
Lemna minor L.	1
Leptochloa fusca (L.) Kunth spp. *fascicularis* (Lam.) N. Snow	1
Leptochloa panicea (Retz.) Ohwi ssp. *brachiata* (Steud.) N. Snow	1
Leucospora multifida (Michx.) Nutt.	2
Lindernia dubia (L.) Pennell	2
Lobelia cardinalis L.	1

Species	Number of sites in which a species occurs
*Lolium perenne** L.	1
Ludwigia glandulosa Walter	1
Ludwigia palustris (L.) Elliott	3
Ludwigia peploides (Kunth) P.H. Raven	3
Ludwigia repens J.R. Frost	2
Lycopus uniflorus Michx.	1
Mikania scandens (L.) Willd.	2
Mollugo verticillata L.	3
Najas guadalupensis (Spreng.) Magnus	1
Neeragrostis reptans (Michx.) Nicora	7
Nelumbo lutea Willd.	5
Nymphaea odorata Aiton	3
Nyssa sylvatica Marsh.	1
Oenothera canescens Torr. & Frém.	1
Oldenlandia boscii (DC.) Chapm.	1
Oxypolis rigidior (L.) Raf.	1
Panicum capillare L.	2
Panicum dichotomiflorum Michx.	1
Panicum flexile (Gattinger) Scribn.	1
Panicum rigidulum Bosc ex Nees	1
Panicum rigidulum Bosc ex Nees var. *rigidulum*	1
Panicum virgatum L.	1
Parthenocissus quinquefolia (L.) Planch.	1
Pascopyrum smithii (Rydb.) A. Löve	1
Paspalum dissectum (L.) L.	1
Paspalum laeve Michx.	1
Phragmites australis (Cav.) Trin. ex Steud.	1
Phyla lanceolata (Michx.) Greene	2
Phyla nodiflora (L.) Greene	1
Phyllanthus caroliniensis Walter	1
Physalis hederifolia A. Gray	1
Phytolacca americana L.	1
Platanus occidentalis L.	2
Pluchea camphorata (L.) DC.	2
Pluchea odorata (L.) Cass.	4
Polygonum amphibium L.	1
Polygonum amphibium L. var. *emersum* Michx.	1
Polygonum hydropiperoides Michx.	15

Species	Number of sites in which a species occurs
Polygonum lapathifolium L.	3
Polygonum pensylvanicum L.	6
*Polygonum persicaria** L.	2
Polygonum punctatum Elliott	1
*Polypogon monspeliensis** (L.) Desf.	1
Populus deltoides Bartram ex Marsh.	4
Portulaca oleracea L.	1
Potamogeton nodosus Poir.	2
Quercus nigra L.	1
Ranunculus sceleratus L.	1
Rhynchospora corniculata (Lam.) A. Gray	2
Rhynchospora glomerata (L.) Vahl	1
Rorippa sinuata (Nutt.) Hitchc.	2
Rorippa palustris (L.) Besser	1
Rosa carolina L.	1
Rotala ramosior (L.) Koehne	4
Rubus argutas Link	1
Rumex altissimus Alph. Wood	1
*Rumex crispus** L.	3
Sagittaria calycina Engelm. var. *calycina*	2
Sagittaria graminea Michx	1
Sagittaria lancifolia L	1
Sagittaria latifolia Willd.	2
Sagittaria platyphylla (Engelm.) J.G. Sm.	1
Salix nigra Marsh.	7
Salsola kali L.	2
Samolus valerandi L. ssp. *parviflorus* (Raf.) Hultén	1
Saururus cernuus L.	1
Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	1
Schoenoplectus tabernaemontani (C.C. Gmel.) Palla	1
Sesbania herbacea (Mill.) McVaugh	3
Setaria parviflora (Poir.) Kerguélen	2
Sida spinosa L.	1
Smilax bona-nox L.	1
Smilax rotundifolia L.	1
Spermacoce glabra Michx.	1
Steinchisma hians (Elliott) Nash	1
Stuckenia pectinata (L.) Börner	1

Species	Number of sites in which a species occurs
Symphoricarpos orbiculatus Moench	1
*Tamarix ramosissima** Ledeb.	1
Teucrium canadense L.	3
Toxicodendron radicans (L.) Kuntze	2
Trachelospermum difforme (Walter) A. Gray	1
Trepocarpus aethusae Nutt. ex DC.	1
Typha angustifolia L.	4
Typha domingensis Pers.	1
Utricularia gibba L.	3
Utricularia macrorhiza Leconte	1
Verbena urticafolia L.	1
Veronica anagallis-aquatica L.	1
Vitis cinerea (Engelm.) Engelm. ex Millard	1
Vitis palmata Vahl	1
Vitis rotundifolia Michx.	1
Xanthium strumarium L.	3
Zizaniopsis miliacea (Michx.) Döll & Asch.	4

Table 5: List of the 207 different species encountered in study sites. The last column records the number of sites in which a species was present.

Vegetation data from each site were compiled. Species richness, the mean Coefficient of Conservatism (mCC_T), the Floristic Quality Index (FQI_T), the average percent cover, and Simpson's diversity index were calculated for each site (see Tables 6 and 7). Table 6 contains site species richness, mCC_T and the FQI_T, which were calculated with both native and nonnative species, and native species richness, mCC_N and FQI_N, which were calculated with native species only.

Site ID	Species Richness	Native Species Richness	Nonnative Species Richness	mCC	Native mCC	FQI	Native FQI
OKM2901	8	8	0	6.13	6.13	17.32	17.32
OKM2902	29	29	0	4.70	4.70	25.30	25.30
KIN2701	11	10	1	2.82	3.10	9.35	9.80
CIM2603	7	6	1	3.57	4.17	9.45	10.21
TEX2501	6	6	0	4.83	4.83	11.84	11.84
SEQ3705	5	4	1	4.00	5.00	8.94	10.00
NOW4003	19	16	3	1.89	2.25	8.26	9.00

CHE3901	10	10	0	5.20	5.20	16.44	16.44
CHE3902	11	11	0	6.00	6.00	19.90	19.90
SEM2903	10	10	0	4.20	4.20	13.28	13.28
BLA2702	22	17	5	3.41	4.41	15.99	18.19
CHO3501	7	5	2	3.71	5.20	9.83	11.63
ATO3601	16	16	0	4.50	4.50	18.00	18.00
ATO3602	12	9	3	3.67	4.89	12.70	14.67
OSA2904	22	22	0	4.18	4.18	19.61	19.61
ROG4004	6	6	0	6.50	6.50	15.92	15.92
ROG4005	8	8	0	6.13	6.13	17.30	17.30
LEF3706	17	13	4	2.94	3.85	12.13	13.87
MCC3503	4	4	0	6.00	6.00	12.00	12.00
MCC3504	6	3	3	0.67	1.33	1.60	2.31
CHO3502	11	10	1	2.64	2.90	8.74	9.17
GRA2704	12	9	3	1.58	2.10	5.49	6.30
MCC3604	7	7	0	4.86	4.86	12.85	12.85
MCC3603	24	24	0	4.75	4.75	23.27	23.27
ELL2606	8	6	2	3.00	4.00	8.49	9.80
OSA2905	14	13	1	2.86	3.08	10.69	11.09
ATO3505	22	22	0	4.09	4.09	19.18	19.18
CIM2502	4	2	2	0.25	0.50	0.50	0.71
HAR2605	7	6	1	1.43	1.67	3.78	4.08
LEF3707	15	15	0	3.40	3.40	13.17	13.17
LEF3708	16	16	0	4.25	4.25	17.00	17.00
HAR2604	2	1	1	1.00	2.00	1.41	2.00
OKL2703	8	6	2	1.25	1.67	3.54	4.08

Table 6: Species Richness, mean Coefficient of Conservatism (mCC) and Floristic Quality Index (FQI) were calculated using native and nonnative species, while native species richness, native mCC and native FQI were calculated using only native species.

The site with the most species was OKM2902 with 29 species (Table 6), at Dripping Springs Lake in the Cross Timbers. The site was topographically heterogeneous, which may have contributed to the high species richness. All 29 species encountered at OKM2902 were native. Dominant species included *Cephalanthus occidentalis* L. (common buttonbush), *Eleocharis acicularis* (L.) Roem. & Schult. (needle spikerush), *Justicia americana* (L.) Vahl. (American water-willow) and *Leersia oryzoides* (L.) Sw. (rice cutgrass). HAR2604 has the least number of species with 2. Vegetation at Site HAR2604 in the Southwestern Tablelands ecoregion was dominated by *Bromus arvensis* L. (field brome), a nonnative grass, and had only one native species.

The highest number of nonnative species (5) was encountered at BLA2702 BLA2702 is located in Blaine County in the Central Great Plains ecoregion (Table 6). This site was a lacustrine fringe wetland dominated by *Cyperus erythrorhizos* Muhl. (redroot flatsedge), *Echinochloa crus-galli* (L.) P. Beauv. (barnyardgrass), *Cyperus squarrosus* L. (bearded flatsedge) and *Populus deltoides* Bartram ex Marsh. (eastern cottonwood). Sixteen sites, mostly in eastern Oklahoma, had no nonnative species present (Table 6). Nonnatives species were also absent at TEX2501, a playa lake in the High Plains ecoregion. TEX2501 was dominated by *Ambrosia grayi* (A. Nelson) Shinners (woollyleaf bur ragweed), *Pascopyrum smithii* (Rydb.) Á. Löve (western wheatgrass), *Polygonum amphibium* L. *var. emersum* Michx. (longroot smartweed) and *Oenothera canescens* Torr. & Frém. (spotted evening primrose).

The mCC_T values range from 0.25 to 6.5, but the mCC_N values ranged from 0.5 to 6.5 (Table 6). ROG4004 has the highest mCC_T and mCC_N value at 6.5 (Table 6). ROG4004 in the Central Irregular Plains ecoregion was an oxbow lake of the Verdigris River dominated by *Ceratophyllum demersum* L. (coon's tail), *Nymphaea odorata* Aiton. (American white waterlily), *Utricularia gibba* L. (humped bladderwort) and *Utricularia macrorhiza* L.econte (common bladderwort). Of the 6 species encountered in ROG4004, 50% had CC values of 7, 8 or 9, while the remaining species received values of 4, 5 and 6. *Utricularia macrorhiza* was the only species with a CC of 9.

Site CIM2502 had the lowest mCC_T and mCC_N at 0.25 and 0.5, respectively and the vegetation was dominated by *Convolvulus arvensis* L. (field bindweed) and *Bassia scoparia* (L.) A.J. Scott (burningbush), both nonnative. Of the 4 species encountered at CIM2502, 100% are generalist species, whose CC values range from between 0 and 3.

Site FQI_T scores ranged from 0.5 to 25.3, while FQI_N scores ranged from 0.707 to 25.3 for the 33 sites, also see Table 6. OKM2902 has the highest FQI_T and FQI_N value at 25.3. In OKM2902, over 65% of the species were assigned intermediate CC values (4-6), while 21% were generalists. Three species were assigned conservative CC values of 7 and 8. Site CIM2502 had the lowest FQI_T and FQI_N at 0.5 and 0.707, respectively CIM2502, located in

Cimarron County, is in an area of large scale agriculture. CIM2502 had a total of 4 species; 3 species had CC values of 0 and one species had a CC value of 1. Furthermore, 50% of the species in CIM2502 were nonnative, which were also the dominant species. This site's low FQI_T score may be a product of the site's long history of agricultural activity.

Site ID	Simpson's Diversity Index (D)
OKM2901	0.5938
OKM2902	0.8147
KIN2701	0.6711
CIM2603	0.1653
TEX2501	0.7111
SEQ3705	0.1356
NOW4003	0.6619
CHE3901	0.6343
CHE3902	0.7109
SEM2903	0.6238
BLA2702	0.8763
CHO3501	0.5928
ATO3601	0.5336
ATO3602	0.4440
OSA2904	0.8545
ROG4004	0.5131
ROG4005	0.6197
LEF3706	0.8086
MCC3503	0.6272
MCC3504	0.4566
CHO3502	0.8210
GRA2704	0.6122
MCC3604	0.3457
MCC3603	0.5631
ELL2606	0.1172
OSA2905	0.5236
ATO3505	0.7467
CIM2502	0.5000
HAR2605	0.2778
LEF3707	0.6626
LEF3708	0.7345
HAR2604	0.2975
OKL2703	0.4340

BLA2702, located in the Central Great Plains, had the highest Simpson's index of diversity value at 0.8763 (Table 7). As noted above, BLA2702 had the highest number of nonnative species, but a higher number of species overall (22). Several species at BLA2702 had high abundance; *C. erythrorhizos* (redroot flatsedge), *E. crus-galli* (barnyardgrass), *C. squarrosus* (bearded flatsedge) and *P. deltoides* (eastern cottonwood). ELL2606, in the Southwestern Tablelands ecoregion, had the lowest Simpson's Diversity Index at 0.1172. There was only one dominant species at the site, *Schoenoplectus americanus* (Pers.) Volkart ex Schinz & R. Keller (chairmaker's bulrush).

Table 7: The Simpson's Diversity Index (D) for each wetland site is shown at the left. D was calculated using average percent cover data for both native and nonnative species. $D = 1 - \sum P_i^2$

Approximately 18% of species had a CC value of 6, the most frequent value, followed by species with a CC value of 0 at 16% (Figure 5). About 28% of species were assigned CC values of 4 and 5, and 14% of species were considered conservative; i.e., they had CC values ranging from 7-10.

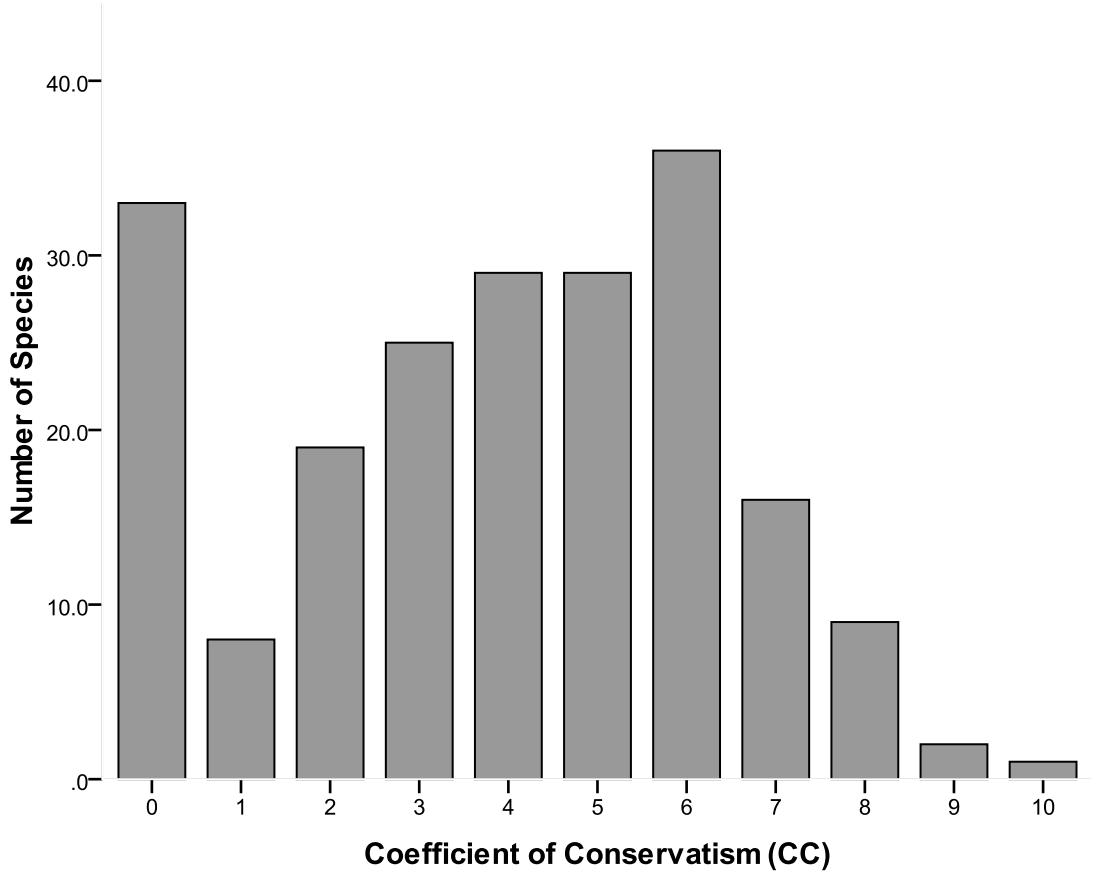

Figure 5: Distribution of Coefficients of Conservatism (CC) for the 207 species encountered in the field.

The Central Great Plains ecoregion had the greatest range of CC values, from 0 to 10, out of any other ecoregion (Figure 6).

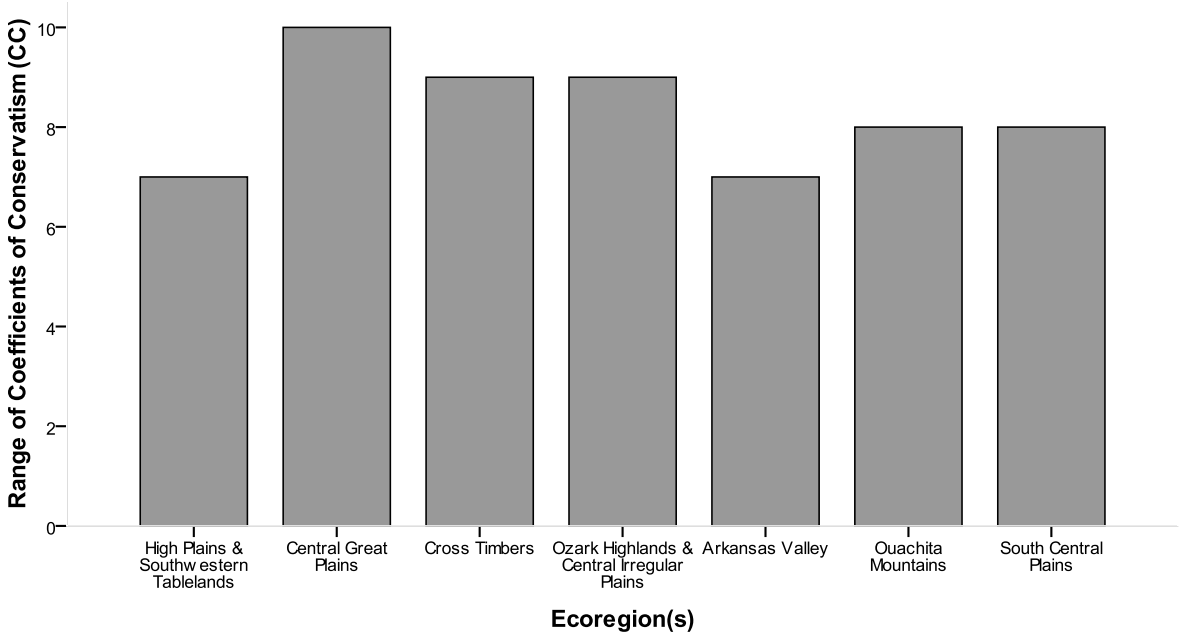

Figure 6: The bar graph below shows the range of CC values for each ecoregion or group of merged ecoregions.

The only site possessing a species with a CC value of 10, *Eleocharis geniculata* (L.) Roem. & Schult. (Canada spikerush), was in the Central Great Plains ecoregion. As mentioned earlier, the Central Great Plains is the largest and most diverse ecoregion, with 8 natural vegetation types. CC values in the Cross Timber and the Ozark Highlands/Central Irregular Plains ranged from 0 to 9. The Ouachita Mountains and South Central Plains had CC values that ranged from 0 to 8. The High Plains/Southwestern Tablelands and the Arkansas Valley ecoregions had the lowest range of CC values, from 0 to 7.

The Cross Timbers had the highest number of species with 70, while the High Plains/Southwestern Tablelands had the lowest species richness with 28 species (Figure 7). The high species richness in the Cross Timbers could be a result of the transitional characteristic of this ecoregion, straddling from western prairies to eastern deciduous forests. The other ecoregions had fairly comparable species richness values: South Central Plains (46), Central Great Plains (47), Arkansas Valley (48), Ozark Highlands/Central Irregular Plains (42), and Ouachita Mountains (49).

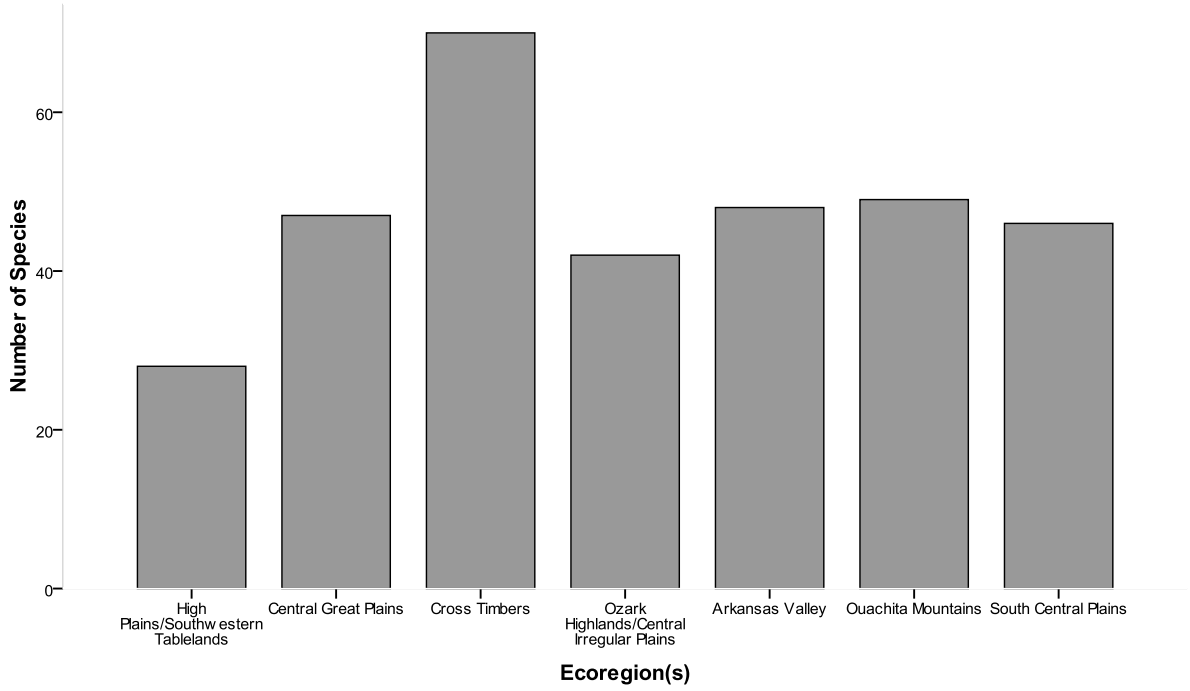

Figure 7: The bar graph below shows the total number of species encountered in each ecoregion or group of merged ecoregions. N = 330.

The Cross Timbers and South Central Plains had the most variation in species richness. Species richness for individual sites in the Cross Timbers ranged from 8 to 29, and from 4 to 22 in the South Central Plains. Variation was more restricted in the High Plains/Southwestern Tablelands and only ranged from 2 to 8 species. This could reflect an east to west gradient here, since for the Oklahoma flora, there are a greater number of species in the east than west.

The mean FQI_T for sites in each merged ecoregion was the highest in the Cross Timbers at 17.24, site in this ecoregion had an average FQI_T ranging from 11.09 to 25.3 (Figure 8).

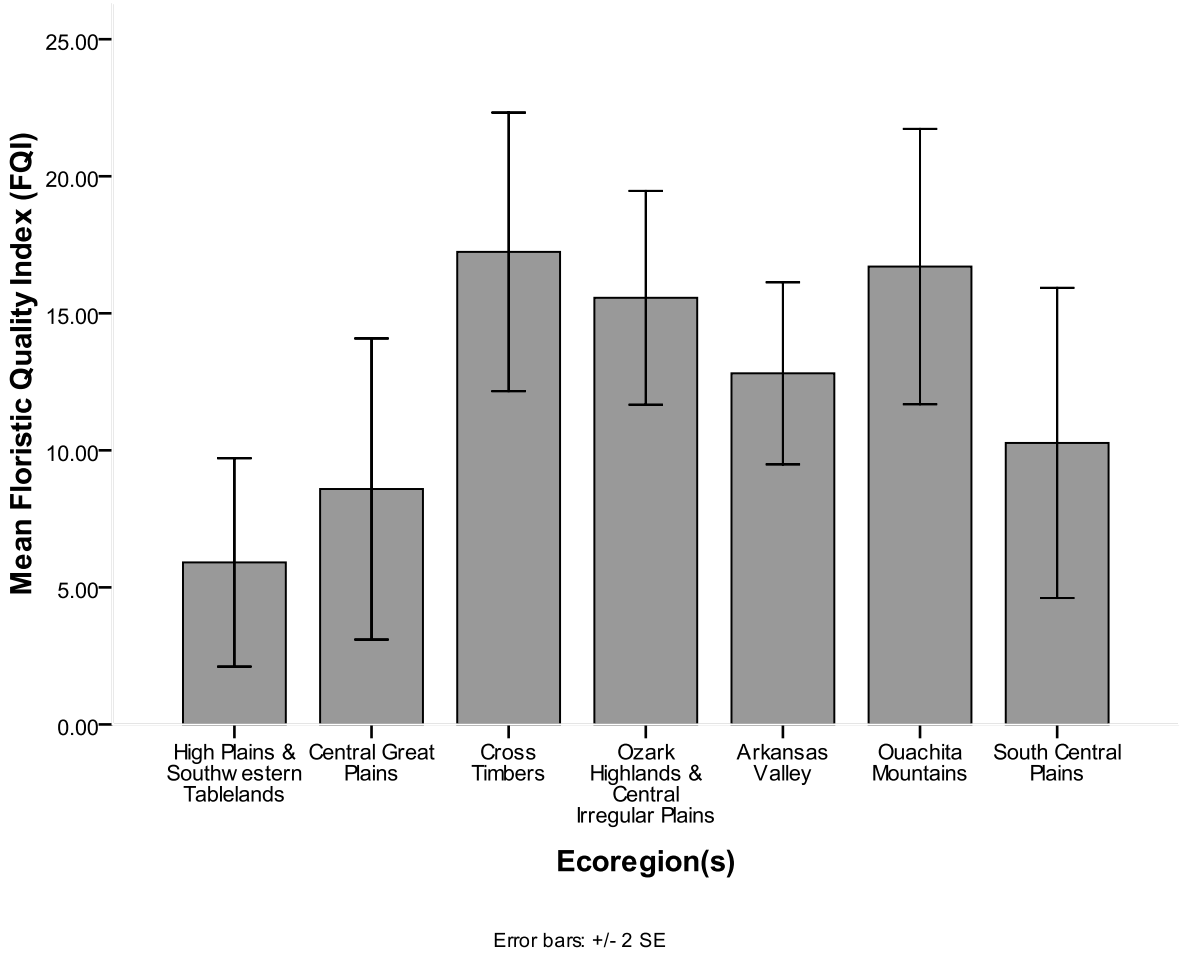

Figure 8: The bar graph below shows the mean Floristic Quality Index (FQI) per ecoregion or group of merged ecoregions.

Thus, sites in the Cross Timbers had on average the highest quality natural areas. The Ouachita Mountain ecoregion had average FQI_T values of 16.71, followed by the Ozark Highland/Central Irregular Plains (15.57). Sites with the lowest mean FQI_T at 5.91 were located in the High Plains/Southwestern Tablelands. Sites in this ecoregion ranged from 0.5 to 11.84. Sites in the Central Great Plains had an average FQI_T of 8.59 and ranged from 3.54 to 15.99. In the South Central Plains, the mean FQI was 10.27, while in the Arkansas Valley, the mean FQI_T was 12.81. In Figure 8, the mean FQI_T is calculated using both native and

nonnative species. There is a stronger east to west gradient here. Sites in eastern and east central ecoregions have higher mean FQI_T values than sites in the western ecoregions of Oklahoma, see Figure 8.

The Cross Timbers sites had the highest average species percent cover at 93.70% (Figure 9). The Ozark Highlands/Central Irregular Plains and the Arkansas Valley ecoregions both had an average species cover of 90.50%. The High Plains/Southwestern Tablelands had the lowest mean average percent cover for species present at 18.33% and the Central Great Plains had the second lowest value at 56%. A clear difference in percent cover between western and eastern sites in Oklahoma is apparent.

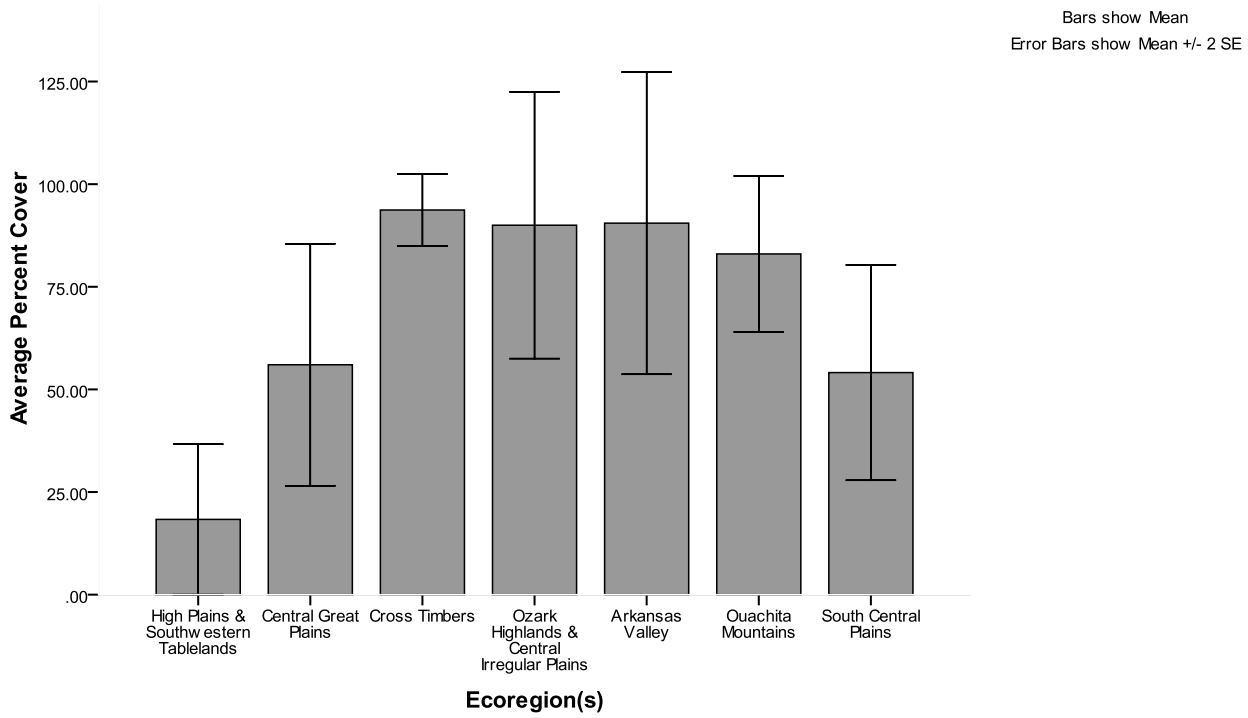

Figure 9: Bar graph showing the mean average percent cover for each ecoregion or group of merged ecoregions.

Sites in the Cross Timbers have the highest average Simpson's diversity index with 0.6821 (Figure 10). Sites in the High Plains/Southwestern Tablelands have the lowest average Simpson's index of diversity with 0.3448. The Arkansas Valley ecoregion has the widest range of diversity values, spanning from 0.1356 (SEQ3705) to 0.8086 (LEF3706), and had a

mean Simpson's diversity value of 0.5853. The Simpson's Diversity Index was calculated using both native and nonnative species. The Ouachita Mountains has the second lowest Simpson's diversity average at 0.4716.

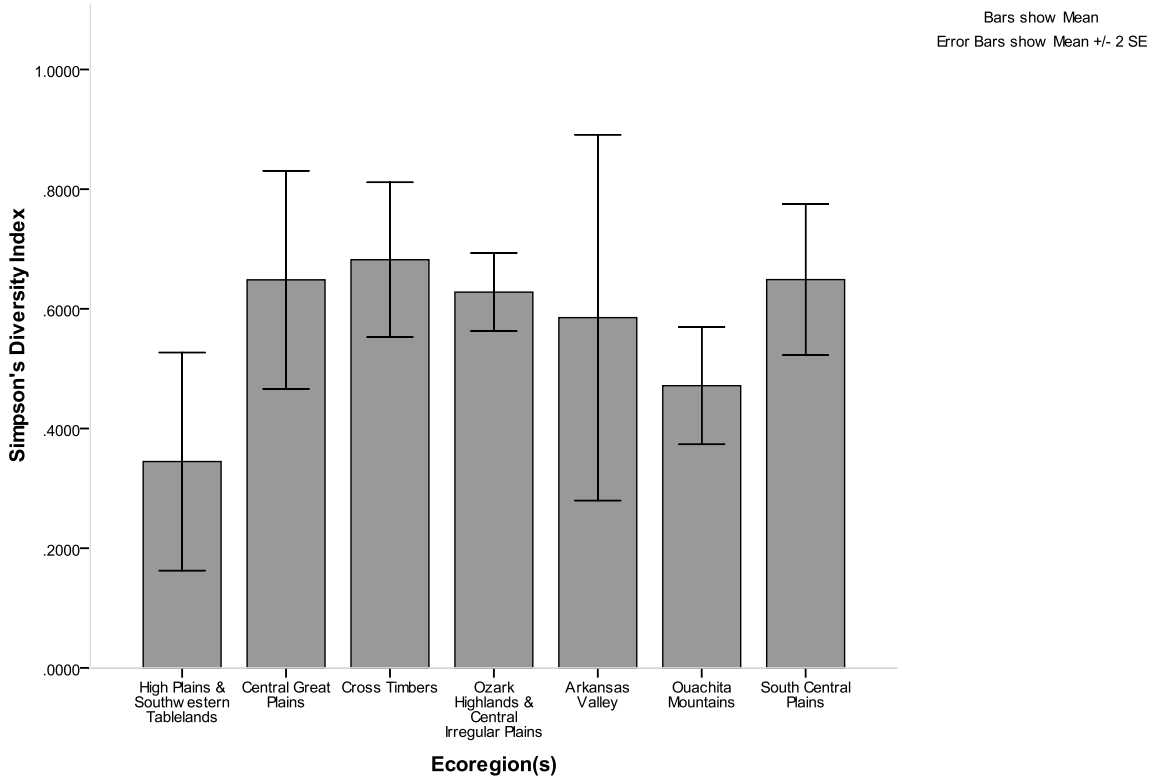

Figure 10: The bar graph below shows the mean Simpson's Diversity Index (D) for sites within each ecoregion or group of merged ecoregions.

A Nonmetric Multidimensional Scaling Ordination (NMDS) was performed on a matrix of average percent cover for 207 species and 33 wetland sites. The Monte Carlo test of 250 randomized runs had a probability of 0.004 or a similar final stress that could have been obtained by chance only. Ninety-eight iterations were used in the final solution. The solution's stability was assessed using the stress vs. iteration number plot given, which showed that the curve stabilized at a low level and remains relatively flat for about 20 steps, and the final stress for the 6-dimensional solution was 11.659. Axis 1 represented 10.3%, Axis 2 represents 7.4%, and Axis 3 explained 8.2% of the variance. Thus, the ordination represented 26.0% of the variance in vegetation composition data.

The results of the NMDS ordination indicate a difference in vegetation composition between eastern and western sites (Figure 11). Western sites are located on the right side of Axis 1, while eastern and east central sites are mostly clustered on left side of Axis 1.

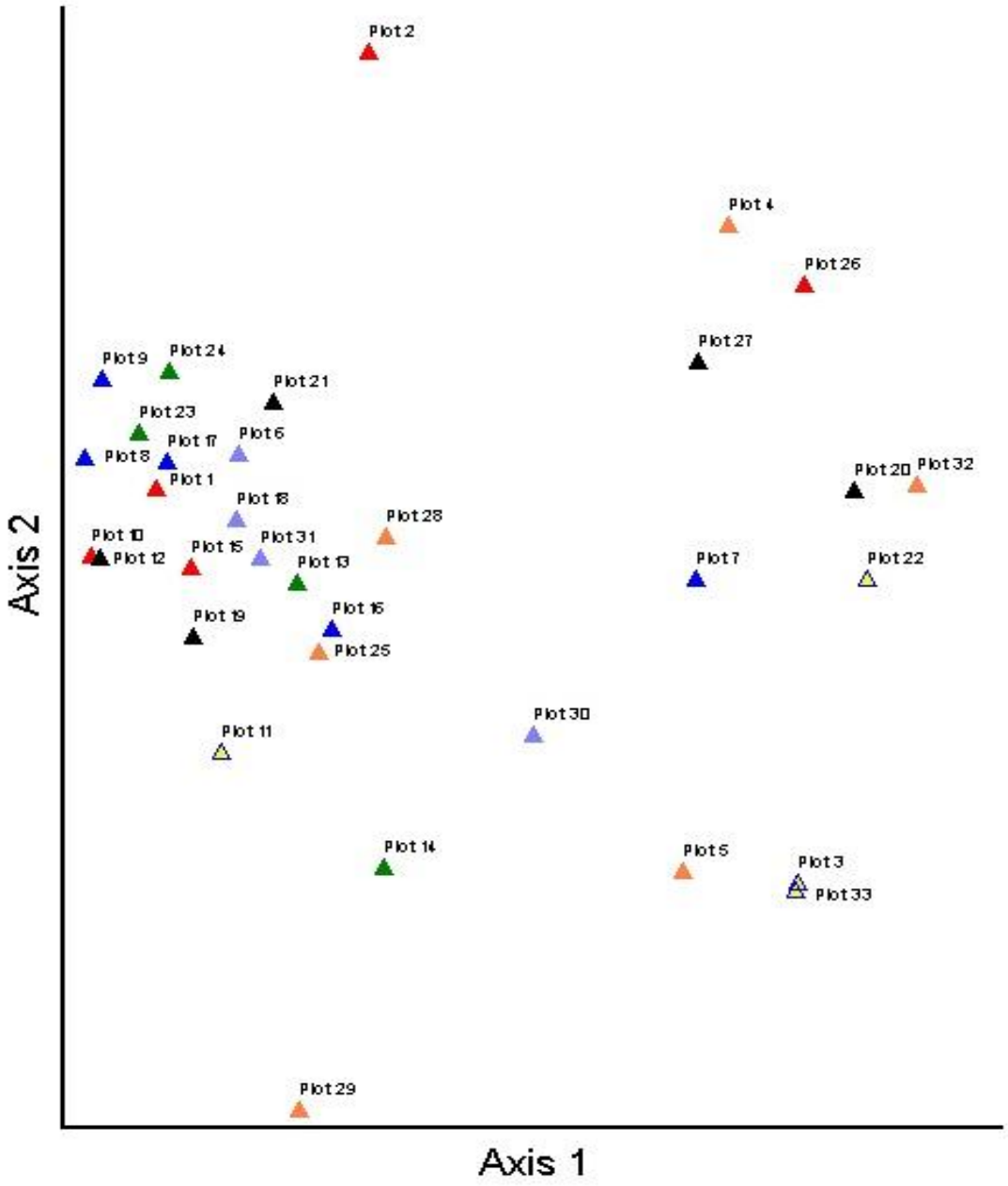

Figure 11: NMDS Ordination was run using all 33 wetland sites. Cross Timbers (red), South Central Plains (black), Ouachita Mountains (green), Arkansas Valley (purple), Ozark Highlands and Central Irregular Plains (blue), High Plains and Southwestern Tablelands (peach), and the Central Great Plains (yellow).

The distribution of species were distributed in ordination space reflects the similarities in vegetation composition (Figure 12).

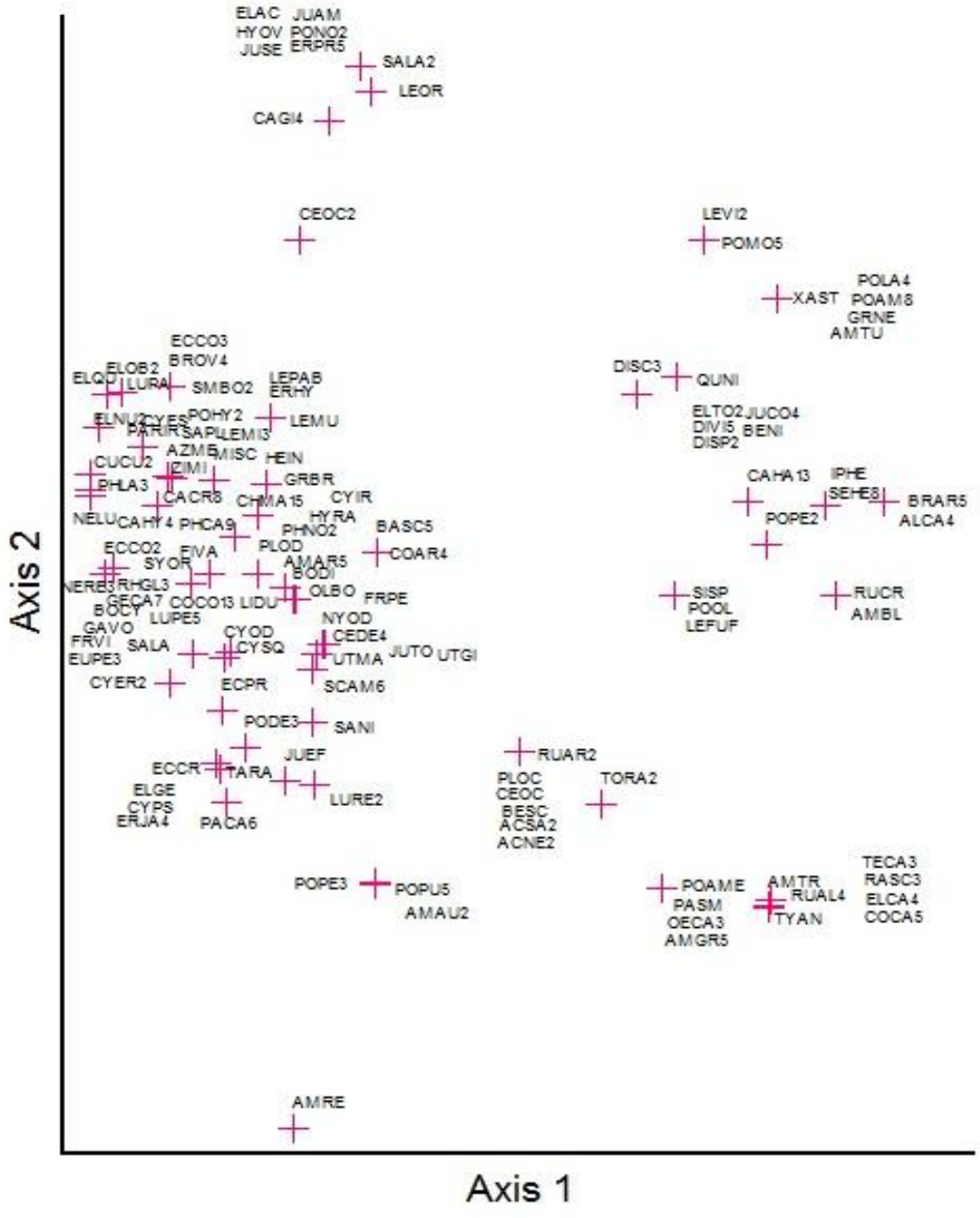

Figure 12: NMDS species ordination for 33 sites and 206 species.

Axis 1 may indicate a west to east vegetation composition gradient with *Rumex crispus* L. (curly dock) and *Typha angustifolia* L. (narrowleaf cattail) on the right, and species such as *Polygonum hydropiperoides* Michx. (swamp smartweed), *Cephalanthus occidentalis* L. (common buttonbush), *Neeragrostis reptans* (Michx.) Nicora (creeping lovegrass), *Nelumbo lutea* Willd. (American Lotus) and *Fimbristylis vahlii* (Lam.) Link (Vahl's fimbry) were on the left hand side of Axis 1. The former species were typical dominants of sites in western ecoregions, while the latter species are frequently dominant in sites of eastern and east central ecoregions. While species help explain Axis 1, this was not the case with Axis 2. Nor were species richness and percent cover data useful.

FQI vs. Wetland Type

There were ten emergent wetlands, seven lacustrine fringe sites, eight riparian woodland sites, two ponds, two sloughs, two oxbow lakes, one playa and one seep/spring. The seep/spring site OSA2904 has the highest FQI_T value at 19.61 (Figure 13). Emergent wetlands had the lowest mean FQI_T at 6.95; not surprising given the wide variety of vegetation types that occur in this category. Riparian woodlands had the largest variance in FQI_T data; sites of this wetland type ranged from 3.54 to 23.27. Sites of the emergent wetland type had the second largest range in FQI_T values ranging from 0.5 to 17.32. Lacustrine Fringe FQI_T values ranged from 8.74 to 25.3. The pond sites (CHE3901, CHE3902) had a mean FQI_T of 18.17, while the oxbow lakes (ROG4004, ROG4005) had a mean FQI_T of 16.61.

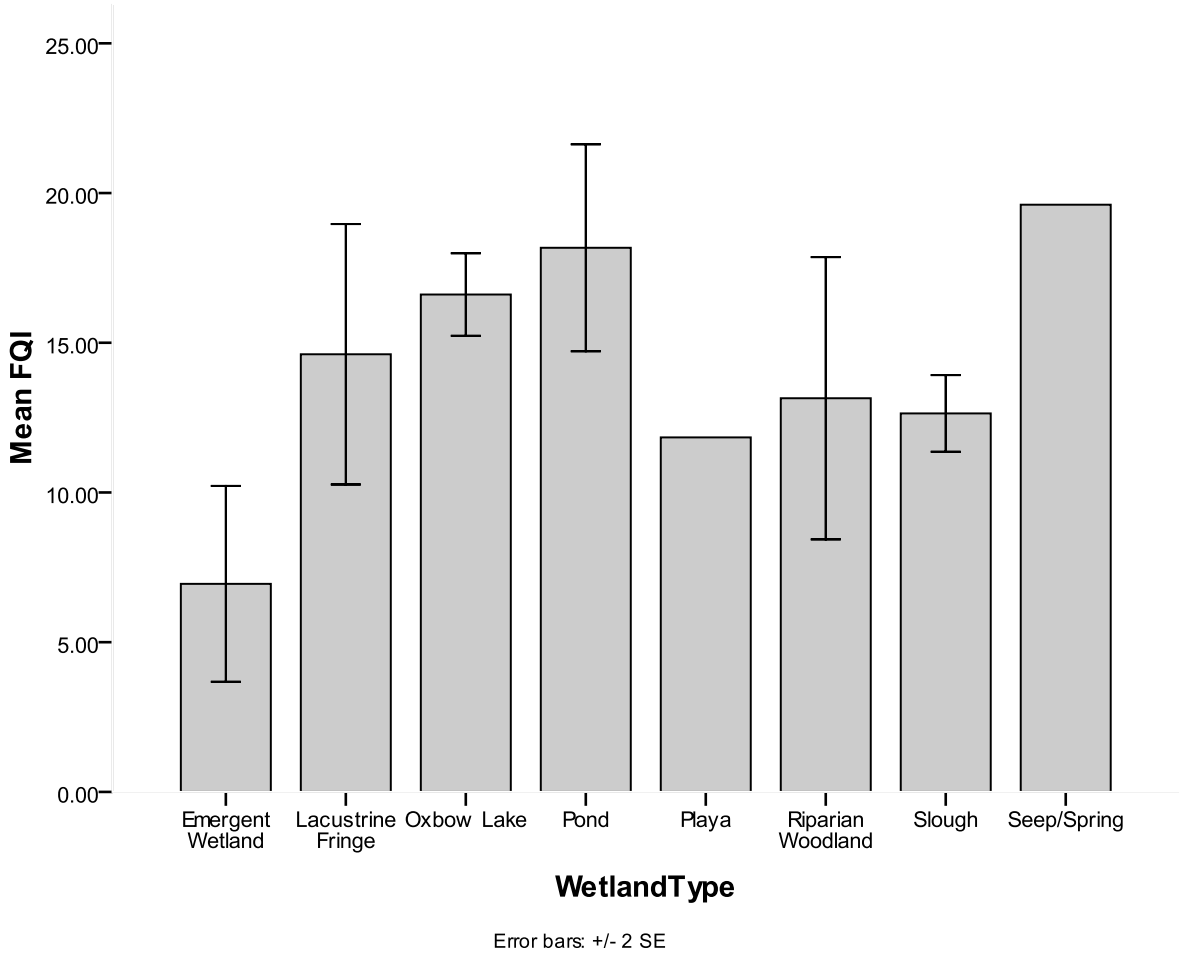

Figure 13: The bar graph below shows the mean Floristic Quality Index (FQI) for each wetland type. N = 33.

Conclusion

As the data has shown there is a definite west to east gradient among sites and vegetation composition. In addition, sites in the eastern ecoregions of Oklahoma had higher mCC_T and FQI_T values, species richness, average percent cover and Simpson's Diversity Index. Also, a majority of eastern and east central ecoregions had higher ranges in CC values; however, the Central Great Plains ecoregion had the only species assigned a CC value of 10, out of the 386 species encountered in the field. I was expecting to see a more northwest to southeast gradient, but remembered that sites in the South Central Plains ecoregion were all sampled

late in the season (October), which could account for these sites' low FQI_T scores, species richness and average percent cover values. Milburn et al. (2007) found similar results regarding differences in FQA index values due to biogeographic differences. Furthermore, these authors also found that various wetland types could have similar FQA index scores due to similar biogeographical location (Milburn et al. 2007).

In researching this topic, I introduced several interpretations of the FQA approach. Contemporary FQA studies have grappled with the issue: does mCC_T or FQI_T better indicate habitat condition? When comparing mCC_T values to FQI_T scores, it is known that mCC_T values can only range from 0 to 10, making the mCC_T scale much more finite than the FQI_T scale. To speculate on the 33 sites' condition or likeness to remnant natural communities based on their FQI_T values, which range from 0.5 to 25.3, seems much more reasonable, because they are so different. Ranging from 0.25 to 6.0, the mCC_T values just do not seem different enough to decisively say what sites are of higher quality than others.

In this study, sites with an FQI_T value of 15 or higher are considered potential remnant natural communities, but more data needs to be analyzed for more solid cutoff points. In the original study of the Chicago Region (Swink and Wilhelm 1994), sites with a FQI_N of at least 35 were considered to represent high floristic quality and other qualities of remnant natural communities. An FQI_N score of 45 or higher represented a remnant natural community (Swink and Wilhelm 1994). In Michigan, FQI_N scores less than 20 have minimal conservatism and are indicative of disturbance; sites with a FQI_N higher than 35 are considered conservative, and sites with FQI_N scores in the 50s and higher are extremely rare and highly conservative and of great significance (Herman et al. 2001).

In conclusion, the objectives were met for the completion of this project: a FQA methodology was developed, a comprehensive list of CC scores for Oklahoma's wetland plant species was created, wetland sites were calibrated across Oklahoma's ecoregions and regional differences in vegetation were evaluated using a NMDS ordination. Also, this study was calibrated by conducting FQA in wetland habitats across ecoregions in Oklahoma.

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APPENDIX A:

Oklahoma's 12 EPA Level III Ecoregions

There are 12 Level III ecoregions in Oklahoma, as delineated by the Environmental Protection Agency (EPA), which includes the High Plains, Southwestern Tablelands, Central Great Plains, Flint Hills, Cross Timbers, East Central Texas Plains, South Central Plains, Ouachita Mountains, Arkansas Valley, Boston Mountains, Ozark Highlands, and the Central Irregular Plains. The EPA approach to ecoregion delineation was adopted from J.M. Omernik (1987, 1995, 1997, 2003, 2004).

Omernik's ecoregion framework was originally devised for stream classification and water quality management (Omernik 1987, 1995, 2004; Bryce and Clark 1996; Griffith et al. 1999). Omernik classifies ecoregions by "identifying areas within which there is spatial coincidence in characteristics of geographical phenomena associated with differences in the quality, health and integrity of ecosystems" (Omernik and Bailey 1997; Omernik 2003, 2004). Omernik's ecoregion delineation schema groups areas of similarity in ecosystems based on broad patterns of the following characteristics: climate, geology, soils, physiographic features, potential natural vegetation, wildlife, land use, land cover, water quality, and anthropogenic activities, since they are known to influence ecosystem patterns and processes (Omernik 1995, 2004; Bryce et al. 1999; Griffith et al. 1999; Gallant et al. 2004).

Ecoregions work on multiple scales, site to regional levels (Omernik 1995; Omernik and Bailey 1997; Griffith et al. 1999). EPA ecoregions adhere to a 5 level Roman numeral hierarchy. Level I partitions North America into 15 ecoregions, while Level II has 52

ecoregions. The coterminous United States is divided into 84 Level III ecoregions. More recently, however, Level III ecoregions have been subdivided further to Level IV ecoregions, and Level IV ecoregions have been further divided into Level V ecoregions, which are the most detailed (Bryce et al. 1999; Woods et al. 2005). The ecoregion hierarchy is designed so that higher level, smaller-scale ecoregions fit within lower level, larger-scale ecoregions; thereby relating site specifics to local and regional ecosystems and ecosystem complexes (Omernik 1987, 1995, 2004; Bryce and Clark 1996).

The following table summarizes biotic and abiotic characteristics such as physiography, climate, geology and soils, potential natural vegetation, land cover and land use for each of Oklahoma's 12 ecoregions. This information was synthesized from the *Ecoregions of Oklahoma* map (Woods et al. 2005).

Level III Ecoregion	Physiography	Climate	Geology and Soils	Potential Natural Vegetation	Land Cover/ Land Use
High Plains (25)	Gently sloping sandy plains Sand hills and dunes Depressions Inter-dunal wetlands **Elevation:** 731.5-1463m(2400'-4800') **Area:** 3577 mi^2	**Mean annual rainfall** ranges from 17 to 20". **Mean annual frost free days** is 175 to 185 days. **January min.** = 19°F (-7.2°C) **Jul. max.** = 94°F (34.4°C)	**Geology**: Quaternary sand and silt were deposited by rivers and shaped by wind. **Soil Orders**: Alfisols, Entisols, Mollisols, Aridisols, Vertisols	1. Short grass prairie 2. Sand sagebrush-bluestem prairie	Grassland Rangeland Cropland Natural gas and oil fields Grazing (livestock) Irrigation (crops)
South-western Tablelands (26)	Dissected, rugged canyons, hills, rock outcrops, buttes, mesas (NW corner). Gently sloping plains **Elevation:** 457-1516m(1500'-4973') **Area:**3582 mi^2	**Mean annual rainfall** ranges from 16 to 28". **Mean annual frost free days** is 175 to 215 days. **January min.** = 18°F (-7.8°C) **Jul. max.** = 96°F (35.6°C)	**Geology:** Quaternary alluvium and colluvium are underlain mostly by Permian shale. Black Mesa is basalt underlain by sandstone and shale. **Soil Orders:** Mollisols, Entisols, Alfisols, Aridisols, Inceptisols	1. Short grass prairie 2. Sand sagebrush-bluestem prairie 3. Juniper-pinyon woodlands 4. Mesquite buffalograss 5. Mixed grass prairie	Grassland Rangeland Cropland Riparian woodlands Natural gas and oil fields Grazing Some Irrigation
	Level to	**Mean annual**	**Geology:**	1. Mixed	Cropland

Level III Ecoregion	Physiography	Climate	Geology and Soils	Potential Natural Vegetation	Land Cover/ Land Use
Central Great Plains (27)	gently rolling to steep, roughly dissected plains Low mountains and hills, escarpments, ledges, ridges Sand dunes **Elevation:** 213-823m(700'-2700') **Area:**28308 mi^2	**rainfall** ranges from 22 to 38". **Mean annual frost free days** is 185 to 230 days. **January min.** = 17°F (-8.3°C) **Jul. max** = 98°F (36.7°C)	Quaternary alluvium and colluvium underlain by Permian shale, sandstone, and limestone among others. **Soil Orders:** Mollisols, Alfisols, Entisols, Inceptisols, Vertisols	grass prairie 2. Mesquite-buffalograss 3. Shinnery 4. Cross Timbers 5. Sand sagebrush-bluestem prairie 6. Tall grass prairie 7. Short grass prairie 8. Oak savanna	Rangeland Open forest Grassland Natural gas and oil fields Grazing Irrigation
Flint Hills (28)	Low, rolling plains Narrow, steep-sided valleys **Elevation:** 244-412m(800'-1350') **Area:**967 mi^2	**Mean annual rainfall** ranges from 38 to 42". **Mean annual frost free days** is 195 to 205 days. **January min.** = 22°F (-5.6°C) **Jul. max.** = 93°F (33.9°C)	**Geology:** Quaternary alluvium and silty to clayey residuum underlain by Pennsylvanian limestone and shale. **Soil Orders:** Mollisols, Alfisols	1. Tall grass prairie	Rangeland Cropland Oil fields
	Rolling hills and plains	**Mean annual rainfall**	**Geology:** Quaternary	1. Cross Timbers	Woodland Rangeland

Level III Ecoregion	Physiography	Climate	Geology and Soils	Potential Natural Vegetation	Land Cover/ Land Use
Cross Timbers (29)	Ridges and ledges Low mountains, valleys, ravines **Elevation:** 175-518m(575'-1700') **Area:**13262 mi^2	ranges from 31 to 46". **Mean annual frost free days** is 195 to 235 days. **January min.** = 22°F (-5.6°C) **Jul. max.** = 95°F (35°C)	clay, silt, sand and loam deposited over Permian and Pennsylvanian sandstone, limestone and shale **Soil Orders:** Alfisols, Mollisols, Inceptisols, Vertisols, Entisols	2. Tall grass prairie 3. Oak-hickory forest 4. Short grass prairie 5. Savanna	Grassland Pastureland Cropland Mesic forest Natural gas and oil fields Fire suppression Recreation
East Central Texas Plains (33)	Level to gently rolling plains **Elevation:** 149-220m(490'-720'(**Area:**364 mi^2	**Mean annual rainfall** ranges from 42 to 45". **Mean annual frost free days** is 230 to 235 days. **January min.** = 29°F (-1.7°C) **Jul. max.** = 93°F (33.9°C)	**Geology:** Quaternary clay, silt, sand underlain by Cretaceous shale and limestone, mainly. **Soil Orders:** Mollisols, Alfisols	1. Tall grass prairie 2. Cross Timbers	Cropland Pastureland Riparian forest
	Level floodplains Natural	**Mean annual rainfall** ranges from	**Geology:** Holocene and	1.Southern floodplain forest	Forested wetland Woodland

Level III Ecoregion	Physiography	Climate	Geology and Soils	Potential Natural Vegetation	Land Cover/ Land Use
South Central Plains (35)	levees, oxbow lakes, backswamps, other wetlands Hilly, dissected, rolling uplands Seeps, Streams **Elevation:** 88-213m(289'-700') **Area:**2625 mi^2	45 to 55". **Mean annual frost free days** is 215 to 235 days. **January min.** = 28°F (-2.2°C) **Jul. max.** = 94°F (34.4°C)	Quaternary alluvium underlain by Cretaceous shale and limestones, mostly. **Soil Orders:** Alfisols, Entidols, Ultisols, Vertisols, Inceptisols, Mollisols	2.Oak-hickory-pine forest	Deciduous forest Wetland Pastureland Cropland Logging Livestock farming Grazing
Ouachita Mountains (37)	Hills, low mountains and ridges Narrow valleys Floodplains Perennial streams Seeps **Elevation:** 114-823m(375'-2700') **Area:**4073 mi^2	**Mean annual rainfall** ranges from 43 to 57". **Mean annual frost free days** is 195 to 230 days. **January min.** = 24°F (-4.4°C) **Jul. max.** = 95°F (35°C)	**Geology:** Quaternary sand to silty clay colluvium and alluvium underlain by Mississippian-age shale and sandstone, mostly. **Soil Orders:** Ultisols, Alfisols, Inceptisols, Entisols	1. Oak-hickory-pine forest 2. Southern floodplain forest	Evergreen/mixed forest Woodland Pastureland Cropland Riparian forest Logging Recreation Grazing
	Level to undulating floodplains and plains	**Mean annual rainfall** ranges from 41 to 51".	**Geology:** Holocene and Quaternary	1. Oak-hickory forest 2. Oak-	Deciduous/mixed forest Pastureland Cropland

Level III Ecoregion	Physiography	Climate	Geology and Soils	Potential Natural Vegetation	Land Cover/ Land Use
Arkansas Valley (37)	Hills, Valleys Mountains and Ridges Streams Oxbow lakes Backswamps Floodplains **Elevation:** 119-457m(390'-1500') **Area:**4824 mi^2	**Mean annual frost free days** is 205 to 235 days. **January min.** = 25°F (-3.9°C) **July max.** = 94°F (34.4)	alluvium underlain by Pennsylvanian shale and sandstone, mostly. **Soil Orders:** Ultisols, Inceptisols, Entisols, Mollisols, Vertisols, Alfisols	hickory-shortleaf pine forest 3. Oak-hickory-pine forest 4. Southern floodplain forest 5. Cross Timbers 6. Tall grass prairie	Wooded riparian area Logging Grazing Recreation Mining Natural gas
Boston Mountains (38)	Low mountains and benches **Elevation:** 145-518m(475'-1700') **Area:**836 mi^2	**Mean annual rainfall** ranges from 44 to 51". **Mean annual frost free days** is 200 to 220 days. **January min.** = 26°F (-3.3°C) **Jul max.** = 92°F (33.3°C)	**Geology:** Quaternary alluvium and colluvium underlain by Pennsylvanian sandstone and shale, mostly. **Soil Orders:** Ultisols, Mollisols, Inceptisols	1. Oak-hickory forest	Forest and woodland Pastureland Logging Recreation
	Level to gently rolling to highly dissected topography	**Mean annual rainfall** ranges from 41 to 49". **Growing**	**Geology:** Quaternary cherty clay residuum underlain	1. Oak-hickory forest 2. Oak-hickory-	Pastureland Woodland Forest Cropland Grazing

Level III Ecoregion	Physiography	Climate	Geology and Soils	Potential Natural Vegetation	Land Cover/ Land Use
Ozark Highlands (39)	Karst features Valleys, Springs Perennial streams **Elevation:** 168-488m(550'-1600') **Area:**2380 mi^2	**season** lasts 200 to 220 days. **January min.** = 22°F (-5.6°C) **Jul. max.** = 91°F (32.8°C)	by Mississppian limestone and chert **Soil Orders:** Ultisols, Alfisols, Mollisols, Entisols	pine forest	Logging Recreation
Central Irregular Plains (40)	Gently sloping to irregular, undulating plains Broad valleys Perennial streams **Elevation:** 152-320m(500'-1050') **Area:**5212 mi^2	**Mean annual rainfall** ranges from 39 to 45". **Mean annual frost free days** is 200 to 220 days. **January min.** = 22°F (-5.6°C) **Jul. max.** = 94°F (34.4°C)	**Geology:** Quaternary alluvium underlain by Pennsylvanian shale and sandstone **Soil Orders:** Mollisols, Alfisols, Vertisols, Ultisols, Inceptisols, Entisols	1. Tall grass prairie 2. Oak-hickory forest 3. Cross Timbers	Rangeland Grassland Cropland Woodland Riparian woodlands Mining Livestock

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APPENDIX B:

Coefficients of Conservatism for Oklahoma's Wetland Plants

SPECIES	Family	Reg. 6 Status	OK Native Status	OK CC Value
Acer negundo L.	Aceraceae	FACW-	N	1
Acer negundo var. *interius* (Britton) Sarg.	Aceraceae	FACW-	N	1
Acer negundo var. *negundo* L.	Aceraceae	FACW-	N	1
Acer negundo var. *texanum* Pax	Aceraceae	FACW-	N	1
Acorus calamus L.	Acoraceae	OBL	N	4
Adiantum capillus-veneris L.	Pteridaceae	FACW+	N	8
Aeschynomene indica L.	Fabaceae	FACW	N	5
Agrimonia parviflora Aiton	Rosaceae	FACW	N	5
Agrostis hyemalis (Walter) Britton, Sterns & Poggenb.	Poaceae	FACW-	N	3
Agrostis stolonifera L.	Poaceae	FACW	I	0
Alisma subcordatum Raf.	Alismataceae	OBL	N	6
Alnus serrulata (Aiton) Willd.	Betulaceae	OBL	N	4
Alopecurus carolinianus Walter	Poaceae	FACW	N	2
Alternanthera philoxeroides (Mart.) Griseb.	Amaranthaceae	OBL	I	0
Ambrosia grayi (A. Nelson) Shinners	Asteraceae	FACW	N	2
Ammannia auriculata Willd.	Lythraceae	OBL	N	6
Ammannia coccinea Rottb.	Lythraceae	OBL	N	6
Amorpha fruticosa L.	Fabaceae	FACW	N	6
Amorpha paniculata Torr. & A. Gray	Fabaceae	FACW	N	4
Amsonia tabernaemontana Walter	Apocynaceae	FACW-	N	6

Amsonia tabernaemontana var. *gattiengeri* Woodson	Apocynaceae	FACW-	N	6
Amsonia tabernaemontana var. *salicifolia* (Pursh) Woodson	Apocynaceae	FACW-	N	6
Anagallis arvensis var. *foemina* (Mill.) Schinz & Thell.	Primulaceae	FACW-	N	0
Anagallis arvensis L.	Primulaceae	FACW-	I	0
Anagallis minima (L.) Krause	Primulaceae	FACW+	N	1
Andropogon glomeratus (Walter) Britton, Sterns & Poggenb.	Poaceae	FACW+	N	3
Andropogon glomeratus var. *glomeratus* (Walter) Britton, Sterns & Poggenb.	Poaceae	FACW+	N	3
Anemopsis californica (Nutt.) Hook. & Arn.	Saururaceae	FACW+	N	0
Aquilegia canadensis L.	Ranunculaceae	FACW	N	7
Arisaema dracontium (L.) Schott	Araceae	FACW	N	6
Arisaema triphyllum (L.) Schott	Araceae	FACW	N	7
Arisaema triphyllum ssp. *pusillum* (Peck) Huttleston	Araceae	FACW	N	7
Arisaema triphyllum ssp. *triphyllum* (L.) Schott	Araceae	FACW	N	7
Arundinaria gigantea (Walter) Muhl.	Poaceae	FACW	N	7
Arundinaria gigantea ssp. *tecta* (Walter) McClure	Poaceae	FACW	N	6
Asclepias incarnata L.	Asclepiadaceae	FACW+	N	5
Axonopus furcatus (Fluegge) Hitchc.	Poaceae	OBL	N	5
Azolla caroliniana Willd.	Azollaceae	OBL	N	6
Azolla mexicana Schltdl. & Cham. ex C. Presl	Azollaceae	OBL	N	6
Baccharis halimifolia L.	Asteraceae	FACW-	N	2
Bacopa monnieri (L.) Pennell	Scrophulariaceae	OBL	N	7
Bacopa rotundifolia (Michx.) Wettst.	Scrophulariaceae	OBL	N	6
Bartonia paniculata (Michx.) Muhl.	Gentianaceae	OBL	N	10
Bartonia paniculata ssp. *paniculata* (Michx.) Muhl.	Gentianaceae	OBL	N	10
Bergia texana (Hook.) Seub. ex Walp.	Elatinaceae	OBL	N	4
Berula erecta (Huds.) Coville	Apiaceae	OBL	N	5
Betula nigra L.	Betulaceae	FACW	N	3

Bidens aristosa (Michx.) Britton	Asteraceae	FACW	N	6
Bidens bigelovii A. Gray	Asteraceae	FACW	N	4
Bidens cernua L.	Asteraceae	OBL	N	5
Bidens discoidea (Torr. & A. Gray)Britton	Asteraceae	FACW+	N	4
Bidens frondosa L.	Asteraceae	FACW	N	2
Bidens laevis (L.) Britton, Sterns & Poggenb.	Asteraceae	OBL	N	7
Boehmeria cylindrica (L.) Sw.	Urticaceae	FACW	N	6
Boltonia asteroides (L.) L'Her.	Asteraceae	FACW	N	4
Boltonia asteroides var. *latisquama* (A. Gray) Cronquist	Asteraceae	FACW	N	4
Boltonia asteroides var. *recognita* (Fernald & Grisc.) Cronquist	Asteraceae	FACW	N	4
Boltonia diffusa Elliot	Asteraceae	FACW-	N	6
Boltonia diffusa var. *diffusa* Elliot	Asteraceae	FACW-	N	6
Boltonia diffusa var. *interior* Fernald & Grisc.	Asteraceae	FACW-	N	6
Brasenia schreberi J.F. Gmel.	Cabombaceae	OBL	N	5
Brunnichia ovata (Walters) Shinners	Polygonaceae	FACW-	N	6
Burmannia capitata (J.F. Gmel.) Mart.	Burmanniaceae	OBL	N	9
Cabomba caroliniana A. Gray	Cabombaceae	OBL	N	8
Calamovilfa arcuata K.E. Rogers	Poaceae	OBL	N	8
Callirhoe alcaeoides (Michx.) A. Gray	Malvaceae	OBL	N	5
Callitriche heterophylla Pursh	Callitrichaceae	OBL	N	5
Callitriche terrestris Raf.	Callitrichaceae	FACW-	N	5
Calopogon tuberosus (L.) Britton, Sterns & Poggenb.	Orchidaceae	OBL	N	9
Calopogon tuberosus var. *simpsonii* (L.) Britton, Sterns & Poggenb. (Small) Magrath	Orchidaceae	OBL	N	9
Calopogon tuberosus var. *tuberosus* (L.) Britton, Sterns & Poggenb.	Orchidaceae	OBL	N	9
Calycocarpum lyonii (Pursh) A. Gray	Menispermaceae	FACW	N	5
Cardamine bulbosa (Schreb. ex Muhl.) Britton, Sterns & Poggenb.	Brassicaceae	OBL	N	8
Cardamine parviflora L.	Brassicaceae	FACW	N	3

Cardamine parviflora var. *arenicola* L. (Britton) O.E. Schulz	Brassicaceae	FACW	N	3
Cardamine pensylvanica Muhl. ex Willd.	Brassicaceae	FACW	N	3
Carex albolutescens Schwein.	Cyperaceae	FACW	N	9
Carex amphibola Steud.	Cyperaceae	OBL	N	4
Carex annectens (E.P. Bicknell) E.P. Bicknell	Cyperaceae	FACW+	N	4
Carex atlantica L.H. Bailey	Cyperaceae	OBL	N	9
Carex bicknellii Britton	Cyperaceae	FACW	N	7
Carex brevior (Dewey) Mack.	Cyperaceae	OBL	N	5
Carex bushii Mack.	Cyperaceae	OBL	N	4
Carex caroliniana Schwein.	Cyperaceae	OBL	N	7
Carex cephalophora Muhl. ex Willd.	Cyperaceae	OBL	N	6
Carex cherokeensis Schwein.	Cyperaceae	FACW-	N	6
Carex complanata Torr. & Hook.	Cyperaceae	OBL	N	8
Carex crawei Dewey	Cyperaceae	FACW	N	6
Carex crinita Lam.	Cyperaceae	OBL	N	7
Carex crinita var. *brevicrinis* Lam. Fernald	Cyperaceae	OBL	N	7
Carex crus-corvi Shuttlw. ex Kunze	Cyperaceae	OBL	N	7
Carex debilis Michx.	Cyperaceae	OBL	N	9
Carex decomposita Muhl.	Cyperaceae	OBL	N	8
Carex diandra Schrank	Cyperaceae	OBL	N	9
Carex emoryi Dewey	Cyperaceae	OBL	N	6
Carex fissa Mack.	Cyperaceae	OBL	N	8
Carex fissa var. *fissa* Mack.	Cyperaceae	OBL	N	8
Carex flaccosperma Dewey	Cyperaceae	FACW	N	8
Carex frankii Kunth	Cyperaceae	OBL	N	5
Carex gigantea Rudge	Cyperaceae	OBL	N	6
Carex granularis Muhl. ex Willd.	Cyperaceae	OBL	N	5
Carex grayi Carey	Cyperaceae	FACW	N	8

Carex hyalina Boott	Cyperaceae	FACW	N	8
Carex hyalinolepis Steud.	Cyperaceae	OBL	N	5
Carex hystericina Muhl. ex Willd.	Cyperaceae	OBL	N	7
Carex intumescens Rudge	Cyperaceae	OBL	N	8
Carex joorii L.H. Bailey	Cyperaceae	OBL	N	8
Carex leptalea Wahlenb.	Cyperaceae	OBL	N	10
Carex longii Mack.	Cyperaceae	OBL	N	7
Carex louisianica L.H. Bailey	Cyperaceae	OBL	N	7
Carex lupuliformis Sartwell ex Dewey	Cyperaceae	OBL	N	8
Carex lupulina Muhl. ex Willd.	Cyperaceae	OBL	N	6
Carex lurida Wahlenb.	Cyperaceae	OBL	N	6
Carex meadii Dewey	Cyperaceae	FACW	N	7
Carex microdonta Torr. & Hook.	Cyperaceae	OBL	N	7
Carex muskingumensis Schwein.	Cyperaceae	OBL	N	8
Carex normalis Mack.	Cyperaceae	OBL	N	6
Carex oklahomensis Mack.	Cyperaceae	FACW+	N	9
Carex oxylepis Torr. & Hook.	Cyperaceae	OBL	N	9
Carex pellita Muhl. ex Willd.	Cyperaceae	OBL	N	6
Carex praegracilis W. Boott	Cyperaceae	FACW	N	3
Carex reniformis (L.H. Bailey) Small	Cyperaceae	OBL	N	6
Carex shortiana Dewey	Cyperaceae	FACW+	N	6
Carex squarrosa L.	Cyperaceae	OBL	N	7
Carex stipata Muhl. ex Willd.	Cyperaceae	OBL	N	5
Carex stipata var. *stipata* Muhl. ex Willd.	Cyperaceae	OBL	N	5
Carex stricta Lam.	Cyperaceae	OBL	N	6
Carex tetrastachya Scheele	Cyperaceae	FACW	N	5
Carex triangularis Boeckeler	Cyperaceae	OBL	N	6
Carex tribuloides Wahlenb.	Cyperaceae	OBL	N	4

Carex tribuloides var. *sangamonensis* Wahlenb. Clokey	Cyperaceae	OBL	N	4
Carex vulpinoidea Michx.	Cyperaceae	OBL	N	3
Carya aquatica (Michx. f.) Nutt	Juglandaceae	OBL	N	9
Carya myristiciformis (Michx. f.) Nutt	Juglandaceae	FACW-	N	6
Cephalanthus occidentalis L.	Rubiaceae	OBL	N	4
Ceratophyllum demersum L.	Ceratophyllaceae	OBL	N	5
Chloracantha spinosa (Benth.) G.L. Nesom	Asteraceae	FACW-	N	4
Cicuta maculata L.	Apiaceae	OBL	N	4
Cinna arundinacea L.	Poaceae	FACW	N	5
Cirsium muticum Michx.	Asteraceae	FACW+	N	9
Commelina diffusa Burm. f.	Commelinaceae	FACW	N	4
Conium maculatum L.	Apiaceae	FACW	I	0
Conoclinium coelestinum (L.) DC.	Asteraceae	FACW-	N	4
Cornus amomum Mill.	Cornaceae	FACW	N	6
Cornus foemina Mill.	Cornaceae	FACW	N	6
Crataegus brachyacantha Sarg. & Engelm.	Rosaceae	FACW	N	4
Cressa truxillensis Kunth	Convolvulaceae	FACW-	N	7
Cynosciadium digitatum DC.	Apiaceae	FACW	N	6
Cyperus acuminatus Torr. & Hook. ex Torr.	Cyperaceae	OBL	N	3
Cyperus bipartitus Torr.	Cyperaceae	FACW	N	5
Cyperus compressus L.	Cyperaceae	FACW	N	2
Cyperus erythrorhizos Muhl.	Cyperaceae	OBL	N	3
Cyperus esculentus L.	Cyperaceae	FACW	N	3
Cyperus esculentus var. *leptostachyus* L. Boeckeler	Cyperaceae	FACW	N	3
Cyperus flavescens L.	Cyperaceae	OBL	N	4
*Cyperus iria** L.	Cyperaceae	FACW	I	0
Cyperus niger Ruiz & Pav.	Cyperaceae	FACW	N	3
Cyperus odoratus L.	Cyperaceae	FACW	N	3

Cyperus polystachyos Rottb.	Cyperaceae	FACW	N	8
Cyperus polystachyos var. *texensis* Rottb. (Torr.) Fernald	Cyperaceae	FACW	N	8
Cyperus pseudovegetus Steud.	Cyperaceae	FACW	N	6
Cyperus squarrosus L.	Cyperaceae	OBL	N	4
Cyperus strigosus L.	Cyperaceae	FACW	N	4
Cyperus surinamensis Rottb.	Cyperaceae	FACW	N	3
Cyperus virens Michx.	Cyperaceae	FACW	N	5
Cypripedium parviflorum Salisb.	Orchidaceae	FACW-	N	9
Cystopteris bulbifera (L.) Bernh.	Dryopteridaceae	FACW	N	7
Dichanthelium scoparium (Lam.) Gould	Poaceae	FACW-	N	7
Dichondra micrantha Urb.	Convolvulaceae	FACW-	N	2
Dicliptera brachiata (Pursh) Spreng.	Acanthaceae	FACW	N	6
Didiplis diandra (Nutt. ex DC.) Alph. Wood	Lythraceae	OBL	N	7
Diodia virginiana L.	Rubiaceae	OBL	N	4
Distichlis spicata (L.) Greene	Poaceae	FACW+	N	4
Doellingeria umbellata var. *umbellata* (Mill.) Nees	Asteraceae	OBL	N	6
Drosera brevifolia Pursh	Droseraceae	OBL	N	7
Dulichium arundinaceum (L.) Britton	Cyperaceae	OBL	N	8
Echinochloa colona (L.) Link	Poaceae	FACW	I	0
Echinochloa crus-galli (L.) Beauv.	Poaceae	FACW-	I	0
Echinochloa crus-pavonis var. *macera* (Kunth) Schult. (Wiegand) Gould	Poaceae	OBL	N	0
Echinochloa crus-pavonis (Kunth) J.A. Schultes	Poaceae	OBL	I	0
Echinochloa muricata var. *microstachya* (P. Beauv.) Fernald Wiegand	Poaceae	FACW	N	0
Echinochloa muricata var. *muricata* (P. Beauv.) Fernald	Poaceae	FACW	N	0
Echinochloa muricata (P. Beauv.) Fernald	Poaceae	FACW	I	0
Echinochloa walteri (Pursh) A. Heller	Poaceae	OBL	N	4
Echinodorus berteroi (Spreng.) Fassett	Alismataceae	OBL	N	8
Echinodorus cordifolius (L.) Griseb.	Alismataceae	OBL	N	8

Echinodorus tenellus (Mart. ex Schult. f.) Buchenau	Alismataceae	OBL	N	10
Eclipta prostrata (L.) L.	Asteraceae	FACW	N	3
Egeria densa Planch.	Hydrocharitaceae	OBL	I	0
Eichhornia crassipes (Mart.) Solms	Pontederiaceae	OBL	I	0
Elatine americana (Pursh) Arn.	Elatinaceae	OBL	N	3
Elatine brachysperma A. Gray	Elatinaceae	FACW	N	3
Eleocharis acicularis (L.) Roem. & Schult.	Cyperaceae	OBL	N	5
Eleocharis acicularis var. *acicularis* (L.) Roem. & Schult.	Cyperaceae	OBL	N	5
Eleocharis albida Torr.	Cyperaceae	OBL	N	5
Eleocharis atropurpurea (Retz.) J. Presl & C. Presl	Cyperaceae	FACW	N	10
Eleocharis compressa Sull.	Cyperaceae	FACW	N	6
Eleocharis compressa var. *acutisquamata* Sull. (Buckley) S.G. Sm.	Cyperaceae	OBL	N	6
Eleocharis engelmannii Steud.	Cyperaceae	FACW	N	5
Eleocharis erythropoda Steud.	Cyperaceae	OBL	N	4
Eleocharis geniculata (L.) Roem. & Schult.	Cyperaceae	FACW+	N	10
Eleocharis lanceolata Fernald	Cyperaceae	FACW	N	7
Eleocharis macrostachaya Britton	Cyperaceae	OBL	N	6
Eleocharis montevidensis Kunth	Cyperaceae	FACW+	N	6
Eleocharis obtusa (Willd.) Schult.	Cyperaceae	OBL	N	4
Eleocharis palustris (L.) Roem. & Schult.	Cyperaceae	OBL	N	7
Eleocharis palustris var. *palustris* (L.) Roem. & Schult.	Cyperaceae	OBL	N	7
Eleocharis parvula (Roem. & Schult.) Link ex Bluff, Nees & Schauer	Cyperaceae	OBL	N	8
Eleocharis quadrangulata (Michx.) Roem. & Schult	Cyperaceae	OBL	N	7
Eleocharis radicans (A. Dietr.) Kunth	Cyperaceae	OBL	N	6
Eleocharis rostellata (Torr.) Torr.	Cyperaceae	OBL	N	8
Eleocharis tenuis (Willd.) Schult.	Cyperaceae	FACW	N	6
Eleocharis tenuis var. *verrucosa* (Willd.) Schult. (Svens.) Svens.	Cyperaceae	FACW	N	6
Eleocharis tortilis (Link) Schult.	Cyperaceae	FACW	N	7

Eleocharis wolfii (A. Gray) A. Gray ex Britton	Cyperaceae	OBL	N	9
Elodea canadensis Michx.	Hydrocharitaceae	OBL	N	8
Elodea nuttallii (Planch.) H. St. John	Hydrocharitaceae	OBL	N	8
Epilobium coloratum Biehler	Onagraceae	OBL	N	4
Epipactis gigantea Douglas ex Hook.	Orchidaceae	OBL	N	9
Equisetum hyemale L.	Equisetaceae	FACW	N	3
Equisetum hyemale L. var. *affine* (Engelm.) A.A. Eaton	Equisetaceae	FACW	N	3
Equisetum laevigatum A. Braun	Equisetaceae	FACW	N	3
Equisetum x ferrissii Clute [hyemale x laevigatum]	Equisetaceae	FACW	N	hybrid
Eragrostis frankii C.A. Mey. ex Steud.	Poaceae	FACW	N	6
Eragrostis hypnoides (Lam.) Britton, Sterns & Poggenb.	Poaceae	OBL	N	5
Eragrostis japonica (Thunb.) Trin.	Poaceae	OBL	I	0
Eriocaulon decangulare L.	Eriocaulaceae	OBL	N	8
Eriocaulon koernickianum van Heurck & Müll. Arg.	Eriocaulaceae	OBL	N	10
Eryngium hookeri Walp.	Apiaceae	FACW*	N	8
Eryngium integrifolium Walter	Apiaceae	FACW+	N	10
Eryngium prostratum Nutt. ex DC.	Apiaceae	FACW+	N	6
Eryngium yuccifolium Michx.	Apiaceae	FACW	N	8
Eryngium yuccifolium Michx. var. *synchaetum* A. Gray ex J.M. Coult. & Rose	Apiaceae	FACW	N	8
Euonymus americanus L.	Celastraceae	FACW	N	8
Eupatoriadelphus fistulosus (Barratt) King & H. Rob	Asteraceae	FACW	N	5
Eupatorium perfoliatum L.	Asteraceae	FACW+	N	5
Eustoma exaltatum (L.) Salisb. ex G. Don	Gentianaceae	FACW	N	6
Euthamia graminifolia (L.) Nutt.	Asteraceae	FACW	N	4
Fimbristylis autumnalis (L.) Roem. & Schult.	Cyperaceae	OBL	N	6
Fimbristylis dichotoma (L.) Vahl	Cyperaceae	FACW+	N	6
Fimbristylis puberula (Michx.) Vahl	Cyperaceae	FACW*	N	4

Fimbristylis puberula (Michx.) Vahl var. *interior* (Britton) Kral	Cyperaceae	FACW*	N	4
Fimbristylis puberula (Michx.) Vahl var. *puberula*	Cyperaceae	FACW*	N	4
Fimbristylis vahlii (Lam.) Link	Cyperaceae	FACW*	N	6
Forestiera acuminata (Michx.) Poir.	Oleaceae	OBL	N	7
Fraxinus pennsylvanica Marsh.	Oleaceae	FACW-	N	3
Fuirena simplex Vahl	Cyperaceae	OBL	N	6
Fuirena simplex Vahl var. *aristulata* (Torr.) Kral	Cyperaceae	OBL	N	6
Fuirena simplex Vahl var. *simplex*	Cyperaceae	OBL	N	6
Fuirena squarrosa Michx.	Cyperaceae	OBL	N	6
Galium obtusum Bigelow	Rubiaceae	OBL	N	5
Galium obtusum Bigelow ssp. *obtusum*	Rubiaceae	OBL	N	5
Galium tinctorium (L.) Scop.	Rubiaceae	OBL	N	6
Gentiana saponaria L.	Gentianaceae	FACW-	N	8
*Glinus lotoides** L.	Molluginaceae	FACW-	I	0
Glinus radiatus (Ruiz & Pav.) Rohrb.	Molluginaceae	FACW-	N	5
Glyceria septentrionalis Hitchc.	Poaceae	OBL	N	8
Glyceria striata Hitchc.	Poaceae	OBL	N	6
Gratiola brevifolia Raf.	Scrophulariaceae	FACW+	N	5
Gratiola neglecta Torr.	Scrophulariaceae	OBL	N	5
Gratiola pilosa Michx.	Scrophulariaceae	FACW+	N	5
Gratiola virginiana L.	Scrophulariaceae	OBL	N	5
Habenaria repens Nutt.	Orchidaceae	OBL	N	9
Helenium autumnale L.	Asteraceae	FACW-	N	5
Helenium autumnale L. var. *autumnale*	Asteraceae	FACW-	N	5
Helenium flexuosum Raf.	Asteraceae	FACW	N	6
Helenium microcephalum DC.	Asteraceae	FACW-	N	6
Helianthus nuttallii Torr. & A. Gray	Asteraceae	FACW*	N	3
Heliotropium curassavicum L.	Boraginaceae	FACW	N	5

*Heliotropium indicum** L.	Boraginaceae	FACW	I	0
Heliotropium procumbens Mill.	Boraginaceae	FACW-	N	3
Heteranthera dubia (Jacq.) MacMill.	Pontederiaceae	OBL	N	7
Heteranthera limosa (Sw.) Willd.	Pontederiaceae	OBL	N	7
Heteranthera reniformis Ruiz & Pav.	Pontederiaceae	OBL	N	7
Hibiscus laevis All.	Malvaceae	OBL	N	4
Hibiscus moscheutos L.	Malvaceae	OBL	N	4
Hottonia inflata Elliott	Primulaceae	OBL	N	9
Hydrocotyle ranunculoides L. f.	Apiaceae	OBL	N	4
Hydrocotyle umbellata L.	Apiaceae	OBL	N	6
Hydrocotyle verticillata Thunb.	Apiaceae	OBL	N	6
Hydrocotyle verticillata Thunb. var. *verticillata*	Apiaceae	OBL	N	6
Hydrolea ovata Nutt. ex Choisy	Hydrophyllaceae	OBL	N	8
Hydrolea uniflora Raf.	Hydrophyllaceae	OBL	N	8
Hydrophyllum virginianum L.	Hydrophyllaceae	FACW*	N	5
Hymenocallis caroliniana (L.) Herbert	Liliaceae	FACW	N	7
Hymenocallis liriosome (Raf.) Shinners	Liliaceae	OBL	N	7
Hypericum densiflorum Pursh	Clusiaceae	FACW-	N	8
Hypericum gymnanthum Engelm. ex A. Gray	Clusiaceae	FACW+	N	8
Hypericum mutilum L.	Clusiaceae	FACW	N	4
Hypoxis hirsuta (L.) Coville	Liliaceae	FACW	N	4
Ilex decidua Walter	Aquifoliaceae	FACW-	N	5
Impatiens capensis Meerb.	Balsaminaceae	FACW	N	5
Impatiens pallida Nutt.	Balsaminaceae	FACW	N	5
Iodanthus pinnatifidus (Michx.) Steud.	Brassicaceae	FACW-	N	6
Ipomoea lacunosa L.	Convolvulaceae	FACW	N	2
Ipomoea wrightii A. Gray	Convolvulaceae	FACW-	I	0
Iresine rhizomatosa Standl.	Amaranthaceae	FACW	N	4

Iris brevicaulis Raf.	Iridaceae	OBL	N	8
Iris virginica L.	Iridaceae	OBL	N	8
Iris virginica L. var. *shrevei* (Small) E.S. Anderson	Iridaceae	OBL	N	8
Isoetes butleri Engelm.	Isoetaceae	OBL	N	8
Isoetes melanopoda Gay & Durieu ex Durieu	Isoetaceae	OBL	N	8
Itea virginica L.	Grossulariaceae	OBL	N	9
Juncus acuminatus Michx.	Juncaceae	OBL	N	5
Juncus biflorus Elliott	Juncaceae	FACW	N	6
Juncus brachycarpus Engelm.	Juncaceae	FACW	N	6
Juncus bufonius L.	Juncaceae	OBL	N	4
Juncus bufonius L. var. *bufonius*	Juncaceae	OBL	N	4
Juncus coriaceus Mack.	Juncaceae	OBL	N	5
Juncus debilis A. Gray	Juncaceae	FACW*	N	6
Juncus dichotomus Elliott	Juncaceae	FACW	N	5
Juncus diffusissimus Buckley	Juncaceae	FACW	N	5
Juncus effusus L.	Juncaceae	OBL	N	5
Juncus effusus L. var. *solutus* Fernald & Wiegand	Juncaceae	OBL	N	5
Juncus marginatus Rostk.	Juncaceae	FACW	N	4
Juncus nodatus Coville	Juncaceae	OBL	N	5
Juncus nodosus L.	Juncaceae	OBL	N	6
Juncus polycephalus Michx.	Juncaceae	OBL	N	4
Juncus repens Michx.	Juncaceae	OBL	N	8
Juncus scirpoides Lam.	Juncaceae	FACW	N	7
Juncus torreyi Coville	Juncaceae	FACW	N	6
Juncus validus Coville	Juncaceae	FACW	N	7
Juncus validus Coville var. *validus*	Juncaceae	FACW	N	7
Justicia americana (L.) Vahl	Acanthaceae	OBL	N	5
Justicia ovata (Walter) Lindau	Acanthaceae	OBL	N	8

Justicia ovata (Walter) Lindau var. *lanceolata* (Chapm.) R.W. Long	Acanthaceae	OBL	N	8
Kyllinga brevifolia Rottb.	Cyperaceae	FACW	N	6
Kyllinga odorata Vahl	Cyperaceae	FACW-	N	4
Kyllinga pumila Michx.	Cyperaceae	FACW	N	4
Leersia lenticularis Michx.	Poaceae	OBL	N	7
Leersia oryzoides (L.) Sw.	Poaceae	OBL	N	4
Leersia virginica Willd.	Poaceae	FACW	N	4
Lemna aequinoctialis Welw.	Lemnaceae	OBL	N	5
Lemna minor L.	Lemnaceae	OBL	N	5
Lemna minuta Kunth	Lemnaceae	OBL	N	5
Lemna obscura (Austin) Daubs	Lemnaceae	OBL	N	7
Lemna perpusilla Torr.	Lemnaceae	OBL	N	7
Lemna valdiviana Phil.	Lemnaceae	OBL	N	7
Leptochloa fusca (L.) Kunth	Poaceae	FACW	N	3
Leptochloa fusca (L.) Kunth ssp. *fascicularis* (Lam.) N. Snow	Poaceae	FACW	N	3
Leptochloa panicea (Retz.) Ohwi ssp. *brachiata* (Steud.) N. Snow	Poaceae	FACW	N	3
Lepuropetalon spathulatum Elliott	Saxifragaceae	FACW	N	4
Lesquerella gracilis (Hook.) S. Watson	Brassicaceae	FACW*	N	5
Lesquerella gracilis (Hook.) S. Watson ssp. *gracilis*	Brassicaceae	FACW*	N	5
Lesquerella gracilis (Hook.) S. Watson ssp. *nuttallii* (Torr. & A. Gray) Rollins & Shaw	Brassicaceae	FACW*	N	5
Leucospora multifida (Michx.) Nutt.	Scrophulariaceae	FACW+	N	0
Limnobium spongia (Bosc) Rich. ex Steud.	Hydrocharitaceae	OBL	N	9
Limnosciadium pinnatum (DC.) Mathias & Constance	Apiaceae	FACW*	N	6
Limonium limbatum Small	Plumbaginaceae	FACW+	N	6
Lindera benzoin (L.) Blume	Scrophulariaceae	FACW-	N	7
Lindera benzoin (L.) Blume var. *benzoin*	Scrophulariaceae	FACW-	N	7
Lindera benzoin (L.) Blume var. *pubescens* (Palmer & Steyerm.) Rehder	Scrophulariaceae	FACW-	N	7

Lindernia dubia (L.) Pennell	Scrophulariaceae	OBL	N	4
Lindernia dubia (L.) Pennell var. *anagallidea* (Michx.) Cooperr.	Scrophulariaceae	OBL	N	4
Lindernia dubia (L.) Pennell var. *dubia*	Scrophulariaceae	OBL	N	4
Linum striatum Walter	Linaceae	FACW+	N	5
Lipocarpha aristulata (Coville) G. Tucker	Cyperaceae	FACW+	N	6
Lipocarpha drummondii (Nees) G. Tucker	Cyperaceae	FACW+	N	6
Lipocarpha micrantha (Vahl) G. Tucker	Cyperaceae	FACW+	N	6
Listera australis Lindl.	Orchidaceae	FACW	N	7
Lobelia cardinalis L.	Campanulaceae	FACW+	N	6
Lobelia puberula Michx.	Campanulaceae	FACW	N	8
Lobelia puberula Michx. var. *mineolana* E. Wimm.	Campanulaceae	FACW	N	8
Lobelia siphilitica L.	Campanulaceae	OBL	N	6
Lobelia siphilitica L. var. *ludoviciana* A. DC.	Campanulaceae	OBL	N	6
Ludwigia alternifolia L.	Onagraceae	OBL	N	5
Ludwigia decurrens Walter	Onagraceae	OBL	N	5
Ludwigia glandulosa Walter	Onagraceae	OBL	N	5
Ludwigia glandulosa Walter ssp. *brachycarpa* (Torr. & A. Gray) Peng	Onagraceae	OBL	N	5
Ludwigia glandulosa Walter ssp. *glandulosa*	Onagraceae	OBL	N	5
Ludwigia grandiflora (Michx. Greuter & Burdet) ssp. *grandiflora*	Onagraceae	OBL	N	5
Ludwigia hirtella Raf.	Onagraceae	OBL	N	5
Ludwigia leptocarpa (Nutt.) H. Hara	Onagraceae	OBL	N	6
Ludwigia linearis Walter	Onagraceae	OBL	N	6
Ludwigia palustris (L.) Elliott	Onagraceae	OBL	N	5
Ludwigia peploides (Kunth) P.H. Raven	Onagraceae	OBL	N	6
Ludwigia peploides (Kunth) P.H. Raven ssp. *glabrescens* (Kuntze) P.H. Raven	Onagraceae	OBL	N	6
Ludwigia peploides (Kunth) P.H. Raven ssp. *peploides*	Onagraceae	OBL	N	6
Ludwigia repens J.R. Frost	Onagraceae	OBL	N	6

Lycopodiella appressa (Chapm.) Cranfill	Lycopodiaceae	OBL*	N	8
Lycopus americanus Muhl. ex W. Bartram	Lamiaceae	OBL	N	4
Lycopus rubellus Moench	Lamiaceae	OBL	N	6
Lycopus uniflorus Michx.	Lamiaceae	OBL	N	6
Lycopus virginicus L.	Lamiaceae	OBL	N	5
Lyonia ligustrina (L.) DC.	Ericaceae	FACW	N	7
Lyonia ligustrina (L.) DC. var. *foliosiflora* (Michx.) Fernald	Ericaceae	FACW	N	7
Lysimachia ciliata L.	Primulaceae	FACW	N	7
Lysimachia radicans Hook.	Primulaceae	FACW+	N	6
Lythrum alatum Pursh	Lythraceae	OBL	N	6
Lythrum alatum Pursh var. *alatum*	Lythraceae	OBL	N	6
Lythrum alatum Pursh var. *lanceolatum* (Elliott) Torr. & A. Gray ex Rothr.	Lythraceae	OBL	N	6
Lythrum californicum Torr. & A. Gray	Lythraceae	OBL	N	6
Marrubium vulgare L.	Lamiaceae	FACW-	I	0
Marsilea vestita Hook. & Grev.	Marsileaceae	OBL	N	4
Mecardonia acuminata (Walter) Small	Scrophulariaceae	FACW+	N	8
Mecardonia acuminata (Walter) Small var. *acuminata*	Scrophulariaceae	FACW+	N	8
Mentha arvensis L.	Lamiaceae	FACW	I	0
Mentha spicata L.	Lamiaceae	FACW	I	0
Mentha x *piperita* L. (pro sp.) [aquatica x spicata]	Lamiaceae	FACW+	I	hybrid
Mikania scandens (L.) Willd.	Asteraceae	FACW+	N	5
Mimulus alatus Aiton	Scrophulariaceae	OBL	N	5
Mimulus glabratus Kunth	Scrophulariaceae	OBL	N	6
Mimulus glabratus Kunth var. *jamesii* (Torr. & A. Gray ex Benth.) A. Gray	Scrophulariaceae	OBL	N	6
Mimulus glabratus Kunth var. *oklahomensis* Fassett	Scrophulariaceae	OBL	N	6
Mimulus ringens L.	Scrophulariaceae	OBL	N	6
Mitreola petiolata (J.F. Gmel.) Torr. & A. Gray	Loganiaceae	FACW+	N	7

Mitreola sessilifolia (J.F. Gmel.) G. Don	Loganiaceae	FACW+	N	7
Muhlenbergia asperifolia (Nees & Meyen ex Trin.) Parodi	Poaceae	FACW	N	4
Muhlenbergia frondosa (Poir.) Fernald	Poaceae	FACW	N	3
Muhlenbergia mexicana (L.) Trin.	Poaceae	FACW	N	6
Muhlenbergia racemosa (Michx.) Britton, Sterns & Poggenb.	Poaceae	FACW	N	5
Muhlenbergia sylvatica (Torr.) Torr. ex A. Gray	Poaceae	FACW-	N	6
Myosurus minimus L.	Ranunculaceae	FACW+	N	4
Myriophyllum aquaticum (Vell.) Verdc.	Haloragaceae	OBL	I	0
Myriophyllum heterophyllum Michx.	Haloragaceae	OBL	N	8
Myriophyllum pinnatum (Walter) Brittton, Sterns & Poggenb.	Haloragaceae	OBL	N	6
*Myriophyllum spicatum** L.	Haloragaceae	OBL	I	0
Najas guadalupensis (Spreng.) Magnus	Najadaceae	OBL	N	8
Najas marina L.	Najadaceae	OBL	N	8
*Nasturtium officinale** W.T. Aiton	Brassicaceae	OBL	I	0
Neeragrostis reptans (Michx.) Nicora	Poaceae	OBL	N	6
Nelumbo lutea Willd.	Nelumbonaceae	OBL	N	6
Neobeckia aquatica (Eaton) Greene	Brassicaceae	OBL	N	9
Nuphar lutea (L.) Sm.	Nymphaeaceae	OBL	N	6
Nuphar lutea (L.) Sm. ssp. *advena* (Aiton) Kartesz & Gandhi	Nymphaeaceae	OBL	N	6
Nymphaea odorata Aiton	Nymphaeaceae	OBL	N	7
Nymphaea odorata Aiton *ssp. tuberosa* (Paine) Wiersma & Hellquist	Nymphaeaceae	OBL	N	7
Nymphoides peltata (S.G. Gmel.) Kuntze	Menyanthaceae	OBL	I	0
Oenothera elata Kunth ssp. *hirsutissima* (A. Gray ex S. Watson) W. Dietr.	Onagraceae	FACW	N	4
Oenothera jamesii Torr. & A. Gray	Onagraceae	FACW+	N	4
Oldenlandia boscii (DC.) Chapm.	Rubiaceae	FACW	N	6
Oldenlandia uniflora L.	Rubiaceae	FACW	N	8
Onoclea sensibilis L.	Dryopteridaceae	FACW	N	9
Ophioglossum vulgatum L.	Ophioglossaceae	FACW-	N	5

Osmorhiza longistylis (Torr.) DC.	Apiaceae	FACW	N	5
Osmunda cinnamomea L.	Osmundaceae	FACW	N	8
Osmunda regalis L.	Osmundaceae	OBL	N	8
Osmunda regalis L. var. *spectabilis* (Willd.) A. Gray	Osmundaceae	OBL	N	8
Oxypolis rigidior (L.) Raf.	Apiaceae	OBL	N	7
Packera glabella (Poir.) C. Jeffrey	Asteraceae	FACW	N	3
Panicum dichotomiflorum Michx.	Poaceae	FACW	N	0
Panicum dichotomiflorum Michx. var. *dichotomiflorum*	Poaceae	FACW	N	1
Panicum flexile (Gattinger) Scribn.	Poaceae	FACW-	N	3
Panicum rigidulum Bosc ex Nees	Poaceae	FACW	N	6
Panicum rigidulum Bosc ex Nees var. *rigidulum*	Poaceae	FACW	N	6
Panicum verrucosum Muhl.	Poaceae	FACW-	N	5
Panicum virgatum L.	Poaceae	FACW	N	4
Panicum virgatum L. var. *virgatum*	Poaceae	FACW	N	3
Parnassia grandifolia DC.	Saxifragaceae	OBL	N	10
Paspalidium geminatum (Forssk.) Stapf	Poaceae	OBL	N	7
Paspalidium geminatum (Forssk.) Stapf var. *geminatum*	Poaceae	OBL	N	7
Paspalum dissectum (L.) L.	Poaceae	OBL	N	7
Paspalum distichum L.	Poaceae	FACW+	N	7
Paspalum floridanum Michx.	Poaceae	FACW-	N	5
Paspalum fluitans (Elliott) Kunth	Poaceae	OBL	N	5
Paspalum laeve Michx.	Poaceae	FACW-	N	2
Paspalum pubilflorum Rupr. ex Fourn.	Poaceae	FACW	N	4
Peltandra virginica (L.) Schott	Araceae	OBL	N	10
Penstemon digitalis Nutt. ex Sims	Scrophulariaceae	FACW-	N	4
Penthorum sedoides L.	Crassulaceae	OBL	N	5
Phalaris arundinacea L.	Poaceae	FACW+	N	0
Phalaris caroliniana Walter	Poaceae	FACW	N	1

Phanopyrum gymnocarpon (Elliott) Nash	Poaceae	OBL	N	8
Phragmites australis (Cav.) Trin. ex Steud.	Poaceae	FACW	N	3
Phyla lanceolata (Michx.) Greene	Verbenaceae	FACW	N	3
Phyla nodiflora (L.) Greene	Verbenaceae	FACW	N	3
Physostegia angustifolia Fernald	Lamiaceae	FACW	N	6
Physostegia intermedia (Nutt.) Engelm. & A. Gray	Lamiaceae	OBL	N	7
Physostegia virginiana (L.) Benth.	Lamiaceae	FACW*	N	6
Physostegia virginiana (L.) Benth. ssp. *virginiana*	Lamiaceae	FACW*	N	6
Pilularia americana A. Braun	Marsileaceae	OBL	N	8
Pinguicula pumila Michx.	Lentibulariaceae	OBL	N	9
Planera aquatica J.F. Gmel.	Ulmaceae	OBL	N	8
Plantago elongata Pursh	Plantaginaceae	FACW-	N	1
Plantago heterophylla Nutt.	Plantaginaceae	FACW-	N	2
Platanthera ciliaris (L.) Lindl.	Orchidaceae	FACW	N	8
Platanthera clavellata (Michx.) Luer	Orchidaceae	OBL	N	8
Platanthera flava (L.) Lindl.	Orchidaceae	FACW	N	8
Platanthera flava (L.) Lindl. var. *flava*	Orchidaceae	FACW	N	8
Platanthera lacera (Michx.) G. Don	Orchidaceae	FACW	N	8
Pluchea camphorata (L.) DC.	Asteraceae	FACW-	N	4
Podostemum ceratophyllum Michx.	Podostemaceae	OBL	N	9
Pogonia ophioglossoides (L.) Ker Gawl.	Orchidaceae	OBL	N	9
Polygala cruciata L.	Polygalaceae	OBL	N	6
Polygala sanguinea L.	Polygalaceae	FACW	N	6
Polygonum amphibium L.	Polygonaceae	OBL	N	7
Polygonum amphibium L. var. *emersum* Michx.	Polygonaceae	OBL	N	7
Polygonum hydropiper L.	Polygonaceae	OBL	I	0
Polygonum hydropiperoides Michx.	Polygonaceae	OBL	N	4
Polygonum lapathifolium L.	Polygonaceae	FACW-	N	4

Polygonum orientale L.	Polygonaceae	FACW	I	0
Polygonum pensylvanicum L.	Polygonaceae	FACW-	N	2
Polygonum persicaria L.	Polygonaceae	FACW+	I	0
Polygonum punctatum Elliott	Polygonaceae	FACW	N	4
Polygonum punctatum Elliott var. *punctatum*	Polygonaceae	FACW	N	4
Polygonum ramosissimum Michx.	Polygonaceae	FACW	N	1
Polygonum ramosissimum Michx. var. *prolificum* Small	Polygonaceae	FACW	N	1
Polygonum ramosissimum Michx. var. *ramosissimum*	Polygonaceae	FACW	N	1
Polygonum sagittatum L.	Polygonaceae	OBL	N	4
Polygonum scandens L.	Polygonaceae	FACW	N	4
Polygonum scandens L. var. *cristatum* (Engelm. & A. Gray) Gleason	Polygonaceae	FACW	N	4
Polygonum scandens L. var. *scandens*	Polygonaceae	FACW	N	4
Polygonum setaceum Baldw.	Polygonaceae	OBL	N	5
Polygonum striatulum B.L. Rob.	Polygonaceae	FACW-	N	4
Polypogon monspeliensis (L.) Desf.	Poaceae	FACW+	I	0
Pontederia cordata L.	Pontederiaceae	OBL	N	7
Potamogeton amplifolius Tuck.	Potamogetonaceae	OBL	N	8
Potamogeton crispus L.	Potamogetonaceae	OBL	I	0
Potamogeton diversifolius Raf.	Potamogetonaceae	OBL	N	6
Potamogeton foliosus Raf.	Potamogetonaceae	OBL	N	5
Potamogeton illinoensis Morong	Potamogetonaceae	OBL	N	9
Potamogeton natans L.	Potamogetonaceae	OBL	N	9
Potamogeton nodosus Poir.	Potamogetonaceae	OBL	N	6
Potamogeton pulcher Tuck.	Potamogetonaceae	OBL	N	10
Potamogeton pusillis L.	Potamogetonaceae	OBL	N	5
Potamogeton pusillus L. ssp. *tenuissimus* (Mert. & W.D.J. Koch) Haynes & C.B. Hellquist	Potamogetonaceae	OBL	N	5
Potentilla paradoxa Nutt.	Rosaceae	FACW+	N	3

Potentilla rivalis Nutt.	Rosaceae	FACW+	N	3
Proserpinaca palustris L.	Haloragaceae	OBL	N	9
Proserpinaca palustris L. var. *crebra* Fernald & Grisc.	Haloragaceae	OBL	N	9
Ptilimnium capillaceum (Michx.) Raf.	Apiaceae	FACW	N	4
Ptilimnium costatum (Elliott) Raf.	Apiaceae	OBL	N	4
Ptilimnium nuttallii (DC.) Britton	Apiaceae	FACW	N	4
Quercus lyrata Walter	Fagaceae	OBL	N	7
Quercus phellos L.	Fagaceae	FACW	N	4
Quercus texana Buckley	Fagaceae	FACW	N	6
Ranunculus cymbalaria Pursh	Ranunculaceae	OBL	N	6
Ranunculus flabellaris Raf.	Ranunculaceae	OBL	N	8
Ranunculus laxicaulis (Torr. & A. Gray) Darby	Ranunculaceae	OBL	N	7
Ranunculus longirostris Godr.	Ranunculaceae	OBL	N	9
Ranunculus macranthus Scheele	Ranunculaceae	FACW+	N	6
Ranunculus muricatus L.	Ranunculaceae	FACW-	I	0
Ranunculus pusillus Poir.	Ranunculaceae	OBL	N	6
Ranunculus recurvatus Poir.	Ranunculaceae	FACW+	N	5
Ranunculus recurvatus Poir. var. *recurvatus*	Ranunculaceae	FACW+	N	5
Ranunculus sceleratus L.	Ranunculaceae	OBL	N	3
Ranunculus sceleratus L. var. *sceleratus*	Ranunculaceae	OBL	N	3
Rhexia mariana L.	Melastomataceae	FACW+	N	7
Rhexia mariana L. var. *mariana*	Melastomataceae	FACW+	N	7
Rhexia virginica L.	Melastomataceae	OBL	N	7
Rhododendron canescens (Michx.) Sweet	Ericaceae	FACW-	N	7
Rhododendron oblongifolium (Small) Millais	Ericaceae	FACW+	N	7
Rhynchospora caduca Elliott	Cyperaceae	OBL	N	6
Rhynchospora capillacea Torr.	Cyperaceae	OBL	N	8
Rhynchospora capitellata (Michx.) Vahl	Cyperaceae	OBL	N	7

Rhynchospora corniculata (Lam.) A. Gray	Cyperaceae	OBL	N	7
Rhynchospora globularis (Chapm.) Small	Cyperaceae	FACW	N	6
Rhynchospora glomerata (L.) Vahl	Cyperaceae	OBL	N	8
Rhynchospora macrostachya Torr. ex A. Gray	Cyperaceae	OBL	N	6
Rhynchospora nivea Boeckeler	Cyperaceae	FACW+	N	6
Rorippa palustris (L.) Besser	Brassicaceae	OBL	N	3
Rorippa palustris (L.) Besser ssp. *fernaldiana* (Butters & Abbe) Jonsell	Brassicaceae	OBL	N	3
Rorippa sessilifloria (Nutt.) Hitchc.	Brassicaceae	FACW+	N	3
Rorippa sinuata (Nutt.) Hitchc.	Brassicaceae	FACW-	N	3
Rorippa teres (Michx.) R. Stuckey	Brassicaceae	OBL	N	1
Rotala ramosior (L.) Koehne	Lythraceae	OBL	N	4
Rumex acetosella L.	Polygonaceae	FACW-	I	0
Rumex altissimus Alph. Wood	Polygonaceae	FACW+	N	0
Rumex crispus L. ssp. *crispus*	Polygonaceae	FACW	N	0
Rumex crispus L.	Polygonaceae	FACW	I	0
Rumex maritimus L.	Polygonaceae	FACW-	N	5
Rumex obtusifolius L.	Polygonaceae	FACW-	I	0
Rumex pulcher L.	Polygonaceae	FACW-	I	0
Rumex verticillatus L.	Polygonaceae	FACW+	N	7
Ruppia maritima L.	Ruppiaceae	OBL	N	6
Sabal minor (Jacq.) Pers.	Arecaceae	FACW	N	7
Saccharum alopecuroides (L.) Nutt.	Aceraceae	FACW-	N	7
Saccharum baldwinii Spreng.	Aceraceae	FACW+	N	7
Saccharum giganteum (Walter) Pers.	Aceraceae	FACW+	N	5
Sacciolepis striata (L.) Nash	Poaceae	OBL	N	6
Sagina decumbens (Elliott) Torr. & A. Gray ssp. *decumbens*	Caryophyllaceae	FACW	N	4
Sagina decumbens (Elliot) Torr. & A. Gray	Caryophyllaceae	FACW	I	0
Sagittaria ambigua J.G. Sm.	Alismataceae	OBL	N	8

Sagittaria brevirostra Mack. & Bush	Alismataceae	OBL	N	4
Sagittaria calycina Engelm.	Alismataceae	OBL	N	8
Sagittaria calycina Engelm. var. *calycina*	Alismataceae	OBL	N	8
Sagittaria cuneata Sheldon	Alismataceae	OBL	N	7
Sagittaria graminea Michx.	Alismataceae	OBL	N	8
Sagittaria graminea Michx. var. *graminea*	Alismataceae	OBL	N	8
Sagittaria lancifolia L.	Alismataceae	OBL	N	8
Sagittaria latifolia Willd.	Alismataceae	OBL	N	5
Sagittaria longiloba Engelm. ex J.G. Sm.	Alismataceae	OBL	N	7
Sagittaria montevidensis Chapm. & Schltdl.	Alismataceae	OBL	N	5
Sagittaria papillosa Buchenau	Alismataceae	OBL	N	8
Sagittaria platyphylla (Engelm.) J.G. Sm.	Alismataceae	OBL	N	7
Salix amygdaloides Andersson	Salicaceae	FACW	N	5
Salix caroliniana Michx.	Salicaceae	FACW+	N	6
Salix exigua Nutt.	Salicaceae	FACW+	N	3
Salix nigra Marsh.	Salicaceae	FACW+	N	2
Samolus ebracteatus Kunth	Primulaceae	FACW*	N	6
Samolus valerandi L.	Primulaceae	OBL*	N	5
Samolus valerandi L. ssp. *parviflorus* (Raf.) Hultén	Primulaceae	OBL*	N	5
Saururus cernuus L.	Saururaceae	OBL	N	6
Saxifraga texana Buckley	Saxifragaceae	FACW	N	8
Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve	Cyperaceae	OBL	N	4
Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve var. *acutus*	Cyperaceae	OBL	N	4
Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller	Cyperaceae	OBL	N	6
Schoenoplectus californicus (C.A. Mey.) Palla	Cyperaceae	OBL	N	4
Schoenoplectus hallii (A. Gray) S.G. Sm.	Cyperaceae	OBL	N	8
Schoenoplectus heterochaetus (Chase) Soják	Cyperaceae	OBL	N	6
Schoenoplectus pungens (Vahl) Palla	Cyperaceae	OBL	N	4

Schoenoplectus pungens (Vahl) Palla var. *pungens*	Cyperaceae	OBL	N	4
Schoenoplectus saximontanus (Fernald) Raynal	Cyperaceae	OBL	N	8
Schoenoplectus tabernaemontani (C.C. Gmel.) Palla	Cyperaceae	OBL	N	6
Scirpus atrovirens Willd.	Cyperaceae	OBL	N	4
Scirpus cyperinus (L.) Kunth	Cyperaceae	OBL	N	7
Scirpus pallidus (Britton) Fernald	Cyperaceae	OBL	N	5
Scirpus pendulus Muhl.	Cyperaceae	OBL	N	5
Scleria pauciflora Muhl. ex Willd.	Cyperaceae	FACW	N	5
Scleria pauciflora Muhl. ex Willd. var. *caroliniana* (Willd.) Alph. Wood	Cyperaceae	FACW	N	5
Scleria pauciflora Muhl. ex Willd. var. *pauciflora*	Cyperaceae	FACW	N	5
Scleria reticularis Michx.	Cyperaceae	OBL	N	7
Scleria verticillata Muhl. ex Willd.	Cyperaceae	OBL	N	9
Scutellaria integrifolia L.	Lamiaceae	FACW-	N	5
Scutellaria lateriflora L.	Lamiaceae	FACW+	N	5
Selaginella apoda L.	Selaginellaceae	FACW-	N	7
Sesbania herbacea (Mill.) McVaugh	Fabaceae	FACW-	N	2
Sesuvium maritimum (Walter) Britton, Sterns & Poggenb.	Aizoaceae	FACW	N	7
Sesuvium verrucosum Raf.	Aizoaceae	FACW-	N	7
Sicyos angulatus L.	Cucurbitaceae	FACW-	N	3
Sisyrinchium angustifolium Mill.	Iridaceae	FACW-	N	3
Sisyrinchium sagittiferum E.P. Bicknell	Iridaceae	FACW+	N	3
Sium suave Walter	Apiaceae	OBL	N	6
Smilax laurifolia L.	Smilacaceae	OBL	N	8
Sparganium americanum Nutt.	Sparganiaceae	OBL	N	7
Sparganium androcladum (Engelm.) Morong	Sparganiaceae	OBL	N	7
Sparganium eurycarpum Engelm.	Sparganiaceae	OBL	N	7
Spartina pectinata Bosc ex Link	Poaceae	FACW+	N	6
Spergularia salina J. Presl & C. Presl	Carophyllaceae	OBL*	N	3

Spermacoce glabra Michx.	Rubiaceae	FACW	N	6
Spermolepis divaricata (Walter) Raf. ex Ser.	Apiaceae	FACW	N	5
Sphenoclea zeylanica Gaertn.	Sphenocleaceae	OBL	I	0
Sphenopholis obtusata (Michx.) Scribn.	Poaceae	FACW+	N	2
Spiranthes cernua (L.) Rich.	Orchidaceae	FACW+	N	5
Spiranthes odorata (Nutt.) Lindl.	Orchidaceae	OBL	N	7
Spiranthes praecox (Walter) S. Watson	Orchidaceae	FACW	N	7
Spiranthes vernalis Engelm. & A. Gray	Orchidaceae	FACW-	N	8
Spirodela polyrrhiza (L.) Schleid.	Lemnaceae	OBL	N	6
Stachys tenuifolia Willd.	Lamiaceae	FACW	N	4
Steinchisma hians (Elliott) Nash	Poaceae	FACW-	N	6
Stuckenia pectinata (L.) Börner	Potamogetonaceae	OBL	N	7
Styrax americanus Lam.	Styracaceae	FACW-	N	9
Suaeda linearis (Elliott) Moq.	Chenopodiaceae	OBL	N	5
Suaeda suffrutescens S. Watson	Chenopodiaceae	OBL	N	5
Symphyotrichum lateriflorum (L.) A. Löve & D Löve	Asteraceae	FACW+	N	4
Symphyotrichum lateriflorum (L.) A. Löve & D Löve var. *lateriflorum*	Asteraceae	FACW+	N	4
Symphyotrichum novae-angliae (L.) G.L. Nesom	Asteraceae	FACW	N	6
Symphyotrichum subulatum (Michx.) G.L. Nesom	Asteraceae	OBL	N	4
Tamarix chinensis Lour.	Tamaricaceae	FACW	I	0
Tamarix gallica L.	Tamaricaceae	FACW-	I	0
Tamarix parviflora DC.	Tamaricaceae	FACW	I	0
Tamarix ramosissima Ledeb.	Tamaricaceae	FACW	I	0
Taxodium distichum (L.) Rich.	Cupressaceae	OBL	N	9
Teucrium canadense L.	Lamiaceae	FACW-	N	3
Teucrium canadense L. var. *canadense*	Lamiaceae	FACW-	N	3
Teucrium canadense L. var. *occidentale* (A. Gray) E.M. McClint. & Epling	Lamiaceae	FACW-	N	3
Thalia dealbata Fraser ex Roscoe	Marantaceae	OBL	N	7

Thalictrum dasycarpum Fisch. & Avé-Lall.	Ranunculaceae	FACW-	N	4
Trachelospermum difforme (Walter) A. Gray	Apocynaceae	FACW	N	6
Tradescantia ohiensis Raf.	Commelinaceae	FACW	N	5
Trepocarpus aethusae Nutt. ex DC.	Apiaceae	FACW	N	6
Triadenum virginicum (L.) Raf.	Clusiaceae	OBL	N	9
Triadenum walteri (J.G. Gmel.) Gleason	Clusiaceae	OBL	N	9
Trianthema portulacastrum L.	Aizoaceae	FACW-	N	3
Tridens muticus (Torr.) Nash	Poaceae	FACW*	N	4
Tridens muticus (Torr.) Nash var. *elongatus* (Buckley) Shinners	Poaceae	FACW*	N	4
Typha angustifolia L.	Typhaceae	OBL	N	3
Typha domingensis Pers.	Typhaceae	OBL	N	2
Typha latifolia L.	Typhaceae	OBL	N	2
Utricularia gibba L.	Lentibulariaceae	OBL	N	6
Utricularia inflata Walter	Lentibulariaceae	OBL	N	8
Utricularia juncea Vahl	Lentibulariaceae	OBL	N	8
Utricularia macrorhiza Leconte	Lentibulariaceae	OBL	N	9
Utricularia radiata Small	Lentibulariaceae	OBL	N	8
Utricularia subulata L.	Lentibulariaceae	OBL	N	9
Vaccinium corymbosum L.	Ericaceae	FACW	N	6
Veratrum virginicum (L.) W.T. Aiton	Liliaceae	FACW+	N	10
Verbena bonariensi L.	Verbenaceae	FACW+	I	0
Verbena scabra Vahl	Verbenaceae	OBL	N	4
Vernonia lettermannii Engelm. ex A. Gray	Asteraceae	OBL	N	8
Vernonia missurica Raf.	Asteraceae	FACW	N	4
Veronica anagallis-aquatica L.	Scrophulariaceae	OBL	N	0
Veronica peregrina L.	Scrophulariaceae	OBL	N	2
Veronica peregrina L. ssp. *peregrina*	Scrophulariaceae	OBL	N	2
Veronica peregrina L. ssp. *xalapensis* (Kunth) Pennell	Scrophulariaceae	OBL	N	2

Viola missouriensis Greene	Violaceae	FACW	N	4
Viola nephrophylla Greene	Violaceae	FACW	N	5
Vitis cinerea (Engelm.) Engelm. ex Millard	Vitaceae	FACW-	N	4
Vitis cinerea (Engelm.) Engelm. ex Millard var. *cinerea*	Vitaceae	FACW-	N	4
Vitis palmata Vahl	Vitaceae	FACW	N	5
Wolffia brasiliensis Weddell	Lemnaceae	OBL	N	5
Wolffia columbiana Karst.	Lemnaceae	OBL	N	5
Wolffiella gladiata (Hegelm.) Hegelm.	Lemnaceae	OBL	N	10
Xyris difformis Chapm.	Xyridaceae	OBL	N	0
Xyris difformis Chapm. var. *difformis*	Xyridaceae	OBL	N	10
Xyris torta Sm.	Xyridaceae	OBL	N	10
Zannichellia palustris L.	Zannichelliaceae	OBL	N	2
Zizaniopsis miliacea (Michx.) Döll & Asch.	Poaceae	OBL	N	9