A Classification and Analysis of Emergent Wetland Vegetation in Western Oklahoma

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Vegetation classification is an important tool for researchers and resource managers. In the case of wetland vegetation, there is a paucity of quantitative data and analysis for classification purposes. This study analyzed quantitative vegetation data from 55 sites in western Oklahoma. Eight vegetation classes were identified. The two most common vegetation types were dominated by *Schoenoplectus americanus* and *Typha domingensis*. Previous studies had not identified vegetation dominated by *Heteranthera limosa-Bacopa rotundifolia-Marsilea vestita*. One site was dominated by *Thalia dealbata*, which had not been reported from western Oklahoma in the past.

INTRODUCTION

Information classification is a crucial aid in the interpretation of the relationships between categories (*1*). The classification of vegetation into units facilitates communication between researchers and resource managers (*2,3*). For wetland managers and researchers the Cowardin et al. (*4*) classification system has become an integral component of wetland inventory and conservation efforts (*5*). The goals set forth by Cowardin et al. (*4*) include (a) the description of ecological units with homogenous natural attributes, (b) arrangement of those attributes in order to aid resource managers, (c) identification of units for classification and inventory, and (d) provision of uniformity in concepts and terminology (*5*). At the base of the Cowardin et al. (*4*) classification are the dominance types which provide a description of vegetation units within a region.

Information on wetland dominance types for a region or state can be obtained through field studies or through a review of the published literature. Unfortunately, there is a paucity of literature regarding the vegetation of western Oklahoma herbaceous wetlands. The need for increased quantitative data for wetland vegetation in Oklahoma has been noted (*6*). Recent studies of western Oklahoma wetlands do not provide a classification of dominance types (*7,8*). Penfound (*9*) recognized 27 wetland vegetation types in western Oklahoma in a study of vegetation associated with reservoirs and natural lakes. The results of this study were based presence/absence data but were not quantitatively analyzed.

The structure and dynamics of vegetation in buffalo wallows is probably the most extensively studied wetland habitat in western Oklahoma (*10-14*). Buffalo wallows are small-scale landscape features with low species diversity and with vegetation composed of primarily perennial wetland species (*14*). Vegetation structure of playa lake wetlands were analyzed by Hoagland and Collins (*15*), including sites in Texas and Cimarron Counties.

The goals of the current study were to provide a quantitatively derived classification and description of herbaceous wetland vegetation. Such a classification will be of value to wetland conservation and management efforts in Oklahoma.

METHODS

Study area: Study sites were located in 16 western Oklahoma counties (Fig. 1). Within the study area, latitudinal variation in temperature and longitudinal variation in precipitation combine to produce a south-

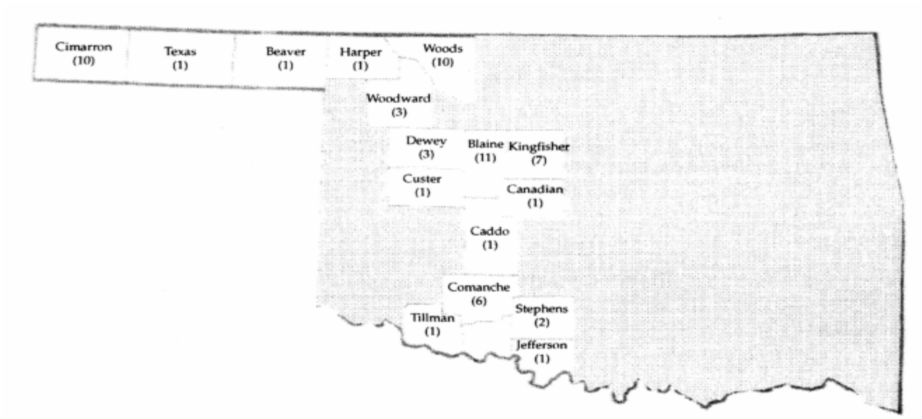

Figure 1: Location of western Oklahoma emergent wetland study sites. The number of sites quantitatively sampled in each is numerically designated.

east-to-northwest environmental gradient (*16*). For example, mean annual temperature in the southeastern portion of the study area is 17.2°C and in the northwest is 13.3°C (*17*). Likewise, the mean annual low temperature decreases from 18°C in the southeast to 1.7°C in Cimarron County, and the mean annual high temperature from 28.9°C to 25.6°C. There are 200 frost free days in Jefferson County as contrasted with 170 days in the northwest (*17*). Mean annual precipitation ranges from 83 cm to 41 cm along a southeast to northwest axis.

Physiographically, the study is characterized by gently rolling topography with local occurrences of dissected hills. The surface geology is composed primarily of shallow-marine deposits (*18*). However, Tertiary sands, clays, and gravels are prominent in Ellis, Harper, and the Panhandle Counties (*18*). Several soil great groups are present in the study area, ranging from darkly colored loams and clay loams developed under mid and shortgrass prairies which are typical of the panhandle, to dark or dark-reddish clay and clay-loam developed under tall, mid, and shortgrass prairie which are prominent in the remainder of the study area (*19*). Stabilized and active sand dunes along major streams are another important group of soils. They are mostly brown and light brown loams and sands with clay lenses that support semi-permanently flooded habitats (*19*). Gypsum outcrops and saline springs produce soils that support halopyhtic vegetation (*20-22*). In excess of 40 hydric soil types have been identified in western Oklahoma (*8*).

Data collection and analysis: Study sites were located by review of 1:24,000 scale US Geological Survey topographic quadrangles and National Wetland Inventory maps. Sites were excluded from this study if they met any of the following criteria: (a) heavily grazed (i.e., vegetation cropped to less than 3 cm and trampled), (b) converted to exotic pasture grasses (i.e., *Cynodon dactylon*), (c) currently or recently in row crop production, or (d) evidence of extensive physical modification. In the field, sites were assigned to the appropriate class in the Cowardin et al. (*4*) system. Quantitative vegetation data were collected from acceptable sites using randomly placed 0.25 m^2 quadrats. This sample size was chosen because of the small size and linear nature of many western Oklahoma wetlands. A larger sample size would increase the amount of upland vegetation in the quadrat. The number of quadrats sampled depended on the total area of the site. All species occurring within a quadrat were recorded, and percent cover was then visually estimated to the nearest 5%.

Vegetation data from each site were compiled into a matrix of mean species cover values-by-site. Vegetation data were classified into floristic associations by using two-way species indicator analysis (*1,23*). These data were subsequently analyzed by using detrended correspondence analysis (DCA; *24,25*) to identify regional gradients and trends in species composition.

RESULTS

Vegetation classification: A total of 55 sites were sampled and 182 species encountered. The greatest number of sites where located in Blaine and Cimarron Counties. The distribution of sites reflects the availability and access to sites which met the sampling criteria. Table 1 lists all species encountered during the sampling, the TWINSPAN clusters into which they were classified, and species richness, diversity, evenness values for each cluster. TWINSPAN analysis produced eight vegetation clusters (Table 2). *Echinochloa crusgalli, Eleocharis palustris, Polygonum pensylvanicum, Rumex altissimus, Schenoplectis americana, S. tabernaemontanii*, and *Typha domingensis* were the most frequently encountered species. All vegetation clusters were dominated by perennial plant species.

Cluster 1 was composed of pond sites that occurred in the swales of stabilized sand dunes. These ponds and attendant vegetation were encountered throughout central Oklahoma, but not in far northwest Oklahoma or in the Panhandle. The dominance type at these sites was described as *Heteranthea limosa-Bacopa rotundifolia-Marsilea vestita*. Associated species included *Ammania coccinea*, *P. pensylvanicum*, *P. coccinea*, and *Sagittaria latifolia*. The most abundant plants on pond shorelines were *Leptochloa fasicularis* and *E. crusgalli*. Upland vegetation was dominated by *Artemisia filifolia*, *Sporobolus cryptandrus*, and *Schizachyrium scoparium*. Several swales throughout the study area contained this vegetation type, but were not sampled because of plowing.

Vegetation of Clusters 2 and 6 occupied small depressions on clay soils, and the dominant species in both were of the genus *Eleocharis*; *E. compressa* in the case of Cluster 2, and *E. palustris* in Cluster 6. Cluster 6 had both the lowest species richness (17) and species diversity value (1.07) of the TWINSPAN clusters. In both cases, upland vegetation was of the mixedgrass prairie dominated by *S. scoparium-Sorghastrum nutans*.

Cluster 3 contained the greatest number of sites and the highest species diversity. The greatest mean cover value and highest frequency was *T. domingensis*. Frequently co-occurring species included *Lippia nodiflora*, *P. lapathifolium*, *P. pensylvanicum*, *Panicum virgatum*, *Salix nigra*, and *S. americanus*. Sites for this vegetation occurred in a broad array of habitats, including palustrine and riverine.

Cluster 4 was dominated by *S. americanus*. Frequently occurring species included *Cephalanthus occidentalis*, *Lycopus americana*, *P. virgatum*, and *S. tabernaemontanii*. No clear vegetation type emerged from cluster 5. Species with high cover values in this cluster included one site dominated by *Nelumbo lutea* and two by *Thalia dealbata*.

Cluster 7 contained playa lakes. *Pascopyrum smithii*, a mesic C_3 grass, was the dominant species at these sites. *L. cuneifolia* and *Oenothera canescens* co-occurred in all playa lake. Guymon playa, which captured irrigation run-off, was the only playa dominated by obligate wetland species (*P. coccinea* and *P. lapathifolium*).

Sites in Cluster 8 occurred in saline areas and were dominated by *Distichlis stricta-S. americana*. Frequently occurring species included *Aster subulatus*, *E. palustris*, and *L. lanceolata*. Boggy Creek salt flats, located in a gypsum outcrop area in Beckham County, a unique salt tolerant species, *Cressa truxillensis*, which had been previously documented from only one site in Oklahoma and not collected since the 1950 (*26*).

Ordination: Species turnover was lower on the first DCA axis (s.d. = 3.54) than the second DCA axis (s.d. = 6.71) (Fig. 2). Eigenvalues were high for both axes, 0.91 and 0.71, respectively. One site, the only site containing *Phragmites australis*, exerted a strong outlier influence and was excluded from analysis. The first axis represents a gradient of decreasing hydroperiod. Floristically, sites were separated by dominance of *Typha* spp. and/or *Schoenoplectus* spp. or grasses. *Typha* spp. and *Schoenoplectus* wetlands occur in semi-permanently flooded to permanently flooded conditions, while playa lakes, by comparison, were in-

TABLE 1: Site summaries for western Oklahoma emergent wetland sites.

Site	County	S[a]	E	H'	Cluster
Beav1	Beaver	4.00	0.57	0.79	CL4
Beck1	Beckham	14.00	0.69	1.82	CL3
Beck2	Beckham	11.00	0.52	1.26	CL3
Beck3	Beckham	19.00	0.60	1.77	CL8
Blai1	Blaine	13.00	0.69	1.76	CL4
Blai	Blaine	7.00	0.64	1.24	CL3
Blai3	Blaine	8.00	0.85	1.76	CL3
Blai4	Blaine	10.00	0.64	1.47	CL4
Blai5	Blaine	10.00	0.76	1.76	CL1
Blai6	Blaine	11.00	0.54	1.29	CL3
Blai7	Blaine	9.00	0.76	1.67	CL4
Blai8	Blaine	7.00	0.74	1.45	CL3
Blai9	Blaine	15.00	0.72	1.96	CL3
Blai10	Blaine	7.00	0.81	1.57	CL1
Blai11	Blaine	17.00	0.78	2.21	CL3
Cadd1	Caddo	13.00	0.67	1.73	CL5
Cana1	Canadian	15.00	0.55	1.49	CL3
Cima1	Cimarron	5.00	0.63	1.01	CL9
Cima2	Cimarron	19.00	0.69	2.02	CL3
Cima3	Cimarron	7.00	0.56	1.08	CL3
Cima4	Cimarron	11.00	0.71	1.69	CL7
Cima5	Cimarron	8.00	0.59	1.22	CL7
Cima6	Cimarron	7.00	0.65	1.27	CL7
Cima7	Cimarron	8.00	0.36	0.75	CL7
Cima8	Cimarron	10.00	0.55	1.26	CL7
Cima9	Cimarron	14.00	0.48	1.26	CL4
Cima10	Cimarron	15.00	0.52	1.39	UNA
Coma1	Comanche	14.00	0.85	2.23	CL2
Coma2	Comanche	17.00	0.80	2.28	CL2
Coma3	Comanche	9.00	0.64	1.41	CL2
Coma4	Comanche	12.00	0.78	1.94	CL2
Coma5	Comanche	15.00	0.88	2.37	CL2
Coma6	Comanche	14.00	0.80	2.11	CL2
Cust1	Custer	20.00	0.74	2.20	CL1
Dewe1	Dewey	13.00	0.61	1.56	CL1
Dewe2	Dewey	8.00	0.74	1.53	CL3
Harp1	Harper	15.00	0.47	1.27	CL3
Jeff1	Jefferson	19.00	0.71	2.09	CL4
King1	Kingfisher	8.00	0.75	1.57	CL4
King2	Kingfisher	14.00	0.63	1.67	CL3
King3	Kingfisher	20.00	0.82	2.46	CL3
King4	Kingfisher	3.00	0.08	0.09	CL3
King5	Kingfisher	17.00	0.70	1.97	CL3
King6	Kingfisher	13.00	0.71	1.83	CL5
King7	Kingfisher	20.00	0.45	1.36	CL3
Kiow1	Kiowa	8.00	0.75	1.56	CL4
Step1	Stephens	16.00	0.72	2.00	CL5
Step2	Stephens	21.00	0.74	2.24	CL5
Texa1	Texas	22.00	0.82	2.53	CL5
Till1	Tillman	23.00	0.73	2.28	CL8
Wood1	Woods	16.00	0.88	2.44	CL4
Wood2	Woods	19.00	0.73	2.14	CL4
Wodw1	Woodward	7.00	0.31	0.60	CL6
Wodw2	Woodward	10.00	0.36	0.83	CL6
Wodw3	Woodward	13.00	0.55	1.40	CL6

[a] S is the number of species at a site, E is the evenness value, and H' is species diversity.

TABLE 2: Species composition of TWINSPAN clusters. Diversity, richness, and evenness are provided for each cluster.

		Cluster 1 (n=4)		Cluster 2 (n=6)		Cluster 3 (n=16)		Cluster 4 (n=10)		Cluster 5 (n=5)		Cluster 6 (n=3)		Cluster 7 (n=5)		Cluster 8 (n=3)	
	F[a]	F	MC	F	MC	F	MC	F	MC	F	MC	F	MC	F	MC	F	MC
Alopecurus carolinianus	6	-	-	6	3.67	-	-	-	-	-	-	-	-	-	-	-	-
Ambrosia grayii	3	-	-	-	-	-	-	-	-	1	1.10	-	1	2.02	-	-	-
A. psilostachya	13	-	-	6	8.25	3	0.48	1	0.60	-	-	-	-	2	0.24	1	0.10
A. trifida	4	-	-	-	-	1	0.03	-	0.06	1	0.60	-	-	-	-	-	-
Ammania coccinea	8	4	7.55	1	0.50	1	0.11	1	0.12	-	-	-	-	-	-	-	-
Aster ericoides	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. subulatus	8	-	-	-	-	3	0.09	1	0.02	2	0.08	-	-	-	-	2	2.40
Bacopa rotundifolia	5	4	11.6	1	2.08	-	0.94	-	-	-	-	-	-	-	-	-	
Bouteloua curtipendula	3	–	-	3	1.67	-	–	-	-	–	-	-	-	-	-	-	-
B. gracilis	3	-	-	-	-	-	-	-	-	-	-	2	0.37	1	0.20	-	-
Bromus japonicus	6	-	-	5	4.67	1	-	-	-	-	-	-	-	-	-	-	-
Buchloe dactyloides	4	-	-	1	5.50	-	-	-	-	-	-	1	1.93	2	6.20	-	-
Cephalanthus occidentalis	10	-	-	-	-	4	0.01	-	-	-	-	-	-	-	-	-	-
Carex hystericina	7	-	-	-	-	3	0.46	1	0.71	-	-	-	-	-	-	-	-
Chenopodium album	4	-	-	-	-	-	-	-	-	-	-	-	-	3	1.16	1	0.87
Conyza canadensis	3	-	-	-	-	1	0.01	-	-	-	-	-	-	1	1.56	1	0.20
Coreopsis tinctoria	8	2	0.33	6	9.33	-	-	-	-	-	-	-	-	-	-	-	-
Cynodon dactylon	6	1	0.70	-	-	3	0.43	2	4.11	-	-	-	-	-	-	-	-
Cyperus aristatus	4	-	-	-	-	1	0.02	-	-	-	-	2	0.50	-	-	-	-
C. pseudovegetus	11	1	0.30	6	3.67	2	0.06	1	0.02	-	-	-	-	-	-	-	-
Distichlis stricta	5	-	-	-	-	-	-	1	0.39	1	0.06	-	-	-	-	3	32.0
Eclipta prostrata	7	-	-	-	-	3	0.31	1	0.02	1	1.36	-	-	1	1.40	1	0.10
Echinochloa crus-galli	17	4	7.98	2	5.67	5	1.20	3	1.34	2	1.12	-	-	-	-	1	0.33
E. muricata	4	-	-	-	-	1	1.51	1	0.25	-	-	2	1.43	-	-	-	-
Echinodorus rostrata	4	1	1.23	-	-	1	0.08	-	-	2	0.34	-	-	-	-	-	-
Eleocharis compressa	10	1	0.08	2	11.42	2	0.84	-	-	4	4.16	-	-	-	-	1	2.93
E. montevidensis	11	-	-	1	0.75	4	2.31	4	2.59	2	0.04	-	-	-	-	-	-
E. palustris	16	-	-	1	0.17	6	5.04	4	3.13	1	0.28	3	47.37	1	0.20	-	-
Elymus canadensis	3	-	-	2	1.25	1	0.05	-	-	-	-	-	-	-	-	-	-
Euphorbia marginata	3	-	-	-	-	1	0.01	-	-	-	-	-	-	1	0.20	1	0.47
E. serpens	3	-	-	-	-	1	0.06	-	-	-	-	1	0.27	-	-	1	0.07
Fuirnea squarrosa	3	-	-	-	-	2	0.29	1	1.30	-	-	-	-	-	-	-	-
Heteranthera limosa	5	4	21.7	-	-	1	0.08	-	-	-	-	-	-	-	-	-	-
Hordeum jubatum	9	-	-	6	1.83	1	0.01	-	-	1	0.06	-	-	1	0.40	-	-

TABLE 2: continued

		Cluster 1 (n=4)		Cluster 2 (n=6)		Cluster 3 (n=16)		Cluster 4 (n=10)		Cluster 5 (n=5)		Cluster 6 (n=3)		Cluster 7 (n=5)		Cluster 8 (n=3)	
	F[a]	F	MC	F	MC	F	MC	F	MC	F	MC	F	MC	F	MC	F	MC
Iva annua	6	-	-	3	9.67	1	0.02	1	0.88	1	1.26	-	-	-	-	1	0.40
Juncus torreyi	11	-	-	-	-	4	2.86	3	0.08	4	0.58	-	-	-	-	-	-
J. diffusissimus	7	-	-	4	1.67	-	-	-	-	2	1.44	1	0.10	-	-	-	-
Justicia americana	3	-	-	-	-	-	-	1	1.54	2	3.88	-	-	-	-	-	-
Leersia oryzoides	4	-	-	-	-	3	0.53	-	-	1	0.72	-	-	-	-	-	-
Lemna valdiviana	4	1	1.28	-	-	2	0.73	-	-	1	2.00	-	-	-	-	-	-
Leptochloa fasicularis	6	2	4.80	-	-	3	0.70	-	-	-	-	-	-	-	-	-	-
Lippia cuneifolia	7	-	-	-	-	-	-	-	-	-	-	3	3.60	5	9.62	-	-
L. lanceolata	5	-	-	-	-	4	2.50	-	-	-	-	-	-	-	-	1	3.33
L. nodiflora	13	-	-	-	-	7	1.85	4	1.90	1	0.12	-	-	-	-	1	1.03
Ludwigia palustri	7	–	-	–	-	5	1.52	2	1.78	-	-	-	-	-	-	-	-
Lycopus americana	7	-	-	-	-	2	0.12	5	0.49	-	-	-	-	-	-	-	-
Lythrum alatum	5	-	-	4	4.17	-	-	1	1.10	-	-	-	-	-	-	-	-
Marsilea vestita	9	2	10.4	3	6.67	-	-	-	-	1	0.02	3	0.30	-	-	-	-
Mollugo verticillata	3	2	0.35	-	-	-	-	-	-	-	-	1	0.10	-	-	-	-
Oenothera canescens	6	-	-	-	-	-	-	-	-	1	0.04	-	-	4	2.00	-	-
Panicum dichotomiflorum	5	1	0.45	-	-	1	0.16	1	0.27	1	0.36	-	-	-	-	1	0.87
P. oligosanthes	3	-	-	2	1.58	-	-	1	0.20	-	-	-	-	-	-	-	-
P. obtusum	3	-	-	-	-	-	-	-	-	-	-	3	5.60	-	-	-	-
P. virgatum	13	-	-	-	-	6	1.74	7	9.69	-	-	-	-	-	-	-	-
Pascopyrum smithii	7	-	-	-	-	-	-	-	-	1	0.34	-	-	5	36.4	1	2.00
Paspalum dilatatum	3	-	-	-	-	-	-	1	0.02	1	0.50	-	-	-	-	1	4.93
Pluchea odorata	10	-	-	-	-	6	3.18	2	0.99	-	-	-	-	-	-	2	0.30
Polygonum amphibium	4	1	2.63	-	-	-	-	-	-	3	4.58	-	-	-	-	-	-
P. hydropiperoides	7	-	-	1	0.08	2	0.46	2	0.67	2	5.78	-	-	-	-	-	-
P. lapathifolium	10	2	1.08	-	-	6	0.41	-	-	2	4.84	-	-	-	-	-	-
P. pensylvanicum	16	4	2.50	-	-	7	1.05	-	-	3	6.46	-	-	1	0.06	1	0.33
P. ramosissimum	5	-	-	-	-	1	0.02	-	-	1	0.56	3	0.43	-	-	-	-
Polypogon monspeliensis	3	-	-	-	-	1	0.09	-	-	-	-	-	-	-	-	2	1.60
Populus deltoides	7	1	0.05	-	-	4	0.15	1	0.03	-	-	-	-	-	-	-	-
Psoralea lanceolata	3	-	-	3	1.17	-	-	-	-	-	-	-	-	-	-	-	-
Ranunculus scleratus	6	-	-	-	-	6	0.49	-	-	-	-	-	-	-	-	-	-
Ratibida tagetes	3	-	-	-	-	-	-	-	-	1	0.06	-	-	2	0.60	-	-
Rorippia sinuata	3	-	-	-	-	-	-	-	-	1	0.48	1	0.13	-	-	-	-

TABLE 2: continued

	F[a]	Cluster 1 (n=4)		Cluster 2 (n=6)		Cluster 3 (n=16)		Cluster 4 (n=10)		Cluster 5 (n=5)		Cluster 6 (n=3)		Cluster 7 (n=5)		Cluster 8 (n=3)	
		F	MC	F	MC	F	MC	F	MC	F	MC	F	MC	F	MC	F	MC
Rumex altissimus	14	-	-	-	-	6	0.94	3	0.75	2	0.46	-	-	1	0.16	2	0.43
Sagittaria latifolia	7	3	7.05	-	-	3	0.61	-	-	1	0.06	-	-	-	-	-	-
Salix nigra	14	1	0.08	-	-	10	1.91	-	-	2	0.52	-	-	-	-	1	1.30
Samolus parviflorus	5	-	-	-	-	3	0.31	2	0.28	-	-	-	-	-	-	-	-
Schenoplectus americanus	21	-	-	-	-	10	6.09	9	25.4	-	-	-	-	-	-	2	12.20
S. tabernamontanae	20	1	0.78	1	0.05	8	1.54	5	4.40	4	8.88	1	0.20	-	-	-	-
Setaria geniculata	4	-	-	-	-	1	0.01	3	0.58	-	-	-	-	-	-	-	-
Spirodela polyrhiza	10	-	-	-	-	7	5.45	2	0.95	1	1.96	-	-	-	-	-	-
Tamarix chinensis	6	-	-	-	-	3	0.22	1	0.50	-	-	-	-	-	-	2	1.07
Tragopogon dubia	4	-	-	-	-	-	-	-	-	-	-	-	-	2	0.08	2	0.07
Typha angustifolia	5	-	-	-	-	3	5.22	1	0.04	-	-	-	-	-	-	-	-
T. domingensis	14	1	6.55	-	-	8	24.4	3	3.94	2	11.1	-	-	-	-	-	-
T. latifolia	4	-	-			3	1.52	-	-	1	0.30	-	-	-	-	-	-
Xanthium strumarium	10	1	0.10	-	-	4	0.41	2	0.04	1	0.02	-	-	-	-	2	0.33
Species richness			28.00		31.00		80.00		64.00		56.00		17.00		28.00		38.00
Evenness			0.78		0.86		0.70		0.70		0.79		0.38		0.54		0.65
Diversity			2.60		2.94		3.09		2.89		3.19		1.07		1.81		2.38

[a] F = frequency, or the number of times a species was recorded within a particular cluster. MC is the mean cover of a species in a cluster.

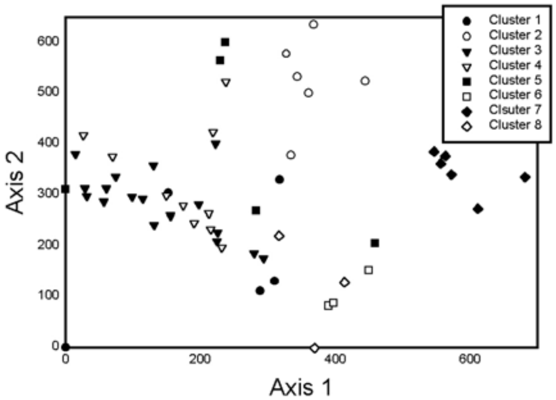

Figure 2: Detrended Correspondence Analysis biplot of emergent wetland sites in western Oklahoma. Sites are coded by Two-way Indicator Species clusters.

frequently flooded. Given the broad distribution to *Typha* spp. and *Schenoplectus* spp., neither axis represented a geographic gradient.

DISCUSSION

Five of the seven vegetation associations correspond with the 29 vegetation associations listed by Penfound (*9*) for western Oklahoma; *E. palustris, T. domingensis, S. americanus, N. lutea*, and *D. stricta*. *D. stricta* vegetation is a dominant type at the Great Salt Plains (*22*). Several of the vegetation types listed by Penfound (*9*) represent stages in the annual hydrologic dynamics of wetlands. For example, six wetland types were listed for playa lakes: *Lythrum-Verbena*, *Buchloë dactyloides*, *Chenopodium-Myosurus*, *P. persicaria*, and *Sida-Triticum*. All of these species and genera, with the exception of *Myosurus*, were encountered to varying degrees of abundance, although none were dominants. *B. dactyloides*, which is capable of withstanding spring flooding (*27*), occurred in several of the playa lakes sampled for this study, but was not a dominant. It was reported as a dominant in playa lakes located in adjacent Texas and New Mexico (*6*).

Wetland vegetation dominated by members of the Cyperaceae, particularly the genus *Eleocharis*, have been reported from other studies. In this study, three of the vegetation types reported were dominated by the Cyperaceae. The genus *Eleocharis* is an important component of buffalo wallow vegetation (*10 - 14,28*). In western Oklahoma, *Eleocharis* species were most abundant in wet depressions or along shorelines. Only Penfound (*9*) reported vegetation dominated by *S. americanus*, which is interesting when its broad distribution in western Oklahoma is considered.

There were several sites dominated by broadleaf wetland plants. *Nelumbo lutea*, the most broadly distributed member of Nymph-aceae in Oklahoma, dominated one site. It has been reported as a dominant in other parts of Oklahoma (*29,30*). Interestingly, *T. dealbata* was the dominant at a Jefferson County site. The Atlas of the Flora of Oklahoma database shows the nearest population of *T. dealbata* to be located in Johnston County, making the Jefferson County station the westernmost in Oklahoma. Hoagland (*6*) reported the co-dominant species to be *T. latifolia*; however, in this study, *Justicia americana* was co-dominant.

This study demonstrates the diversity of vegetation in western Oklahoma emergent wetlands. However, further study is needed. The inclusion of aquatic vegetation as well as woody riparian vegetation is warranted. Although in many areas woody riparian wetland vegetation has been displaced by the *Tamarix* spp., stands of *Salix nigra* and *S. exigua* are extensive. Such efforts would complement this work by completing a classification of wetland vegetation.

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