PLANT SPECIES RICHNESS OF

LYNDON B. JOHNSON NATIONAL GRASSLAND PONDS

by

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Introduction

Small lakes and ponds speckle the landscape of the central United States, where they are a familiar sight to rural landowners. Oftentimes they have been constructed by ranchers as stock tanks, serving as oases for cattle during the scorching summer months. Approximately eight million of these small, artificial water bodies can be found across the country, with the highest concentration located in the eastern Great Plains and lower Mississippi Valley (Renwick et al. 2005; Smith et al. 2002). In the U.S.A., small water bodies are numerically dominant (Smith et al. 2002), and across the globe, farm ponds are estimated to cover six times the area of large dams (Downing et al. 2006). Despite their high density, small ponds are often overlooked in scientific studies due to their size (Downing 2010; Nicolet et al. 2004), although their role is anything but trivial. According to Smith et al. (2002, 21), "their impact on hydrology, sedimentology, geochemistry, and ecology is apparently large in proportion to their area." Downing (2010) concurs, arguing that the role of these small aquatic systems is of global importance. Ponds may sequester more carbon than forests, grasslands, and oceans (Downing 2010). Additionally, according to Downing's (2010) estimates, small lakes and ponds represent over one third of limnological processing by the world's aquatic ecosystems. Many processes, including sediment deposition, productivity, and carbon processing are more intense or complex in small lakes and ponds than in larger water bodies. Their rapid rates of processing are likely a function of their high surface to volume ratio. This "intensive activity" makes them more "dynamic in time;" under extreme conditions of erosion, a small pond may last for only few decades before fading back into the landscape (Downing 2010, 13). Small water bodies also play an important role ecologically. Their low fish biomass and abundance of macrophyte vegetation yield increased regional biodiversity of birds, amphibians, plants, and invertebrates (Scheffer et al. 2006; Downing 2010). This study examines the vegetation richness of a group of man-made ponds in Lyndon B. Johnson National Grassland (LBJNG), located in an area of high impoundment density per square kilometer (Figure 1).

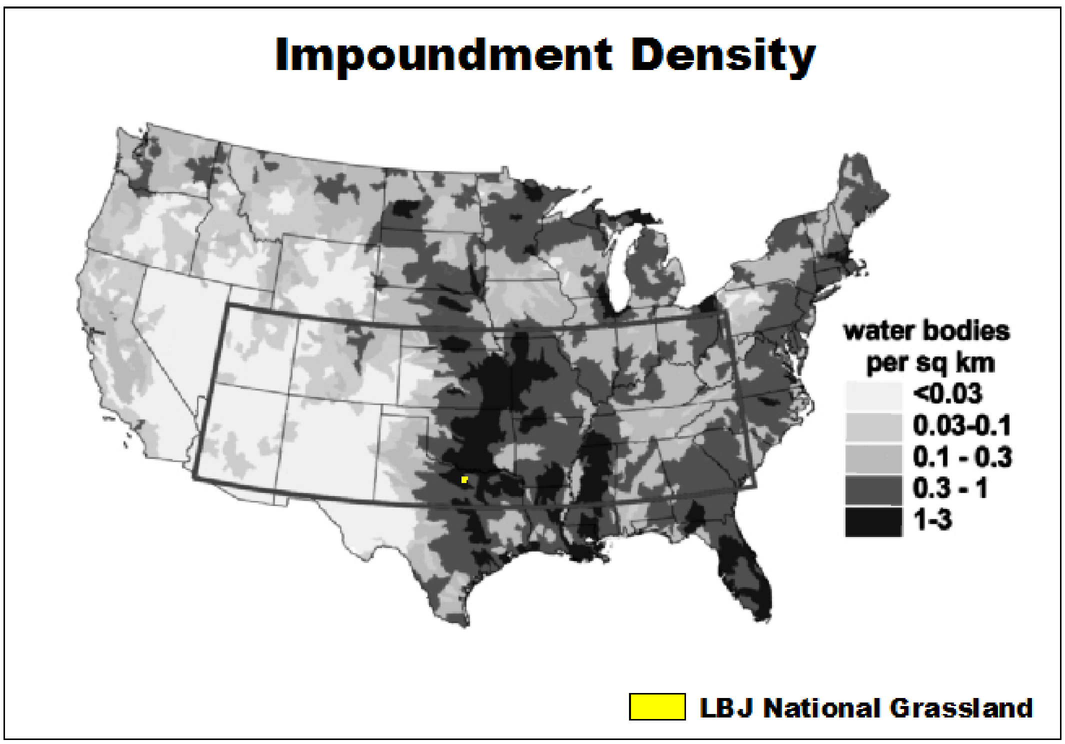

Figure 1. Map of impoundment density. Adapted from Smith et al. (2002).

Small impoundments, such as the LBJNG ponds, are major sediment sinks (Renwick et al. 2005). In highly erodible areas, small ponds may fill after only a few decades (Downing 2010). The LBJNG dams and berms that created the ponds were constructed to prevent soil erosion (Blackwell and Drenner 2009), and some of the ponds, especially those built during the 1950s, may be nearing the end of their lifetimes. Their relatively short existence does not make them less important or less worthy of study than larger lakes. Downing (2010, 14) argues that it is precisely this unique "temporal dynamic" that "accentuates our need to understand their function as well as their succession."

The effect of ponds on regional biodiversity enhancement can be large. In the United Kingdom, Williams et al. (2003) found that ponds support more species than other water body types. Even if the α diversity of an individual pond is low, pond clusters may be valuable for sustaining local β diversity; multiple small ponds can in fact be more effective at enhancing local species richness than a single, large pond (Jeffries 2008; Scheffer et al. 2006).

In the study of ponds, a variety of terms are used to refer to these small water bodies. Some, such as *vernal pool*, describe the temporary nature of these waters; others names, such as *dayas*, are a reflection of a specific culture or region (Zacharias et al. 2007). The multitude of names for ponds highlights an important objective: the need to distinguish small from larger water bodies. For years, there was no widespread agreement among the scientific community about what constitutes a pond, although many definitions emphasized similar qualities, including a shallow depth, small size, among other physical characteristics (Biggs et al. 2005). Pond Conservation, a non-governmental organization that began the United Kingdom National Pond Survey, developed a definition of ponds as "water bodies between 1 m^2 and 2ha in area which may be permanent or seasonal, including both man-made and natural water bodies" (Biggs et al. 2005, 694). Oertli et al. (2005, 535) expanded this definition, adding that a pond is "a waterbody with a maximum depth of no more than 8m, offering water plants the potential to colonise almost the entire area of the pond."

Freshwater ponds may be viewed as terrestrial islands, patches of suitable habitat surrounded by areas of unsuitable habitat (Dodson 1992; Ripley and Simovich 2008). Temporary ponds, which may dry up for months at one time, may be considered as islands in time as well as space (Ripley and Simovich 2008; Ebert and Balko 1987). MacArthur and Wilson's (1967) theory of island biogeography explains how extinction and colonization rates on an island eventually result in an equilibrium number of species. One assumption of this theory is that increasing area tends to decrease the rate of extinction; thus the number of species present tends to increase with the area of an island. The slope of this relationship declines but remains positive as area continues to increase (Lomolino 2001). Smith and Haukos (2002) posited that in the playa lakes, the species-area relationship could be due in part to an increase in environmental heterogeneity with area, although this assumption does not always hold true. Lomolino (2001) described the small island effect, explaining that richness may vary independently of area on smaller islands because of stochastic effects. Scheffer et al. (2006) provide an explanation of this effect in ponds. They note that the absence of fish in small, shallow ponds and lakes results in a vegetation-dominant state with high diversity. The number of species present on an island is also proportionate to the distance from the source of biodiversity, such as the mainland for an island ecosystem

(MacArthur and Wilson 1967). Some studies have examined the role of pond isolation and area on species richness (Bosiacka and Pieńkowski 2012), but we chose to focus on pond area. The biogeographic factor of pond area and its influence on plant species richness and diversity has been investigated for ponds in numerous regions (Oertli et al. 2002; Smith and Haukos 2002; Biggs et al. 1998; Møller and Rørdam 1985; Edvardsen and Økland 2006).

Studies in northern Europe have provided the most evidence for a plant species-area relationship in ponds. Biggs et al. (2005) found a significant, positive relationship between pond area and number of plant species. Studies in Poland (Bosiacka and Piénkowski 2012) and Denmark (Møller and Rørdam 1985) have also provided additional evidence; however, this relationship has not been confirmed in every study. In Sweden, Oertli et al. (2002, 66) observed, "the biogeographic principle that larger areas support more species seems to have limitations in its application to ponds." Although studies of European ponds have supported the species-area relationship, studies of the playa lakes have not. Hoagland and Collins (1997) found no statistically significant relationship between playa area and species richness, evenness, or diversity. Smith and Haukos (2002) found a weak but insignificant relationship between species richness and playa area. Studies of floral diversity of the playa lakes in the Great Plains may provide an interesting comparison to the diversity of the LBJNG ponds. A large number of playa lakes are found in the grasslands of the Texas panhandle. Due to their geographic proximity, the playas lakes are subjected to environmental conditions similar to those experienced by the LBJNG ponds. Their erratic hydroperiods and water fluctuations (Smith 2003) mirror the cycles of flooding and drought observed at LBJNG (Bob O'Kennon, pers. comm.).

Water permanence has also been investigated as an influence on plant species richness and composition. According to Smith (2003), hydroperiod is the most important factor in determining species composition of prairie wetlands. Their dynamic hydrology can produce multiple diverse communities within a single year. Upland plants may dominate these wetlands during the dry parts of the spring, but they die off once heavier rains inundate the ponds (Smith 2003). Perennials and plants with longer life cycles have an advantage in permanent aquatic habitats (Della Bella et al. 2008). Plants with short life cycles are able to take advantage of periods of favorable growth conditions, such as the inundation phase in a temporary pond (Della Bella et al. 2008). Drought is the primary constraint in temporary ponds, particularly due to its unpredictability (Della Bella et al. 2008).

Della Bella et al. (2008) compared temporary and permanent pounds in Italy and found significantly higher macrophyte species richness in the permanent ponds. They also saw a high dissimilarity in plant species composition between the two pond types. Although these ponds are located thousands of miles from our study site, the Mediterranean region is located at similar latitude to north Texas. While the climates of the two regions are certainly distinct, summer drought, as well as disturbance by fire and grazing, has been attributed as factors in the diversity of Mediterranean plant communities (Cowling et al. 1996) and of the Southern Plains, including the LBJNG plant communities. Additionally, the ponds Della Bella et al. (2008) investigated displayed widely fluctuating water levels during the study period, much like the LBJNG ponds do. Considering these similarities, Mediterranean ponds may serve as another potential site of comparison for the LBJNG ponds.

This study aimed to examine some of the factors influencing plant species richness of the ponds at LBJNG, specifically the roles of water permanence and pond surface area. We addressed the following questions: (1) is pond species richness positively correlated with pond surface area; and (2) do permanent and temporary ponds vary in plant species richness or compositions?

Methods

Study Site

Lyndon B. Johnson National Grassland (LBJNG), located in Wise County in north central Texas, contains over 8000 ha in 72 non-contiguous units managed by the USDA-Forest Service (USFS 2013). LBJNG lies at the eastern edge of the Cross Timbers and Prairies ecological region. Once a large area of woodland bordered on the east and west by open prairie, the region was fragmented and cleared for pastures, ranches, cropland, and other development (TPWD 2013). During the 1930s, the U.S. government bought many abandoned farms in the area with severe soil erosion problems (Drenner et al. 2009). To prevent further erosion, the U.S. Forest Service constructed numerous water retention levees and earthen dams from 1958 to 1995, creating hundreds of small ponds (Drenner et al. 2009, Henderson et al. 2012). Many of the ponds dry out periodically and lack fish, although some are permanent (Drenner et al. 2009; Figure 2). Species composition varies from year to year with changes in precipitation in weather (O'Kennon and Taylor, unpublished data).

Figure 2. LBJNG Pond 714 in November 2012 (left) and May 2013 (right).

Unit 29 was selected for study due to its high density of ponds and accessibility by vehicle. O'Kennon and Taylor (unpublished data) mapped approximately 1200 ponds in LBJNG and over 100 ponds in LBJNG Unit 29. Sampling was restricted to a single unit to control for historical land management and current land use factors, such as grazing.

During our study, ponds were inundated to full capacity during the spring rains of May 2013. LBJNG experienced moderate drought to near normal conditions over the course of the study period, according to the Palmer Drought Severity Index (NOAA 2014). Grazing is allowed for two months per year. A prescribed burn was completed in the year prior to the study. Fine to very fine sandy loams and soil complexes are the dominant soils (NRCS 2014b). The unit is a mosaic of prairie and hardwood forest.

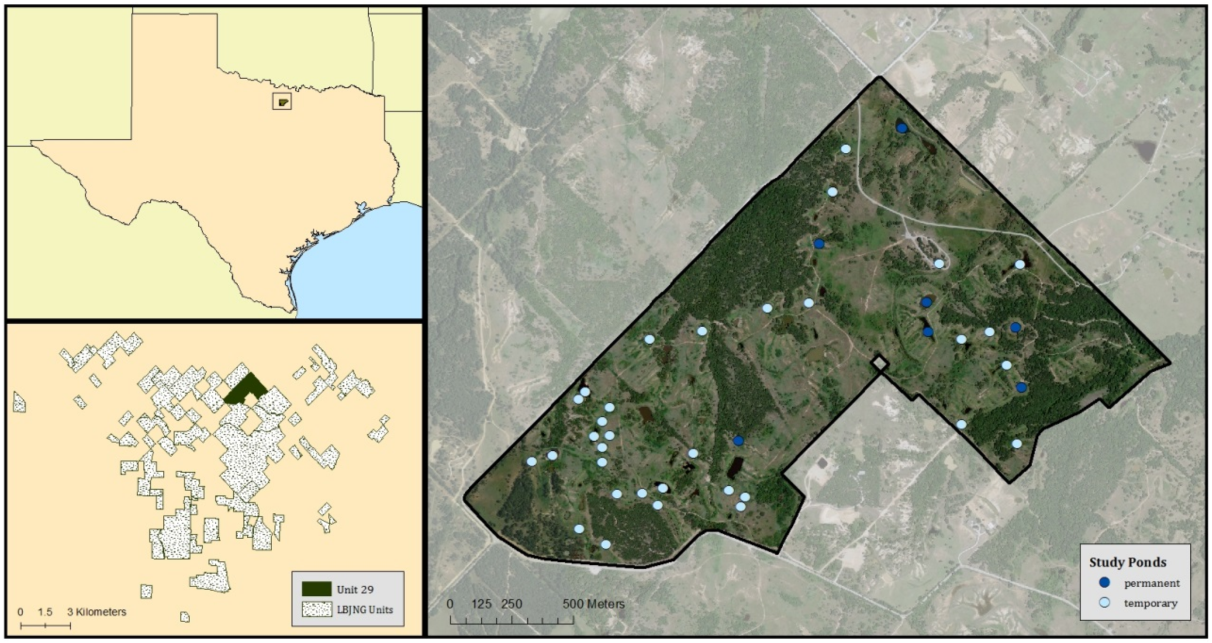

Figure 3. Location of LBJNG in north central Texas (upper left) and of Unit 29 within LBJNG (lower left). LBJNG Unit 29 study area and ponds (right). Imagery and GIS data from TNRIS (2014) and USFS, n.d.

Field Studies

Forty ponds in Unit 29 were randomly selected (Figure 3). Ponds ranged in surface area from <100 m^2 to >4000 m^2. The ponds were surveyed during a spring and a fall 2013 field season. For each pond, all vascular plant species present were recorded until no additional species was found, following Bosiacka and Piénkowski (2012) and Della Bella et al. (2008). The area sampled included the water's surface area and the pond margin, up to the outer boundary of the pond at the maximum water level. At LBJNG, this level is often distinguishable by a ring of *Salix nigra* (Black Willow) and can be confirmed with historic aerial photos. Pond perimeter at the maximum water level was recorded using a GPS unit and used to calculate maximum pond surface area in ESRI-ArcGIS (Figure 4).

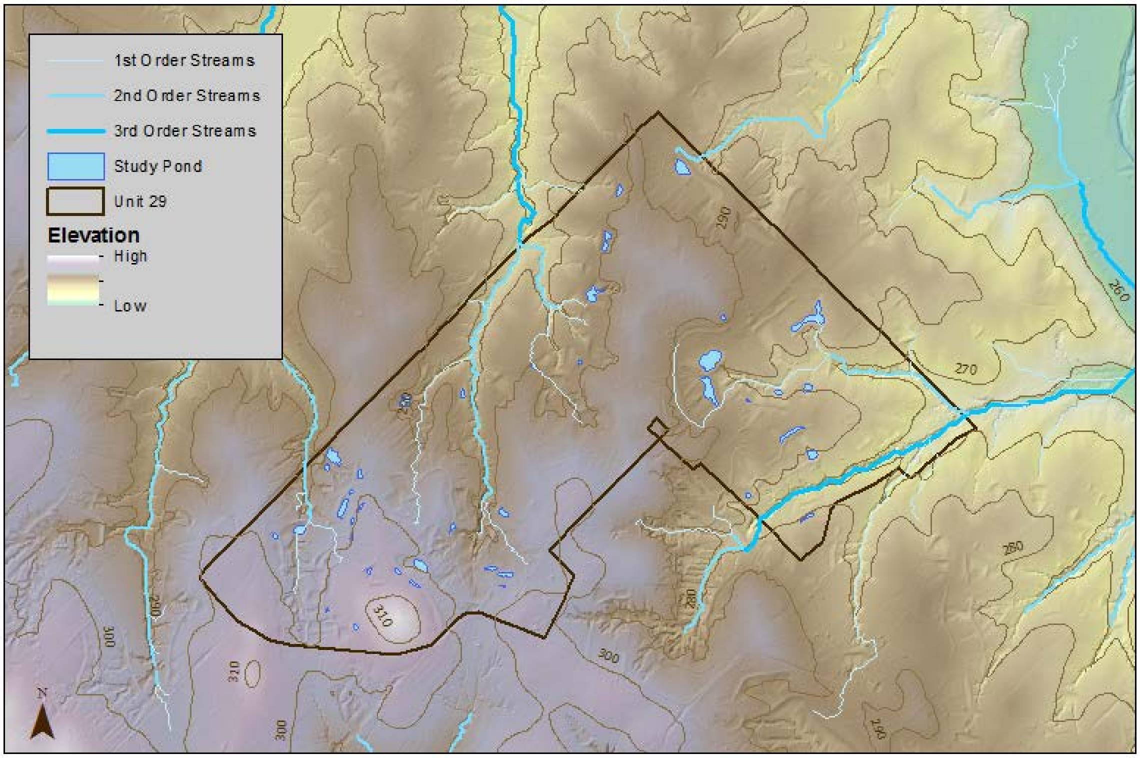

Figure 4. Map of study site with pond maximum surface area displayed over a hillshade model. Elevation across the unit ranges from 260 to 317 meters. GIS data from TNRIS (2014).

Data Analysis

Plants observed or collected were identified to species level with evidence specimens deposited in the Botanical Research Institute of Texas (BRIT) herbarium (Appendix A). Nomenclature follows the BONAP North American Vascular Flora's traditional classification (Kartesz 2013). Each species was categorized by wetland indicator status (Table 1) for the Great Plains Region, according to Lichvar (2013) and NRCS (2014a). Species classified as obligate wetland or facultative wetland plants were considered wetland species in the analysis. Species were also classified by growth habit, duration, and native status following NRCS (2014a; Appendix A). Plants with a tree or shrub growth habit, as well as vines observed to be woody, were grouped together as "woody" species for analysis. Other growth habits, including herb/forb, graminoid, subshrub, and non-woody vine were considered "herbaceous."

Table 1. Wetland indicator status definitions from Lichvar et al. (2012).

Wetland Indicator Status	Definition
Obligate Wetland (OBL)	Almost always occur in wetlands
Facultative Wetland (FACW)	Usually occur in wetlands, but may occur in non-wetlands
Facultative (FAC)	Occur in wetlands or non-wetlands
Facultative Upland (FACU)	Usually occur in non-wetlands, but may occur in wetlands
Obligate Upland (UPL)	Almost never occur in wetlands

Annuals were grouped with short-lived perennials (such as biennials) for analysis, separate from longer-lived perennials. Ponds were categorized as permanent or temporary based on analysis of historic aerial photos in ArcGIS and observation of water regime as described by the U.S. Fish and Wildlife Service's wetland classification system (Cowardin et al. 1979; Table 2).   Originally, temporary ponds were further subdivided into semi-permanent and ephemeral ponds, but separating the two temporary types proved to be a subjective effort in the absence of long-term hydrological data. Manual bootstrapping of data in and out of the classes showed a three-way classification to be highly inconsistent.

Table 2. Pond types and water regime modifiers. Adapted from Cowardin et al. 1979.

PERMANENT	**Permanently Flooded**	Water covers the land surface throughout the year in all years.
	Intermittently Exposed	Surface water is present throughout the year except in years of extreme drought.
TEMPORARY	**Semi-permanently Flooded**	Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the surface.
	Seasonally Flooded	Surface water is present for extended periods especially early in the growing season, but is absent by the end of the season in most years. When surface water is absent, the water table is often near the land surface.
	Saturated	The substrate is saturated to the surface for extended periods during the growing season, but surface water is seldom present.
	Temporarily Flooded	Surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface for most of the season.
	Intermittently Flooded	The substrate is usually exposed, but surface water is present for variable periods without detectable seasonal periodicity. Weeks, months, or even years may intervene between periods of inundation.

Data from both field seasons was pooled for analysis. Using linear regression with Aabel software (version 3, http://www.gigawiz.com), pond surface area was compared with species richness, as well as with the composition (by percent) of and absolute number of wetland, perennial, and woody species. Log-transformed measures were used for all variables, since they provided the strongest relationships. A cluster analysis was performed using PAST software to separate ponds into floristically similar groups (Hammer et al. 2001). A watershed analysis was conducted in ESRI-ArcGIS to examine factors related to pond clustering. Micro-watersheds of all second- and third-order streams within the study area were delineated to determine the watershed ponds are located in. Unpaired t-tests were used to compare differences in species richness and the number of wetland, perennial, and woody species between permanent and temporary ponds.

Results

A total of 228 taxa from 51 families were found in the 40 ponds surveyed (Appendix B). Twenty-eight of these are introduced species, and eight are invasive. Fifty are wetland indicator species (obligate wetland or facultative wetland). Species richness ranged from 20 species to 78 species ($\bar{x}$ = 40.35). Pond size varied from <100 m^2 to >4000 m^2 ($\bar{x}$ = 800.85 m^2; Figure 5).

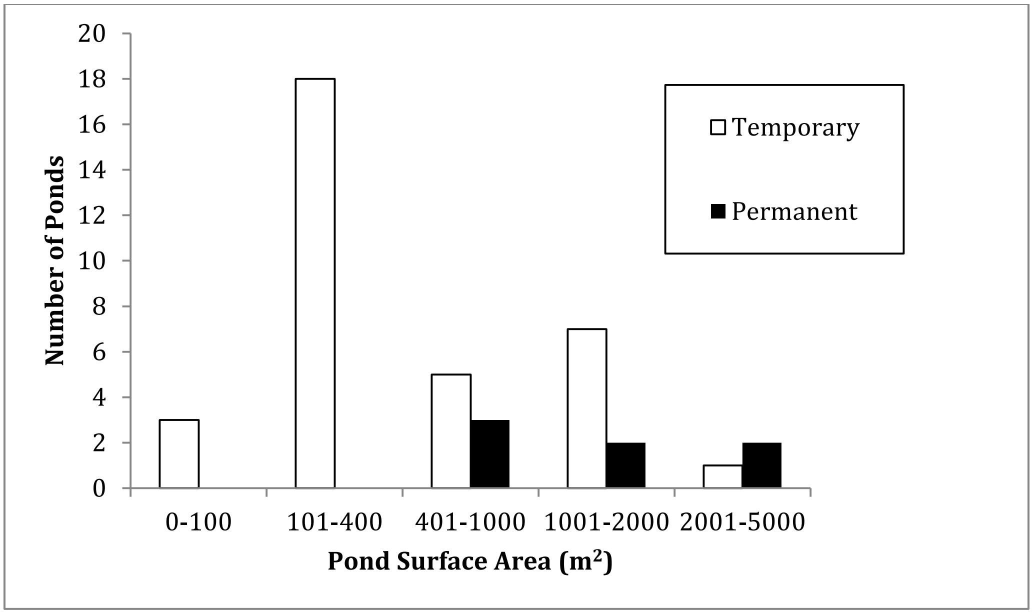

Figure 5. Size frequency distribution by pond type.

Species-Area Relationship

There was a significant, positive relationship between pond surface area and species richness (r^2 = .56, r = .75, p < 0.001, 95% confidence). There was also a significant, positive correlation between area and number of wetland species (r^2 = .34, r = .49, p < 0.001, 95% confidence), as well as between area and number of perennial species (r^2 = 0.23,r = .42, p = 0.002, 95% confidence). There was a significant, negative relationship between area and percent composition of perennial species (r^2 = 0.34, r = -.51, p < 0.001, 95% confidence). Graphs of the linear regression between these variables are shown in Figure 6. There was no significant relationship between area and percent composition of wetland species (r^2 = 0.04, r = -.25, p = 0.230, 95% confidence).

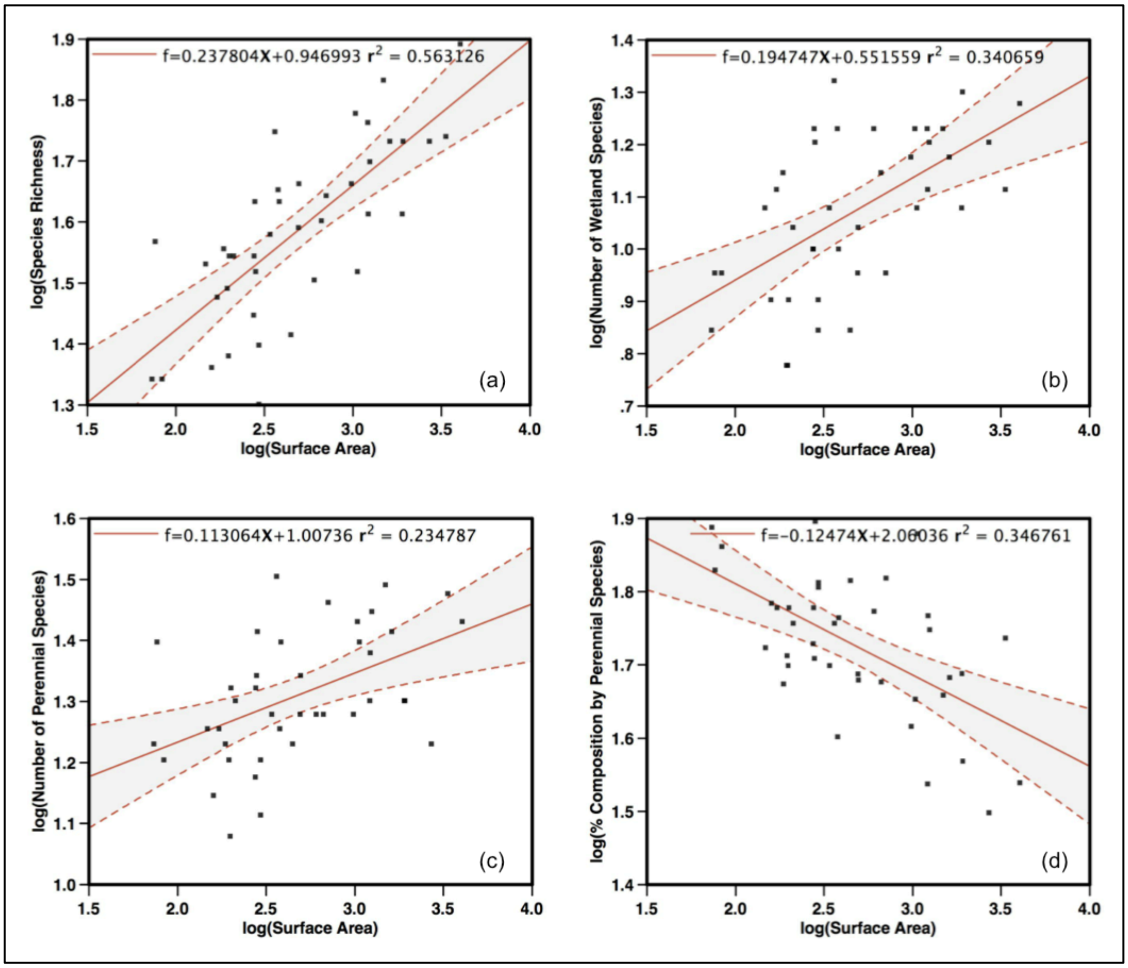

Figure 6. Linear regression of pond surface area against (a) species richness, (b) wetland species, (c) perennial species, and (d) percent composition by perennial species.

Species-Water Permanence Relationship

Permanent ponds displayed significantly higher species richness (t=-2.52246, p *(two-tailed)*=0.016, 95% confidence) and percent composition of woody species (t=2.26986, p *(two-tailed)*=0.029, 95% confidence) than temporary ponds. Permanent ponds also had significantly more wetland species (t=-3.2204, p *(two-tailed)*=0.003, 95% confidence). Temporary ponds had a significantly higher percent composition of perennial species (t=3.31762, *p (two-tailed)*=0.002, 95% confidence). When percent composition of wetland species was examined, there was no significant difference between the two types (t=-0.99704, p *(two-tailed)*=0.325, 95% confidence). There was also no significant difference in the number of woody species (*t*=1.57024, *p (two-tailed)*=0.125, 95% confidence) or number of perennial species (*t*=0, *p (two-tailed)*=>0.5, 95% confidence). Notched box plots (McGill et al. 1978) are used to show relationships for which there was a significant difference (Figure 7). The mean values for each variable are provided in Appendix C.

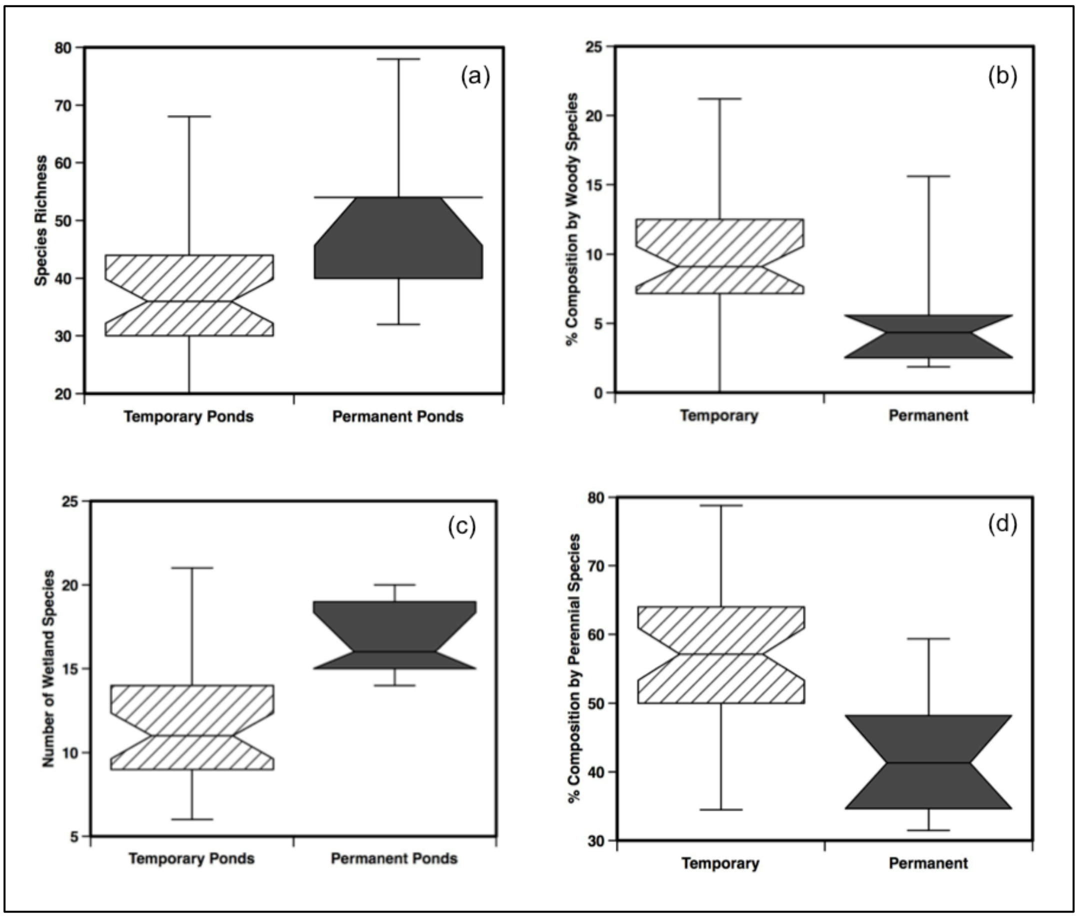

Figure 7. Notched box plots comparing (a) Species richness, (b) percent composition by woody species, (c) number of wetland species, and (d) percent composition by perennial species between temporary and permanent ponds. The notches represent the ~95% confidence interval of the median, with the half width of the notch calculated as (75th Percentile – 25th Percentile) * 1.57/($\sqrt{N}$) (McGill et al. 1978).

Not all taxa occurred equally frequently in each pond type. To select species with a difference in distribution between pond types, we set a threshold at a minimum frequency of three ponds and limited our selection to species for which there was a 20% or greater difference in occurrence between temporary and permanent ponds (Figure 8). These thresholds were an arbitrary selection. Most notable in its distribution was *Eleocharis palustris* (Common Spike-Rush), which occurred in all permanent ponds.

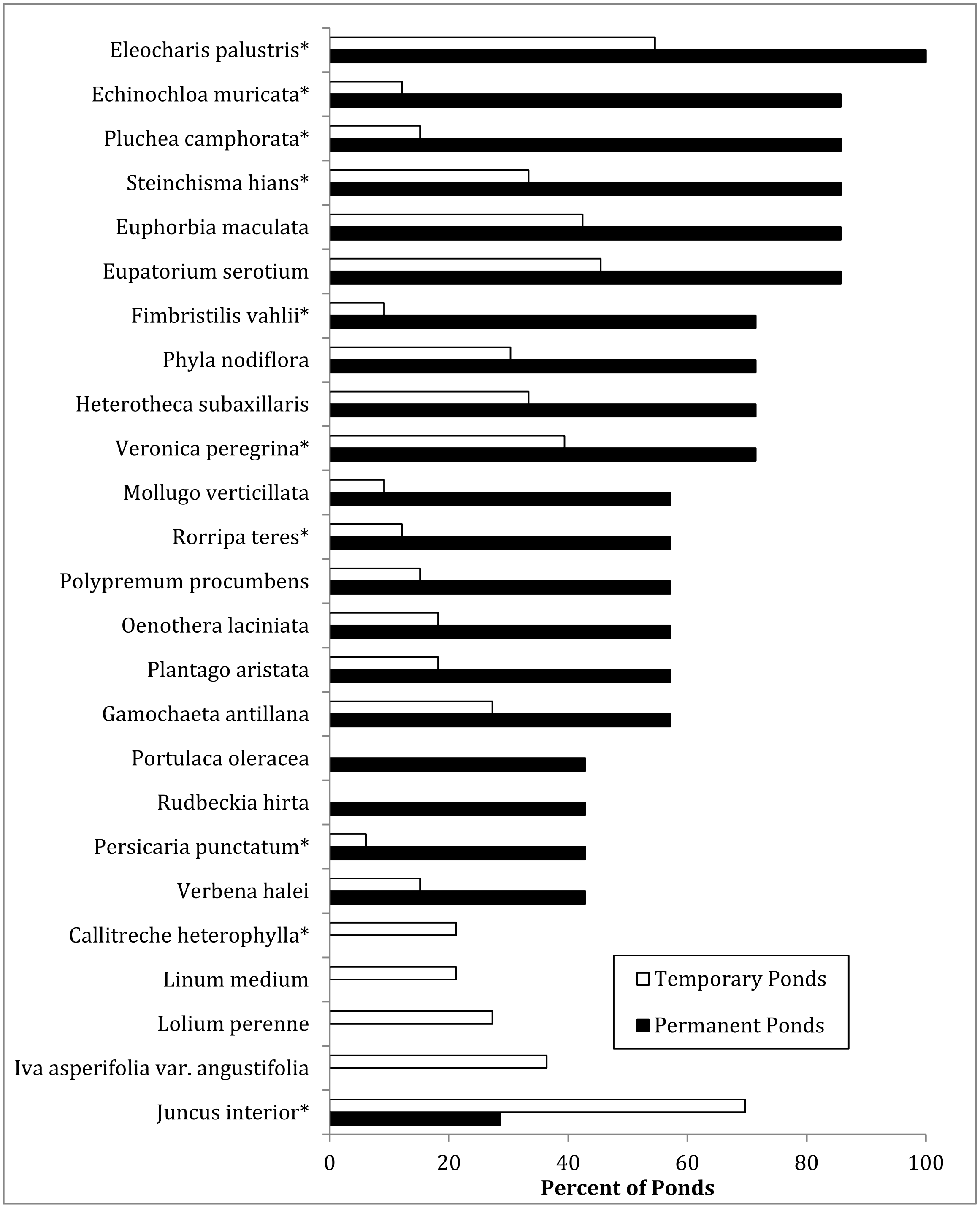

Figure 8. Percent occurrence of selected species in temporary and permanent ponds. * indicates a wetland species (OBL or FACW).

Among-Pond Variation

A cluster analysis showed all ponds were at least 50% dissimilar in floristic composition (Figure 9). The analysis grouped ponds into five main clusters. The deepest division (E) is between Pond 806 and all the other ponds. Pond 806 had low species richness, but not the lowest, and is located in the center of a patch of woodland in a camping area. The other ponds, though some sit near wooded areas, are surrounded by grassland. Group D could not be distinguished from Groups A, B, and C by species richness, water permanence, or pond surface area alone, but the ponds in Group D do show close geographic proximity (Figure 10). Ponds within Group C were all found within the same micro-watershed of a second order stream (Figure 10). Group B contained ponds of smaller surface areas than ponds in Group A. Additionally, all permanent ponds but one were in Group A. Despite these general patterns, there appears to be little similarity between ponds. Each group is characterized by its own relatively unique floral elements, with no strong identity tied together by prominent characteristics.

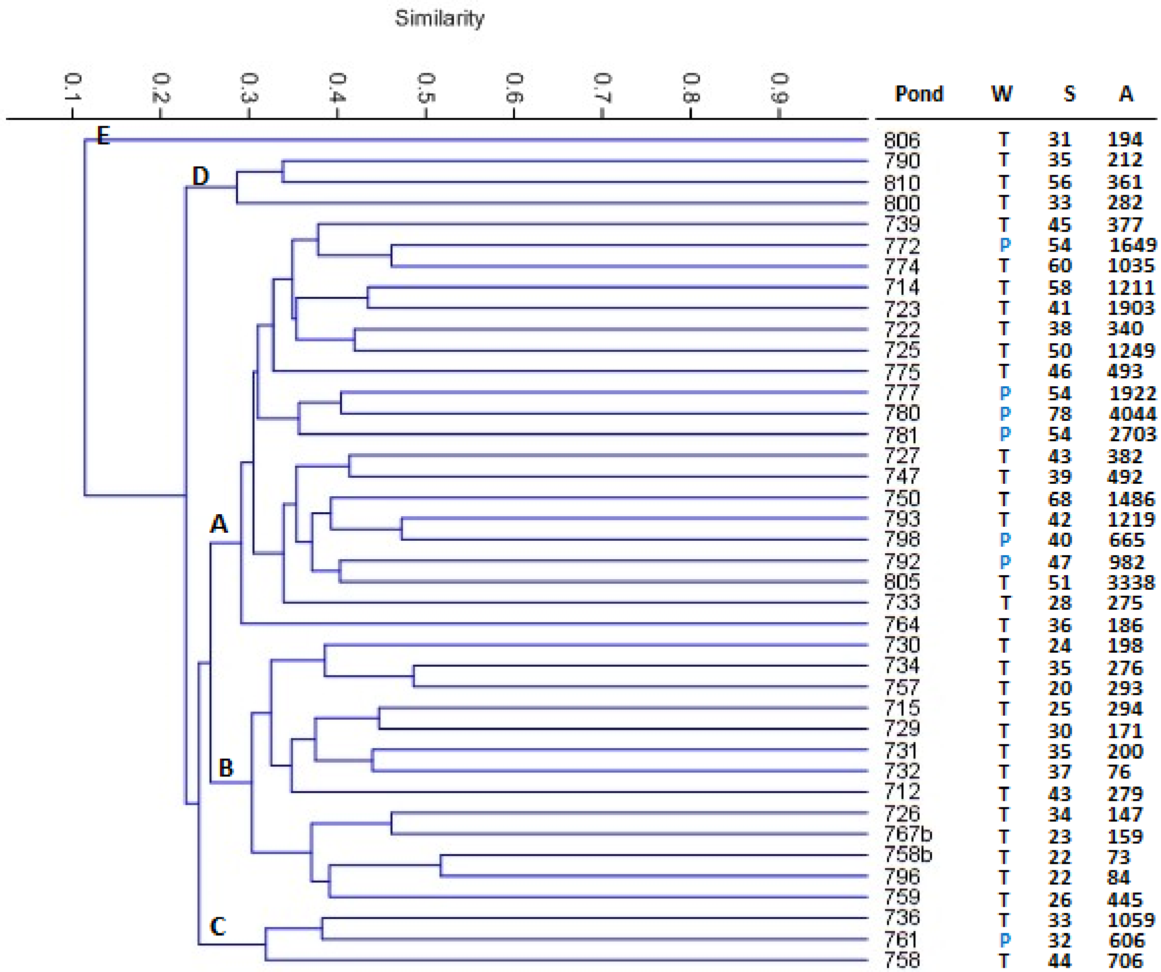

Figure 9. Cluster diagram of ponds based on plant composition. Each branch tip represents a pond, identified by its number. Other variables measured in this study that might influence clusters are included. Water permanence (W) is listed as permanent (P) or temporary (T). Species richness (S) is the total species richness of the pond. Pond area (A) is listed in m^2. Similarity is based on the Jaccard index.

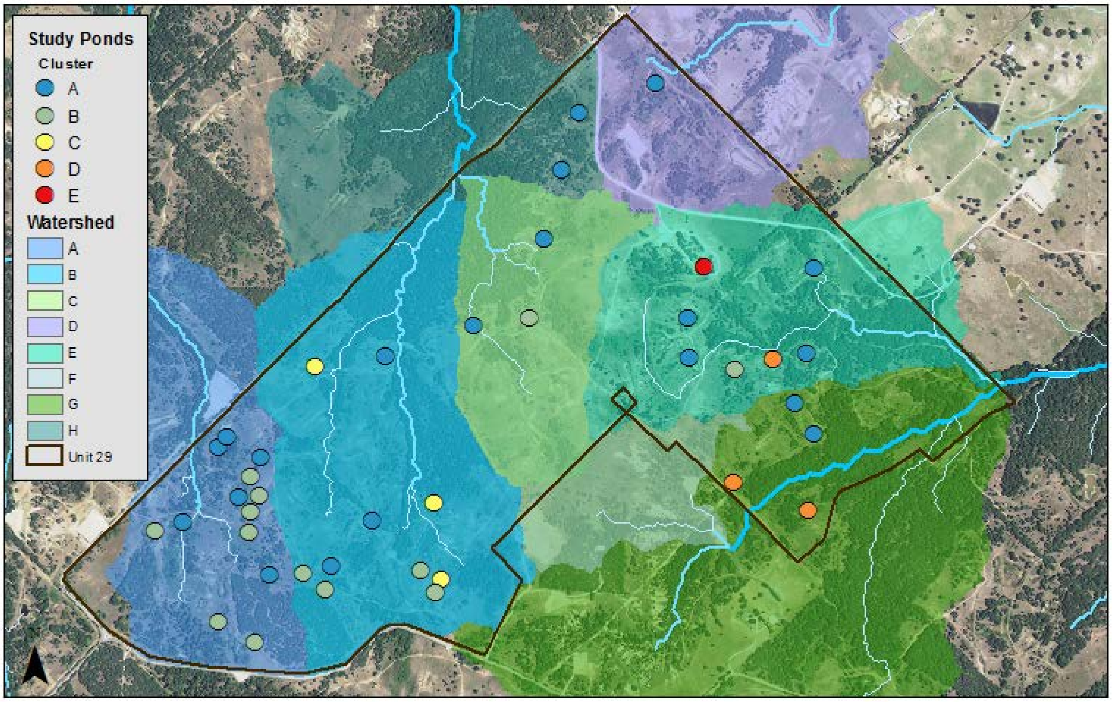

Figure 10. Map of pond clusters by watershed. Imagery from TNRIS (2014).

Species frequency

Approximately one third of all taxa recorded (76 species; 33%) were found only in one pond (Figure 11). *Salix nigra* was the most common species and occurred in all but three ponds (Table 3).

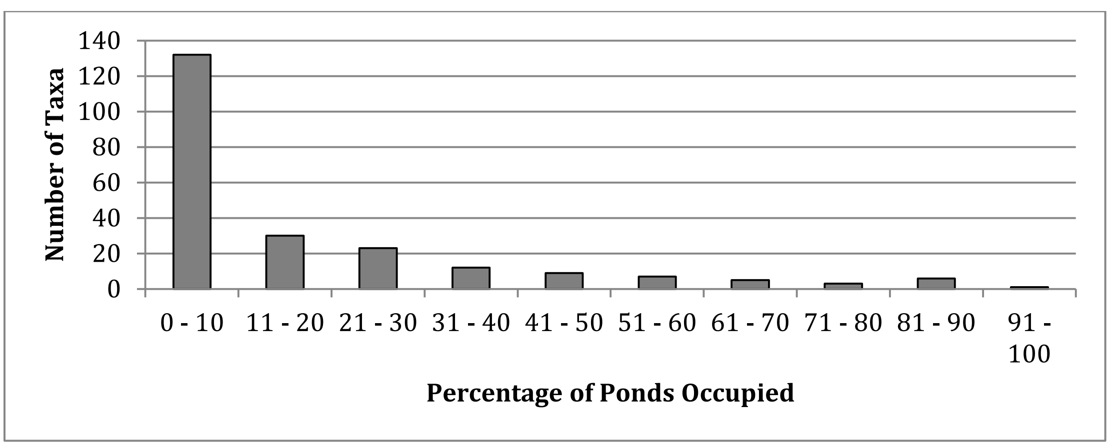

Figure 11. Frequency of taxa in LBJNG Unit 29 ponds.

Table 3. Most frequent taxa in the study ponds in Unit 29.

Taxon	**Number of ponds**
Salix nigra	37
Juncus nodatus	36
Persicaria hydropiperoides	36
Ambrosia artemisefolia	35
Ludwigia glandulosa	34
Panicum vergatum	34
Symphiotricum divaricatum	34
Andropogon virginicus	32
Cyperus pseudovegetus	32
Lespedeza cuneata	31
Helenium amarum	28
Dichanthelium acuminatum	26
Eleocharis palustris	25
Juncus interior	25
Smilax bona-nox	25

Discussion

Species-Area Relationship

The significant relationship between pond area and species richness at LBJNG mirrors findings from the United Kingdom (Biggs et al. 2005) and Poland (Bosiacka and Pienkowski 2012) but not the playa lakes, where Hoagland and Collins (1997) and Smith and Haukos (2002) found no statistically significant relationship between playa area and species richness, evenness, or diversity. This is somewhat surprising, since the LBJNG ponds are similar to the playa lakes in both location and hydrology. Perhaps the LBJNG ponds have greater habitat heterogeneity than the playa lakes due to a greater elevation gradient. Playas display little elevation change with an increase in area (Smith and Haukos 2002). While many of the LBJNG ponds are similarly flat, some display greater topographic relief. Without further investigation and measurement of pond depth, however, it is hard to ascertain whether differences in habit diversity due to elevation gradient are indeed the source of the divergence in results.

Smith and Haukos (2002) hypothesized that if only wetland plant species were considered, the relationship between richness and area would improve. They argued that since large playas stay wet for longer than small playas, they provide aquatic plants a better opportunity to reproduce successfully. At LBJNG, this appears to be the case, since larger ponds tended to have more wetland species. In our study, ponds of increasing surface area tend to have more permanent water (Figure 5), but not all ponds of a large surface area have longer hydroperiods than small ponds. Human alterations to the landscape, such as the creation of berms and addition of overflow pipes, have altered pond hydroperiod. Some ponds were also lined with bentonite to slow infiltration of water into the soil (Erik Taylor, pers. comm.). Increasing surface area thus does not necessarily indicate an increased hydroperiod, so it is not surprising that the correlation between LBJNG pond area and number of wetland species is only moderate.

The positive relationship between the number of wetland species and pond area could be a function of total species richness, especially considering there was no significant relationship between percent composition of wetland species and pond area. Ponds with a greater number of species in total would be expected to have a proportionately large number of wetland species. When species richness is plotted against number of wetland species, there is a significant, positive relationship (r^2=.57, p=0.001, 95% confidence). There is also a significant relationship between species richness and number species.

Interestingly, larger ponds tended to have a greater number of perennial species but smaller percent composition of perennial species. The relationship between area and number of perennial species could again potentially be explained by reasoning that if a larger pond contains more species total than a small pond, it will also have more perennial species than a small pond. It is difficult to explain the relationship between area and percent composition of perennials, but it is likely due to a small island effect across the total set of ponds measured.

Species-Water Permanence Relationship

At LBJNG, permanent ponds had significantly more wetland species and greater species richness than temporary ponds. Smith (2003) explains that hydroperiod is the main influence on composition of playas and other prairie wetlands. Their dynamic hydrologic nature results in a changing flora; annuals and short-lived perennials are successful in these conditions, while it is more difficult for species that require consistent water to become established (Smith 2003). Considering this, we expected such a difference in the number of wetland species between the two types. At LBJNG, some of the temporary ponds are ephemeral; they fill following a storm event and then stay dry for months. In such ponds, we would expect to see fewer wetland species. Greater total species richness in permanent ponds could possibly be attributed to the increase in habitat diversity resulting from the various conditions that can exist in a permanent pond within a single season. While retaining permanent water suitable for wetland species, a permanent pond may still experience substantial drawdown, allowing grassland plants to encroach inwards.

Temporary ponds had significantly higher percent composition of perennial species and woody species. Since perennials have an advantage in the stable conditions of permanent ponds while annuals can exploit short periods of favorable conditions in temporary ponds (Della Bella et al. 2008), we expected permanent ponds to have higher composition of perennials. Additionally, we expected permanent ponds, with their year-round water available to prevent drought stress, to have higher composition of woody species. It is possible that temporary ponds, if they are indeed shallower than permanent ponds, may bear closer resemblance to the topography of playa lakes, which have been observed to be vegetated by perennial species (Hoagland and Collins 1997).

Species frequency

In their study of the playa lakes, Hoagland and Collins (1997) found the majority of playa species to be infrequent, with few species distributed widely. This held true at LBJNG. Although there was not a large number of species that were widely distributed among the ponds (for this study, a species was considered widely distributed if found in >75% of ponds), there were a few species that were commonly found in a pond. Most notable were *Salix nigra*, *Persicaria hydropiperoides*, *Panicum virgatum*, *Ambrosia artemisefolia*, *Andropogon virginicus*, *Juncus nodatus*, *Lespedeza cuneata*, and *Ludwigia glandulosa*. Many of these common species were observed to form distinct rings or were found in certain zones (i.e. at the water's edge or the farthest edge of the margin against upland vegetation), although specific patterns of zonation were not investigated in this study.

The importance of *Salix nigra* in pond vegetation composition cannot be ignored. It can be found in nearly every pond. *Salix nigra* was found in 92.5% of the ponds in our study. No other woody species was found in more than 52.5% of the ponds.

The seven invasive species found include *Lespedeza cuneata* (31 ponds), *Cynondon dactylon* (16), *Bothriochloa ischaemum* (16), *Lolium perenne* (9), *Trifolium campestre (7), Sorghum halepense* (1), and *Medicago minima* (1). With the exception of *Lespedeza cuneata*, these species did not have a widespread distribution among the ponds. Many of these species, such as *Cynodon dactylon*, are facultative upland species, and so their presence may be greater in the surrounding prairies than in the ponds themselves. *Lespdeza cuneata* was found in over three quarters of the ponds surveyed. Considering its current presence and its ability to establish dense stands that crowd out native plants (Texas Invasives 2011), further research could be directed toward the study of the management of this species at LBJNG at whether its presence in a pond is correlated with low species richness.

Among-Pond Variation

Hoagland and Collins (1997) noted a high degree of variation among playas, with an approximate percent dissimilarity of ~40%. At LBJNG, there was even greater variation between ponds (at least 50%). Some ponds with close geographic proximity varied greatly in composition. Ponds 780 and 806, for example, are located only 160 m apart but were 90% dissimilar. Additionally, Watershed E contains 7 study ponds, but these ponds were divided into 4 separate groups in the cluster analysis (Figure 10). Proximity does not guarantee similarity in plant composition.

Conclusions

A number of factors influence pond plant species richness. Our study found that pond surface area was correlated with species richness, the number of wetland and perennial species, and the composition of perennial species in a pond. Although these relationships were significant, the correlations between surface area and the other variables were not strong. This indicates that while pond surface area is important, it does not completely explain the variation in species richness among ponds. We also found that water permanence was related to species richness, number of wetland species, and percent composition of woody and perennial species. Some of these relationships, such as the link between permanence and the number of wetland species, were expected. Others, such as the connection between permanence and composition by woody species, were more surprising and harder to explain.

Although we chose to focus on pond area and water permanence for our study, soils, land use history, pond depth, pond age, isolation, sedimentation, and a variety of factors play important roles. The composition of pond vegetation is a result of the interplay between these many factors, but stochastic events may also result in different communities in ponds of similar sizes (Scheffer et al. 2006), and changes in species composition may easily occur over a single growing season (Hoagland and Collins 1997). As O'Kennon and Taylor (unpublished data) have observed, the plant composition of the ponds at LBJNG is far from static. This study represents a snapshot of the LBJNG ponds at a relatively brief moment in time.

The LBJNG ponds represent an important contribution to regional biodiversity. While larger ponds with permanent water tended to contain more plant species, small ponds and temporary ponds had unique plant compositions. The cluster analysis illustrated that the multiple pond types present at LBJNG are highly dissimilar. Pond clusters, as described by Jeffries (2008), play a valuable role in enhancing the diversity of LBJNG. Some ponds held considerably more species than others, but as a whole, the group of ponds in the study contained a varied array of taxa. The abundance and diversity of vegetation help support richness of birds and invertebrates as well. Considering their diversity, the LBJNG ponds could potentially serve as reference sites for bioswale design. As Swadek and Burgess (2012) note, rain gardens and other storm water management systems in Texas must be capable of handling hot, dry summers and seasonal rains. The LBJNG ponds experience these conditions and support native species tolerant of extreme drought followed by flooding.

It is also worth noting that human alteration to a landscape may not always decrease diversity. Although no botanical studies were conducted at LBJNG prior to the construction of the earthen berms and levees, it is clear that the creation of ponds provided a habitat type that allowed a different mix of species to flourish. The ponds serve as a refuge to many species of wetland plants not found in the surrounding prairies and woodlands.

While the LBJNG ponds are notable for their diversity of vegetation, ponds play a role in multiple ecological processes. Despite their size, their abundance, total area covered, and intensity of processing make them an important ecosystem on a global scale. Our understanding of the importance of small ponds is still developing, and further research is needed to continue increasing our understanding or their role and function.

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APPENDIX A: Plant List

Abbreviations following taxon:

Wetland Indicator Status (Wet)
OBL = Obligate Wetland
FACW = Facultative Wetland
FAC = Facultative
FACU = Facultative Upland
UPL = Obligate Upland

Duration (Dur)
P = perennial
A = annual
B = biennial

Woody/Herbaceous (W/H)
W = woody
H = herbaceous

Growth Habit (Hab)
H = herb/forb
G = graminoid
S = shrub
R = subshrub
T = tree
V = vine

Nativity (Nat)
N = native
I = introduced
* = invasive

Taxon	Common Name	Wet	Dur	Hab	W/H	Nat
ACANTHACEAE						
Dyschoriste linearis (Torr. & Gray)	Polkadots	-	P	H	H	N
ALISMATACEAE						
Sagittaria platyphylla (Engelm.) J.G. Sm.	Delta Arrowhead	OBL	P	H	H	N
ANACARDIACEAE						
Rhus copallinum L.	Winged Sumac	-	P	T,S	W	N

Taxon	Common Name	Wet	Dur	Hab	W/H	Nat
Rhus glabra L.	Smooth Sumac	-	P	T,S	W	N
Toxicodendron radicans (L.) Kuntze	Eastern Poison Ivy	FACU	P	V,H,R	H	N
APIACEAE						
Chaerophyllum tainturieri Hook	Hairy-Fruit Chervil	-	A	H	H	N
Daucus pusillus Michx.	American Wild Carrot	-	A	H	H	N
APOCYNACEAE						
Apocynum cannabinum L.	Indian-Hemp	FAC	P	H	H	N
ASCLEPIADACEAE						
Asclepias tuberosa L.	Butterfly Milkweed	-	P	H	H	N
ASTERACEAE						
Achillea millefolium L.	Common Yarrow	FACU	P	H	H	N
Ambrosia artemisiifolia L.	Annual Ragweed	FACU	A	H	H	N
Ambrosia trifida L.	Great Ragweed	FAC	A	H	H	N
Baccharis neglecta Britt.	Roosevelt-Weed	FAC	P	S	W	N
Chaetopappa asteroides Nutt. DC.	Arkansas Leastdaisy	-	A	H	H	N
Bradburia pilosa Nutt. Semple	Soft Bradbury-Bush	-	A	H	H	N
Cirsium ×iowense (Pammel) Fern. (pro sp.)	Thistle	FACU	P	H	H	N
Cirsium texanum Buckl.	Texas Thistle	-	B,P	H	H	N
Coreopsis tinctoria Nutt.	Golden Tickseed	FAC	A,B,P	H	H	N
Echinacea purpurea (L.) Moench	Eastern Purple-Coneflower	-	P	H	H	N
Erigeron canadensis (L.)	Canadian Horseweed	FACU	A,B	H	H	N
Erigeron geiseri Shinners	Geiser's Fleabane	-	A	G	H	N
Erigeron philadelphicus L.	Philadelphia Fleabane	FAC	B,P	H	H	N
Erigeron strigosus Muhl. ex Willd.	Prairie Fleabane	FACU	A,B,P	H	H	N
Eupatorium serotinum Michx.	Late-Flowering Thoroughwort	FAC	P	H	H	N
Euthamia gymnospermoides Greene	Texas Goldentop	FAC	P	H	H	N
Diaperia verna Raf.	Spring Pygmy-Cudweed	-	A	H	H	N
Facelis retusa (Lam.)Schultz-Bip.	Annual Trampweed	-	A	H	H	I
Gaillardia aestavalis (Walt.) H. Rock	Lance-Leaf Blanket-Flower	-	P	H	H	N

Taxon	Common Name	Wet	Dur	Hab	W/H	Nat
Gaillardia pulchella Foug.	Indian Blanket	UPL	A,B,P	H,R	H	N
Gamochaeta antillana (Urban) A. Anderb.	Antilles Everlasting	-	A	H	H	N
Gamochaeta pensylvanica (Willd.) Cabrera	Pennsylvania Everlasting	UPL	A,B	H	H	N
Gamochaeta purpurea (L.) Cabrera	Spoon-Leaf Purple Everlasting	FACU	A,B	H	H	N
Grindelia squarrosa (Pursh) Dunal	Curly-Cup Gumweed	-	A,B,P	H	H	N
Gutierrezia texana (DC.) Torr. & Gray	Texas Broomweed	-	A	H	H	N
Helenium amarum (Raf.) H. Rock	Yellowdicks	FACU	A	H	H	N
Helianthus annuus L.	Common Sunflower	FACU	A	H	H	N
Helianthus pauciflorus Nutt.	Stiff Sunflower	-	P	H	H	N
Heterotheca subaxillaris (Lam.) Britt. & Rusby	Camphorweed	UPL	A	H	H	N
Hypochaeris glabra L.	Smooth Cat's Ear	-	A	H	H	I
Iva annua L.	Annual Marsh-Elder	FAC	A	H	H	N
Iva asperifolia var. *angustifolia* (Nutt. ex DC.) B.L. Turner	Pensacola Marsh-Elder	-	A,B	H	H	N
Krigia caespitosa (Raf.) Chambers	Weedy Dwarf-Dandelion	FAC	A	H	H	N
Krigia occidentalis Nutt.	Western Dwarf-Dandelion	-	A	H	H	N
Krigia virginica (L.) Willd.	Virginia Dwarf-Dandelion	FACU	A	H	H	N
Krigia wrightii (Gray) Chambers ex Kim	Wright's Dwarf-Dandelion	-	A	H	H	N
Lactuca saligna L.	Willow-Leaf Lettuce	FACU	A,B	H	H	I
Lactuca serriola L.	Prickly Lettuce	FAC	A,B	H	H	I
Liatris punctata Hook.	Dotted Gayfeather	-	P	H	H	N
Pluchea camphorata (L.) DC.	Plowman's-Wort	FACW	A,P	H	H	N
Pseudognaphalium obtusifolium (L.) Hilliard & Burtt	Blunt-Leaf Rabbit-Tobacco	-	A,B	H	H	N
Pyrrhopappus carolinianus (Walt.) DC.	Carolina Desert-Chicory	-	A,B	H	H	N
Pyrrhopappus grandiflorus (Nutt.) Nutt.	Tuberous Desert-Chicory	-	P	H	H	N
Pyrrhopappus pauciflorus (D. Don) DC.	Small-Flower Desert-Chicory	-	A,P	H	H	N
Rudbeckia hirta L.	Black-Eyed-Susan	FACU	A,B,P	H	H	N
Solidago nitida Torr. & Gray	Shiny Goldenrod	-	P	H	H	N
Sonchus asper (L.) Hill	Spiny-Leaf Sow-Thistle	FAC	A	H	H	I
Symphyotrichum divaricatum (Nutt.) Nesom	Lawn American-Aster	OBL	A,B	H	H	N

Taxon	Common Name	Wet	Dur	Hab	W/H	Nat
Symphiotricum ericoides (L.) Nesom	White Heath American-Aster	-	P	H	H	N
Xanthium strumarium L.	Rough Cockleburr	FAC	A	H	H	N
BRASSICACEAE						
Capsella bursa-pastoris (L.) Medik.	Shepherd's-Purse	FACU	A	H	H	I
Lepidium austrinum Small	Southern Pepperwort	-	A,B	H	H	N
Lepidium virginicum L.	Poorman's-Pepperwort	FACU	A,B,P	H	H	N
Rorippa teres (Michx.) R. Stuckey	Southern Marsh Yellowcress	OBL	A,B	H	H	N
BUDDLEJACEAE						
Polypremum procumbens L.	Juniper-Leaf	UPL	A,P	H	H	N
CALLITRICHACEAE						
Callitreche heterophylla Pursh	Greater Water-Starwort	OBL	P	H	H	N
CAMPANULACEAE						
Triodanis perfoliata (L.) Nieuwl.	Clasping-Leaf Venus'-Looking-Glass	FAC	A	H	H	N
CARYOPHYLLACEAE						
Arenaria benthamii Fenzl ex Torr. & Gray	Hilly Sandwort	-	A	H	H	N
Cerastium glomeratum Thuill.	Sticky Mouse-Ear Chickweed	FACU	A	H	H	I
Petrorhagia dubia (Raf.) G. López & Romo	Hairy-Pink	-	A	H	H	I
Silene antirrhina L.	Sleepy Catchfly	-	A	H	H	N
CISTACEAE						
Lechea mucronata Raf.	Hairy Pinweed	-	P	H	H	N
Lechea tenuifolia Michx.	Narrow-Leaf Pinweed	-	P	H	H	N
CYPERACEAE						
Carex bushii Mackenzie	Bush's Sedge	OBL	P	G	H	N
Carex leavenworthii Dewey	Leavenworth's Sedge	-	P	G	H	N
Carex reniformis (Bailey) Small	Kidney-Shape Sedge	OBL	P	G	N	N
Cyperus acuminatus Torr. & Hook. ex Torr.	Taper-Tip Flat Sedge	OBL	A,P	G	H	N
Cyperus erythrorhizos Muhl.	Red-Root Flat Sedge	OBL	A,P	G	H	N

Taxon	Common Name	Wet	Dur	Hab	W/H	Nat
Cyperus pseudovegetus Steud.	Marsh Flat-Sedge	FACW	P	G	H	N
Eleocharis atropurpurea (Retz.) J.& K. Presl	Purple Spike-Rush	FACW	A	G	H	N
Eleocharis engelmannii Steud.	Engelmann's Spike-Rush	FACW	A	G	H	N
Eleocharis palustris (L.) Roemer & J.A. Schultes	Common Spike-Rush	OBL	P	G	H	N
Eleocharis quadrangulata (Michx.) Roemer & J.A. Schultes	Square-Stem Spike-Rush	OBL	P	G	H	N
Fimbristylis puberula (Michx.) Vahol var. *puberula*	Hairy Fimbry	-	P	H	H	N
Fimbristylis vahlii (Lam.) Link	Vahl's Fimbry	FACW	A	G	H	N
EBENACEAE						
Diospyros virginiana L.	Common Persimmon	FAC	P	T	W	N
ELATINACEAE						
Elatine triandra Schkuhr	Eurasian Waterwort	OBL	A	H	H	N
EUPHORBIACEAE						
Acalypha gracilens Gray	Slender Three-Seed-Mercury	FAC	A	H	H	N
Acalypha monococca (Engelm. ex Gray) L. Mill. & Gandhi	Single-Seed Three-Seed-Mercury	-	A	H	H	N
Croton capitatus Michx.	Hogwort	-	A	H	H	N
Croton glandulosus L.	Vente-Conmigo	-	A	R,H	H	N
Croton monanthogynus Michx.	Prairie-Tea	-	A	H	H	N
Euphorbia bicolor Engelm. & Gray	Snow-on-the-Prairie	-	A	H	H	N
Euphorbia maculata L.	Spotted Sandmat	FACU	A	H	H	N
FABACEAE						
Acaciella angustissima (P. Mill.) Britt. & Rose	Prairie-Wattle	-	P	R,H	W	N
Acmispon americanus (Nutt.) Rydb.	American Deerweed	FACU	A	H	H	N
Chamaecrista fasciculata (Michx.) Greene	Sleepingplant	FACU	A	H	H	N
Dalea multiflora (Nutt.) Shinners	Round-Head Prairie-Clover	-	P	H	H	N
Desmanthus leptolobus Torr. & Gray	Slender-Lobe Bundle-Flower	-	P	H	H	N

Taxon	Common Name	Wet	Dur	Hab	W/H	Nat
Desmodium paniculatum (L.) DC.	Panicled-Leaf Tick-Trefoil	UPL	P	H	H	N
Indigofera miniata Ortega	Coastal Indigo	-	P	H	H	N
Lespedeza cuneata (Dum.-Cours.) G. Don	Chinese Bush-Clover	FACU	P	HR,	H	I*
Lespedeza Michx. sp.	Bush-Clover	-	-	H	H	-
Lespedeza stuevei Nutt.	Tall Bush-Clover	-	P	H	H	N
Lespedeza virginica (L.) Britt.	Slender Bush-Clover	-	P	H	H	N
Medicago lupulina L.	Black Medick	FACU	A,P	H	H	I
Medicago minima L. L. ex Bartalini	Burr Medick	-	A	H	H	I*
Neptunea lutea (Leavenworth) Benth.	Yellow Puff	FACU	P	H	H	N
Strophostyles helvola (L.) Ell.	Trailing Fuzzy-Bean	FACU	A	V,H	H	N
Strophostyles leiosperma (Torr. & Gray) Piper	Slick-Seed Fuzzy-Bean	-	A	V,H	H	N
Trifolium campestre Schreb.	Lesser Hop Clover	-	A,B	H	H	I*
Trifolium repens L.	White Clover	FACU	P	H	H	I
Trifolium vesiculosum Savi	Arrow-Leaf Clover	-	A	H	H	I
Vicia minutiflora F.G. Dietr.	Pygmy-Flower Vetch	UPL	A	H,V	H	N
Vicia sativa L.	Garden Vetch	FACU	A	H,V	H	I
FAGACEAE						
Quercus stellata Wangenh.	Post Oak	FACU	P	T	W	N
GERANIACEAE						
Geranium carolinianum L.	Carolina Crane's-Bill	-	A,B	H	H	N
JUGLANDACEAE						
Juglans nigra L.	Black Walnut	FACU	P	T	W	N
JUNCACEAE						
Juncus bufonius L.	Toad Rush	OBL	A	G	H	N
Juncus diffusissimus Buckl.	Slim-Pod Rush	FACW	P	G	H	N
Juncus interior Wieg.	Inland Rush	FACW	P	G	H	N
Juncus marginatus Rostk.	Bog Rush	FACW	P	G	H	N
Juncus nodatus Coville	Stout Rush	OBL	P	G	H	N

Taxon	Common Name	Wet	Dur	Hab	W/H	Nat
LAMIACEAE						
Hedeoma hispida Pursh	Rough False Pennyroyal	-	A	H	H	N
Monarda citriodora Cerv. ex. Lag.	Lemon Beebalm	-	A,B,P	H	H	N
Monarda punctata L.	Spotted Beebalm	UPL	A,B,P	H,R	H	N
Teucrium canadense L.	American Germander	FACW	P	H	H	N
LILIACEAE						
Nothoscordum bivalve L.	Crowpoison	FACU	P	H	H	N
LINACEAE						
Linum berlandieri Hook	Berlandier's Yellow Flax	-	A,P	H	H	N
Linum medium (Planch.) Britt.	Stiff Yellow Flax	FAC	A,P	H	H	N
LYTHRACEAE						
Ammania coccinea Rottb.	Valley Redstem	OBL	A	H,R	H	N
Lythrum alatum Pursh	Wing-Angle Loosestrife	OBL	P	H,R	H	N
Rotala ramosior (L.) Koehne	Lowland Toothcup	OBL	A	H	H	N
MALVACEAE						
Callirhoe involucrata (Torr. & Gray) Gray	Purple Poppy-Mallow	-	P	H	H	N
MENISPERMACEAE						
Cocculus carolinus (L.) DC.	Carolina Coralbead	FACU	P	V	H	N
MOLLUGINACEAE						
Mollugo verticillata L.	Green Carpetweed	FAC	A	H	H	N
ONAGRACEAE						
Ludwigia alternifolia L.	Seedbox	OBL	P	H	H	N
Ludwigia glandulosa Walt.	Cylindric-Fruit Primrose-Willow	OBL	P	H	H	N
Ludwigia peploides (Kunth) Raven	Floating Primrose-Willow	OBL	P	H	H	N
Oenothera laciniata Hill	Cut-Leaf Evening-Primrose	FACU	A,P	H	H	N
Oenothera suffulta (Engelm. ex Gray) W.L. Wagner & Hoch	Kisses	-	A	H	H	N

Taxon	Common Name	Wet	Dur	Hab	W/H	Nat
OXALIDACEAE						
Oxalis dillenii Jacq.	Slender Yellow Wood-Sorrel	FACU	P	H	H	N
PLANTAGINACEAE						
Plantago aristata Michx.	Large-Bract Plantain	-	A,P	H	H	N
Plantago heterophylla Nutt.	Slender Plantain	FACW	A	H	H	N
Plantago patagonica Jacq.	Wooly Plantain	-	A	H	H	N
Plantago rhodosperma Dcne.	Red-Seed Plantain	FACU	A	H	H	N
Plantago virginica L.	Pale-Seed Plantain	FACU	A,B	H	H	N
POACEAE						
Alopecurus carolinianus Walt.	Tufted Meadow-Foxtail	FACW	A	G	H	N
Andropogon gerardii Vitman	Big Bluestem	FACU	P	G	H	N
Andropogon virginicus L.	Broom-Sedge	FACU	P	G	H	N
Bothriochloa ischaemum (L.) Keng	King Ranch Bluestem	-	P	G	H	I*
Bothriochloa saccaroides (Sw.) Rydb.	Plumed Beard Grass	-	P	G	H	I
Bromus arvensis L.	Field Brome	FACU	A	G	H	I
Bromus catharticus Vahl	Rescue Grass	-	A,P	G	H	I
Chloris verticillata Nutt.	Tumble Windmill Grass	-	P	G	H	N
Coelorachis cylindrica (Michx.) Nash	Carolina Joint-Tail Grass	FAC	P	G	H	N
Coleataenia rigidula (Bosc ex Nees) LeBlond	Red-Top Cut-Throat Panic Grass	FACW	P	G	H	N
Cynodon dactylon (L.) Pars.	Bermuda Grass	FACU	P	G	H	I*
Dichanthelium acuminatum (Sw.) Gould & C.A. Clark	Tapered Rosette Grass	FAC	P	G	H	N
Dichanthelium oligosanthes (J.A. Schultes) Gould	Heller's Rosette Grass	FACU	P	G	H	N
Digitaria ciliaris (Retz.) Kiel.	Southern Crab Grass	FACU	A	G	H	N
Echinochloa colona (L.) Link	Jungle-Rice	FACW	A	G	H	I
Echinochloa crus-galli (L.) Beauv.	Large Barnyard Grass	FAC	A	G	H	I
Echinochloa muricata (Beauv.) Fern.	Rough Barnyard Grass	FACW	A	G	H	I
Elymus canadensis L.	Nodding Wild Rye	FACU	P	G	H	N
Eragrostis capillaris (L.) Nees	Lace Grass	-	A	G	H	N

Taxon	Common Name	Wet	Dur	Hab	W/H	Nat
Eragrostis hirsuta (Michx.) Nees	Big-Top Love Grass	FACU	P	G	H	N
Eragrostis pectinacea (Michx.) Nees ex Jedw.	Purple Love Grass	FAC	A,P	G	H	N
Eragrostis pilosa (L.) Beauv.	Indian Love Grass	FACU	A	G	H	I
Eragrostis secundiflora J. Presl	Red Love Grass	FACU	P	G	H	N
Hordeum pusillum Nutt.	Little Barley	FACU	A	H	H	N
Lolium perenne L.	Perennial Rye Grass	FACU	A,P	G	H	I*
Panicum dichotomiflorum Michx.	Fall Panic Grass	FAC	A	G	H	N
Panicum virgatum L.	Switchgrass	FAC	P	G	H	N
Paspalidium geminatum (Forssk.) Stapf	Egyptian Water Crown Grass	OBL	P	G	H	N
Paspalum floridanum Michx.	Florida Crown Grass	FACW	P	G	H	N
Paspalum setaceum Michx.	Slender Crown Grass	FAC	P	G	H	N
Phalaris carolineana Walt.	May Grass	FACW	A	G	H	N
Schizachyrium scoparium (Michx.) Nash	Little Bluestem	FACU	P	G	H	N
Setaria parviflora (Poir.) Kerguélen	Marsh Bristle Grass	FAC	P	G	H	N
Sorghastrum nutans (L.) Nash	Yellow Indian Grass	FACU	P	G	H	N
Sorghum halepense (L.) Pers.	Johnson Grass	-	P	G	H	N*
Sphenopholis obtusata (Michx.) Scribn.	Prairie Wedgescale	FAC	A,P	G	H	N
Sporobolus pyramidatus (Lam.) A.S. Hitchc.	Target Dropseed	FAC	A,P	G	H	N
Steinchisma hians (Ell.) Nash	Gaping Grass	FACW	P	G	H	N
Tridens albescens (Vasey) Woot. & Standl.	White Fluff Grass	FAC	P	G	H	N
Tridens flavus (L.) A.S. Hitchc.	Tall Redtop	UPL	P	G	H	N
Vulpia bromoides (L.) S.F. Gray	Brome Six-Weeks Grass	FAC	A	G	H	I
Vulpia octoflora (Walt.) Rydb.	Eight-Flower Six-Weeks Grass	FACU	A	G	H	N
POLYGONACEAE						
Persicaria hydropiperoides (Michx.) Small	Swamp Smartweed	OBL	P	H	H	N
Persicaria pensylvanica (L.) M. Gómex	Pinkweed	FACW	A	H	H	N
Persicaria punctata (Ell.) Small	Dotted Smartweed	OBL	A,P	H	H	N
Rumex crispus L.	Curly Dock	FAC	P	H	H	I
Rumex hastatulus Baldw.	Heart-Wing Sorrel	FAC	P	H	H	N
Rumex pulcher L.	Fiddle Dock	FACW	P	H	H	I

Taxon	Common Name	Wet	Dur	Hab	W/H	Nat
PONTEDERIACEAE						
Heteranthera limosa (Sw.) Willd.	Blue Mud-Plantain	OBL	A	H	H	N
PORTULACACEAE						
Portulaca oleraceae L.	Little-Hogweed	FAC	A	H	H	I
POTAMOGETONACEAE						
Potomogeton diversifolius Raf.	Waterthread Pondweed	OBL	P	H	H	N
PRIMULACEAE						
Lysimachia minima (L.) U. Mans & A. Anderb.	Chaffweed	FACW	A	H	H	N
ROSACEAE						
Prunus angustifolia Marsch.	Chicasaw Plum	-	P	S	W	N
Rubus oklahomus Bailey	Oklahoma Blackberry	FAC	P	R	W	N
RUBIACEAE						
Cephalanthus occidentalis L.	Common Buttonbush	OBL	P	S	W	N
Diodia teres Walt.	Poorjoe	FACU	P	H	H	N
Galium aparine L.	Sticky-Willy	FACU	A	V,H	H	N
Stenaria nigricans (Lam.) Terrell	Diamond-Flowers	-	P	H,R	H	N
SALICACEAE						
Populus deltoides Bartr. ex Marsh.	Eastern Cottonwood	FAC	P	T	W	N
Salix nigra Marsh.	Black Willow	FACW	P	T	W	N
SAPOTACEAE						
Sideroxylon languinosum Michx.	Gum Bully	-	P	T	W	N
SCROPHULARIACEAE						
Agalinis heterophylla (Nutt.) Small ex Britt.	Prairie False Foxglove	FAC	A	H	H	N
Castilleja indivisa Engelm.	Entire-Leaf Indian-Paintbrush	FAC	A	G	H	N
Lindernia dubia (L.) Pennel	Yellow-Seed False Pimpernel	OBL	A,B	H	H	N

Taxon	Common Name	Wet	Dur	Hab	W/H	Nat
Nuttallanthus canadensis (L.) D.A. Sutton	Oldfield-Toadflax	-	A,B	H	H	N
Nuttallanthus texanus (Scheele) D.A. Sutton	Texas-Toadflax	-	A,B	H	H	N
Veronica peregrina L.	Neckweed	FACW	A	H	H	N
SMILACACEAE						
Smilax bona-nox L.	Fringed Greenbrier	FACU	P	S,V	W	N
SOLANACEAE						
Chamaesaracha sordida (Dunnal) Gray	Hairy Five-Eyes	-	P	H	H	N
Solanum dimidiatum Raf.	Western Horse-Nettle	-	P	H	H	N
Solanum rostratum Dugal	Horned Nightshade	-	A	H	H	N
TYPHACEAE						
Typha domingensis Pers.	Southern Cat-Tail	OBL	P	H	H	N
ULMACEAE						
Ulmus alata Michx.	Winged Elm	FACU	P	T	W	N
Ulmus americana L.	American Elm	FAC	P	T	W	N
VALERIANACEAE						
Valerianella P. Mill. sp.	Cornsalad	-	-	-	H	-
VERBENACEAE						
Phyla lanceolata (Michx.) Greene	Northern Frogfruit	FACW	P	H	H	N
Phyla nodiflora (L.) Greene	Turkey-Tangle	FAC	P	H	H	N
Verbena halei Small	Texas Vervain	-	P	H,R	H	N
VIOLACEAE						
Viola bicolor Pursh	Field Pansy	FAC	A	H	H	N
VITACEAE						
Parthenocissus quinquefolia (L.) Planch.	Virgina-Creeper	FACU	P	V	H	N
Vitus mustangensis Buckl.	Mustang Grape	-	P	V	H	N

APPENDIX B: Pond Survey Presence-Absence Data

1 = Present   0 = Absent

POND NUMBER / TAXON	712	714	715	722	723	725	726	727	729	730	731	732	733	734	736	739	747	750	757	758	758b	759	761	764	767b	772	774	775	777	780	781	790	792	793	796	798	800	805	806	810	TOTAL
Acaciella angustissima	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
Achillea millefolium	0	0	0	1	0	1	0	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	**10**
Acalypha gracilens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Acalypha monococca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	1	0	**4**
Acmispon americanus	1	1	0	0	1	0	1	1	0	1	0	0	1	1	0	0	1	1	1	0	0	0	0	1	1	1	0	0	1	1	0	0	1	1	1	1	0	1	0	1	**22**
Agalinus heterophylla	0	1	1	1	1	0	0	1	1	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**10**
Alopecurus carolinianus	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	**5**
Ambrosia artemisefolia	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	**35**
Ambrosia trifida	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Ammania coccinea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	1	0	1	**7**
Andropogon gerardii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**1**
Andropogon virginicus	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	0	1	1	1	0	1	1	1	1	0	1	0	1	**32**
Apocynum cannabinum	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	**6**
Arenaria benthamii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**1**
Asclepias tuberosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Baccharis neglecta	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**2**
Bothriochloa ischaemum	1	1	1	1	1	1	0	0	1	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0	1	1	**16**
Bromus arvensis	1	0	1	1	0	1	1	1	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0	1	0	1	1	0	0	0	0	0	1	1	0	0	0	1	0	0	**16**
Bothriochloa saccharoides	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Bradburia pilosa	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	**8**
Bromus catharticus	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	**3**
Callirhoe involucrata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Callitreche heterophylla	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	**7**
Capsella bursa-pastoris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Carex bushii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
Carex leavenworthii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**1**
Carex reniformis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Castilleja indivisa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Cephalanthus occidentalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	**3**
Cerastium glomeratum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**
Chaerophyllum tainturieri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**

POND NUMBER / TAXON	712	714	715	722	723	725	726	727	729	730	731	732	733	734	736	739	747	750	757	758	758b	759	761	764	767b	772	774	775	777	780	781	790	792	793	796	798	800	805	806	810	TOTAL
Chaetopappa asteroides	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Chamaechrista fasciculata	1	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	0	1	0	1	0	1	0	1	0	0	0	0	1	1	0	1	1	1	1	1	1	1	0	1	**19**
Chamaesaracha sordida	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**4**
Chloris verticillata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Cirsium ×iowense	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	**5**
Cirsium texanum	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	1	1	1	0	0	1	1	0	1	0	0	0	0	**12**
Cocculus carolinus	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Coelorachis cylindrica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**2**
Coleataenia rigidula	1	1	0	0	0	1	0	1	0	0	0	1	1	1	1	0	1	1	1	1	0	0	1	0	0	0	0	0	0	1	1	0	1	1	0	0	0	1	0	1	**19**
Coreopsis tinctoria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**1**
Croton capitatus	1	1	1	1	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	1	1	0	0	1	0	0	1	0	1	0	0	**19**
Croton glandulosus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	**2**
Croton monanthogynus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Cynodon dactylon	1	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	0	1	0	0	1	1	1	1	0	0	0	0	1	0	1	0	1	1	1	**16**
Cyperus acuminatus	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	1	0	0	**10**
Cyperus erythrorhizos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
Cyperus pseudovegetus	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	0	0	1	**32**
Dalea multiflora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Daucus pusillus	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	1	0	0	**9**
Desmanthus leptolobus	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Desmodium paniculatum	1	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	**8**
Diaperia verna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**
Dichanthelium acuminatum	0	1	0	1	1	1	1	1	1	0	1	1	0	0	0	1	0	1	1	1	1	1	1	1	0	1	1	0	1	1	0	0	0	1	1	1	1	0	0	1	**26**
Dicanthelium oligosanthes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**2**
Digitaria ciliaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	**2**
Diodia teres	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	1	0	1	1	0	1	0	1	1	0	0	1	0	1	**15**
Diospyros virginiana	1	1	1	0	1	1	0	1	1	1	1	1	0	1	1	1	0	1	0	1	0	0	1	1	0	0	0	0	0	0	1	0	0	1	0	0	1	1	0	0	**21**
Dyschoriste linearis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Echinacea pupurea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Echinochloa colona	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**1**
Echinochloa crus-gali	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**1**
Echinochloa muricata	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0	1	1	0	0	1	**10**
Elatine triandra	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	**6**
Eleocharis atropurpurea	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**
Eleocharis engelmannii	1	0	0	1	1	1	0	1	1	0	0	0	1	1	0	1	0	1	0	1	1	0	1	1	0	0	1	1	1	1	1	0	0	1	1	1	0	0	0	1	**23**
Eleocharis palustris	1	1	1	1	0	1	0	1	1	0	0	0	1	0	1	1	0	1	0	0	0	0	1	1	0	1	1	1	1	1	1	1	1	1	0	1	0	1	0	1	**25**

POND NUMBER / TAXON	712	714	715	722	723	725	726	727	729	730	731	732	733	734	736	739	747	750	757	758	758b	759	761	764	767b	772	774	775	777	780	781	790	792	793	796	798	800	805	806	810	TOTAL
Eleocharis quadrangulata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	**4**
Elymus canadensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Eragrostis capillaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Eragrostis hirsuta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**2**
Eragrostis pectinacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	**3**
Eragrostis pilosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**1**
Eragrostis secundiflora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Erigeron canadensis	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1	0	1	1	1	0	0	0	1	0	1	**18**
Erigeron geiseri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Erigeron philadelphicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**
Erigeron strigosus	0	1	0	0	1	1	0	1	0	0	0	0	1	0	1	0	1	1	0	1	0	0	1	0	0	0	0	0	0	1	1	1	0	1	0	1	0	1	0	1	**17**
Eupatorium serotium	0	1	0	1	1	1	0	1	0	0	1	1	0	0	1	0	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	1	0	1	0	1	0	1	**21**
Euphorbia bicolor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**
Euphorbia maculata	0	1	0	1	1	1	0	0	0	0	0	0	1	0	1	1	0	1	0	1	0	0	1	1	0	1	1	1	1	1	1	0	1	0	0	0	0	1	1	0	**20**
Euthamia gymnospermoides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Facelis retusa	0	0	1	1	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	**11**
Fimbristylis puberula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**
Fimbristilis vahlii	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	1	**8**
Gaillardia aestivalis	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**4**
Gaillardia pulchella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	**1**
Galium aparine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Gamochaeta antillana	0	1	0	0	1	1	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	1	0	1	0	1	0	0	**13**
Gamochaeta pensylvanica	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Gamochatea purpurea	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0	**7**
Geranium carolinianum	1	1	1	0	0	1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	1	1	0	1	1	0	1	0	1	1	0	0	0	1	0	0	**23**
Grindelia squarrosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Gutierrezia texana	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	**7**
Hedeoma hispida	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	**4**
Stenaria nigricans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Helenium amarum	0	0	1	1	0	0	1	1	1	1	1	0	1	1	0	1	1	1	0	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	0	0	0	1	**28**
Helianthus annuus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	**3**
Helianthus pauciflorus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	**2**
Heteranthera limosa	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
Heterophica subaxillaris	1	1	0	0	1	1	0	1	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	1	0	0	**16**
Hordeum pusillum	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	**5**
Hypocharis glabra	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	**4**

POND NUMBER / TAXON	712	714	715	722	723	725	726	727	729	730	731	732	733	734	736	739	747	750	757	758	758b	759	761	764	767b	772	774	775	777	780	781	790	792	793	796	798	800	805	806	810	TOTAL
Indigofera miniata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Iva annua	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**4**
Iva asperifolia	0	1	0	0	1	1	1	1	1	0	1	0	0	1	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**12**
Juglans nigra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Juncus bufonius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**1**
Juncus diffusissimus	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	**6**
Juncus interior	1	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	0	0	0	1	1	1	0	1	0	1	0	0	0	0	1	1	1	1	**25**
Juncus marginatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	**3**
Juncus nodatus	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	**36**
Krigia caespitosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**3**
Krigia occidentalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**1**
Krigia virginica	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**2**
Krigia wrightii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**2**
Lactuca saligna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Lactuca serriola	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	0	1	1	0	0	0	0	1	0	0	0	0	**11**
Lechea mucronata	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	**6**
Lechea tenuifolia	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**
Lepidium austrinum	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Lepidium virginicum	1	0	0	0	1	1	0	1	0	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	**13**
Lespedeza cuneata	0	1	1	1	0	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1	0	0	1	1	1	0	1	1	1	1	0	1	**31**
Lespedeza stuevei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Lespedeza virginica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**5**
Lespedeza species	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Liatris punctata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Lindernia dubia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**
Linum berlandieri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**1**
Linum medium	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	**7**
Lolium perenne	0	1	0	0	0	0	1	1	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	**9**
Lysimachia minima	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Ludwigia alterniflora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	**2**
Ludwigia glandulosa	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	0	1	**34**
Ludwigia peploides	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	1	1	0	0	0	0	1	0	0	0	0	1	**9**
Lythrum alatum	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
Medicago lupulina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**1**
Medicago minima	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Mollugo verticillata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	1	0	0	1	1	**7**

POND NUMBER / TAXON	712	714	715	722	723	725	726	727	729	730	731	732	733	734	736	739	747	750	757	758	758b	759	761	764	767b	772	774	775	777	780	781	790	792	793	796	798	800	805	806	810	TOTAL
Monarda citriodora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	**2**
Monarda punctata	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**2**
Neptunea lutea	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
Nothoscordum bivalve	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Nuttallanthus canadensis	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	1	0	0	0	0	0	1	**11**
Nuttallanthus texanus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**1**
Oenothera laciniata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	1	1	0	1	0	0	1	0	1	1	0	**10**
Oenothera suffulta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Oxalis dillenii	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	**7**
Panicum dichotomiflorum	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	1	**9**
Panicum vergatum	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	**34**
Parthenocissus quinquefolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Paspalidium germinatum	0	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**5**
Paspalum floridanum	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	**3**
Paspalum setaceum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**1**
Persicaria hydropiperoides	1	1	1	0	1	1	1	1	1	0	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**36**
Persicaria pensylvanicum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Persicaria punctatum	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	**5**
Petrorhagia dubia	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**2**
Phalaris carolineana	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Phyla lanceolata	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Phyla nodiflora	1	1	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	1	1	0	1	0	0	**15**
Plantago aristata	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	1	0	0	1	1	0	1	0	0	0	0	0	0	0	**10**
Plantago heterophylla	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**2**
Plantago patagonica	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	**4**
Plantago rhodosperma	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	1	0	0	**5**
Plantago virginica	0	1	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	0	1	1	0	1	0	0	0	0	0	1	0	**12**
Pluchea camphorata	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	1	1	0	1	0	1	0	1	0	0	1	0	0	0	0	**11**
Polypremum procumbens	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	1	0	1	0	1	**9**
Populus deltoides	0	0	1	1	1	1	0	1	1	0	0	1	0	1	1	1	1	1	1	0	0	0	0	1	0	1	1	1	0	0	0	1	1	0	1	0	1	0	0	0	**21**
Portulaca oleracea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	**3**
Potamogeton diversifolius	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	1	1	0	0	0	**8**
Prunus angustifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**
Pseudognaphalium obtusifolium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Pyrrhopappus carolinianus	1	1	0	1	1	0	0	1	0	1	0	0	1	0	0	1	1	1	0	1	0	0	0	1	0	0	0	0	1	1	1	1	1	1	0	1	0	1	0	1	**21**

POND NUMBER / TAXON	712	714	715	722	723	725	726	727	729	730	731	732	733	734	736	739	747	750	757	758	758b	759	761	764	767b	772	774	775	777	780	781	790	792	793	796	798	800	805	806	810	TOTAL
Pyrrhopappus grandiflora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Pyrrhopappus pauciflorus	1	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0	0	0	0	0	0	**8**
Quercus stellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	**2**
Rhus copallinum	0	0	0	1	1	1	1	0	0	0	0	0	0	1	1	1	1	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**13**
Rhus glabra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	1	**7**
Rorripa teres	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	1	1	**8**
Rotala ramosior	0	1	0	1	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**9**
Rubus oklahomus	0	0	0	1	0	1	1	1	1	0	0	0	1	1	0	0	1	0	0	1	0	1	0	0	1	1	0	0	0	1	1	1	0	1	0	0	0	1	0	1	**18**
Rudbeckia hirta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	**3**
Rumex crispus	1	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	**14**
Rumex hastatulus	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**3**
Rumex pulcher	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Sagittaria platyphylla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**1**
Salix nigra	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	**37**
Schizachyrium scoparium	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	**9**
Setaria parviflora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
Sideroxylon languinosum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Silene antirhina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	**2**
Smilax bona-nox	0	0	1	1	0	1	1	1	1	0	1	0	1	1	1	0	1	0	0	1	1	0	1	0	1	1	1	1	0	1	0	0	1	1	1	0	1	1	1	0	**25**
Solanum dimidiatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Solanum rostratum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Solidago nitida	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**5**
Sonchus asper	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	1	**7**
Sorghastrum nutens	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**9**
Sorghum halepense	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Spenopholis obtusata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	**3**
Sporobolus pyramidatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Steinchisma hians	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	**17**
Stenaria nigricans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Strophostyles helvula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**3**
Strophostyles leiosperma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	**3**
Symphiotricum divaricatum	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	0	1	1	1	1	0	1	0	1	**34**
Symphiotricum ericoides	1	1	0	0	0	1	0	1	0	0	1	1	0	1	0	0	0	0	1	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	**13**
Teucrium canadense	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
Toxicodendron radicans	0	0	0	0	0	1	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**5**
Tridens albescens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**

POND NUMBER / TAXON	712	714	715	722	723	725	726	727	729	730	731	732	733	734	736	739	747	750	757	758	758b	759	761	764	767b	772	774	775	777	780	781	790	792	793	796	798	800	805	806	810	TOTAL
Tridens falvus	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	**3**
Trifolium campestre	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	**7**
Trifolium repens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	**3**
Trifolium vesiculosum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**2**
Triodanus perfoliata	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	**9**
Typha domingensis	0	1	0	0	1	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	**10**
Ulmus alata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	**3**
Ulmus americana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**
Vallerianella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	**3**
Verbena halei	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	1	0	0	1	1	0	0	0	0	1	0	**8**
Veronica peregrina	1	1	1	1	0	1	1	0	1	0	1	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1	0	1	1	1	1	0	1	0	0	0	0	1	0	0	**18**
Vicia minutiflora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
Vicia sativa	1	1	0	0	0	0	1	1	0	1	1	1	0	1	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	1	0	**14**
Viola bicolor	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**2**
Vitis mustangensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**1**
Vulpia bromoides	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Vulpia octoflora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**2**
Xanthium strumarium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**1**
TOTAL TAXA IN POND	**43**	**58**	**25**	**38**	**41**	**50**	**34**	**43**	**30**	**24**	**35**	**37**	**28**	**35**	**33**	**45**	**39**	**68**	**20**	**44**	**22**	**26**	**32**	**36**	**23**	**55**	**60**	**46**	**54**	**78**	**54**	**34**	**46**	**41**	**22**	**40**	**33**	**55**	**31**	**56**	

APPENDIX C: Table of Plant Community Characteristics

	Temporary (n = 33)		Permanent (n = 7)	
	$\bar{x}$	SE	$\bar{x}$	SE
Species richness	32.61	2.03	48.14	6.02
No. of perennial species	21.00	0.94	21.00	1.46
Composition of perennials (%)	57.02	1.82	42.78	3.64
No. of wetland species	11.64	0.68	16.57	0.84
Composition of wetland species (%)	31.13	1.22	34.22	3.55
No. of woody species	3.58	0.27	2.57	0.53
Composition of woody species (%)	9.96	0.80	5.61	1.75

VITA

Personal Background

Sarah Ziomek
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Education

Keller High School, Keller, Texas — June 2009
Diploma, *Salutatorian*

Texas Christian University, Fort Worth, Texas — May 2012
Bachelor of Science, Environmental Science, *summa cum laude*

Universidad San Francisco de Quito, Ecuador — Dec. 2011
Semester Study Abroad, Galápagos Islands Ecology Program

Texas Christian University, Fort Worth, Texas — May 2014
Master of Science, Environmental Science

Experience

Pape-Dawson Engineers, Inc.
Environmental Scientist Intern — Apr. 2014 – present
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TCU School of Geology, Energy, & the Environment
Graduate Teaching Assistant — Aug. 2012 – present
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National Park Service
Visitor Service Assistant — Summers 2010 – 2013
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TCU Housing and Residence Life
Resident Assistant — Aug. 2010 – May 2013
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ABSTRACT

PLANT SPECIES RICHNESS OF LYNDON B. JOHNSON NATIONAL GRASSLAND PONDS

by Sarah Ziomek, M.S. 2014
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We examined the influence of surface area and water permanence on plant species richness of ponds at Lyndon B. Johnson National Grassland in north central Texas. Forty ponds were randomly selected and surveyed during a spring and fall field season. Ponds varied in size from <100 m^2 to >4000 m^2; species richness ranged from 20 to 78 species. A total of 228 taxa from 51 families were found. A cluster analysis showed all ponds to be at least 50% dissimilar in floristic composition. There was a significant, positive relationship between surface area and richness, number of wetland species, and number of perennial species. Permanent ponds displayed significantly higher richness, composition of perennial species, and numbers of wetland species than temporary ponds. While surface area and permanence helped in part to explain the variation in richness between ponds, stochastic events and other factors also influence the composition of pond vegetation.