

## The Vascular Flora of Mason Mountain Wildlife Management Area, Mason County, Texas

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**Abstract** - A survey of the vascular flora of Mason Mountain Wildlife Management Area, located in the Llano Uplift of Central Texas, was conducted between spring of 2001 and spring of 2006. A total of 693 species and infraspecific taxa in 103 families and 376 genera were documented from 14 plant associations. Poaceae (117 species), Asteraceae (102 species), Fabaceae (46 species), and Euphorbiaceae (31 species) were the families with the largest number of species. Five taxa, *Campanula reverchonii* (basin bellflower), *Eriogonum tenellum* Torr. var. *ramosissimum* (tall buckwheat), *Isoetes lithophila* (rock quillwort), *Packera texensis* (Llano groundsel), and *Tradescantia pedicellata* (Edwards Plateau spiderwort) are endemic to the Llano Uplift, while 24 others are endemic to Texas. Other noteworthy taxa included *Isoetes piedmontana* (Piedmont quillwort), *Pilularia americana* (American pillwort), and *Senecio ampullaceus* (Texas ragwort).

### Introduction

The Llano Uplift (Gould 1975, Lyndon B. Johnson School of Affairs 1978) of Texas comprises about 12,950 km<sup>2</sup> (5000 mi<sup>2</sup>) of gently rolling to hilly lands that lie to the west of Austin and encompasses portions of Blanco, Burnet, Gillespie, Kimble, Llano, Lampasas, Mason, Menard, McCulloch, San Saba, and Travis counties. The study area is located in the eastern portion of the Edwards Plateau vegetation area of the state and is characterized by granite outcrops. Correll and Johnston (1970) describe the Edwards Plateau as a region of significant endemism; however, the granite-outcrop portion of this region has received limited botanical exploration over the past 150 years. Some of the first efforts to describe these outcrops' flora were by Lindheimer (Geiser 1948), who made two collecting trips to the Llano Uplift in 1847–48, and Reverchon, who made the first extensive collections in the region in 1885–86. Others included Whitehouse (1933), Roemer (1849), Butterwick (1979), and Walters and Wyatt (1982). These studies were mostly concentrated on an area centered on present day Enchanted Rock State Park in Llano County. Mason County was not included. The general lack of botanical study in the Llano Uplift

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and specifically Mason County is reflected by the low number of plant collections represented in University of Texas Plant Resources Center's Flora of Texas database (2006). This database cites only 378 collections from Mason County out of approximately 250,000 records for the state. The low number of collections is undoubtedly due to the high percentage of land in private ownership that is mostly unavailable for scientific study.

In 1997, Mr. C.G. Johnson donated to the State of Texas the area now known as the Mason Mountain Wildlife Management Area (MMWMA), a gift that consisted of approximately 2147 ha (5304 ac) located about 10 km northwest of Mason in Mason County. Today, MMWMA is the largest publicly owned property on the Llano Uplift. Prior to acquisition, the area was a working ranch that primarily raised exotic ungulates for hunting and for breeding stock. The area is currently divided into seven pastures by 2.4-m high fences. Among the non-native ungulates present are *Tragelaphus strepsiceros* Pallas (greater kudu), *Oryx gazella* Gray (gemsbok) and nine others. *Odocoileus virginianus* Zimmermann (white-tailed deer) is the only native ungulate. Presently, the specific mission of MMWMA is to manage natural resources of the area in a holistic, ecosystem process-oriented philosophy. To accomplish this goal, Texas Parks and Wildlife Department (TPWD) has implemented a public hunting program and also offers limited public access for natural interpretation and restoration events. In an effort to reduce the population of exotics and generate revenue, a program of aggressive hunting and selling of exotic ungulates has been implemented (Schwertner 1998).

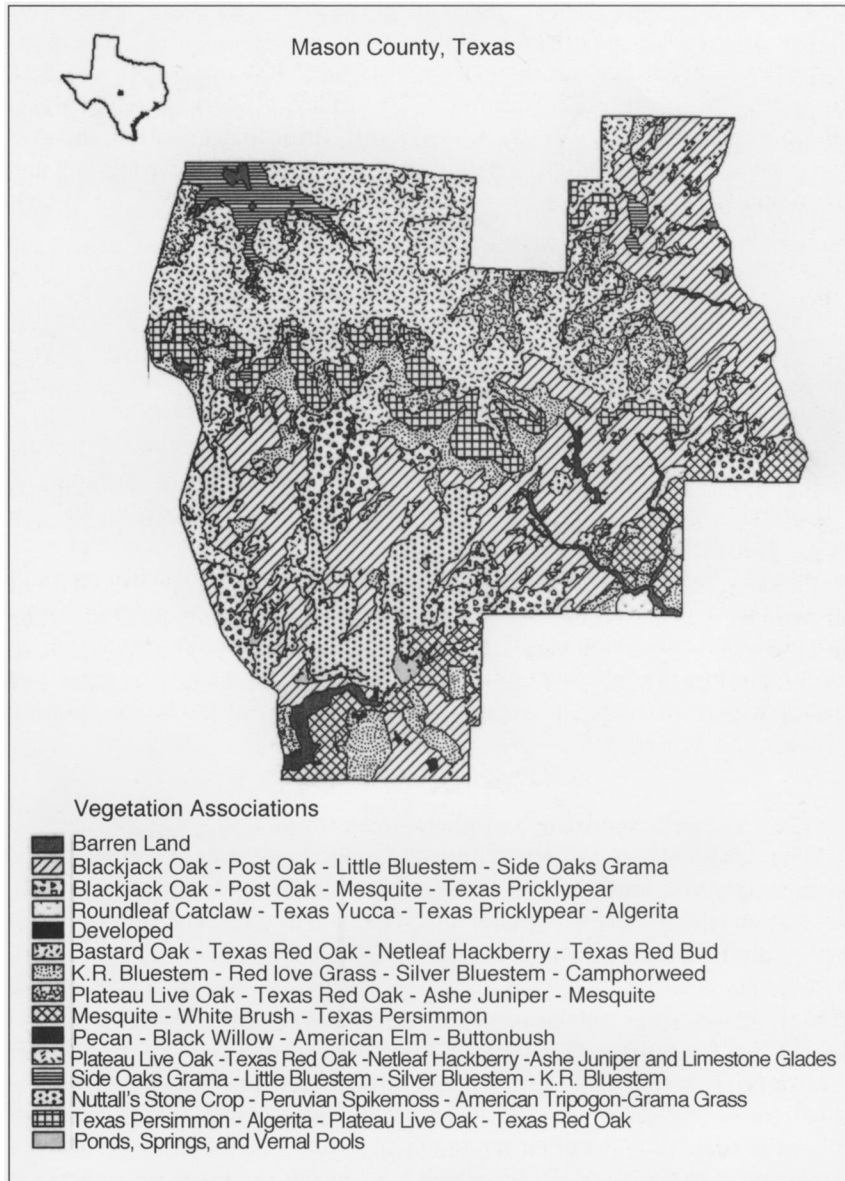
The present study is part of an effort by TPWD to enumerate the flora of lands under their authority (see Fleming et al. 2002, Singhurst et al. 2003). The specific objectives of this research were to compile an annotated checklist of the flora of MMWMA, determine if plants of special concern are present, and provide a qualitative description of the plant communities of the area.

### Materials and Methods

The checklist (shown in **Supplementary Appendix 1**. Available only online at <http://dx.doi.org/10.1656/S497.s1>) has been compiled largely from specimens collected between summer of 1998 and fall of 2005. Vouchers were made for all species except for a few cacti that were photographed with a digital camera for identification. Nomenclature follows Jones et al. (1997), Turner et al. (2003), and United States Department of Agriculture (2005). Plant specimens were deposited at Baylor University Herbarium (BAYLU) and Mason Mountain Wildlife Management Area Herbarium (herein referred to as MMWMA). All duplicate specimens were sent to the University of Texas Herbarium (TEX-LL). The flora of Texas database of the University of Texas Plant Resources Center (TEX-LL), (2006) and the Herbarium Specimen Browser of Texas A&M University (both TAES and TAMU), College Station (2006), was examined for additional records. This, however, yielded minimal results because the study area was generally not

available for botanical study while privately owned, and thus few herbarium specimens were collected there before 1999.

Plant associations (Fig. 1; **Supplementary Appendix 2**. Available only online at <http://dx.doi.org/10.1656/S497.s2>) were mapped utilizing 1996 digital orthophoto aerial photography and ERDAS Imagine 8.7 software (Leica Geosystems 2005) based on dominant species (qualitative floristic



**Figure 1.** A vicinity map showing Mason Mountain Wildlife Management Area Vegetation Associations (Leica Geosystems, ERDAS Imagine 8.7).

inventories), landscape position (utilizing digital raster graphic elevation lines), and digital soils (Natural Resource Conservation Service 2006). Sorenson's Index (Jongman et al. 1995, Sorensen 1948) was used to compare floristic similarity between MMWMA and Enchanted Rock State Natural Area (O'Kennon 1993), a 655-ha. (1643-ac) granite dome complex located in Llano County, TX, approximately 64 km (40 mi) southeast of the study area. Sorenson's Index is calculated as:  $2C / (A + B)$ , where C is the number of shared taxa, A is the number of taxa in sample one, while B is the number in sample two. The focus of this analysis is to compare the ecology relation or resemblance between the two largest conservation tracts of land on the Llano Uplift.

A plant association is defined as an assemblage of definite floristic composition, presenting a uniform physiognomy, and growing in uniform habitat conditions (Flahault and Schroter 1910). In this sense, the association concept applies to existing vegetation regardless of successional status. The plant associations are arranged into terrestrial, aquatic, disturbed, and barren or developed systems, which are further subdivided into natural and disturbed types. The natural types of both terrestrial and aquatic systems are further subdivided into units based upon the underlying geology, this being sandstone, igneous, or limestone. Natural types are characterized predominantly by woody dominants that were presumed to be remnants of the natural vegetation. Disturbed types that lack woody species would be expected because of past or current land-use practices such as tillage. Disturbed aquatic systems are referred to as artificial impoundments. Vernal pools within wetland types are defined as precipitation-filled seasonal wetlands inundated during periods when temperature is sufficient for plant growth, followed by a brief waterlogged-terrestrial stage and culminating in extreme desiccating soil conditions of extended duration (Keeley and Zedler 1998).

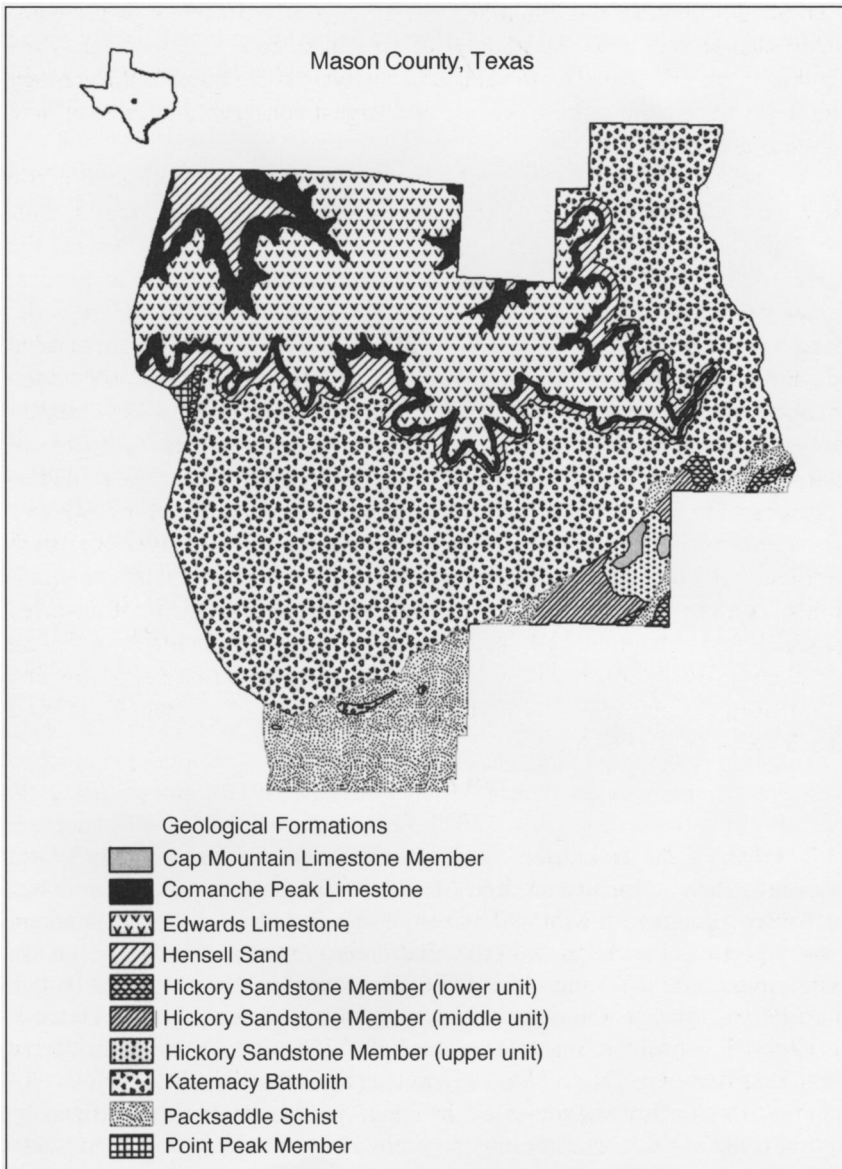
### Study Area

The MMWMA is located within the subtropical humid region of the modified marine climate, an area of central Texas characterized by long, hot summers and mild winters (Bomar 1995). Based on data from a recent 100-yr. period, average annual precipitation is approximately 66 cm (26 in), with a maximum of 71 cm (28 in) and a minimum of 61 cm (24 in) (Hatch et al. 1990). Average annual temperature is approximately 18.8 °C (Hatch et al. 1990). The growing season is about 240 days, with the frost-free period extending from April through October (Hatch et al. 1990). MMWMA is located on the northwest portion of the Llano Uplift and is characterized by rolling terrain with elevation ranging from 518 m (1700 ft) to 621 m (2040 ft) (Hatch et al. 1990).

The geology (Fig. 2) of the area is comprised of seven formations: dolomite, granite, limestone, quartz, sand, sandstone, and shale. Soils are



classified as clay loam, deep sand, sandy loam, granite sand, granite gravel, granite hills (rock outcropping), sandstone hills (rock outcropping), and flat and steep limestone hills (rock outcropping) (Natural Resource Conservation Service 2006). The south-southeast portion of MMWMA is predominantly Packsaddle Schist (fine- to medium-grained quartz feldspar biotite, gneiss and marble). The lower, middle, and upper Hickory Sandstones (which includes



**Figure 2.** A map showing Mason Mountain Wildlife Management Area Geologic Formations (University of Texas Bureau of Economic Geology 1982).

lower, middle, and upper layers composed of quartz, silt, calcite, and massive sandstone) are included within this formation. The Cap Mountain Limestone (finely grained, distinctly jointed, and somewhat massive limestone) also occurs in the southeast corner of MMWMA as two small bluffs. Just north of these is an extensive area of granite composed of Katemcy Batholiths (coarse gravel and massive pink granite) that form the large hilly “domes” and include a few small inclusions within the Packsaddle Schist. North of the Katemcy Batholiths, two narrow bands of the Hensell Sand (fine-grained, poorly sorted, dolomitic sandstone) and Comanche Peak Limestone (fine grained, dolomitized) are exposed on steep slopes and in small canyons. Just to the north of the Hensell Sand and Comanche Peak Limestone is an Edwards Limestone (fine grained, dolomitized, and chert nodules) mesa, which is the highest point in the property. The preceding summary of the geology, which is discussed from south-southeast to north-northwest, is extracted from the University of Texas Bureau of Economic Geology (1982).

## Results

The MMWMA flora (**Supplementary Appendix 1**. Available only online at <http://dx.doi.org/10.1656/S497.s1>) consists of 693 species and infraspecific taxa in 103 families and 376 genera. Ferns and fern allies constituted 20 species, gymnosperms 1, monocots 184, and dicots 488. The largest families were Poaceae (117), Asteraceae (102), Fabaceae (46), and Euphorbiaceae (31). Other families with a significant number of species included Cyperaceae (30), Lamiaceae (17), Brassicaceae (17), Scrophulariaceae (14), and Apiaceae (13). Genera with the largest number of species are *Cyperus* (12), *Eragrostis* (11), *Panicum* (10), and *Croton* (9). Introduced species (59) represent 8.51% of the total flora, of which 23 were in the Poaceae. Five highly restricted Llano Uplift endemics (Carr 2002, 2005) that are ranked as special plants of concern (Nature Serve 2006) occur at MMWMA. These are *Campanula reverchonii* Gray (basin bellflower; G2S2), *Eriogonum tenellum* Torr. var. *ramosissimum* Benth. (tall buckwheat; G5T3), *Isoetes lithophila* N.E. Pfeiffer (rock quillwort; G2S2), *Packera texensis* R.J. O’Kennon and D.K. Trock (Llano groundsel ; G2S2), and *Tradescantia pedicellata* Celarier (Edwards Plateau spiderwort; G2S2). More widespread Texas endemic taxa that were abundant at MMWMA include *Astragalus pleianthus* (Shinners) Isely (Edwards Plateau milkvetch), *Castilleja purpurea* (Nutt.) G. Don var. *lindheimeri* (Gray) Shinners (Lindheimer’s Indian paintbrush), *Chaetopappa bellidifolia* (Gray & Engelm.) Shinners (whiteray leastdaisy), *Chamaesyce angusta* (Engelm.) Small (blackfoot sandmat), *Cheilanthes kaulfussii* Kunze (Kaulfuss’ lipfern), *Croptilon hookerianum* (Torr. & Gray) House var. *hookerianum* (Hooker’s scratchdaisy), *Euphorbia roemeriana* Scheele (Roemers’ spurge), *Galactia texana* (Scheele) Gray (Texas milkpea), *Indigofera miniata* var. *texana* (Buckl.) B.L. Turner (Texas indigo), *Lechea san-sabeana* (Buckl.) Hodgdon (San Saba pinweed), *Lesquerella densiflora* (Gray) S. Wats. (denseflower bladderpod), *Muhlenbergia lindheimeri* A.S. Hitchc.

(Lindheimer's muhly), *Nolina lindheimeriana* (Scheele) S. Wats. (devil's shoestring), *Parthenocissus heptaphylla* (Buckl.) Britt. ex Small (sevenleaf creeper), *Phlox pilosa* subsp. *latisejala* Wherry (downy phlox), *P. roemeriana* Scheele (goldeneye phlox), *Silphium albiflorum* Gray (white rosinweed), *Tephrosia lindheimeri* Gray (Lindheimer's hoarypea), *Tradescantia edwardsiana* Tharp (plateau spiderwort), *Triodanis texana* McVaugh (Texas Venus' looking-glass), *Vitis monticola* Buckl. (sweet mountain grape), and *Yucca rupicola* Scheele (Texas yucca). Texas endemics restricted to a single mesic limestone canyon at MMWMA include *Arabis petiolaris* (Gray) Gray (Brazos rockcross), *Argythamnia aphoroides* Muell.-Arg. (Hill Country silverbush), and *Matelea edwardsensis* Correll (plateau milkvine). There are several other noteworthy species. *Isoetes piedmontana* Piedmont (quillwort) is known in Texas from this study area and two sites in Llano County (Holmes et al. 2005). The species also occurs in Alabama, Georgia, North Carolina, South Carolina, and Virginia (Holmes et al. 2005). *Pilularia americana* A. Braun (American pillwort) is restricted to a few granite and limestone vernal pools and shallow ponds in Burnet, Llano, Mason, and Wise counties in Texas (K. McLemore and R.J. O'Kennon, Botanical Research Institute of Texas, Fort Worth, pers. comm.; Turner et al. 2003). American pillwort occurs in one shallow pond at MMWMA. Also present is *Senecio ampullaceus* Hook. (Texas groundsel), endemic to the West Gulf Coastal Plains (Sorrie and Weakly 2001), which is at the western limits of its distribution. A few eastern plants also reach their southern and western-most known distribution at MMWMA and include *Fimbristylis puberula* (Michx.) Vahl var. *interior* (Britt.) Kral (hairy fimbry), *Juncus diffusissimus* Buckl. (slimpod rush), *Lepuropetalon spathulatum* Ell. (petiteplant), and *Rumex hastatulus* Baldw. (heartwing sorrel).

O'Kennon (1993) recorded a total of 555 species at the much smaller Enchanted Rock State Natural Area (ERSNA), with 37 being introduced. The park consists of two granite domes (Enchanted Rock dome and Little Rock dome) and a large canyon between the domes. The canyon is largely shaded and remains moist for most of the year, thus supporting many shade and seep species that do not occur at MMWMA. The park also has more surface seeps and spring contacts than are present at MMWMA. ERSNA has 555 species recorded and MMWMA has 693 species, with 367 species common to both areas. The similarity index for the two areas is:

$$\begin{aligned} IS &= 2C / (A + B) \\ &= 2(367) / (555 + 693) \\ &= 0.588 \end{aligned}$$

## Discussion

MMWMA is a floristically diverse landscape that currently cites the highest number of plant taxa (693 species and infraspecific taxa) documented for a defined area within the Llano Uplift. This number is 27% of the species recorded within the Edwards Plateau by Stanford (1976).

MMWMA also has a low number of non-native plants (59 of 693 species), which is 8.51% of the flora documented. For comparative purposes, ERSNA has 37 non-native plants (6.7%) of the 555 species reported (O'Kennon 1993). Thirty species occurring at MMWMA are listed as Texas endemic plants (Carr 2002, 2005; Nature Serve 2006). Travis and Bexar counties, which lie on the east and southeast edge of the Llano Uplift, have the highest number of Texas endemics, with 89 and 85 respectively (Flora of Texas Consortium 1996). This, in part, seems related to their larger size and that they lie within four of the ten vegetational areas of the state. In comparison, Mason County has 50 Texas endemics, while adjacent Llano County has 39 endemic plants recorded (Flora of Texas Consortium 1996), but both lie fully within one vegetational region (Edwards Plateau). In further comparison of MMWMA with ERSNA, MMWMA contains 30 endemic plants (60.0% of the endemics documented for Mason County), whereas ERSNA has 21 endemic plants (53.8% of the endemics documented for Llano County). In addition, the similarity index value (0.588) for these two areas in the same ecoregion appears low. This low value could, in part, be related to the size of the areas or more likely to the presence of the limestone plant community associations at MMWMA.

MMWMA is also a strikingly complex site, with 12 natural or semi-natural plant community associations (Fig. 1; **Supplementary Appendix 2**. Available only online at <http://dx.doi.org/10.1656/S497.s2>). The study resulted in the discovery of two plant community associations (**Supplementary Appendix 1**. Available only online at <http://dx.doi.org/10.1656/S497.s1>) not previously documented in Texas, but known in Oklahoma, which is approximately 400 km to the north. Additionally, two newly described associations, which are apparently limited to Texas, were discovered and documented.

While the present work contributes to the botanical knowledge of the state, it can only serve as an invitation for additional botanical study of this very interesting geological area of Texas.

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### Literature Citation

- Bomar, G.W. 1995. Texas Weather. University of Texas Press, Austin, TX. 275 pp.
- Butterwick, M. 1979. A survey of the flora of Enchanted Rock and vicinity, Llano and Gillespie counties, Texas. *In* D. Kennard (Ed.). Enchanted Rock, a Natural Area Survey No. 14. LBJ School of Public Affairs, University of Texas, Austin, TX.
- Carr, W.R. 2002. Plant taxa endemic to the State of Texas. The Nature Conservancy of Texas, San Antonio, TX. 11 pp. Unpubl. report.
- Carr, W.R. 2005. No place but Texas: An annotated list of plant taxa endemic to the Lone Star State. The Nature Conservancy of Texas, San Antonio, TX. Unpublished report.
- Correll, D.S., and M.C. Johnston. 1970. Manual of the Vascular Plants of Texas. Texas Research Foundation, Renner, TX. 1881 pp.
- Flahault, C., and C. Schroter. 1910. Rapport sur la nomenclature phytogéographique. Proceedings of the 3rd International Botanical Congress, Brussels, 1910, 1: 131–164.
- Fleming, K., J.R. Singhurst, and W.C. Holmes. 2002. Vascular flora of Big Lake Bottom Wildlife Management Area, Anderson County, Texas. *Sida* 20(1):355–371.
- Flora of Texas Consortium. 1996. Vascular plants endemic to Texas. Available online at <http://www.csdl.tamu.edu/FLORA/endemics/endemic1.htm>. January 2006.
- Geiser, S.W. 1948. Naturalists of the Frontier. Second Edition. Southern Methodist University Press, Dallas, TX. 296 pp.
- Gould, F.W. 1975. Texas plants. A Checklist and Ecological Summary. 1975 Revision. Texas Agricultural Experiment Station, College Station, TX. 121 pp.
- Hatch, S.L., K.N. Gandhi, and L.E. Brown. 1990. Checklist of the Vascular Plants of Texas. Texas Agricultural Experiment Station, Texas A&M University, College Station, TX. 158 pp.
- Holmes, W.C., A.E. Rushing, and J.R. Singhurst. 2005. The Genus *Isoetes* (Isoetaceae) in Texas. *Lundellia* 8:1–6.
- Jones, S.D., J.K. Wipff, and P.M. Montgomery. 1997. Vascular Plants of Texas. University of Texas Press, Austin, TX. 404 pp.
- Jongman, R.G., C.F. Ter Braak, and O.R. Van Tongeren. 1995. Data Analysis in Community and Landscape Ecology. Cambridge University Press, New York, NY. 299 pp.
- Keeley, J.E., and P.H. Zedler. 1998. Characterization and Global Distribution of Vernal Pools. Pp. 1–14, *In* C.W. Witham, E.T. Bauder, D. Belk, W.R. Ferren, Jr., and R. Ornduff (Eds.). Ecology, Conservation, and Management of Vernal Pool Ecosystems—Proceedings from the 1996 Conference. California Native Plant Society, Sacramento, CA. 1998.
- Leica Geosystems. 2005. Imagine Software, Version 8.7 Available online at <http://www.leica-geosystems.com/>. Accessed January 2006. Heerbrugg, Switzerland.
- Lyndon B. Johnson School of Public Affairs. 1978. Preserving Texas' Natural Heritage. Lyndon B. Johnson School of Public Affairs Policy Research Project Report 31, University of Texas Austin, TX. 34 pp.
- Nature Serve 2006. Nature Serve explorer database. Available online at <http://www.natureserve.org/>. Accessed January 2006. Arlington, VA.

- Natural Resource Conservation Service. 2006. Digital soil database. Available online at <http://soildatamart.nrcs.usda.gov/>. January 2006. National Cartography and Geospatial Center, Ft. Worth, TX.
- O'Kennon, R.J. 1993. Checklist for the flora of Enchanted Rock State Park. Texas Parks and Wildlife Department, Austin, TX. 6 pp. Unpubl. report.
- Roemer, F. 1849. Texas with Particular Reference to German Immigration and the Physical Appearance of the Country. Translated from the German by O. Mueller, Standard Printing Company, San Antonio, TX., Reprinted 1983 by the German-Texan Heritage Society, Texian Press, Waco, TX.
- Schwertner, T.W. 1998. Mason Mountain wildlife management plan: Long-range management plan. Texas Parks and Wildlife Department, Austin, TX. 118 pp. Unpubl. report.
- Singhurst, J.R., J.C. Cathy, D. Prochaska, H. Haucke, G.C. Kroh, and W.C. Holmes. 2003. Vascular flora of Gus Engeling Wildlife Management Area, Anderson County, Texas. *Southeastern Naturalist*. 2(3):247–368.
- Sorrie, B.A., and A.S. Weakley. 2001. Coastal Plain vascular plant endemics: Phyto-geographic patterns. *Castanea* 66:50–82.
- Sorensen, T. 1948. A method of establishing groups of equal amplitude in plant sociology based on similarity of species content. *Det. Kong. Danske Videnskabernes Selskabs Bekientgiorelse, Copenhagen*. (4):1–34.
- Stanford, J.W. 1976. Keys to the Vascular Plants Edwards Plateau and Adjacent Areas. Howard Payne University, Brownwood, TX. 365 pp.
- Texas A&M University. 2006. Herbarium specimen browser. Available online at <http://www.csdl.tamu.edu/FLORA/tracy/main1.html>. Accessed January 2006. College Station, TX.
- The Nature Conservancy. 1997. National Vegetation Classification System: Oklahoma-Texas subset. 1997. The Nature Conservancy, Conservation Science Department, Southeast Region, Chapel Hill, NC. 217 pp.
- Trock, D.K., and R.J. O'Kennon. 2003. A new species of *Packera* (Asteraceae: Senecioneae) from the Edwards Plateau of Texas. *Sida* 20:945–952.
- Turner, B.L., H. Nichols, G. Denny, and O. Doron. 2003. Atlas of the Vascular Plants of Texas. *Sida, Bot. Miscellaneous*. 24. Botanical Research Institute of Texas, Ft. Worth.
- United States Department of Agriculture, Natural Resource Conservation Service. 2005. The PLANTS database, Version 3.5. Available online at <http://plants.usda.gov>. The Nature Conservancy 1997. National Plant Data Center, Baton Rouge, LA.
- University of Texas Bureau of Economic Geology. 1982. Purdy Hill sheet-map, 1:24,000. The University of Texas, Austin, TX.
- University of Texas Plant Resources Center. 2006. Flora of Texas database. Available online at <http://129.116.69.198:427/Texas.html>. Accessed January 2006. Austin, TX.
- Walters, T.W., and R. Wyatt. 1982. The vascular flora of granite outcrops in the Central Mineral Region of Texas. *Bulletin of the Torrey Botanical Club* 109: 344–364.
- Whitehouse, E. 1933. Plant succession on central Texas granite. *Ecology* 14: 391–405.