

**A NEW SPECIES OF *TETRANEURIS* (ASTERACEAE, HELENIEAE) FROM
THE LATE TERTIARY VERDE FORMATION OF CENTRAL ARIZONA**

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ABSTRACT

A new species, *Tetranneuris verdiensis* R.A. Denham & B.L. Turner, is described from Yavapai County, Arizona where it is restricted to lacustrine marl in the Verde Formation. It is related to the *Tetranneuris* "scaposa -- acaulis complex," and can be readily distinguished from the closely sympatric *T. scaposa* (*Hymenoxys acaulis* var. *arizonica*) by its dwarf habit, relatively short broad leaves, long-pilose vestiture, and rayless heads.

KEY WORDS: Asteraceae, Helenieae, *Tetranneuris*, Arizona

Preparation of a systematic study of the genus *Tetranneuris* (Bierner & Turner 1997) by the junior author has occasioned the present paper. This new species was brought to his attention by the senior author, who first became aware of its existence during the winter of 1993-1994 while engaged in floristic studies of localized substrates within the lacustrine limestone Verde Formation in northeastern Yavapai County, Arizona. Jean Searle of the Arizona Native Plant Society, while accompanying the senior author on a field trip to the type location, first pointed out the uniqueness of these populations as compared to *Tetranneuris* elsewhere in Arizona.

TETRANEURIS VERDIENSIS R.A. Denham & B.L. Turner, *spec. nov.*
TYPE: U.S.A. Arizona: Yavapai Co., 5 mi. E of Camp Verde, 3300 ft., occurring on marl with gypsum crystals at the surface, 14 May 1995, *Denham, Fobes, & Searle 1840* (HOLOTYPE: TEX).

Similis *Tetranneuri scaposae* (DC.) Greene sed planta nana et eradiata est, 4-7 cm alta, indumentum candudum -- pilosum habens, pilis 3-7 mm longus.

Dwarf scapose perennial 4-7 cm high, the stems arising from a branched woody caudex. Leaves relatively thick, all basal, 1.5-2.5 cm long, 3-5 mm wide; blades ovate to narrowly ovate, moderately but deeply glandular-punctate, entire, markedly

white-pilose throughout with hairs 3-6 mm long, the apices acute to obtuse. Scapes 4-6 cm long, ebracteate, pilose with upwardly appressed and widely spreading hairs 1-4 mm long. Heads single, hemispheric. Involucres 5-6 mm high, 3-4 mm across. Ray florets absent. Disk florets ca. 40 (est.); corollas yellow, ca. 3.5 mm long, the tube ca. 0.5 mm long, the lobes 5, densely pubescent. Anthers yellow with ovate appendages. Style branches truncate, apically hispidulous. Achenes (immature) ca. 3 mm long, densely pubescent; pappus of ca. 8 lanceolate scales 2-3 mm long.

Additional collections: *Denham, Fobes, & Searle 1835, 1836, 1837, 1838, and 1839*, all from the same location as the type, from either the same population as the type or from an adjacent population on a nearby hilltop.

GEOLOGY AND FLORISTICS OF THE TYPE LOCATION

Tetraneuris verdiensis can best be understood with a perspective on the geology and floristic patterns of the type location and surrounding areas within the Verde Formation. During the late Tertiary Period, the Verde Formation and other lacustrine deposits formed in a series of basins across the sub-Mogollon region of Arizona. These basins are home to a number of endemics which are often restricted to particular substrates. In addition to these endemics, disjunct occurrences of several other species are found in these lacustrine deposits (Anderson 1996).

The Verde Formation in northeastern Yavapai County was formed primarily through deposition and precipitation within a shallow lake bed created by down-dropping along the Verde Fault and subsequent blockage of the drainage outlet by volcanic and/or tectonic activity. The upper part of the formation, exposed at the northwestern end of the Verde Valley near Cottonwood, Arizona, is comprised of narrow interbedded layers of limestones, mudstones, and marls. The lower part of the formation, exposed at the southeastern end of the valley near Camp Verde, Arizona, is comprised mostly of more massive limestones formed in the deepest parts of the lake and evaporites, such as salt deposits and gypsum. Near the lower end of the valley are volcanoclastic deposits adjacent to and of approximately the same age as the lacustrine deposits.

Major changes in the floristic communities occur along with changes in substrate within the Verde Formation. The xeric hillside habitats on the interbedded layers near the upper end of the valley are dominated by *Canotia holacantha* and *Juniperus coahuilensis* (Martinez) Gaussen *ex* R.P. Adams. On the massive limestones in the lower valley, the flora includes some species more typical of higher elevations, such as *Juniperus osteosperma* (Torrey) Little, *Purshia stansburiana* (Torrey) Henrickson, and *Ipomopsis aggregata* (Pursh) V. Grant. The adjacent volcanic tuff supports a community with a Sonoran component, including *Agave chrysantha* Peebles, *Opuntia acanthacarpa* Engelm. & Bigelow var. *thorneri* (Thorner & Bonker) L. Benson, and *Acacia constricta* Benth.

Several taxa endemic to the late Tertiary sub-Mogollon lacustrine basins are found to occur along particular soil horizons. In the Verde Valley, *Purshia subintegra*

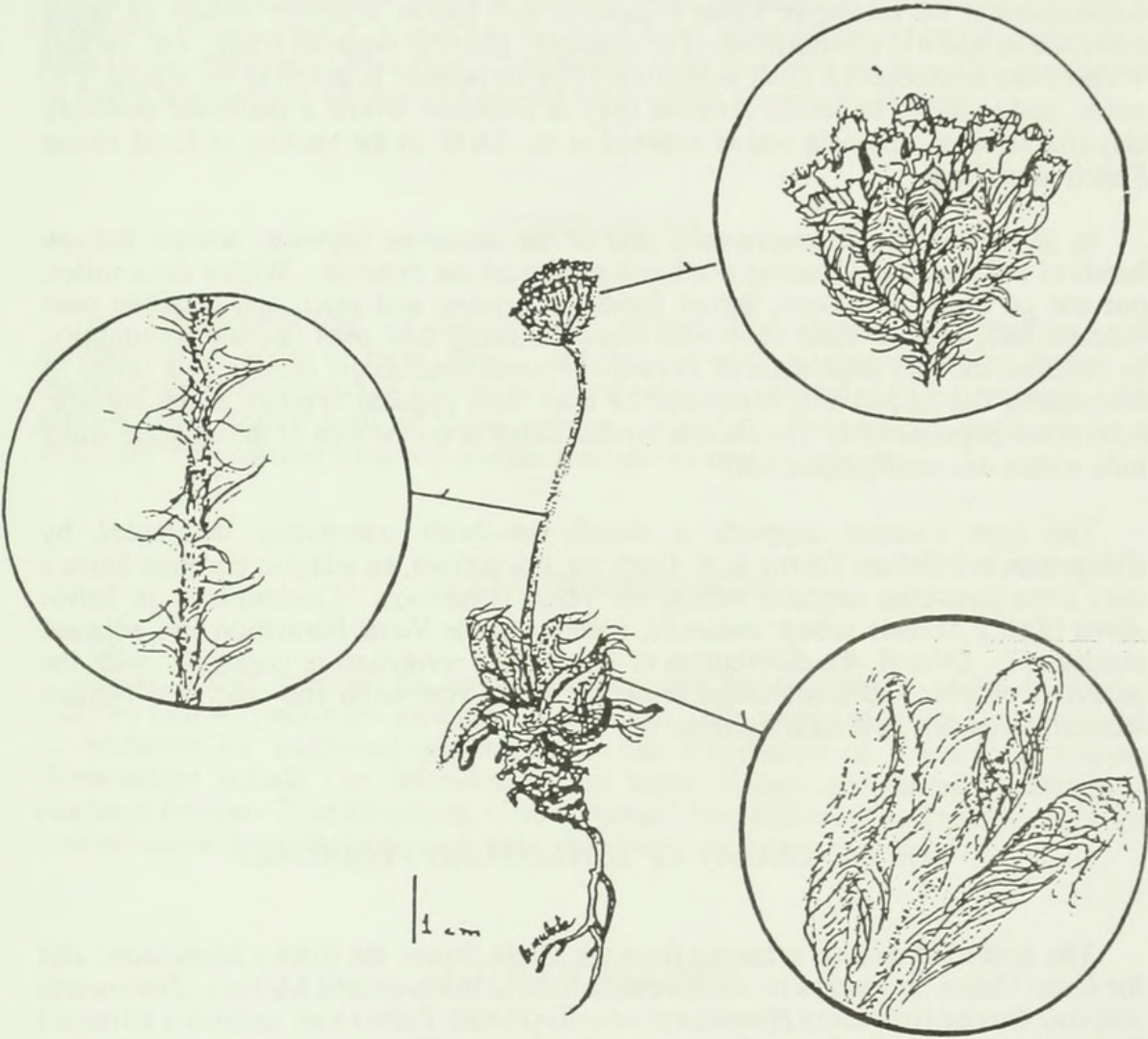


Figure 1. *Tetraneuris verdiensis* R.A. Denham & B.L. Turner, from holotype. The enlarged circle at lower right depicts several folded leaves.

(Kearney) Henrickson only occurs near the upper end of the Verde Formation and then only where there are clastic elements derived from the Mesozoic sandstones of the Supai Group, and *Eriogonum apachense* is restricted to a horizon at ca. 3500' in the block-forming limestones of the lower valley. Many other species with disjunct occurrences in the lacustrine Verde Formation also follow a similar pattern of being restricted to specific soil horizons. For example, *Quercus havardii* Rydb. var. *tuckeri* Welsh from southeastern Utah is disjunct from its nearest population by almost 170 miles, and is found in central Arizona only at locations where a particular powdery clay-like calcium carbonate soil is exposed at ca. 3400' in the vicinity of Dead Horse Ranch State Park.

In the lowest, southeastern-most end of the lacustrine deposits, several narrow bands of different soils running northeast-southwest are exposed. Within three miles, one can go from limestones, across bands of gypsum and marl, and continue onto volcanic tuff, each of these substrates accommodating their own floristic community. In this area, the type population of *Tetrandeuriis verdiensis* occurs on one of a series of low chalky flat-topped hills composed of marl with gypsum crystals at the surface. Additional populations of *Tetrandeuriis verdiensis* occur on the tops of the adjacent small hills within this stratigraphic unit.

The type location supports a dwarf sub-shrub community dominated by *Eriogonum ericifolium* Torrey & A. Gray var. *ericifolium*, an edaphic endemic known only from lacustrine deposits within the Verde Formation. Co-dominant is *Salvia dorrii* (Kell.) Abrams subsp. *mearnsii*, endemic to the Verde Formation and adjacent sandstones. Overall, the distribution of *Tetrandeuriis verdiensis* is consistent with the pattern of edaphic endemism found within the Verde Formation and other late Tertiary lacustrine deposits in central Arizona.

THE TAXONOMY OF *TETRANDEURIS VERDIENSIS*

The genus *Tetrandeuriis* is known from the Great Basin, the Rocky Mountains, and the Great Plains. It reaches its southwestern limit in north-central México. *Tetrandeuriis scaposa* Greene (including *Hymenoxys acaulis* (Pursh) Parker var. *arizonica* [Greene] Parker) is common in the northern parts of Arizona. This taxon also has a disjunct range to the south in the lacustrine limestone Verde Formation and adjacent Mesozoic sandstones in Yavapai County (Anderson 1996 *ibid.*). In the Verde Valley, *T. scaposa* has been collected by the senior author at Cottonwood, Arizona near the upper end of the valley. Anderson (1996 and pers. comm.) has collected this same taxon along Middle Verde Rd., west of Camp Verde, Arizona. This latter site is approximately seven miles from the type location of *T. verdiensis*. Although both of these species occur in the Verde Valley, there is no evidence of intergradation, no intermediate forms, and no individuals exhibiting a recombination of characteristics between these two species.

One important characteristic of *Tetrandeuriis verdiensis* is its discoid heads. Discoid individuals are known elsewhere in *Tetrandeuriis*, as isolated individuals within populations of *T. acaulis* Greene (*Hymenoxys acaulis* var. *acaulis*) in Wyoming.

These individuals, which have formed the basis for *T. eradiata* A. Nelson, differ from their neighbors only in their discoid condition, and are currently considered to be aberrant forms of *T. acaulis*. The situation in the Verde Valley is radically different. Here *T. scaposa* and *T. verdiensis* can be distinguished by a suite of characteristics which are always consistent at the population level. In addition to its discoid heads, *T. verdiensis* differs from *T. scaposa* in its dwarf habit, relatively short broad leaves, and long pilose vestiture. Other than *T. verdiensis*, there has been no report in *Tetraneris* of entire populations, or series of populations, which are wholly discoid.

CONCLUSION

In *Tetraneris* and in the closely related *Hymenoxys*, a syndrome of characteristics, some of these subtle, separate the various species. The degree of morphological distinction of *Tetraneris verdiensis* is consistent with recognition at the species level within both of these genera. In short, *Tetraneris verdiensis* is a relatively well-marked localized edaphic endemic of central Arizona.

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