Acacia s.l. Dominated Thorn-scrub Woodland Communities at Harris Ranch, Uvalde County, Texas.

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ABSTRACT

Woody species have dramatically increased in density and cover in the semiarid grasslands in southwestern North America during the past 150 years. This brush encroachment involves mostly native species, not uncommonly the dominants being woody members of the Fabaceae. Anthropomorphic factors are mostly responsible, particularly intense grazing pressure from cattle and sheep and fire suppression. At Harris Ranch, Uvalde County, Texas, thorn-scrub woodlands are common. Dominated by thorny woody legume species, the most common taxa are *Senegalia berlandieri* [=*Acacia berlandieri* (guajillo, fern acacia)] and *Senegalia wrightii* [=*Acacia wrightii* (Wright's senegalia)]. In the two communities studied, these two legume species dominated with importance values between 58 and 159 (possible 200), with 13 to 18 woody and succulent species present in the community. Published on-line **www.phytologia.org** *Phytologia 95(2): 192-201 (May 1, 2013).*

KEY WORDS: community structure, *Senegalia berlandieri, S. wrightii*, thorn-scrub woodland.

Much of the South Texas Plains and the Edwards Plateau once supported a grassland or open savanna with a ground layer of short grasses and forbs. The woody legume *Prosopis glandulosa* (honey mesquite) along with lesser numbers of other shrubs and trees were usually clustered or scattered throughout this grassland (Van Auken 2000). During the past 200 years the composition and structure of these semiarid grasslands has changed, mostly the result of dramatic increases in native woody species (Johnston 1963, Archer et al. 1988, Archer 1989). Most of this change to brushy thorn-scrub woodland is apparently due to anthropogenic forces, primarily overgrazing by domestic livestock and fire suppression (Correll and Johnston 1970, Archer et al. 1988, Ruthven et al. 2000, Van Auken 2000, Ruthven 2001). These well-armed species are common throughout the arid and semi-arid environments of the South Texas Plains and the Edwards Plateau (Isely 1998), and along with *Prosopis glandulosa* are important sources of animal fodder, fuel, and timber (Fagg and Stewart 1994).

Thorn-scrub vegetation is common on much of Harris Ranch, which is located in the southern foothills of the Edwards Plateau in the northern part of Uvalde County, Texas. Two distinct thorn-scrub communities were encountered, a lowland community dominated by *Senegalia wrightii/Ziziphus obtusifolia*, and an upland community dominated by *Senegalia berlandieri/Opuntia engelmannii/Vachellia rigidula*. The objective of this study was to examine the structure and composition of these two thorn-scrub woodland communities on the Harris Ranch to understand better the importance, distribution, and habitat preferences of thorny legume species.

METHODS

Study Area: Harris Ranch is located near Cline, 20 miles west of Uvalde, Uvalde County, Texas at the northern edge of the South Texas Plains ecological region in the foothills of the Edwards Plateau. Managed by the Texas A & M University, Agricultural Research and Extension Center, Uvalde, the ranch is not deer-proof fenced, about 6,764 ha in size, and utilizes a cattle stocking rate of one animal unit to 35 ha (Cooper et al. 2008). Hot summers and mild winters characterize the climate of Uvalde, Texas. In a typical year the temperature varies from 4° C (40°F) to 36°C (97°F), and is rarely below -1°C (31°F) with a growing season of 250 to 365 days. The mean annual precipitation (96 year record) is 61.7 cm distributed bimodally with peaks occurring in late spring (May-June), and early fall (September-October). Short-term periods of drought are common and rainfall can be highly variable with annual extremes from 23.6 cm to 114.4 cm (Owens et al. 2002). Topography is gently rolling with the average elevation about 350 m above mean sea level.

Survey Procedures: During the summer of 2003 the two thorn-scrub woodland communities were studied. Both sites were nearly level areas with minimal disturbance other than grazing. At each site a line transect was randomly established near the center of the long axis of each community. At 30 m intervals along the length of the transect, circular plots 0.03 ha in size were located (10 plots) and all woody plants and succulents greater than 0.4 m tall were identified and their height and average crown diameter determined to the nearest dm. Data from the plots were used to determine density, average cover, relative density, relative cover, and importance value (IV) for each species at each site. The IV is calculated as the sum of the relative density and relative cover (Seigler et al. 2007).

Floristic Composition: Harris Ranch was visited five times during the growing seasons of 2002 to 2005. During these visits voucher specimens of all vascular plant species observed in and around each of the study sites, were collected, identified, and deposited in the herbarium of the University of Illinois, Urbana, Illinois (ILL). As both sites were heavily grazed most collections were from habitat not accessible to cattle. Nomenclature follows Jones et al. (1997), exotic species follows Nesom (2010).

RESULTS

At both study sites, *Senegalia* species dominated and accounted for at least 25% of the total importance value (total possible IV of 200). The upland community, on the thin soils of calcareous ridges and caliche cuestas, was dominated by *Senegalia berlandieri* (guajillo), *Opuntia engelmannii* (prickly pear), and *Vachellia rigidula* (blach bush). These three species accounted for more than 90% of the total IV, the remaining 10 species being uncommon (Table 1). The lowland community, on the relatively deep alluvial soil of a shallow valley with a small stream, was dominated by *Senegalia wrightii* (Wright's senegalia) and *Ziziphus obtusifolia* (lotebush, gumdrop tree). These two species, with IV's of 57.9 and 31.4 respectively, accounted from about 45% of the total IV. In this community, four other species (*Condalia hookeri, Quercus virginiana, Colubrina texensis, Prosopis glandulosa*) had IV's greater than 10, the remaining 11 species being uncommon (Table 2)

The number of woody and succulent species recorded for the two thorn-scrub woodland sites ranged from 13 to 18 with a total of only 21 different species recorded. Of the 21 species encountered, 10 occurred on both sites: *Aloysia gratissima* (white bush), *Berberis trifoliata* (agarito), *Condalia hookeri* (brazil), *Condalia spathulata* (squaw-bush), *Diospyros texana* (Texas persimmon), *Forestiera angustifolia* (narrowleaf forestiera), *Leucophyllum frutescens* (purple sage), *Opuntia engelmannii* (prickly pear), *O. leptocaulis* (tasajillo), and *Schaefferia cuneifolia* (desert yaupon). *Proposis glandulosa*, a common species that usually dominates thorn-scrub woodlands, was only encountered in the lowland thorn-scrub community, but was common on parts of Harris Ranch.

Diversity was relatively low with only 121 species of vascular plants encountered (Appendix I). No fern, "fern-allies" or gymnosperms were collected. Of the taxa encountered, 23 were monocots in four families, and 98 were dicots in 37 families. Non-native (exotic) species accounted for five taxa, about 4% of the species collected. As is typical of prairie and thorn-scrub vegetation, Poaceae was the most common family with 19 species, Asteraceae was second with 17 species. No state endangered or threatened species were encountered.

DISCUSSION

The thorn-scrub vegetation of Harris Ranch and surrounding area was representative of that associated with the foothills and much of the uplands of the Edwards Plateau and the adjacent South Texas Plains (Correll and Johnston 1970, Van Auken 2000, Owens et al. 2002). In much of this rangeland, *Prosopis glandulosa* was the dominant species, with about 10 to 15 other woody or succulent, mostly armed species, varying in abundance and composition. This woodland community, where dominant trees were 3 m tall and formed a 26-60% canopy, would be equivalent to the Deciduous Woodland, Mesquite-Huisache Series (*Prosopis glandulosa-Vachellia farnesiana*) of Diamond et al. (1987) with other thorny legume species replacing huisache (*V. farnesiana*). Also referred to as the mesquite/mixed acacia savanna, this community varies extensivly in overstory composition with *Prosopis glandulosa* not always present or only in low concentrations.

In south central Texas the dominant woody species of these thorn-scrub communities is mostly *Prosopis glandulosa,* but various species of the genera *Senegalia* and *Vachellia* are also common, and may dominated, sometime with a total lack of *Prosopis glandulosa.* The common species of these two genera in Texas include *Senegalia berlandieri* [=*Acacia berlandieri* (guajillo, fern acacia)], *S. greggii* [=*Acacia greggii* (catclaw acacia)], *Vachellia bravoensis* [=*Acacia schaffneri* var. *bravoensis* (huisachillo), V. *farnesiana* [=*Acacia farnesiana* (huisache)], and *V. rigidula* [=*Acacia rigidula* (blackbrush)] (Seigler et al. 2007, 2011). At Harris Ranch, *Prosopis glandulosa* was not the dominant woody species, being replaced by other woody legumes.

Senegalia berlandieri, along with lesser amounts of *Vachellia rigidula*, dominated limestone ridges and caliche cuestas of the Harris Ranch (Table 1). This community, in which the dominants were shrubs or small trees 0.5 to 4 m tall, and formed 26 percent of more of the total canopy, would be equivalent to the Deciduous Shrubland, Blackbrush Series (*Vachellia rigidula*) of Diamond et al. (1987). *Vachellia rigidula* appeared to be fairly site specific at the Harris Ranch being restricted to the calcareous ridges. This species appears to be well adapted to dry sites with high levels of available calcium. *Senegalia berlandieri*, in contrast, was a component of disturbed habitats, often along roadsides and in arroyos, but also an important stand component on the limestone ridges. Common throughout southern and western Texas, this species is abundant on limestone ridges and caliche cuestas (Correll and Johnston 1970, Isely 1998, Seigler et al. 2007, 2011).

Senegalia wrightii was the dominant species in the thorn-scrub woodland community on alluvial soil at Harris Ranch (Table 2). This taxon is closely related to *S. greggii* and has, in the past, been considered a variety of *S. greggii* (Isely 1969). *Senegalia berlandieri* and *S. wrightii* occasionally hybridize, producing the uncommon *S. x turnerii*. A population of this hybrid was observed at Harris Ranch on a hillside near the *S. wrightii* thorn-scrub community. On this hillside, both parental species were encountered along with numerous individuals of the resulting hybrid (Seigler et al. 2012).

A species of calcareous soils, *Senegalia wrightii* is known from near sea level to about 800 m in southern Arizona and southwestern Texas in the United States, and the states of Baja California Sur, Chihuahua, Coahuila, Nuevo Leon, and Tamaulipas, Mexico. Until this study, we have never seen an extensive population of *S. wrightii*, generally finding one, or a few individuals along roadsides, in

pastures, or other disturbed areas. In this thorn-scrub community many individuals exceed 3 m in height: *S. wrightii, Quercus virginiana,* and *Celtis laevigata.* The remaining species were mostly less than 2 m tall. *Prosopis glandulosa,* sixth in IV, was mostly present as small individuals rarely exceeding 2 m tall.

Though some of the acacia species at Harris Ranch have distinct habitat preferences, the reason for their continued importance and the continued prevalence of thorn-scrub woodland communities they dominate is not entirely clear. Most information suggests that overgrazing and fire suppression were the primary causes of this encroachment (Lehmann 1969, Van Auken 2000). When much of the South Texas Plains and the Edwards Plateau was covered with open savanna containing a dense groundcover of grasses and forbs, wildfires were frequent and of sufficient intensity to prevent encroachment by native woody species. However, overgrazing by livestock reduced the fuel load. At the same time, fire suppression allowed for a significant decrease in fire frequency creating ideal conditions for the rapid expansion of native invaders. Presently, prescribed burns are being used as one way to reduce shrub and tree densities and increase the extent of prairie (Owens et al. 2002). These fires many not be of sufficient intensity and frequency to reduce the extent of thorn-scrub woodlands significantly.

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Table 1. Density (#/ha) by height class (m), average crown cover (m^2), relative frequency, relative crown cover, and importance value (I.V.) of the species encountered at the *Senegalia berlandier/Vachellia rigidula* site at Harris Ranch, Uvalde County, Texas.

Species	Density (#/ha) by height class (m)					Av. Cover	Rel. Den.	Rel. Cov.	I.V.
	0.4-1	1-2	2-3	3+	Totals				
Senegalia berlandieri	1112	217	20	--	1349	2.657	74.8	84.5	159.3
Opuntia engelmannii	230	--	--	--	230	1.643	12.7	8.9	21.6
Vachellia rigidula	27	10	10	--	47	3.080	2.6	3.4	6.0
Leucophyllum frutescens	43	--	--	--	43	0.739	2.4	0.8	3.2
Berberis trifoliata	37	--	--	--	37	0.353	2.0	0.3	2.3
Diospyros texana	7	13	--	--	20	2.055	1.1	1.0	2.1
Opuntia leptocaulis	33	--	--	--	33	0.441	1.8	0.3	2.1
Condalia hookeri	13	--	--	--	13	1.174	0.7	0.4	1.1
Aloysia gratissima	10	3	--	--	13	0.577	0.7	0.2	0.9
Eysenhardtia texana	7	--	--	--	7	1.324	0.4	0.2	0.6
Forestiera angustifolia	7	--	--	--	7	0.161	0.4	0.0	0.4
Condalis spathulata	3	--	--	--	3	0.385	0.2	0.0	0.2
Schaefferia cuneifolia	3	--	--	--	3	0.196	0.2	0.0	0.2
Totals	1532	243	30	--	1805		100.0	100.0	200.0

Table 2. Density (#/ha) by height class (m), average crown cover (m^2), relative frequency, relative crown cover, and importance value (I.V.) of the species encountered at the *Senegalia wrightii* site at Harris Ranch, Uvalde County, Texas.

Species	Density (#/ha) by height class (m)					Av. Cover	Rel. Den.	Rel. Cov.	I.V.
	0.4-1	1-2	2-3	3+	Totals				
Senegalia wrightii	57	17	23	50	147	6.796	12.6	45.3	57.9
Ziziphus obtusifolia	213	40	3	--	256	0.795	22.1	9.3	31.4
Condalis hookeri	127	27	--	--	154	0.887	13.2	6.2	19.4
Quercus virginiana	--	--	--	10	10	34.780	0.9	15.8	16.7
Colubrina texensis	90	23	--	--	113	1.109	9.7	5.7	15.4
Prosopus glandulosa	133	3	3	--	139	0.173	12.0	1.1	13.1
Opuntia engelmannii	70	3	--	--	73	0.965	6.3	3.2	9.5
Aloysia gratissima	20	30	10	--	60	1.181	5.2	3.2	8.4
Diospyros texana	27	13	7	--	47	0.906	4.0	1.9	5.9
Celtis laevigata	30	13	--	3	46	0.563	4.0	1.2	5.2
Opuntia leptocaulis	37	3	--	--	40	0.826	3.4	1.5	4.9
Guajacum angustifolium	17	7	--	--	24	2.596	2.0	2.8	4.8
Condalia spathulata	23	--	--	--	23	1.036	2.0	1.1	3.1
Berberis trifoliata	10	3	--	--	13	1.267	1.1	0.8	1.9
Forestiera angustifolia	7	--	--	--	7	2.455	0.6	0.7	1.3
Leucophyllum frutescens	3	--	--	--	3	0.950	0.3	0.2	0.5
Schaefferia cuneifolia	3	--	--	--	3	0.710	0.3	0.0	0.3
Vachellia bravoensis	3	--	--	--	3	0.031	0.3	0.0	0.3
Totals	870	182	46	63	1161		100.0	100.0	200.0

Appendix I. Vascular plant species encountered at Harris Ranch near Cline, Uvalde County, Texas are listed alphabetic by families. The material was collected during five field trips to the ranch between 2002 and 2003. Collecting numbers after each name are those of D.S. Seigler, and are deposited in the herbarium of the University of Illinois (ILL). Except for the genus *Acacia* s.l. nomenclature follows Jones et al. (1997). The members of the genus *Acacia s.l.* are separated into their presently recognized genera: *Senegalia* and *Vachellia.* A few species were not collected and are listed as observed in this list. Note: *= exotic species.

MONOCOTS
Agavaceae
Nolina texana S. Watson, 15905

Bromeliaceae
Tillandsia recurvata L., 15839

Liliaceae
Cooperia drummondii Herbert, 15462, 15722
Nothoscordum bivalve (L.) Britton, 15452

Poaceae
Aristida purpurea Nuttall var. *purpurea*, 15256
Aristida purpurea Nuttall var. *wrightii* Nash, 15241, 15431
Bouteloua barbata Lagasca y Segura, 15447

Bouteloua curtipendula (Michaux) Torrey, 15240
**Bromus catharticus* Vahl, 15249
Buchloe dactyloides (Nuttall) Engelmann, 15257
Chloris cucullata Bischoff, 15429, 15433
**Cynodon dactylon* (L.) Persoon, 15222
Elymus virginicus L., 15220
Digitaria cognatum (Schultes) Pilger, 15436, 15448
Nassella leucotricha (Trin. & Rupr.) Pohl, 15242
Panicum hallii Vasey var. filipes (Scribner) Waller,15434
Panicum hallii Vasey var. hallii, 15449, 15450
Paspalum pubiflorum Fournier, 15247
Setaria texana Emery, 15430
Tridens albescens (Vasey) Wooton & Standley, 15254, 15255
Tridens muticus (Torrey) Nash, 15234
Tridens texanus (S. Watson) Nash, 15432
Urochloa fasciculata (Swartz) Webster, 15435

DICOTS
Acanthaceae
Carlowrightii torreyana Wasshausen, 15706
Ruellia occidentalis (A. Gray) Tharp & Barkley, 15264

Anacardiaceae
Rhus aromatic Aiton, 15712
Rhus microphylla Engelmann, 15713

Asclepiadaceae
Cynanchum racemosum (Jacquin) Jacquin var. *unifarium* (Scheele) Sundall, 15260
Matelea reticulata (A. Gray) Woodson, 15718

Asteraceae
Acourtia runcinata (D. Don) Turner, 15699
Acourtia wrightii (A. Gray) Reveal & King, 15704
Ambrosia confertiflora DC., 15442
Calyptocarpus vials Lessing, 15444
Chaetopappa asteroids (Nuttall) DC., 15457
Conoclinum greggii (A. Gray) Small, 15437
Dyssodia pentachaeta (DC.) Robinson, 15232, 15458
Grindelia microcephala DC., 15225
Gutierrezia texana (DC.) Torrey & A. Gray, 15842
Helenium quadridentatum Labillardiére, 15246
Helianthus debilis Nuttall, 15226
Melampodium cinereum DC., 15456
Parthenium confertum A. Gray, 15236, 15454
Psilostrophe gnaphalioides DC., 15854
Ratibida columnifera (Nuttall) Wooton & Standley, 15243
Simsia calva (Engelmann & Gray) A. Gray, 15441
Thelesperma burridgeanum (Regel et al.) Blake, 15235

Berberidaceae
Berberis trifoliolata Moricand, 15857, 15919

Boraginaceae
Heliotropium tenellum (Nuttall) Torrey, 15849
Tiquilia canescens (DC.) Richardson, 15701

Cactaceae
Opuntia atrispina Griffiths, 15725
Opuntia engelmannii Salm-Reifferscheid-Dyck, observed
Opuntia leptocaulis DC., 15711

Celastraceae
Schaefferia cuneifolia A. Gray, 15845

Cucurbitaceae
Ibervillea lindheimeri (A. Gray) Greene, 15846

Cuscutaceae
Cuscuta gronovii Schultes, 15453

Ebenaceae
Diospyros texana Scheele, 15698

Euphorbiaceae
Acalypha monostachya Cavanilles, 15237
Argythamnia humilis (Engelmann & A. Gray) Muell. Arg., 15253
Bernardia myricaefolia (Scheele) S. Watson, 15851
Croton incanus Kunth, 15900
Croton lindheimerianus Scheele, 15708
Croton monanthogynus Michaux., 15856
Euphorbia micromera Boissier, 15451
Phyllanthus polygonoides Sprengel, 15460
Stillingia treculiana (Muell. Arg.) I.M. Johnston, 15714
Tragia ramosa Torrey, 15705, I5721

Fabaceae
Dalea pogonathera A. Gray, 15461
Eysenhardtia texana Scheele, 15697
Indigofera miniata Ortega, 15707
Mimosa aculeaticarpa Ortega var. *biuncifera* (Bentham) Barneby, 15238
Prosopis glandulosa Torrey, 15853
Senegalia berlandieri (Bentham) Britton & Rose, 15250
Senegalia x turneri Seigler & Ebinger, 15217
Senegalia wrightii (Bentham) Britton & Rose, 15228
Senna roemeriana (Scheele) Irwin & Barneby, 15702, 15709
Sophora secundiflora (Ortega) DC., 15723
Vachellia rigidula (Bentham) Seigler & Ebinger, 15251
Vachellia bravoensis (Isely) Seigler & Ebinger, 15218

Gentianaceae
Sabatia campestris Nuttall, 15695

Lamiacae
Hedeoma drummondii Bentham, 15239b
**Marrubium vulgare* L., 15245
Salvia ballotiflora Bentham, 15443
Salvia texana (Scheele) Torrey, 15239a

Malvaceae
Abutilon fruiticosum Guillemin & Perrottet, 15263, 15540
**Malvastrum coromandelianum* (L.) Garcke, 15248, 15445
Sida abutifolia Miller, 15446, 15855

Menispermaceae
Cocculus carolinus (L.) DC., 15716

Nyctaginaceae
Acleisanthes longiflora A. Gray, 15715
Nyctaginia capitata Choisy, 15719

Oleaceae
Forestiera angustifolia Torrey, 15920

Onagraceae
Gaura parviflora Lehmann, 15223

Oxalidaceae
Oxalis dichondraefolia A. Gray, 15703

Passifloraceae
Passiflora tenuiloba Engelmann, 15221

Phytolaccaceae
Rivina humilis L., 15852

Polgalaceae
Polygala lindheimeri A. Gray, 15694
Polygala ovatifolia A. Gray, 15439

Ranuculaceae
Clematis drummondii Torrey & A. Gray, 15244

Rhamnaceae
Colubrina texensis (Torrey & A. Gray) A. Gray, 15230
Condalia hookerii M.C.Johnston, 15231
Condalia sparthulata A. Gray, 15844
Zizyphus obtusifolia (Torrey & A. Gray) A. Gray, 15843

Rosaceae
Prunus minutiflora Engelmann, 15918

Rubiaceae
Hedyotis nigricans (Lamarck) Fosberg, 15696

Rutaceae
Ptelea trifoliata L., 15261
Thamnosma texana (A. Gray) Torrey, 15901

Sapindaceae
Sapindus saponaria L. var. *drummondii* (H. & A.) L. Benson, 15841
Ungnadia speciosa Endlicher, 15850

Scrophulariaceae
Leucophyllum frutescens (Berlandier) I.M. Johnston, 15229

Solanaceae
Solanum elaeagnifolium Cavanilles, 15859
Solanum rostratum Dunal, 15692
Solanum triquetrum Cavanilles, 15438

Sterculiaceae
Hermannia texana A. Gray, 15717
Melochia pyramidata L., 15720

Ulmaceae
Celtis laevigata Willdenow, 15252
Celtis pallida Torrey, 15858
Ulmus crassifolia Nuttall, 15840

Verbenaceae
Aloysia gratissima (Gillies & Hooker) Troncoso, 15233
**Lantana camara* L., 15224
Verbena halei Small, 15459

Viscaceae
Phorodendron tomentosum (DC.) A. Gray, 15724

Zygophyllaceae
Guajacum angustifolium Engelmann, 15710