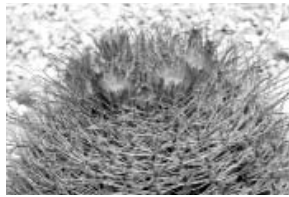


Cacti of the Trans-Pecos & Adjacent Areas





Cacti of the Trans-Pecos & Adjacent Areas



A. Michael Powell and
James F. Weedin

Texas Tech University Press

Contents

Preface	ix
Acknowledgments	xii
Introduction	i
Biology of Cacti	4
<i>Morphology and Anatomy</i>	4
<i>Physiology (= Primary Compound Chemistry)</i>	20
<i>Secondary Compound Chemistry</i>	26
<i>Ecology and Biogeography</i>	30
<i>Evolution</i>	36
<i>Pollination Biology</i>	39
<i>Uses and Other Ethnobotany</i>	44
<i>Horticulture</i>	57
<i>Conservation</i>	61
Classification of Cacti	65
Key to the Genera	68
Descriptive Cactus Flora	73
Selected Glossary	465
Literature Cited	479
Index	497



Preface

THE Chihuahuan Desert Region (Wauer and Riskind, 1977) holds more species of cacti than any other comparable area in North America (Hernández and Bárcenas, 1995). This center of cactus diversity lies mostly in northern Mexico; it extends into the United States only in the Trans-Pecos region of Texas and some adjacent parcels in New Mexico and Arizona. This area west of the Pecos River involves about 32,000 square miles, or 20.5 million acres, equivalent in size to the state of Maine. The Trans-Pecos shares some species and vegetation types with the Edwards Plateau (“Hill Country”) of Central Texas, the Tamaulipan thorn-scrub of the Rio Grande valley, the Great Plains of the Texas Panhandle and eastern New Mexico, and the Apachean floristic region of southeastern Arizona. However, by far the greatest part of the Trans-Pecos vegetation and flora pertains to the Chihuahuan Desert. Consequently, the Trans-Pecos is one of the major centers of cactus distribution in the United States.



In Trans-Pecos Texas, the southern Big Bend area is best known as cactus country. The lowest elevation in the entire Chihuahuan Desert Region lies in the Boquillas Basin near the Rio Grande, just downslope from the southeastern foothills of the Chisos Mountains. Endemic taxa and subfossil remains of desert plants indicate that the Boquillas Basin served as a major biological refugium during the last Ice Age and thus must have been one of the major dispersal centers for Chihuahuan Desert species.

The present work is the first that emphasizes the cacti of Trans-Pecos Texas. Several publications with wider geographic coverage that have included the Trans-Pecos cactus flora are cited in the Introduction. Most of the sources are out of print. The cactus books most widely used to identify Texas cacti were those by Del Weniger and Lyman Benson. The extensive nomenclatural differences between the Weniger and Benson publications were disconcerting to many who wanted to use the scientific names of southwestern cacti. One objective of our cactus treatment was to reconcile the differences between Weniger and Benson,

16. Tubercles with areolar grooves; flowers and fruits apical; flowers emerging from the areoles or areolar grooves, although sometimes at the base of the groove near the tubercle axil, spines or bracts not present in the tubercle axils (17).
- 17(16). A thin, yellowish, mucilaginous layer beneath older stem surface tissue (bark), usually evident in longitudinal sections of living plants; pith and cortex not mucilaginous; flowers pink to magenta; fruits dry, thin-walled, green to tan or whitish when mature; seeds like those of *Ariocarpus*
 10. *Neolloydia*, page 322
17. A thin, yellowish, mucilaginous layer not present beneath old bark in living plants, pith and cortex mucilaginous or not; flowers white, yellow, pink, or magenta; fruits scarcely succulent to succulent, green to red when mature; seeds very different (18).
- 18(17). Stems ribbed, the ribs well or poorly defined, the podaria decurrent and confluent to some degree; areolar glands absent; fruits green, scarcely succulent at first, quickly drying after ripening
 14. *Echinomastus*, page 348
18. Stems strongly tuberculate; areolar glands present except in subgenus *Escobaria*; fruits green or red, usually succulent (often juicy), in most species remaining succulent after ripening
 17. *Coryphantha*, page 392

Descriptive Cactus Flora

1. OPUNTIA Mill.

Club Chollas, Chollas, Prickly Pears

Plants low with creeping stems or erect and shrublike, 6 cm to 2–4 m high, with or without a short trunk or caudex. Stems of cylindroid or flattened joints, 5–28 cm long (to ca. 1 m long in the cultivar *O. engelmannii* var. *linguiformis*), the cylindroid joints 0.5–5 cm in diameter, flattened stem joints (pads) 5–28 cm broad. Ribs none (or well-defined in a few Mexican species, especially *O. bradtiana*). Tubercles absent (or reduced to swellings, especially in subgenus *Opuntia*, the prickly pears) or present but low and strongly decurrent in several chollas (e.g., *O. imbricata*) and club chollas (e.g., *O. emoryi*). Leaves cylindroid or awl-shaped, 0.5–1.5 cm long, usually present only on new stems and fruits, falling after the stems are a month or more old. Areoles circular or elongated. Spines white, gray, yellow, brown, pink, reddish, purplish, to black, or more than one color on same spine, (0–)1–10 or more per areole, smooth, straight, or curved, usually needlelike and 0.25–1 mm in diameter or awl-shaped and flattened (elliptic or angled in cross section) and 1–2 mm or more wide at the base, sometimes with full-length or partial sheaths; glochids (only in *Opuntia*) in areoles with (or without) spines. Flowers 1–9(–12) cm in diameter; floral tube short, shallow, cuplike, so that stamens are borne a short distance above the ovary; inner tepals usually not white (our species yellow, red, magenta, pinkish, brown, or greenish); in some species the inner tepal bases, in the flower center, contrastingly colored; stamens of many species are sensitive to touch, quickly closing around the style. Fruits succulent or dry, indehiscent, or (rarely) rupturing irregularly, obovoid, turbinate, elliptical, or spheroidal, 1–8 cm long, 0.8–6 cm in diameter; areoles mostly naked or bearing spines, glochids, or hairs, round to elongate, 1.2–5.5 mm long, 1.2–4.5 mm in diameter. Seeds whitish, gray, tan, brown, or a mixture of colors, flattened and discoid, or longer than broad, 1.5–6(–7) mm in largest measurement; funicular envelope with girdle (midvein) developed over seeds (pseudoaril). $x = 11, 22, 33, 44$ (our species).

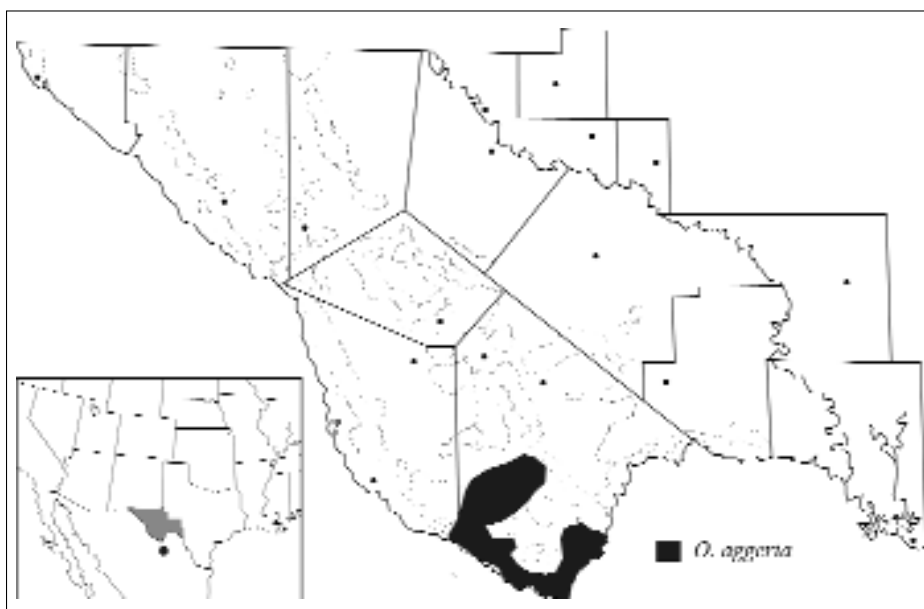


- 24(22). Plants low, spreading, trailing, or weak-stemmed, 30–60 cm high, with 1–3 whitish spines
21. *O. phaeacantha*.
24. Plants usually erect or spreading with stout stems, usually 30–60 cm or more high, with 1–11 spines of various colors, if mostly whitish then usually showing some brownish at least basally (25).
- 25(24). Spines typically yellow (red-spined color-phases or forms occur in some populations) (26).
25. Spines various colors, white to reddish, reddish-brown, to nearly black, not yellow; polyploids (28).
- 26(25). Plants usually over 1 m high; lower Pecos (Sheffield, Pandale) and Boquillas area downstream to the Gulf of Mexico; hexaploids
24b. *O. engelmannii* var. *lindheimeri*.
26. Plants usually less than 1 m high; distribution mostly otherwise; diploids (27).
- 27(26). Spines 1–5 per areole, yellow in younger pads but darker with age; fresh flowers pale yellow, lacking red centers; fruits succulent, juicy, spineless; Chisos Mts, in the oak zone
19. *O. chisosensis*.
27. Spines 4–11 per areole, yellow to orange, brown, or nearly black; fresh flowers relatively bright yellow, with sharply defined red centers; fruits fast-drying, spiny; near Rio Grande, Mariscal Mt to Boquillas, in rocky desert
14c. *O. azurea* var. *aureispina*.
- 28(25). Spines typically whitish (may have dark bases) or color-banded, but not all-brown; pads averaging relatively large (spines appearing relatively short; hexaploids) (29).
28. Spines (at least the largest ones) usually reddish-brown to nearly black, other colors; pads averaging smaller (spines appearing relatively long); tetraploids and hexaploids (30).
- 29(28). Spines usually 3–4 per areole arranged in a “bird’s-foot” pattern; inner tepals all-yellow (may redden prior to wilting); hairy seedlings
24a. *O. engelmannii* var. *engelmannii*.
29. Spines usually 2(–4) per areole, not in a “bird’s-foot” pattern; inner tepals yellow with red bases; ordinary (bristly) seedlings
23. *O. dulcis*.
- 30(28). Fruits typically spiniferous distally, drying rapidly; erect shrubs; near Rio Grande, vicinity of Hot Springs, S Brewster Co.; tetraploid
20. *O. spinosibacca*.
30. Fruits spineless or rarely few-spined near the apex, remaining succulent

long after ripening; low shrubs; widespread in the Trans-Pecos;
hexaploid

22. *O. camanchica*.

1. *Opuntia aggeria* Ralston & Hilsenb., Madroño 36: 226–28, f. 2. 1989. CLUMPED DOG CHOLLA. Plates 32, 33. Loosely consolidated desert alluvium, gravel to silt, often gypseous, igneous, or limestone. Presidio Co., extreme SE portion; Brewster Co., southern half, most common within 10–20 mi of the Rio Grande. 1,800–3,500 ft. Flowering late Mar–Apr (to early May in cultivation). $2n = 22$. Mexico, S into Coahuila (where replaced by *O. moelleri* A. Berger near Cuatro Ciénegas), presumably in NE Chihuahua. Map 2.



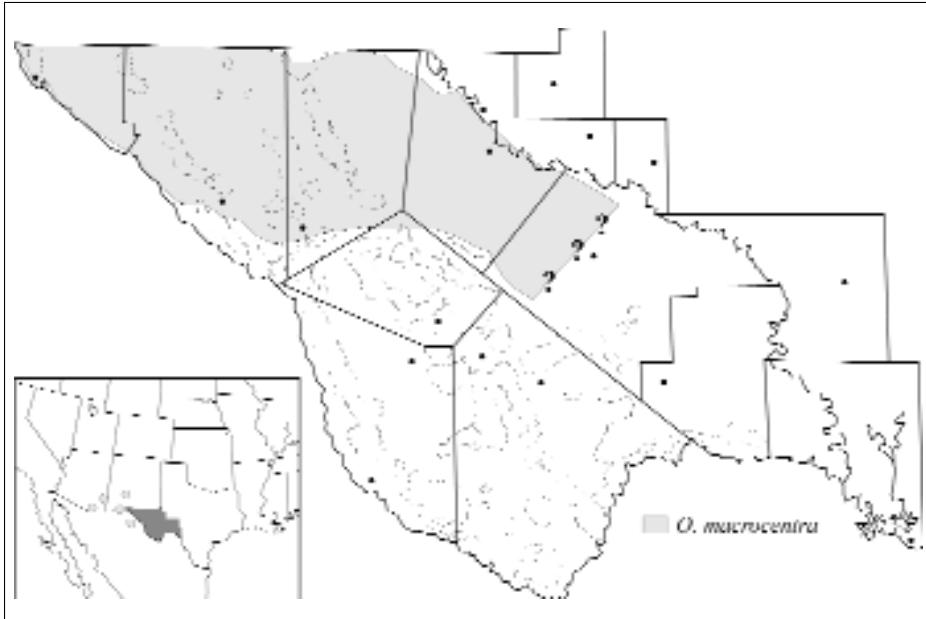
Map 2. Generalized distribution of *Opuntia aggeria* (clumped dog cholla).

The type locality is Tornillo Flats at 2,800 ft, Big Bend National Park, Brewster County, Texas. The specific epithet refers to the aggregated growth habit of *O. aggeria*, after the Latin *aggerus*, “mound.”

Opuntia aggeria is a recently named member of a small group of closely related taxa, the “*O. schottii* complex” (Ralston and Hilsenbeck, 1989). In the Trans-Pecos these low, matted, mound-forming, or sprawling plants are known as dog chollas: “club cholla” is an international name for these and the larger “devil chollas” in the taxon *Corynopuntia*, currently included in the subgenus or segregate genus *Grusonia*. The dog chollas in general are disliked by some people because the readily dislodged stems of *O. schottii* and its closest relatives easily disperse as dangerously spiny nuisances embedded in shoes, tires, or hapless ani-

E through Hudspeth, Culberson, and Reeves counties, NE Brewster Co. E of Alpine and adjacent Pecos Co. 3,000–5,000 ft. $2n = 22, 44$. Flowering Apr–May. Southern NM and SE AZ. Mexico, NE Chihuahua S to near Ciudad Chihuahua (Ferguson, sight records), and barely into NE Sonora from AZ. Map 11.

Opuntia macrocentra is one of relatively few prickly pears noted for purple stems, the product of a betalain pigment (presumably one particular compound, betacyanin) most evident when the plants are stressed by cold or drought. Benson (1982) treated *O. macrocentra* as one of five varieties within *O. violacea*. According to Ferguson (1988) and Pinkava and Parfitt (1988), *O. violacea* was



Map 11. Generalized distribution of *Opuntia macrocentra* (long-spined purplish prickly pear).

not validated until 1895, and then only accidentally (attributed to Engelmann by B. D. Jackson, Index Kewensis 2: 358); by then, in 1856, Engelmann had formally named *O. macrocentra*. Of the varieties recognized by Benson, Pinkava and Parfitt considered *violacea* and *castetteri* as synonymous with *O. macrocentra*; two others were removed as distinct species [*O. santa-rita* (Griffiths & Hare) Rose and *O. gosseliniana* F. A. C. Weber]. Thus, Pinkava and Parfitt recognized no varieties of *O. macrocentra* in the southwestern United States and northern Mexico. The variety of *O. macrocentra* described by Anthony (1956), *O. macrocentra* var. *minor*, was treated erroneously by Benson (1969b, 1982) as synonymous with *O. atrispina* and not reviewed by Pinkava and Parfitt in 1988. Ferguson erroneously equated *minor* with the small-padded endemic diploids of the lower Big Bend. Weniger (1984) presented *O. macrocentra* as a species without varieties; he did not comment on Benson's varieties of this taxon except to exclude one of them, as *O. violacea* var. *santa-rita*. Ferguson reviewed this taxonomic complex and divided Benson's five varieties of *O. violacea* between two

species, *O. macrocentra* and *O. chlorotica* (see Biosystematics under *O. azurea* var. *diplopurpurea*).

Our review of the *O. macrocentra* complex in Trans-Pecos Texas and adjacent areas suggested that there are at least eight taxonomic entities mentioned in the literature on this complex, including Mexican and Sonoran Desert fringe taxa. One taxon, previously known as *O. macrocentra* var. *minor*, was paired by us with *O. mackensenii* var. *mackensenii*. In the present treatment we recognize *Opuntia macrocentra*, sensu stricto, and five related taxa now placed in *O. azurea*; among these, three are newly named and described herein.

Some populations of *O. macrocentra*, sensu lato, conspicuously fit the popular names of “long-spined prickly pear” and “purple prickly pear.” The syntype locality for *O. macrocentra* first appeared in print as “Sand-hills on the Rio Grande near El Paso.” Specifically (quote from *Cactaceae of the Boundary*), the syntypes were from “Sandy ridges in the bottom of the Rio Grande near El Paso, also on the Limpia (*Wright*),” later restricted (by lectotypification) to the El Paso locality. Engelmann’s diagnosis might be based on a mixture of both El Paso and Limpia Creek populations. The specific epithet alludes to the long central spines, after the Greek *makros*, “long,” and *kentron*, “spine.”

Identifying Characters. The plants are spreading to nearly upright shrubs usually 30–60 cm tall, but to 1 m high, and only rarely with a short trunk. The “smooth” blue-gray, blue-green, or purplish pads are obovate to orbicular, 10–20 cm long, 10–20 cm in diameter, or the pads are slightly wider than long. The areoles are 1.5–3 cm apart, and spines are produced in areoles on the upper one-fourth to one-half of the pad, or only on the upper margin. The largest spines are notably directed upward. In most upper areoles there are 1–2(–4) central spines, with the upper projecting ones usually 5–10(–12) cm long, and black, dark brown, or reddish-brown, at least basally, sometimes tipped more or less extensively with yellowish or white. There are abundant reddish-brown to yellowish glochids, especially in the upper areoles.

The yellow flowers of *O. macrocentra* have sharply defined bright red centers. The flowers are 6–8 cm long, 5.5–8 cm wide, and in general not opening as widely as most other opuntias. The inner tepals are 3–5 cm long, 2–3.5 cm wide, obovate-spatulate, obtuse apically, sometimes emarginate and/or apiculate. The red bases of the yellow tepals extend upward to near midtepal, often tapering distally so that the red center of the flower is “star-shaped,” and in some plants the red pigment extends along the midvein almost to the tepal apex, like a “mid-stripe” (rare in *Opuntia*). The filaments are ca. 1.5 cm long, pale green proximally and cream-colored distally. The anthers are 1.8–2 mm long, and yellow. The cream-colored style is 1.7–2 cm long. The ca. 6 stigma lobes are ca. 5 mm long, and cream-colored or pale green. The pericarpel is 2.5–3 cm long, slender, 1.2–1.5 cm in diameter, with scattered areoles (12–16), mostly on the upper half, and small, with brown glochids.

The fruit at ripening turns reddish-purple or purple and remains succulent. It is obovoid, ovoid, or ellipsoid, 3–4.3 cm long, 1.5–3 cm in diameter, not much, if at all, constricted below the apical rim. The umbilicus is deeply concave. The fruits usually have 12–16 areoles. The fruit rind is purple, and the juice and pulp

turnal, 2.5–5 cm in diameter; receptacles cup-shaped or turbinate, 5–6 mm in diameter, on slender pedicels, bracteate, with trichomes and spines in areoles in axils of the bracts; outer tepals green, 2–5, ovate, 4–11 mm long; inner tepals white or greenish-white or with yellowish or pink tinge, obovate to spatulate, 1.5–2.5 cm long; stamens numerous, 5–10 mm long, filaments whitish proximally, white or yellow to reddish distally, anthers yellow; ovary superior at anthesis but in fruit enclosed by the perigynous rim of the receptacular cup and filament bases; style 10–12 mm long, white, stigma lobes 4–7, white, 3–5 mm long, erect or suberect. Fruit yellow to orange at maturity, globular to subglobular, fleshy, 1.5–2.5 cm in diameter, bearing 6–15 areoles with spreading spines 3–8 mm long. Seeds only 2–5 (solitary in each carpel, unusual for cacti), black, smooth, flat or weakly concave on one side (bilaterally asymmetrical, unlike all other cactus seeds), almost circular in general outline, 4.5–5 mm in diameter.

This tropical leafy cactus genus was unknown in Texas until 11 May 1996 (Ideker, 1996) in Willacy County, lower Rio Grande valley. The plants were located on a wooded tract of land surrounded by cotton fields, with stems climbing and spreading like vines in trees and hanging within 2 m of the ground. Previously the species, also known as Barbados gooseberry, was known to occur in Florida, southern Mexico, Central America, and the West Indies, where probably it is naturalized after cultivation (also escaped in South Africa), and in lowland tropical South America, its natural territory (Leuenberger, 1986). The plants are assumed to be naturalized in Willacy County but probably not introduced directly at the site where they were discovered. The genus name commemorated the French scholar Nicolas Claude Fabri de Peiresc (1580–1637), although the nomenclaturally correct spelling of the genus name turned out to be *Pereskia*, probably reflecting the French pronunciation of Peiresc. The specific epithet is derived from the Latin *aculeus*, “needle,” obviously a reference to the spines of this broad-leafed cactus.

***Selenicereus spinulosus* (DC.) Britton & Rose** QUEEN OF THE NIGHT. [*Cereus spinulosus* DC., Mém. Mus. Hist. Nat. 17: 117. 1828; *Selenicereus pseudospinulosus* Weing.] Plants clambering. Roots aerial. Stems many, usually 2–4 m long, light green, 1–2 cm in diameter. Ribs 4–6, acute. Areoles 1.5–2.5 cm apart. Spines brown, 1 mm long; central spine 1; radial spines 6–7. Flowers nocturnal, white to pinkish, 10–12 cm long, to 8.5 cm or more in diameter. Reported for South Texas. Main distribution in Tamaulipas, Veracruz, Hidalgo, San Luis Potosí, Oaxaca, and Chiapas, Mexico. A photograph is available in Anderson (2001).

Selected Glossary

- ABAXIAL.** The side of an organ away from the main axis; for example, the lower side or edge of a tubercle (opposite of adaxial).
- ABSCISSION.** Separation of a plant part through disintegration of a special layer(s) of cells.
- ACICULAR.** Needlelike; slender, elongate, circular in cross section, and tapering to a pointed apex.
- ACUMINATE.** A shape abruptly narrowed into a long, pointed apex.
- ACUTE.** Tapering to an apex, at less than 45° .
- ADAXIAL.** Adjacent to the axis (facing the stem); said of the upper side or edge of a leaf or tubercle.
- ADVENTITIOUS.** Formed in an unusual place; said especially of roots that sprout directly from stems or fruits instead of from preexisting roots.
- ALLOGAMY.** Cross-fertilization; outcrossing (opposite of autogamy).
- ALLUVIUM.** A geologic substrate deposited by running water; clay, silt, sand, gravel, or loose rocks.
- ANNULAR.** In the form of a ring, such as annular thickenings encircling stems or spines.
- ANNULATE.** Having ringlike bands; said of spines that show swollen daily growth increments, as in *Ferocactus wislizeni*.
- ANTHER.** The upper pollen-producing part of the stamen, consisting mostly of the pollen sacs.
- ANTHESIS.** The time of opening of a flower.
- ANTHOCYANIN.** A water-soluble flavonoid pigment (red, purple, or blue) occurring in cell vacuoles of many types of plants except cacti and their relatives.
- ANTHROPOGENIC.** Engendered by humans.
- APEX.** The uppermost point; the tip (pl., apexes or apices).
- APICAL.** At the apex.
- APICULATE.** A shape ending abruptly in a short, protruding point (an apiculation), but not a hard prickly point (see Mucronate).
- APOMIXIS.** Reproduction without fertilization; asexual reproduction; in plants

