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Texas Rolling Plains Prairie Fen: A New Association for the USNVC

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Abstract

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We provide a first-ever description of a prairie fen type in the Rolling Plains Ecoregion of north-central Texas. Our goal was to characterize the ecology and vegetation of the fen and describe threats. The results of this investigation included sampling the vegetation composition and documenting the floristics of five (5) fen sites to formally describe this regional rare plant community type. These fen sites contain several plants at their eastern limits, as well as disjunct, and peripheral species. Two native plant additions to the Texas flora has resulted from these surveys. New flora additions include *Epilobium leptophyllum* (Mink et al. 2011a) and *Equisetum arvense* (Mink et al. 2011b), and disjunct species include *Anemopsis californica*, *Epipactis gigantea*, *Liatris lancifolia*, *Lobelia siphilitica*, *Scutellaria galericulata*, *Spiranthes magni-camporum*, *Symphyotrichum expansum*, and *Thalictrum dasycarpum*. Comparisons of the data with other community types described in the United States National Vegetation Classification were made, and, based on visual inspection of these data, we propose this as a new association.

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Cover Photo: Texas Rolling Plains Prairie Fen with an abundance of *Liatris lancifolia* at Black Kettle National Grasslands, Hemphill County, Texas.

About the USNVC and the Proceedings

The United States National Vegetation Classification (USNVC) Standard enables federal agencies to produce uniform statistics about vegetation resources across the nation, facilitates interagency cooperation on vegetation management issues that transcend jurisdictional boundaries, and encourages non-Federal partners to utilize and contribute to a common system when working with their Federal partners. In 1997, the first U.S. National Vegetation Classification Standard was adopted, and the first Classification was approved.

The Classification represents the end result of applying the USNVC Standard. The USNVC Standard represents the collective set of rules and guidelines for setting and approving the structure of the vegetation hierarchy, and the Classification represents the fully listed vegetation hierarchy. This standard is "dynamic" in that it outlines a process for incorporating new information into the hierarchy as the scientific body of knowledge continues to grow. The Proceedings of the USNVC serves as the official record of approved revisions to the classification and contains published manuscripts and reports that document the reasoning and evidence behind those changes.

The U.S. National Vegetation Classification is supported by a formal partnership between the federal agencies, the Ecological Society of America (ESA), and NatureServe, working through the Federal Geographic Data Committee (FGDC) Vegetation Subcommittee. Primary signators include the U.S. Forest Service (which chairs the subcommittee), ESA, NatureServe, and the U.S. Geological Survey Core Science Systems (USGS/CSS). Together we are committed to supporting the implementation and maintenance of the National Vegetation Classification (NVC) Standard (FGDC 2008).

For more information on the USVNC visit our website: http://usnvc.org/

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Introduction

The Wildlife Diversity Program (WDP) (formally the Texas Natural Heritage Program) at Texas Parks and Wildlife Department (TPWD) was established in 1983 and has been collecting information on the natural communities of Texas from published and unpublished literature, knowledgeable individuals, and field surveys. The WDP published its first plant community classification in 1987 (Diamond et al. 1987) which described 78 late seral stage plant community types at the series level (characterized by dominant species and genera). The classification in the late 1980's to date has been expanded to include finer subdivision at the plant association level (defined as a plant community of definite floristic composition within a uniform habitat). In the early 2000's the WDP migrated to the United States National Vegetation Classification (USNVC) a federal vegetation classification standard (FGDC 2008), and in 2012 began tracking 190 globally rare plant community associations. WDP added the relationship of the plant community association to the ecological systems for each of these rare associations. (Our Landscape Ecology Program (LEP) at TPWD, in cooperation with private, state, and federal partners, has produced a new land classification map for Texas consisting of 398 ecological systems at 10 meter spatial resolution (Elliott 2009-2014).) The WDP in cooperation with the LEP are working with NatureServe ecology staff to help improve the USNVC as it pertains to Texas. The LEP produces updates to the vegetation data as funds become available in regions that are priorities for either TPWD or partners. One of the major needs is to produce quantitative data on rare vegetation types at the association level that will enlighten stewardship of existing natural areas, and the need to consider landscape ecology in preserve design and selection mark one of the greatest challenges in the future of Texas conservation (Diamond et al. 1987).

Reports of an unusual "boggy" wetland type in north-central Texas led to a field survey in the region. The objectives of this survey were to determine the vegetation composition, floristics, and spatial area of five (5) prairie fen sites in the Rolling Plains Ecoregion of Texas (Singhurst 2016 and Singhurst 2017). Here we report on the findings of that survey, which was conducted to gain a better understanding of the type of landscape position, dominant and characteristic flora, and ecological site conditions. We also identified impacts and threats to this plant community type. Based on this field experience, additional sites were remotely sensed by means of digital aerial interpretation in ArcGIS, to provide a potential distribution of fens in this region of Texas.

Study Area

In fall of 2009, Texas Parks and Wildlife Department (TPWD) regional wildlife division staff brought to the attention of Nongame and Rare Species Program Botanist/Plant Community Ecologist staff that a set of 'bogs' with 'quaking conditions' had been found in the Rolling Plains Ecoregion of Texas (Cantu Pers. Comm. 2009). Given the potential conservation significance, arrangements were made in the summer of 2010 for Dr. Walter Holmes and Dr. Jeff Mink, both of Baylor University, to join the author in conducting a preliminary survey of these wetlands on the Britt Ranch in Wheeler County, Texas and Gene Howe Wildlife Management Area (GHWMA) and Black Kettle National Grasslands in Hemphill County, Texas. The preliminary site visits resulted in discovering that these 'bogs' were an undescribed prairie fen plant community type. In the summers of 2016 and 2017, the author returned to the latter two sites, and also investigated a new fen site on the Pat Murphy Unit of the GHWMA in Lipscomb County and two fen sites on the Boys Ranch in Oldham County, with the support of Chip Ruthven (TPWD Regional Biologist), Jamie Baker (GHWMA Area Manager), and Amie Treuer-Kuehn (TPWD Ecologist).

Methods

Field Methods

We created boundary data for all tracts of land where fen sites were surveyed as shown in Figure 1. We digitized potential fen wetland features on National Agriculture Imagery Program aerial photography at 1:10,000 feet with ArcGIS software to map fen extent and produce field maps to utilize during ground-truthing. Fen features include wetland vegetation signatures typically found at the headwaters of stream valleys or at the upper ends of natural marshes and ponds within sandhills. In the field, the perimeter of each fen was walked and mapped with a hand-held GPS, followed by smoothing polygons with advanced editing tools in ArcGIS in the office. These data provided the precise extent of fens at each site (Table 1). The plant community survey was conducted utilizing the Texas Natural Diversity Database community element occurrence (EO) field form (available on request).

At each site, a landscape profile based upon biotic factors (dominant and indictor plants) and abiotic factors (types of soils, slope, elevation, peat thickness, and water depth) was developed, describing center to outer edge vegetation zones which ranged from very mucky to slightly seeping. The mucky to quaking center of a fen was often at the center of a linear stream valley or the middle to lower slope of a hillside fen. Vegetation data were collected from a single radial plot at each fen site. To randomly locate the centroid of each radial plot chosen, a pin flag was tossed while walking from the edge toward the center of the transition zone along a transect. Transect length varied from site to site depending on size and shape of a fen and a transect was established while developing the profile. The plot radius was 28 m (0.25 ha). A full vascular species list was compiled in the plot, and cover values were assigned using a modified Braun Blanquet 7-point scale (<1%, 1-5%, 5-10%,

10-25%, 25-50%, 50-75%, 75-100%) (Podani 2006). In addition, the majority of each fen site was surveyed to assess all micro-habitats encountered and record a thorough list of the flora. Micro-habitats included very small patch areas with open water containing floating and emergent aquatic plants, saline barrens, and submergent aquatics occurring along or in stream channels.

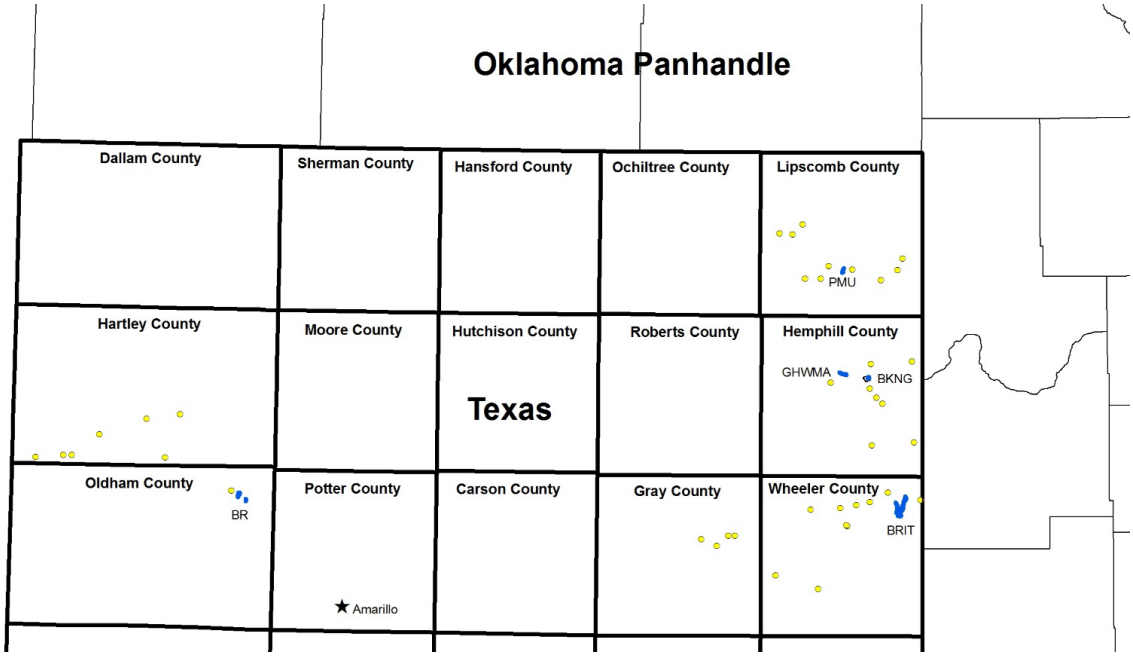

Figure 1. Locations of Texas Rolling Plains Prairie Fen Sites. Sites highlighted as blue polygons are described in this report (BR = Boys Ranch; PMU = Pat Murphy Unit; GHWMA = Gene Howe Wildlife Management Area; BKNG = Black Kettle National Grasslands; and BRIT = Britt Ranch—part of the preliminary survey in 2010 only). Potential fen sites are mapped with yellow point locations.

Analysis

The plot data were entered in an Excel spreadsheet and analyzed by visual tabular inspection for changes in the kinds and numbers of species, with no formal quantitative analyses. Raw plot data are presented here (Supplement 2) along with the accession number in VegBank. Nomenclature for all taxa follows Plants Database (USDA, NRCS 2018).

Table 1. Texas Rolling Plains Prairie Fen Sites

Site Name	County	Fen Acres
Black Kettle National Grasslands Fen (BKNG)	Hemphill	55
Boys Ranch Fen 1 (BR 1)	Oldham	22.5
Boys Ranch Fen 2 (BR 2)	Oldham	79.5
Gene Howe Wildlife Management Area Fen (GHWMA)	Hemphill	58
Pat Murphy Unit of GHWMA Fen (PMU)	Lipscomb	23

We compared our type description to other published descriptions. A limited number of ecological surveys of fens of the Central Great Plains have been conducted during the past 15-20 years and have largely focused on the Sandhills of north-central Nebraska and south-central South Dakota, the largest sand-dune area in the Western Hemisphere (Steinauer 1996, 2003; Harvey et al. 2007). There are many similarities between plant community types and flora there and in the sandhills of the Rolling Plains of Texas and Oklahoma. These earlier surveys included a review of ecological descriptions of three fen types described for the Terrestrial Natural Communities of Nebraska (Steinauer 2003); an inventory of sandhills fens in Cherry County, Nebraska (Steinauer 1996); and an article on ground water sustenance of Nebraska's unique sandhills peatland fen ecosystems (Harvey et al 2007).

Results

We propose, based on our data, the recognition of a new association: *Eleocharis rostellata – Schoenoplectus pungens – Tripsacum dactyloides – Spartina pectinata* Rolling Plains Prairie Fen (CEGL007722). This community type is documented in the southern Great Plains from only five sites (Table 1) in the Sandhills region of the Rolling Plains of Texas. The sites were typically found at the headwaters of Sandhills stream valleys, in between alluvial terraces along larger streams and rivers, or along sloughs. Black Kettle National Grasslands Fen and Pat Murphy Unit of GHWMA Fen occur on sloping to level valley bottoms bordering headwater streams and marshes. Boys Ranch Fen 1 and Boys Ranch Fen 2, and GHWMA Fen occur on east/southeast facing slopes. The water table is very close to the soil surface, and according to TPWD regional ecologists and ranch managers, soils at these sites remain saturated throughout the year but never become flooded. Soils are deep and consist of peat or muck formed from decaying herbaceous vegetation, and sometimes intermixed with sand; both overlay impervious clay layers. Soils include Sweetwater Series in Hemphill and Lipscomb Counties and Gracemore Series in Oldham County, and are generally moist throughout the year and formed in calcareous loam over sandy alluvium under wet conditions (Crump and Williams 1975, Pringle 1980, and Williams 1974 & 1975). The region is semi-arid with rainfall ranging between 16-22 inches (Bomar 1995).

A description of this association, following the USNVC type description template, is provided in Supplement 1. A floristic list of each of the five sites is provided in Supplement 2. Visual images of the type are shown in Figures 2-5.

Eleven of 27 species are either obligate or facultative wetland species (Lichvar et al. 2012, Lichvar 2014; Table 2). Taxa with greater than 7% cover were sedges and grasses, including *Eleocharis rostellata, Schoenoplectus pungens, Tripsacum dactyloides, Spartina pectinata*, and *Equisetum* spp. (*Equisetum arvense, Equisetum hyemale*, or *Equisetum laevigatum*). Other species frequently encountered included *Carex stricta, Carex pellita, Carex hystericina, Carex emoryi, Carex oklahomensis, Andropogon gerardii, Juncus arcticus, Juncus torreyi, Berula erecta*, *Helianthus maximiliani*, *Panicum virgatum,* and *Asclepias speciosa*. In areas of well-preserved fibrous peat, *Carex pellita, Carex hystericina, Carex emoryi*, and *Carex oklahomensis* dominate. Some parts of the fen may be dominated by taller graminoids, such as *Glyceria striata*, *Leersia oryzoides*, *Schoenoplectus tabernaemontani,* and *Typha latifolia.*

In portions of the sites, shrub cover can be high; primarily *Baccharis salicina*, *Salix exigua, Amorpha fruticosa*, and *Cephalanthus occidentalis*. Fifteen plant species found in fibrous peat at the sites are either disjunct or at the periphery of their ranges, including *Agrimonia parviflora, Anemopsis californica, Epilobium leptophyllum, Epipactis gigantea, Liatris lancifolia, Lobelia siphilitica, Mimulus glabratus, Scutellaria galericulata, Scutellaria lateriflora, Spiranthes magnicamporum, Symphyotrichum expansum, Thalictrum dasycarpum, Verbena hastata, Verbena urticifolia*, and *Viola nephrophylla* (Singhurst et al. 2016, Singhurst and Baker 2016, Singhurst and Treuer-Kuehn 2017).

Figure 2. Texas Rolling Plains Prairie Fen with an abundance of *Liatris lancifolia* at Black Kettle National Grasslands, Hemphill County, Texas.

Figure 3. Texas Rolling Plains Prairie Fen at Gene Howe Wildlife Management Area, Hemphill County, Texas.

Figure 4. Texas Rolling Plains Prairie Fen at the Britt Ranch, Wheeler County, Texas.

Figure 5. Texas Rolling Plains Prairie Fen at base of sandhill slope at the Boys Ranch, Oldham County, Texas.

Table 2. Floristics Summary of Texas Rolling Plains Prairie Fen. Summary table is based on 5 plots, 1 plot per site (see Table 1). Dominant species (Dom) = species ≥ 5% Mean % Cover. Constant species (C) = ≥ 60% Constancy. Differential species (Dif) = a species that differentiates a type from one or more similar types. Additional species with < 60% constancy, and not otherwise part of the diagnostic combination of species are not shown here. Taxon authority is Plants Database (USDA, NRCS 2018).. Wetland Indicator Status: FAC = Facultative, FACU = Facultative Upland, FACW = Facultative Wetland, OBL = Obligate, U = Upland.

Physiognomy-Structure Category	Taxon Name	Specific Growth Form	Constancy	Mean % Cover	Differ-ential	Diagnostic Combination	Wetland Indicator Status
Herb	*Eleocharis rostellata*	FF	100	17	Y	Dom, Dif, C	OBL
Herb	*Schoenoplectus pungens*	FF	100	9		Dom, C	OBL
Herb	*Tripsacum dactyloides*	Gr	100	7	Y	Dom, Dif, C	FAC
Herb	*Spartina pectinata*	Gr	100	17		Dom, C	FACW
Herb	*Equisetum laevigatum*	FA	100	7	Y	Dom, Dif, C	FAC
Herb	*Carex hystericina*	FF	100	15		Dom, C	OBL
Herb	*Panicum virgatum*	Gr	60	4		C	FAC
Herb	*Juncus arcticus*	FF	100	2		C	OBL
Herb	*Leersia oryzoides*	Gr	80	3	Y	Dif, C	OBL
Herb	*Schoenoplectus tabernaemontani*	FF	100	2		C	OBL
Herb	*Typha latifolia*	FF	80	2		C	OBL
Herb	*Asclepias speciosa*	FF	20[1]	1	Y	Dif	FAC
Herb	*Andropogon gerardii*	Gr	40[2]	<1	Y	Dif	FACU
Shrub	*Amorpha fruticosa*	DS	40[2]	1		Dif	FACW
Shrub	*Baccharis salicina*	DS	100	2		C	FAC
Shrub	*Ribes aureum*	DS	60	1		C	FACU
Shrub	*Cornus drummondii*	DS	60	1		C	FAC
Shrub	*Elaeagnus angustifolia*	DS	60	1		C	FACU
Tree (sdlg)	*Ulmus americana*	BT	100	7		Dom, C	FAC
Tree (sdlg)	*Populus deltoides*	BT	100	7		Dom, C	FAC
Tree (sdlg)	*Salix nigra*	BT	100	2		C	FACW
Tree (sdlg)	*Salix exigua*	BT	100	2		C	FAC

[1] Despite 40% constancy, it occurs in 80% of sites.

[2] Despite 20% constancy, it occurs in 80% of sites.

We also ranked the conservation status of this new type, following NatureServe methodology (Master et al. 2012), and arrived at the rank of critically imperiled (G1S1), meaning high quality examples are extremely rare throughout its global range and in the state of Texas. This ranking evaluation criteria takes into account components such as threats to the community, quality and condition of the known examples, and current preservation or future permanent land acquisition or conservation initiatives to preserve the known examples.

Field observations suggest that a number of threats may impact these stands, including invasion by non-native shrubs and grasses, and invasion by native woody plants that are inhibiting open herbaceous fen vegetation. Although regional fire history is not well documented, it is very likely that fire played a role as an infrequent natural component to maintaining the herbaceous flora of these fens and surrounding sandhill prairie. Re-introducing fire through prescribed burning would benefit all the fen sites observed.

Discussion

In our ecological assessment of the Rolling Plains in Texas, we discovered a regionally unique plant association that we describe as the Texas Rolling Plains Prairie Fen. It supports a diverse flora (including regionally rare, disjunct and peripheral species) compared to other wetland communities in the region. Among vegetation types currently in the USNVC, these fen sites bear some similarity to the Bulrush - Spikerush Marsh (*Schoenoplectus americanus - Eleocharis* spp. Marsh) [CEGL001586] association, which is fairly common in the Rolling Plains of Texas and adjacent New Mexico north to Colorado. Dominant species include *Schoenoplectus americanus*, *Eleocharis macrostachya, Fuirena simplex, Paspalum distichum,* and *Potamogeton illinoensis*. The surrounding landscape is rolling sandhills that include sparsely vegetated xeric dunes to densely vegetated sandy prairie communities such as Sand Bluestem - Giant Sandreed Grasslands [CEGL004016] and Sand Sagebrush / Little Bluestem - Sand Bluestem Shrubland [CEGL002178] (USNVC 2017, v2.01).

This community type differs significantly from the geographically nearest fen in the USNVC, i.e., Sandhills Fen (*Carex interior - Eleocharis elliptica - Thelypteris palustris* Fen) [CEGL002390] (USNVC v2.01), known from the Sandhills region of the Central Great Plains in northwestern Nebraska and adjacent southwestern South Dakota. No similar associations are documented adjacent to Texas in nearby New Mexico, Oklahoma, Kansas or Colorado. Inventories of Sandhills fens in Cherry County, Nebraska in 1991 and 1992 documented 39 fens ranging in size from 4 to 280 ha. The majority had been ditched and were used as hay meadows. In 1996, a detailed floristic survey of six fens in Cherry County, Nebraska documented 191 species and one subspecies of vascular plants, including 21 species considered rare in Nebraska. Fifteen Sandhills fen indicator species were also identified. The Sandhills populations of the indicator species are disjunct from

their primary ranges to the north and east of the Great Plains, suggesting these populations to be glacial relicts.

The preliminary studies of Texas Rolling Plains Fens have found a rather diverse flora with 187 species, 10 disjunct north and east of the Great Plains, and a number of indicator species, including *Eleocharis rostellata, Schoenoplectus pungens, Tripsacum dactyloides, Spartina pectinata*, and *Equisetum* spp. (*Equisetum arvense, Equisetum hyemale*, or *Equisetum laevigatum*). Additional plant community surveys are planned with TPWD regional wildlife division staff for the summer of 2019 and beyond. This effort will focus on gaining access to several more potential fen sites that have been mapped on private land (Figure 1). We also plan to measure fibrous peat depth in wetland zonations from outer edge of fen to central interior. Furthermore, we hope to become more acquainted with fen micro-habitat niches that support regionally rare plants in order to better predict where to search for these plants in future assessments.

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The author thanks Chip Ruthven, Amie Treuer-Kuehn, and Jamie Baker with Texas Parks and Wildlife for their assistance in documenting these prairie fens.

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Supporting Information

S-1: Singhurst_Type Description Template

S-2: Singhurst_Plot Data_5-17-19

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