
THE DISTRIBUTION, SYNONYMY, AND TAXONOMY OF THREE JUNIPERS OF SOUTHWESTERN UNITED STATES AND NORTHERN MEXICO

ROBERT P. ADAMS AND THOMAS A. ZANONI

*Science Research Center, Hardin-Simmons University, Grover, TX 79040 and
Oklahoma Biological Survey, University of Oklahoma, Norman, OK 73019*

ABSTRACT. Revised distribution maps, new keys, and updated synonymy are presented for *Juniperus erythrocarpa*, *J. monosperma*, and *J. pinchotii*. These revisions reflect the authors' evidence from the past several years and are presented to aid field workers in the identification of these difficult taxa.

The one-seeded junipers of the southwestern United States and northern Mexico have been both confused and confusing for many years. Previous to the work of Adams and Zanoni, the only taxonomic treatments dealing with the taxa were those in the manuals and floras of the states involved (Correll 1966, Correll and Johnston 1970, Kearney and Peebles 1951, McDougall 1973, Wootton and Standley 1915). The two taxa recognized were *Juniperus monosperma* (Engelmann) Sargent and *J. pinchotii* Sudworth. Although Cory (1936) recognized a third taxon, *J. erythrocarpa* Cory, in Texas, subsequent floras and checklists for Texas (Correll 1966, Correll and Johnston 1970, Gould 1975) relegated *J. erythrocarpa* to synonymy under *J. pinchotii*. Concurrently, however, Martinez (1946, 1953, 1963) accepted the usage of *J. erythrocarpa* (as *J. erythrocarpa* var. *coahuilensis* Martinez) for plants in Mexico. Van Melle (1952) further confused the issue by naming the "bright red" fruited form of *J. pinchotii* from the Chisos Mountains as *J. texensis*. Adams (1975) found no evidence for *J. texensis* and found only *J. pinchotii* and *J. erythrocarpa* in the Chisos Mountains (although hybridization between these two taxa seems likely). It appears that the "bright red" fruited plants (*J. texensis*) are either a form of *J. pinchotii* or perhaps backcrossed individuals from *J. erythrocarpa* with *J. pinchotii*.

Adams (1972, 1975) and Zanoni and Adams (1975, 1976), in analyses of *J. pinchotii* and of the taxa in Mexico, recurrently dis-

covered that certain populations sampled in western Texas, southwestern New Mexico, and southern Arizona were neither *J. monosperma* nor *J. pinchotii*. Vasek and Scora (1976), using terpenoids, reported two chemical races of *J. monosperma*. Collection of specimens and subsequent terpenoid work in 1974 by R. P. Adams (unpublished) have confirmed that the two "races" were in fact *J. monosperma* at 1800 m and higher on the Mogollon Rim and *J. erythrocarpa* at 1600 m and lower, south of the Mogollon Rim. Examination of the specimens cited by Vasek and Scora revealed both *J. monosperma* and *J. erythrocarpa* were indeed included in their analyses! These three taxa are quite distinct chemically, but very similar morphologically. Since field workers (and those working with sub-fossils from rat middens) must use the available morphological characters, it is not surprising that errors have been made in the identification of these taxa. Part of the problem is inherent in *Juniperus*, because accurate identification usually requires a specimen with mature female cones. Another difficulty is that an occasional mutant, "sport," or aberrant, is easily seen as being "different" and is often impossible to identify from a herbarium specimen, but an experienced field worker would quickly note that one aberrant specimen does not make a taxon. The recognition of only *J. monosperma* and *J. pinchotii* also accounts for part of the difficulty in identifying material from this region. The inclusion of *J. erythrocarpa* under *J. pinchotii* in Texas led to *J. pinchotii* being a quite variable taxon as described in the manuals or floras. The lack of recognition of *J. erythrocarpa* in southern Arizona and New Mexico led to an extremely variable *J. monosperma*.

The following key and synonymy are presented so that field and herbarium workers will be able to identify these taxa.

KEY TO THE TAXA.

- A. Female cones copper, copper red, to reddish-brown or pinkish to rose-colored; almost always with some whip leaf glands ruptured and then with conspicuous white crystalline exudate on the abaxial surface.
 - B. Female cones with bloom, rose to pink or pinkish-blue; whip leaves glaucous on the adaxial side (easily seen by looking directly down the stem of a terminal whip); plant habit tending toward a stronger central axis (main stem) than *J. pinchotii*; bark on upper limbs (6-10 mm across) grayish.
 - 1. *J. erythrocarpa*.
 - B. Female cones without bloom; copper, copper-red, red to reddish-brown; whip leaves without glaucousness on adaxial surface; plant habit tending to branch

at the base with limbs ascending; bark on upper limbs (6–10 mm) peeling and reddish beneath.

. 2. *J. pinchotii*.

- A. Female cones bluish-brown to blue; surface of cone with bloom; whip leaf glands if ruptured, not with white crystalline exudate on abaxial surface; whip leaves glaucous on the abaxial side.

. 3. *J. monosperma*.

SYNONYMY (see Zanoni 1978 for other species in North America).

1. *Juniperus erythrocarpa* Cory, Rhodora 38:196. 1936. *Type*: United States: Texas: Brewster Co.: Laguna in Chisos Mts., *Cory 7642* (*Holotype*: A!).

J. erythrocarpa var. *coahuilensis* Martinez, Anal. Inst. Biol. Mexico 17:115, 116. 1946. *Type*: Mexico: Coahuila: Sierra de los Hechiceros, *Johnston and Muller 1290* (*Holotype*: MEXU!; *Isotypes*: GH!, NA!, TENN!, TEX!); *J. coahuilensis* (Martinez) Gaussen, Trav. Lab. Forest. Toulouse Tome II. Sect I, Vol. 1, partie II 2, Fasc. 10, 154. 1968.

Distribution.—**MEXICO**: CHIHUAHUA, COAHUILA, DURANGO, NUEVO LEON, SONORA, TAMAULIPAS, ZACATECAS; **USA**: southern ARIZONA, southern NEW MEXICO, Trans-Pecos TEXAS.

This species is generally associated with the *Bouteloua* grasslands on the margin of the Chihuahuan Desert at about 1600 m. In Arizona it is found below the Mogollon Rim and thence southward.

2. *Juniperus pinchotii* Sudworth, Forest & Irrig. 10:204. 1905. *Type*: United States: Texas: Randall Co.: Palo Duro Canyon, *Clothier* in May, 1905 (*Holotype*: U.S. 15836581!); *Sabina pinchotii* (Sudworth) I. M. Lewis, Univ. Texas Bull 22:44. 1915; *J. monosperma* var. *pinchotii* (Sudworth) Van Melle, Phytologia 4:29. 1952; *J. texensis* Van Melle, Phytologia 4:26, 1952. *Type*: United States: Brewster Co.: Big Bend National Park, *Brenchle 51019* (*Holotype*: NY!, *Isotype*: A).

Distribution.—**MEXICO**: COAHUILA; **USA**: OKLAHOMA, western TEXAS, SE NEW MEXICO.

This species has the largest populations in the Permian clay breaks of Texas to the east of the Llano Estacado from Palo Duro Canyon south to San Angelo. Other populations are found on gypsum outcrops (Oklahoma, New Mexico); in Mexico the populations are generally small and appear to be relictual. This species occupies the driest sites of the three species with elevations ranging from about 300 to 1000 m but up to 1700 m in the Trans-Pecos region of Texas and Mexico.

3. *Juniperus monosperma* (Engelmann) Sargent var. *monosperma* Silva N. Amer. 10:38. 1896. *J. occidentalis* var. *B monosperma* Engelmann, Tras. Acad. Sci. St. Louis 3:590. 1877. *Type*: United States: Colorado: Fremont Co.: Canon City, (Collector?), (*Holotype*: MO); *Sabina monosperma* (Engelmann) Rydberg, Bull. Torrey Bot. Club 32:598. 1904. *J. mexicana* var. *monosperma* (Engelmann) Cory, Rhodora 38:183. 1936. *J. occidentalis* var. (c) *gymnocarpa* Lemmon, Handb. West-Amer. Cone-Bearers ed. 3, 80. 1895. *Type*: none designated; *J. monosperma* f. *gymnocarpa* (Lemmon) Rehder, J. Arnold Arbor. 7:329. 1926. *J. gymnocarpa* (Lemmon) Cory, in part, Rhodora 38:184. 1936.

Distribution.—**USA**: SE COLORADO, into northern ARIZONA, NEW MEXICO, NW OKLAHOMA, and Trans-Pecos and N Panhandle TEXAS,

DISCUSSION. Since the occurrence of seeds exerted from the female cones is very common in *J. monosperma*, it seems in order to comment on the problem of "gymnocarpy." Florin (1933) and Morton (1941) reviewed the occurrence of gymnocarpy in *Juniperus*. Our field observations indicate that gymnocarpy occurs in cones of most species of *Juniperus* in North America. Insect larvae infest the immature cones, causing abnormal development of seeds and cones, resulting in the gymnocarpous condition and the seed does not usually contain a fully-developed endosperm and embryo. Cory (1936), in changing the status of *J. occidentalis* var. *gymnocarpa* Lemmon, included several species in his *J. gymnocarpa*. Lemmon (1895) states that he observed *J. gymnocarpa* on the Sandia Mountains near Albuquerque, New Mexico. These plants are referable to *J. monosperma*. Cory (1936) altered Lemmon's description to include plants from southwestern Texas, New Mexico, Arizona, Utah, Nevada, Colorado, and Mexico. Subsequently, he inadvertently included plants that are now recognized as *J. erythrocarpa*, *J. pinchotii*, and possibly *J. osteosperma* in his *J. gymnocarpa*. Cory did not recognize the teratological nature of gymnocarpy in his specimens, and assumed it to be a valid characteristic.

Although *J. monosperma* var. *monosperma* has been reported from southern Arizona (south of the Mogollon Rim) and in northern Mexico (Sonora, Chihuahua, Durango, Coahuila, Zacatecas, Nuevo Leon, San Luis Potosi, and Tamaulipas), our field observations and chemotaxonomic investigations (Adams 1972, 1975; Zanoni and Adams 1975, 1976) have shown that the junipers in these localities are *J. erythrocarpa*, *J. pinchotii*, and *J. monosperma* var. *gracilis* (sensu Martinez). We have not seen herbarium specimens nor observed live plants of *J. monosperma* var. *monosperma* from Mexico. The status of *J. monosperma* var. *gracilis* Martinez is still in doubt. Our previous studies (Zanoni and Adams 1975, 1976) showed it to have somewhat stronger affinities to *J. erythrocarpa* than to *J. monosperma* var. *monosperma*, but perhaps it exhibits enough differentiation and evolutionary divergence to warrant recognition as a species.

Juniperus monosperma var. *monosperma* generally occurs at higher elevations and in more mesic sites than *J. erythrocarpa* or *J. pinchotii* (generally 1000 m in northern Texas up to about 2300 m in northern Arizona).

Juniperus erythrocarpa, *J. monosperma* var. *monosperma*, and *J. pinchotii* have different moisture requirements and seldom overlap (Fig. 1). Sympatry between *J. pinchotii* and *J. erythrocarpa* is found

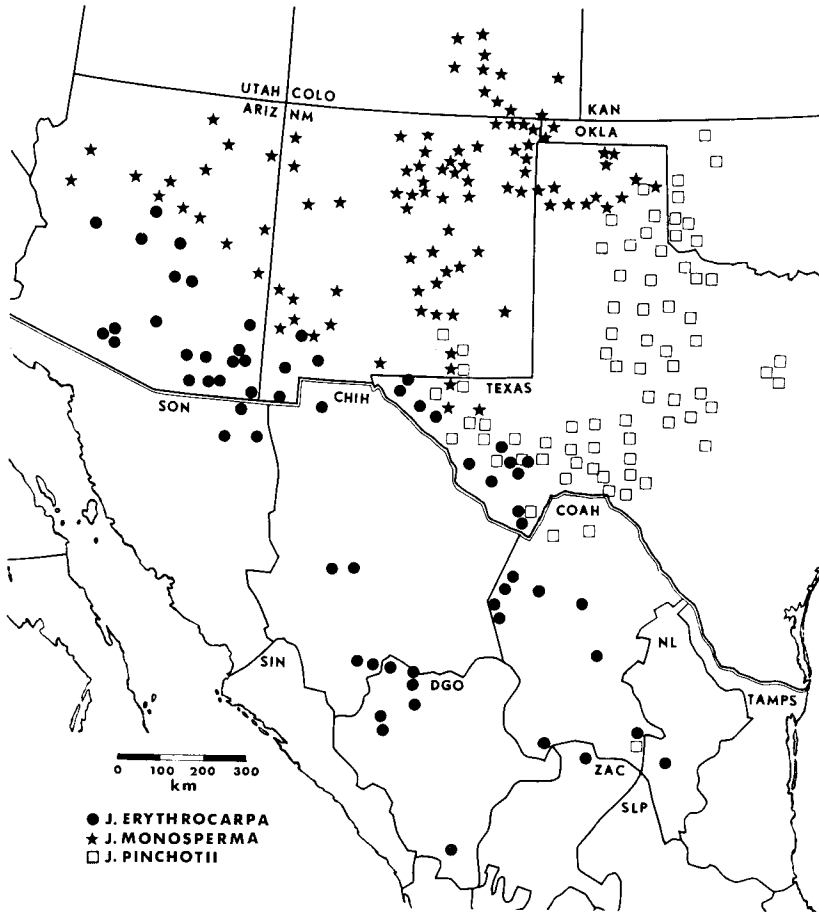


Fig. 1. Distributions of *Juniperus erythrocarpa*, *J. monosperma* var. *monosperma*, and *J. pinchotii* based on herbarium specimens at ARIZ, ASU, BRY, COLO, CS, OKLA, SRSC, TEX, UCR, UNLV, UNM, UT and UTC. The distribution of *J. erythrocarpa* may be more extensive in the western portion of the Chihuahuan Desert.

in the Chisos Mountains, near Alpine, Texas, and occasionally in the mountains of Coahuila, Mexico. Sympatry between *J. monosperma* and *J. erythrocarpa* is known only from the lower portion of Oak Creek Canyon, Arizona, but should be expected in canyons coming off the Mogollon Rim and in southwestern New Mexico, as well as possibly in the mountains of Trans-Pecos Texas. *Juniperus pinchotii* and *J. monosperma* are found together in Palo Duro Canyon, Texas, *J. monosperma* entering the canyon from the west (New Mexico) and

J. pinchotii entering the canyon from the Permian clay breaks. They are also found together in the breaks of the Canadian River near Canadian, Texas, and in the southern Guadalupe Mountains near Carlsbad Caverns, New Mexico, and McKittrick Canyon, Texas.

Although *J. erythrocarpa*, *J. monosperma*, and *J. pinchotii* are very similar morphologically, we feel they should be maintained as species because (see Ownbey 1950): (1) they are natural groups characterized by a combination of morphological and chemical characters; (2) they are reproducing under natural conditions; and (3) they are genetically isolated (*J. pinchotii* generally produces pollen in September and October, *J. erythrocarpa* in November and December, and *J. monosperma* in February and March) although there may be occasional hybridization.

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