

**AJO PEAK TO TINAJAS ALTAS: A FLORA OF SOUTHWESTERN ARIZONA
PART 20. EUDICOTS: SOLANACEAE TO ZYGOPHYLLACEAE**

RICHARD STEPHEN FELGER

Herbarium, University of Arizona
Tucson, Arizona 85721

&

International Sonoran Desert Alliance
PO Box 687

Ajo, Arizona 85321

*Author for correspondence: rfelger@email.arizona.edu

SUSAN RUTMAN

90 West 10th Street
Ajo, Arizona 85321

tjt@tabletoptelephone.com

ABSTRACT

A floristic account is provided for Solanaceae, Talinaceae, Tamaricaceae, Urticaceae, Verbenaceae, and Zygophyllaceae as part of the vascular plant flora of the contiguous protected areas of Organ Pipe Cactus National Monument, Cabeza Prieta National Wildlife Refuge, and the Tinajas Altas Region in southwestern Arizona—the heart of the Sonoran Desert. This account includes 40 taxa, of which about 10 taxa are represented by fossil specimens from packrat middens. This is the twentieth contribution for this flora, published in Phytoneuron and also posted open access on the website of the University of Arizona Herbarium: <<http://cals.arizona.edu/herbarium/content/flora-sw-arizona>>.

Six eudicot families are included in this contribution (Table 1): Solanaceae (9 genera, 21 species), Talinaceae (1 species), Tamaricaceae (1 genus, 2 species), Urticaceae (2 genera, 2 species), Verbenaceae (4 genera, 7 species), and Zygophyllaceae (4 genera, 7 species). The flora area covers 5141 km² (1985 mi²) of contiguous protected areas in the heart of the Sonoran Desert (Figure 1).

The first article in this series includes maps and brief descriptions of the physical, biological, ecological, floristic, and deep history of the flora area (Felger et al. 2013a). This flora includes the modern, present-day taxa as well as fossil records from packrat middens. Explanation of the format for the flora series is provided in part 3 (Felger et al. 2013b). These contributions are also posted open access on the website of the University of Arizona Herbarium (ARIZ). Family designations follow APG III and 1V (Angiosperm Phylogeny Group 2009, 2016; also see Stevens 2012). Non-native taxa established in the flora area are marked with an asterisk (*) and non-natives not established in the flora area are marked with double asterisks (**). Present-day taxa also represented by fossil specimens are indicated with a dagger symbol (†) and the one species no longer present in the flora is marked with two dagger symbols (††).

All specimens cited are at the University of Arizona Herbarium (ARIZ) unless otherwise indicated by the abbreviations for herbaria at Cabeza Prieta National Wildlife Refuge (CAB), Organ Pipe Cactus National Monument (ORPI), and the standardized abbreviations for herbaria (Index Herbariorum, Thiers 2016). All photos and scans are by Sue Rutman unless otherwise stated and botanical illustrations are by Lucretia Breazeale Hamilton (1908–1986). Descriptions and keys pertain to taxa and populations as they occur in the flora area.

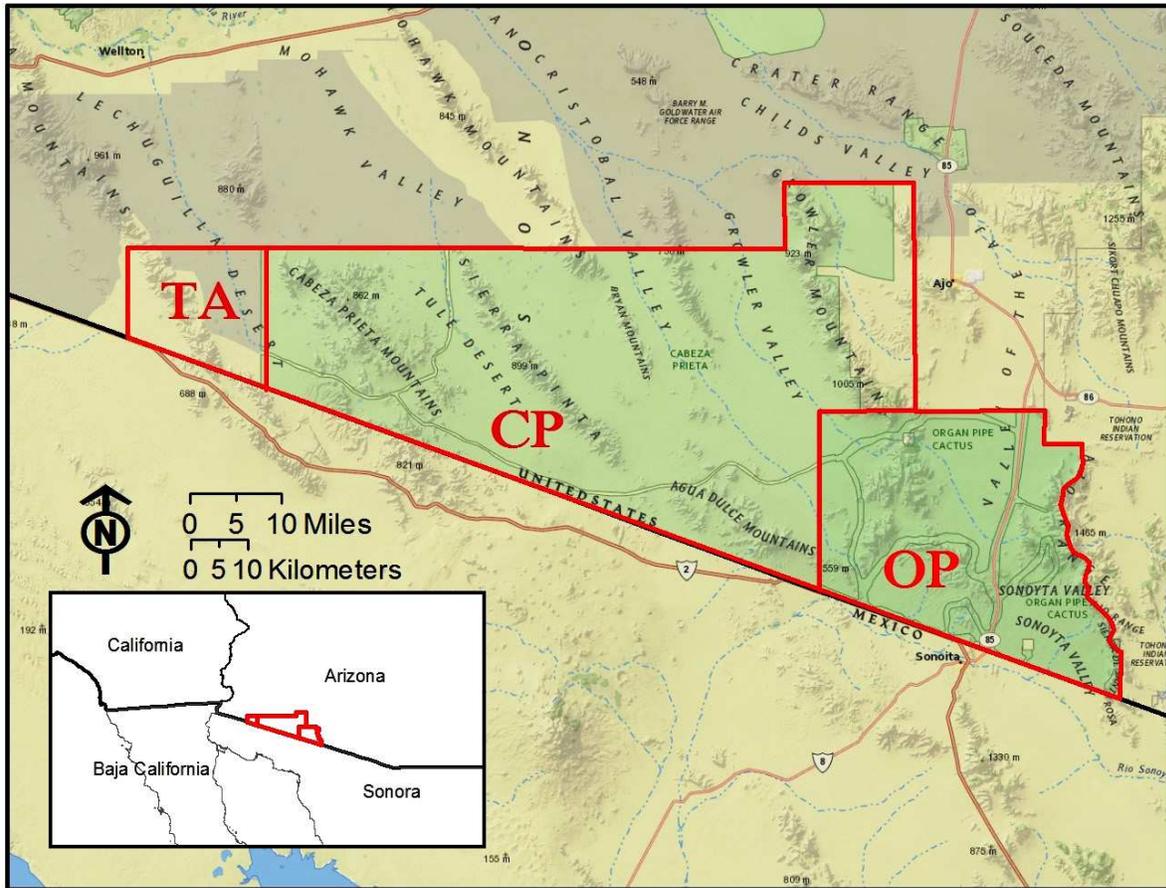


Figure 1. Flora area in southwestern Arizona. OP = Organ Pipe Cactus National Monument; CP = Cabeza Prieta National Wildlife Refuge; TA = Tinajas Altas Region. Green shading indicates approximate boundaries of federally designated wilderness. Map by Jim Malusa.

Table 1. Local distributions and growth forms of Solanaceae, Talinaceae, Tamaricaceae, Urticaceae, Verbenaceae, and Zygophyllaceae. † = Modern species also represented by a fossil; †† = fossil taxon no longer present; * = non-natives taxa; ** = non-native species not established in the flora area. OP = Organ Pipe Cactus National Monument; CP = Cabeza Prieta National Wildlife Refuge; TA = Tinajas Altas Region. SU = Summer/warm-season ephemerals; WI = winter-spring/cool-season ephemerals; AP = facultative annuals or perennials; PR = perennials.

Taxon	Region			Growth Form				
	Organ Pipe	Cabeza Prieta	Tinajas Altas	Ephemerals			Facultative annual or perennial	Perennial
				Summer	Winter	Non-seasonal		
SOLANACEAE								
<i>Calibrachoa parviflora</i>	OP					NS		
<i>Capsicum annuum</i>	OP							PR
<i>Chamaesaracha arida</i>		CP	TA					PR
<i>Datura discolor</i>	OP	CP	TA			NS		
†† <i>Datura wrightii</i>	(OP)							(PR)
<i>Lycium andersonii</i>	OP	CP	TA					PR
<i>Lycium berlandieri</i>	OP	CP						PR
† <i>Lycium cf. berlandieri</i>	(OP)							PR
<i>Lycium californicum</i>	OP	CP						PR

<i>Lycium exsertum</i>	OP							PR
<i>Lycium fremontii</i>	OP	CP	TA					PR
† <i>Lycium macrodon</i>	OP	CP	TA					PR
<i>Lycium parishii</i>	OP	CP	TA					PR
† <i>Lycium</i> sp./spp.	(OP)		(TA)					PR
<i>Nicotiana clevelandii</i>	OP	CP	TA		WI			
** <i>Nicotiana glauca</i>	(OP)							PR
† <i>Nicotiana obtusifolia</i>	OP	CP	TA					PR
* <i>Physalis acutifolia</i>	OP	CP?		SU				
<i>Physalis crassifolia</i>	OP	CP	TA					PR
† <i>Physalis</i> sp./spp.	(OP)		(TA)					
<i>Quincula lobata</i>	OP							PR
* <i>Solanum americanum</i>	OP						AP	
† <i>Solanum hindsianum</i>	OP		(†TA)					PR
<i>Solanum nigrescens</i>	OP							PR
<i>Solanum umbelliferum</i>	OP							PR
TALINACEAE								
<i>Talinum paniculatum</i>	OP							PR
TAMARICACEAE								
** <i>Tamarix aphylla</i>	(OP)	(CP)						PR
* <i>Tamarix chinensis</i>	OP	CP						PR
URTICACEAE								
† <i>Parietaria hespera</i>	OP	CP	TA		WI			
<i>Urtica gracilentia</i>	OP			SU				
VERBENACEAE								
<i>Aloysia wrightii</i>	OP	CP						PR
<i>Glandularia gooddingii</i>	OP	CP					AP	
<i>Glandularia latilobata</i>	OP						AP	
† <i>Glandularia</i> sp./spp.	(OP)		(TA)				?	
** <i>Lantana camara</i>	(OP)							PR
<i>Verbena bracteata</i>		CP			WI			
<i>Verbena menthifolia</i>	OP	CP					AP	
<i>Verbena xylopoda</i>	OP							PR
ZYGOPHYLLACEAE								
<i>Fagonia laevis</i>		CP	TA					PR
<i>Fagonia longipes</i>	OP	CP						PR
<i>Fagonia pachyacantha</i>		CP	TA					PR
<i>Kallstroemia californica</i>	OP	CP	TA	SU				
<i>Kallstroemia grandiflora</i>	OP	CP		SU				
† <i>Kallstroemia</i> sp./spp.	(OP)			SU				
† <i>Larrea tridentata</i>	OP	CP	TA					PR
* <i>Tribulus terrestris</i>		CP		SU				

SOLANACEAE – Nightshade or Potato Family

Herbs and shrubs in the flora area (some vines and trees elsewhere). Leaves alternate (often fascicled on short shoots) or sometimes subopposite; stipules none. Flowers bisexual or sometimes unisexual, 4- or 5-merous, and often showy. Calyx 4- or 5-lobed, and persistent. Corollas 4- or 5-lobed, mostly radially symmetrical (those in the flora area), mostly plicate in bud. Stamens 4 or 5, the filament bases fused to the corolla. Ovary superior, the style 1, the stigma 2-lobed or capitate. Fruit a berry (becoming indurate in *Lycium macrodon*) or a capsule; seeds few to many.

Worldwide, mostly tropical and temperate, greatest diversity in Central and South America; 94 genera, 2950 species.

- 1. Herbage glabrous, or with simple or stellate hairs; anthers opening with a terminal pore (longitudinal slit in *S. umbelliferum*) and longer than the filaments; fruits of berries..... **Solanum**
- 1. Hairs, if present, not stellate; anthers opening longitudinally and shorter than the filaments (or nearly as long as the filaments in *Capsicum*); fruits of berries or capsules.
 - 2. Woody shrubs or if not especially woody then more than 1.5 m tall.
 - 3. Widespread hardwood shrubs, the twigs thorn-tipped or bearing spines; leaves less than 5 cm long, sessile or short-petioled..... **Lycium**
 - 3. Scarce in the flora area, roadsides; unarmed and scarcely woody; leaves more than 7 cm long, the petiole more than 3 cm long..... **Nicotiana glauca**
 - 2. Plants herbaceous, mostly less than 1–1.5 m tall, annuals or herbaceous perennials, or sometimes scarcely woody at the base.
 - 4. Plants prostrate and rooting at nodes; leaves 0.5–1.5 (2) cm long, nearly sessile to short petioled (petiole much shorter than the blade)..... **Calibrachoa**
 - 4. Plants not both prostrate and rooting at nodes; leaves 2.5–15 cm long, or if less than 2.5 cm in length then the petiole about as long as or longer than the blade.
 - 5. Corollas more than 10 cm long; fruits prickly-spinescent..... **Datura**
 - 5. Corollas less than 4 cm long; fruits not prickly-spinescent.
 - 6. Corollas tubular; fruit a capsule (dry)..... **Nicotiana**
 - 6. Corollas as broad as or broader than long or deep (not tubular); fruit a berry (fleshy).
 - 7. Fruiting calyx not inflated, not growing around fruit; fruits bright red when ripe. **Capsicum**
 - 7. Fruiting calyx enlarging to partially or fully surround fruit; fruits green.
 - 8. Fruiting calyx partially growing around and tightly enclosing the berry; corollas greenish yellow with a woolly pad at center..... **Chamaesaracha**
 - 8. Fruiting calyx completely and loosely growing around the berry like a bag; corollas various colors, without a woolly pad.
 - 9. Roots not thickened; stems or branches held aloft; corollas yellow or white; herbage with short, straight, glandular hairs about the same color as the herbage..... **Physalis**
 - 9. Perennials from a thickened root; stems spreading to decumbent; corollas lavender; herbage scurfy with rounded white “hairs” (vesicular trichomes) especially on young growth and young calyces..... **Quincula**

Calibrachoa

Annual and perennial herbs. South America and one also in North America; 25 species. A genus segregated from *Petunia*. Horticultural selections of *Calibrachoa* and *Calibrachoa–Petunia* hybrids, known as *×Petchoa*, with brightly-colored flowers, are grown as garden plants.

Calibrachoa parviflora (de Jussieu) D'Arcy

[*Petunia parviflora* de Jussieu]

Small-flowered petunia. Figure 2.

Ephemerals, probably non-seasonal, and glandular-viscid. Stems spreading-prostrate, rooting at nodes, reaching 50 cm long. Leaves alternate, 5–20 mm long, mostly linear to spatulate or

oblanceolate, often semi-succulent; margins entire or nearly so. Calyx lobed halfway or more, the lobes much longer than the tube, and about as long as the corolla. Corollas funnellform to cup-shaped, 8 mm wide, the tube white or yellowish, the corolla limb and lobes purple. Fertile stamens 4, plus a sterile filament. Fruit a capsule opening apically; seeds numerous, minute, 0.5 mm long, chunky, brown, conspicuously reticulate with minute iridescent “windows” or facets.

In the flora area known only from Quitobaquito where about a half dozen plants were found in 1988 on moist soil of the alkaline flat just west of the pond, but these plants were not present the following year. The nearest records are along the banks of the Colorado River at Yuma and the Buenos Aires National Wildlife Refuge.

Southern United States to South America, and introduced and weedy elsewhere; perhaps not native outside of South America.

OP: Quitobaquito, rare on barren ground on alkaline flat, 6 Apr 1988, *Felger 88-317*.



Figure 2. *Calibrachoa parviflora*. Salero Ranch, Santa Cruz Co., photos by Sue Carnahan: (A) Cattle tank near ranch headquarters, 26 Mar 2014; (B) Cattle tank in unit 4, 30 May 2013.

Capsicum

Annual and perennial herbs and small shrubs. Americas, mostly tropical and subtropical; 25 species. Includes the diverse cultivated chiles.

Capsicum annuum Linnaeus var. **glabriusculum** (Dunal) Heiser & Pickersgill

[*C. indicum* Dierbach forma *aviculare* Dierbach. *C. annuum* var. *aviculare* (Dierbach) D'Arcy & Eshbaugh (nom. illegit.)]

Chiltepin, bird-pepper; *chiltepín*; a'al ko'okol. Figure 3.

Slender-stemmed, much-branched bushes, perennial and scarcely woody at the base; glabrate to sparsely puberulent. Leaves with slender petioles, the blades thin and ovate to lanceolate-ovate, 2–6 cm long, the tip acute, the margins entire. Flowers on slender pedicels elongating in fruit; calyx minutely 5-toothed; corollas white, 7–10 mm wide, nearly rotate and broadly 5-toothed with a very short tube. Anthers opening by longitudinal, full-length slits, the filaments as long as or longer than the anthers. Berries rounded to ellipsoid, 8 mm in diameter, red when ripe, ripening at least in late summer and fall, and often persisting through winter or early spring; multiple-seeded with pale

yellowish brown seeds 2.5 mm wide.

Scattered and locally in canyons and steep slopes in the Ajo Mountains.

This is the famous, fiery-hot wild chile ranging from southern Arizona and Texas to South America. The westernmost limit is in the Ajo Mountains and it is more common eastward in the Tohono O'odham region and to the southeast in Sonora.

OP: Alamo Canyon, 14 Sep 1941, *Gooding 310-41* (ASU). Boulder Canyon: Side drainage to the S, on steep N-facing shaded slope, 4 ft high, growing up through *Simmondsia*, 15 Jan 1989, *Wilson 207*; N-facing, growing along W wall of very steep side drainage with *Rhamnus ilicifolia* and *Prosopis velutina*, one plant, *Tewksbury 11 Sep 2004*.



Figure 3. *Capsicum annuum* var. *glabriusculum*. Plant grown from seed from Native Seed/Search, from Tumacacori Chiltipine Preserve, Santa Cruz Co., 25 Aug 2015, photos by Jim Verrier.

Chamaesaracha

Herbaceous perennials. Mexico and southwestern United States; 8 species.

Chamaesaracha arida Henrickson

[*C. felgeri* B.L. Turner, *Phytologia* 97(3): 232–233, Fig. 1, Map 7, 2015.]

False nightshade. Figure 4.

Herbaceous perennials from deeply buried roots, rhizomatous, and the stems often partially buried. The above-ground portion is frost sensitive. Stems ascending to spreading, 5–55 cm long. Herbage with branched and forked hairs with thick, short, white cells; new growth densely pubescent, older herbage often less densely to sparsely pubescent. Leaves alternate and opposite (even on the same stem), (2.5) 4–9 cm long, mostly narrowly elliptic, sessile to petioled, the margins mostly pinnately lobed or sometimes wavy. Flowers 1 or 2 in axils, on slender pedicels (1) 2–6 cm long. Calyx 5-lobed, moderately enlarging and partially or mostly covering the berry (not inflated as in *Physalis*). Corollas 1.5–2.5 cm wide, rotate or circular in outline (with very short lobes), cream-yellow to white, with darker, thicker, plicae (pleats) forming a star-shaped pattern and woolly pads alternating with the filament bases. Anthers yellow, opening longitudinally. Berries globose, 6–8 mm wide, usually whitish and becoming rather dry, few-seeded and bearing seeds only near the base. Growing and flowering during warmer times of the year depending on soil moisture.

Locally common in low-lying silty soils of playas, sand flats, valleys, and low dunes along the southern part of Cabeza Prieta and the Lechuguilla Valley.

Arizona to Utah, Colorado, New Mexico and west Texas, and northern Mexico from Sonora eastward and southward in the Chihuahuan Desert Region.



Figure 4. *Chamaesaracha arida*. Salero Ranch, 8 miles E of Tubac, Santa Cruz Co., 13 Apr 2013, photos by Sue Carnahan. [ID corrected 10 Aug 2016]

Three botanists have each provided different taxonomies for *Chamaesaracha*. The most conservative is by Averett (1973, 2010), in which he recognized a widespread *C. coronopus*. Henrickson (2009) segregated western populations of *C. coronopus* as *C. arida*, and noted that the type material of *C. coronopus* is glabrous. Turner (2015) opted for narrower interpretations, restricting *C. coronopus* to southern Texas and adjacent northeastern Mexico. He mapped *C. arida* in Arizona, including Yuma County, to Utah, Colorado, and Texas and much of northern Mexico. Turner (2015: 232–233) named *C. felgeri* as a narrow endemic that is “apparently adapted to deep sandy soils and appears restricted to southern Yuma Co. (and perhaps closely adjacent Mexico)” and “resembles *C. arida*, but differs in having larger mid-stem leaves (ca. 7–12 cm long vs. 3–5 cm), longer hairs on both stems and calyx (ca. 2–3 mm vs. 0.5–1.0 mm), and larger, more expanded, corollas (2–3 cm across vs. 1–2 cm).” Turner cited the following specimens for *C. felgeri*: *Felger 92-26, 92-626, 01-548, and 04-63* (holotype). Some plants on the dunes benefit from the captured water in the sands below and indeed are larger with larger leaves and larger flowers than other populations. Other plants from Yuma County and elsewhere have smaller leaves and flowers and some on the dunes produced in years of scant rainfall also have relatively small leaves and flowers (James Henrickson, pers. comm. 2016).

Chamaesaracha felgeri joins the ranks of other endemic or quasi-endemic taxa adapted and restricted to dune and windblown sand habitats of southwestern Arizona and adjacent or nearby areas in northwestern Sonora, southeastern California, and northeastern Baja California. These plants show varying morphological distinctions that may or may not be sufficiently or genetically differentiated to warrant taxonomic recognition. *Dalea mollissima*, *Euphorbia platysperma*, *Heterotheca thiniicola*, and *Stephanomeria schottii* are clearly endemic at the species level. Others, such as *Argythamnia serrata* sensu stricto, *Chamaesaracha felgeri*, *Croton wigginsii* sensu stricto, *Larrea tridentata* var. *arenaria*, *Palafoxia arida* var. *gigantea*, and *Sphaeralcea orcuttii*, offer fertile ground for further investigation (e.g., Felger 2000; Felger et al. 2015a; Felger & Rutman 2015a).

CP: Pinacate Flats, *Hardy & Goodding 3 Dec 1935*. Pinacate Plateau, Camino del Diablo, 28 Oct 1937, *Gentry 3507* (DES). NE edge of Las Playas, Tule Desert, 15 Apr 1964, *Niles 355*. E edge of Las Playas, 700 ft, *Simmons 13 Sep 1964*. Camino del Diablo, 10.3 mi WSW of Papago Well, creosote flat, corolla yellowish, frequent, 12 Mar 1983, *Daniel 1683* (ASU). Dunes N of Camino del Diablo, 6 mi W of O'Neils grave, flowers white, 13 Mar 1983, *Eiber 37*. Playa west of O'Neil Hills, *Harlan 20 Mar 1983*. W of Pinacate lava flow, common in silty depressions, sandy plains, 29 Mar 1985, *McLaughlin 2989*. Pinta Sands along Camino del Diablo, common on low dunes with extensive populations of spring ephemerals, 780 ft, 1 Feb 1992, *Felger 92-26* (ARIZ, TEX). Lava and sand on Pinacate Lava flow, old sandy streambed, white flowers, 21 Mar 1992, *Harlan 60*. Tule Tank drainage, 23 Mar 1992, *Harlan 115b* (CAB). West Pinta Sands, 780 feet, locally common on low stabilized dunes, *Larrea divaricata*, *Hilaria rigida*, *Palafoxia arida*, *Oenothera avita*, *O. deltoidea*, 16 Jun 1992, *Felger 92-626* (ARIZ, TEX). E Pinta Sands, sand soil, *Larrea divaricata*, *Prosopis velutina-glandulosa*, *Hilaria rigida*, *Opuntia kunzei*, *Ambrosia deltoidea*, few *Ferocactus wislizeni*, 15 Sep 1992, *Felger 92-763*. W Pinta Sands, sand flats and low, stable dunes, *Prosopis* cf. *glandulosa* var. *torreyana*, *Larrea divaricata*, *Stillingia linearifolia*, and ephemerals, 15 Sep 1992, *Felger 92-782*. Pinacate Lava along Camino del Diablo at 2 mi E of W edge of the lava flow, 28 Nov 2001, *Felger 01-548* (ASU, TEX).

TA: Lechuguilla Valley, vicinity Coyote Water in Coyote Wash, wash banks, broad sandy wash, cut about 1 m deep, 975 ft, *Prosopis glandulosa*, *Acacia greggii*, *Lycium parishii*, *L. fremontii*, *L. macrodon*, *Encelia farinosa*, *Ambrosia ambrosioides*, *Hymenoclea salsola*, dense growth of ephemerals, 25 Oct 2004, *Felger 04-35*. Coyote Wash at Camino del Diablo, bottom of Lechuguilla Valley, SE of Tinajas Atlas, 1010 ft, lowest point on Camino crossing, there is a sheet flow here in the valley bottom but no wash (erosion) has formed, perennials from deep-seated roots, corollas whitish, 25 Oct 2004, *Felger 04-63* (holotype of *C. felgeri*, TEX; isotypes, ARIZ, ASU, MO).

Datura – Jimsonweed

Annuals and herbaceous perennials. New World, tropical to warm temperate, especially Mexico and southwestern United States, adventive in the Old World; 13 species. The plants contain narcotic and poisonous alkaloids.

Datura discolor Bernhardt

Desert datura; *toloache*. Figure 5.

Non-seasonal ephemerals, but frost-sensitive and responding poorly to cooler weather; highly variable in size, 8–60 cm to sometimes more than 100 cm tall. Herbage stinky, glabrate or variously pubescent. Leaves broadly ovate, entire or toothed or pinnately lobed, larger leaves 7–20 cm long, the petioles prominent. Flowers large, solitary, erect, fragrant, nocturnal, and lasting one day. Flowering calyx tubular, ribbed, 7–9.5 cm long, most of the calyx falling away as the fruit develops, leaving the calyx base to form a bract-like skirt 1–1.5 cm wide around the base of the fruit. Corollas 8–17 cm long, white with a purple flush in the throat. Anthers opening longitudinally. Fruits globose, prickly (spinescent) capsules, turning down at maturity, (3.5) 4–5 (7) cm wide including spines. Seeds small, kidney-shaped, and blackish, with a white caruncle.

Widely scattered across the flora area, mostly along washes, also waterholes and canyon bottoms.

Southern Arizona and southeastern California to Baja California Sur and southern Mexico, and the Caribbean. The flowers are the largest of any plant in the Sonoran Desert.

All parts of the plant are poisonous and may cause dizziness, vomiting, dermatitis, permanent mental disorder, and even death. The common English name, Jimsonweed, is derived from Jamestown, Virginia, where British troops were poisoned by eating the foliage. Some Native American names refer to its narcotic effect or sacredness, although various indigenous people treat the plant with considerable respect and caution. Medicinal uses have been widespread, including among the Seris and the Hia-Ced O'odham (Felger & Moser 1985; Felger et al. 1992).

OP: SE of Walls Well, 30 Aug 1945, *Gould 3216*. Dos Lomitas, Warren 17 Nov 1974. Aguajita Wash, 13 Sep 1986, *Felger 86-282*.

CP: Papago Well, 27 Oct 1937, *Gentry 3498* (DES). West Pinta Sands, 15 Sep 1992, *Felger 92-778*.

TA: Tinajas Altas, bajada, 19 Mar 1998, *Felger* (observation). Coyote Wash at Camino del Diablo, 25 Oct 2004, *Felger 04-64*.

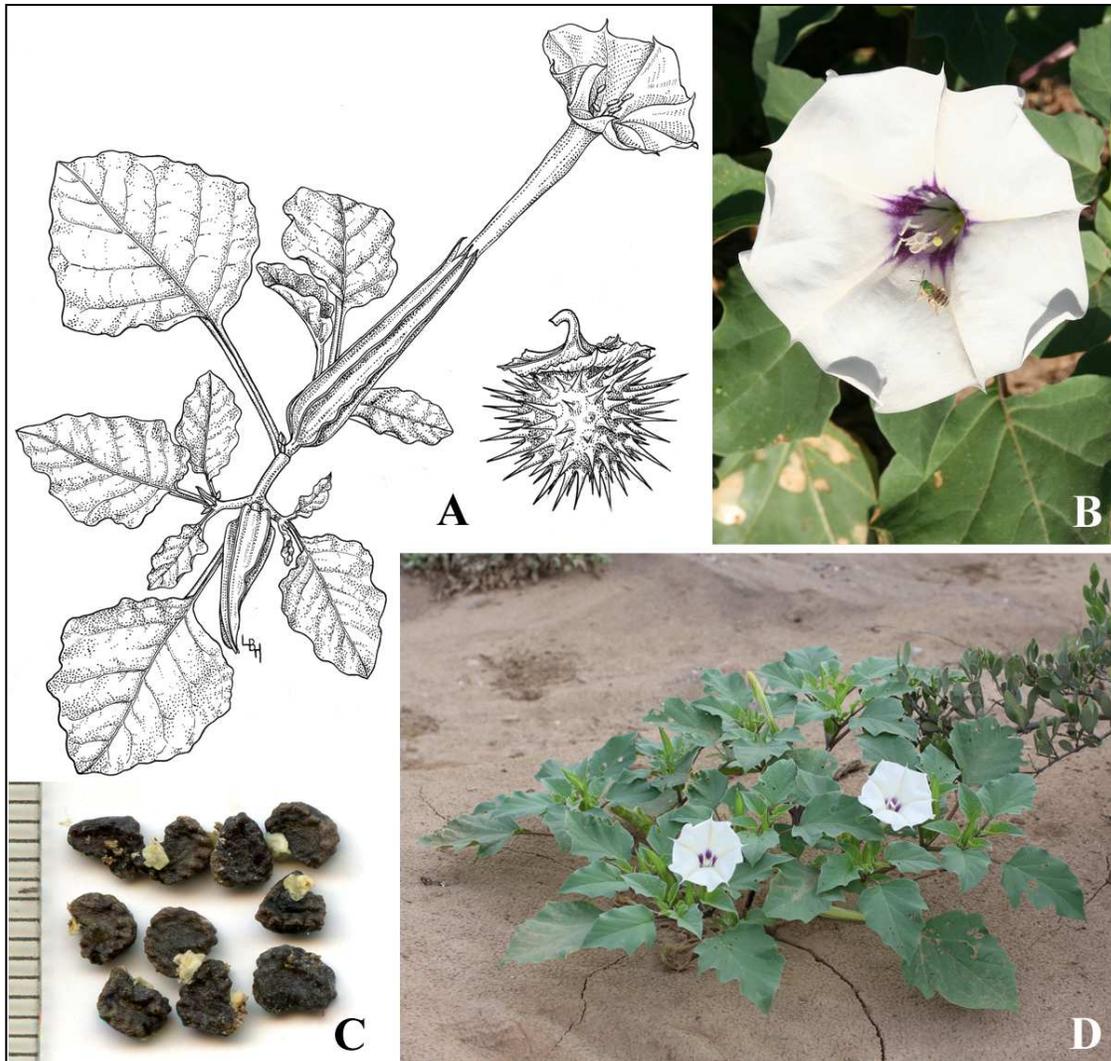


Figure 5. *Datura discolor*. (A) By Lucretia Breazeale Hamilton. (B) Arch Canyon, 16 Sep 2006. (C) Seeds, note the white strophioles, Ajo, 20 Sep 2014. (D) W of Hwy 85 at mile 66, 6 Oct 2012.

††***Datura wrightii*** Regel

[*D. meteloides* of authors, not *D. meteloides* Dunal]

Toloache

Large herbaceous perennials with large white flowers. The seeds differ in part from those of *D. discolor* by being larger, more pear shaped, flattened, and bony in texture.

It was in Organ Pipe more than 9000 years ago. The nearest present-day population is in the Baboquivari Mountains. A widespread and often weedy species, southwestern United States and northwestern Mexico.

OP: †Alamo Canyon, seeds, 9570 ybp. Puerto Blanco Mts, seeds, 9070 ybp.

Lycium – Wolfberry, box thorn; *saliciso* (Sonora), *frutilla* (Baja California)

Densely branched, unpleasantly thorny or spinescent shrubs with hard wood and rigid stems (those in the flora area); glabrate or glabrous, or with multicellular glandular and/or non-glandular hairs. Leaves gradually drought deciduous, entire, and semi-succulent, clustered (fascicled) in short shoots, as well as widely spaced on long shoots (primary growth). Flowers borne in the leaf axils, single or in groups of 2–6 per leaf fascicle. Most flowers (4-) 5-merous. Calyx cup-shaped to tubular, (2–4) 5-toothed or lobed. Filaments longer than the anthers, the anthers opening longitudinally. Often flowering in mid-winter to early spring depending on soil moisture, or with sufficient rain some may flower at any time of year. Fruit a berry (fleshy and red or orange) or drupe-like (hard and scarcely fleshy, green or red-orange). Seeds 2–many, usually somewhat flattened.

Worldwide, mostly deserts and warm semi-arid regions, a few in more humid regions, many semi-halophytic; 90 species. The Chinese wolfberry, *L. chinensis*, is cultivated in the East Asia as a leaf vegetable, the goji berry is the fruit of *L. barbarum*, also from China, and a few species are grown in temperate climates as ornamental shrubs.

Identification can be risky or hopeless without flowers or fruits. However, even in dry season you can often find at least a few dried flowers or fruits, allowing identification. *L. exsertum*, and *L. fremontii* have morphologically distinctive male and female/bisexual flowers on separate plants (Miller & Venable 2002; Yeung et al. 2005). The other species in the flora area produce bisexual flowers. The fleshy-fruited species have edible fruits, although only *L. fremontii* seems to have been a significant food plant (Felger 2007; Felger & Moser 1985; Hodgson 2001). Chiang and Landrum (2009) provide useful floristic information and distribution maps for Arizona.

- 1. Corollas whitish, or whitish with a greenish tube; fruits scarcely fleshy or with a thin fleshy pericarp, greenish glaucous or red-orange, 1–4-seeded.
 - 2. Shrubs mostly less than 1 (1.3) m in height; leaves 2.5–20 mm long, at least the short-shoot, fascicled leaves rounded in cross-section and often bead-like; calyx lobes (2 or 3) 4, the corolla lobes 4; fruits not constricted, 2–4 mm long, orange to red-orange when ripe.
 **Lycium californicum**
 - 2. Shrubs often more than 1.5 m tall; leaves 15–50 cm long, flattened; calyx lobes 5, the corolla lobes 5; fruits constricted near or below middle, 10 mm long, greenish-glaucous even when ripe.
 **Lycium macrodon**
- 1. Corollas whitish or lavender; fruits fleshy, orange to red-orange when ripe, several- to many-seeded.
 - 3. Calyx lobes about as long as or longer than the calyx tube (lobes sometimes shorter on some flowers on a shrub).
 - 4. Calyx usually 4- or 5-keeled, the areas (sinuses) between lobes of flowering calyx rounded, the calyx lobes unequal in size, some lobes essentially absent; flowers often highly congested (crowded) on stems..... **Lycium brevipes**
 - 4. Calyx usually not keeled (or not conspicuously so), areas between lobes of flowering calyx narrow, acute, the calyx lobes equal in size; flowers not congested..... **Lycium parishii**
 - 3. Calyx lobes shorter than the tube (sometimes as long as the tube in *L. berlandieri*).
 - 5. Leaves, pedicels, and calyces glandular-hairy; pedicels 4–16 mm long; flowers unisexual, male and female flowers of different sizes and on separate plants.

- 6. Corollas mostly white, flared above, the tube pubescent inside; male flowers with stamens exerted, the free portion of the filaments very densely hairy below..... **Lycium exsertum**
- 6. Corollas lavender, tubular, the tube glabrous inside; male flowers with stamens not exerted, the free portion of the filaments glabrous to moderately hairy..... **Lycium fremontii**
- 5. Plants glabrous; pedicels mostly 1–7 mm long; flowers bisexual.
 - 7. Flowers slender, longer than wide; corolla tube narrow, cylindrical or nearly so, the lobes lavender; filaments sparsely hairy to glabrous at base of free portion..... **Lycium andersonii**
 - 7. Flowers broad, as wide as or wider than long, the corolla tube campanulate (conspicuously expanded above), the corollas (including lobes) whitish; filaments densely hairy at base of free portion..... **Lycium berlandieri**

Lycium andersonii A. Gray var. **andersonii**

[*L. andersonii* var. *deserticola* (C.L. Hitchcock) Jepson]

Desert wolfberry; *salicieso*; s-toa kuavulī. Figure 6.

Shrubs, often 1.2–2.5 m tall, the bark tan to grayish and often striate, twigs often thorn-tipped. Leaves glabrous, mostly linear-spatulate, 5–30 × 1.5–4 (6) mm. Pedicels 1–7.5 mm long. Flowers nearly tubular. Calyx tube 1.6–2.6 mm long, the teeth (lobes) 0.4–1.3 mm long and often with minutely ciliate margins (calyx often cleft, forming 2 larger lobes, each with 2 or 3 teeth, the calyx then appearing 2-lipped). Corollas slender, the tube mostly very narrow and nearly tubular, greenish white, 5.5–12.5 mm long when fresh, the lobes 1.4–2.5 mm long, lavender, 4 or 5 (sometimes even on the same plant; the fifth lobe sometimes larger than the others). Stamens about as long as the tube to moderately but conspicuously exerted; basal part of free portion of filaments glabrous or moderately pubescent with short white hairs, the fused portion densely hairy. Fruits often 1 cm long, ovoid, fleshy, bright orange, with multiple seeds, each 1.3–1.5 mm long. Flowering mostly February to April, and also with rains at other seasons.

Common and widespread across the flora area in many habitats including plains, sand or rocky hills, mountains, and especially common along washes and on rocky slopes. The fruits are edible.

Variety *andersonii* occurs through most of the species range: Arizona to Sinaloa, Utah, Nevada, and southern California to Baja California Sur. Three other varieties, only one of which, var. *pubescens* S. Watson, is probably worth recognizing (Felger 2000; Felger & Wilder 2012).

OP: Kino Peak, 18 Mar 1944, *Clark 11418* (ORPI). Dos Lomitas, *Warren 17 Nov 1974* (ORPI). Puerto Blanco loop, 1.3 mi S of junction with Bates Well Road, 7 Jun 1975, *Chiang 662* (ASU). Quitobaquito, 23 Feb 1990, *Felger 90-47*.

CP: Pinacate Plateau, 24 Nov 1934, *Gooding 253G*. Buckhorn Tank, *Monson 22 Dec 1954* (CAB). . 5 mi N of Tule Tank, 2 Feb 1992, *Felger 92-76*. E Pinta Sands, 15 Sep 1992, *Felger 92-756*. Chico Shunie Wash, 2 Feb 2003, *Rutman 2003-31*.

TA: Borrego Canyon, 3 Feb 1990, *Felger* (observation). Arroyo 2 mi SE of Tinajas Altas, 22 Nov 2008, *Felger 08-196*.

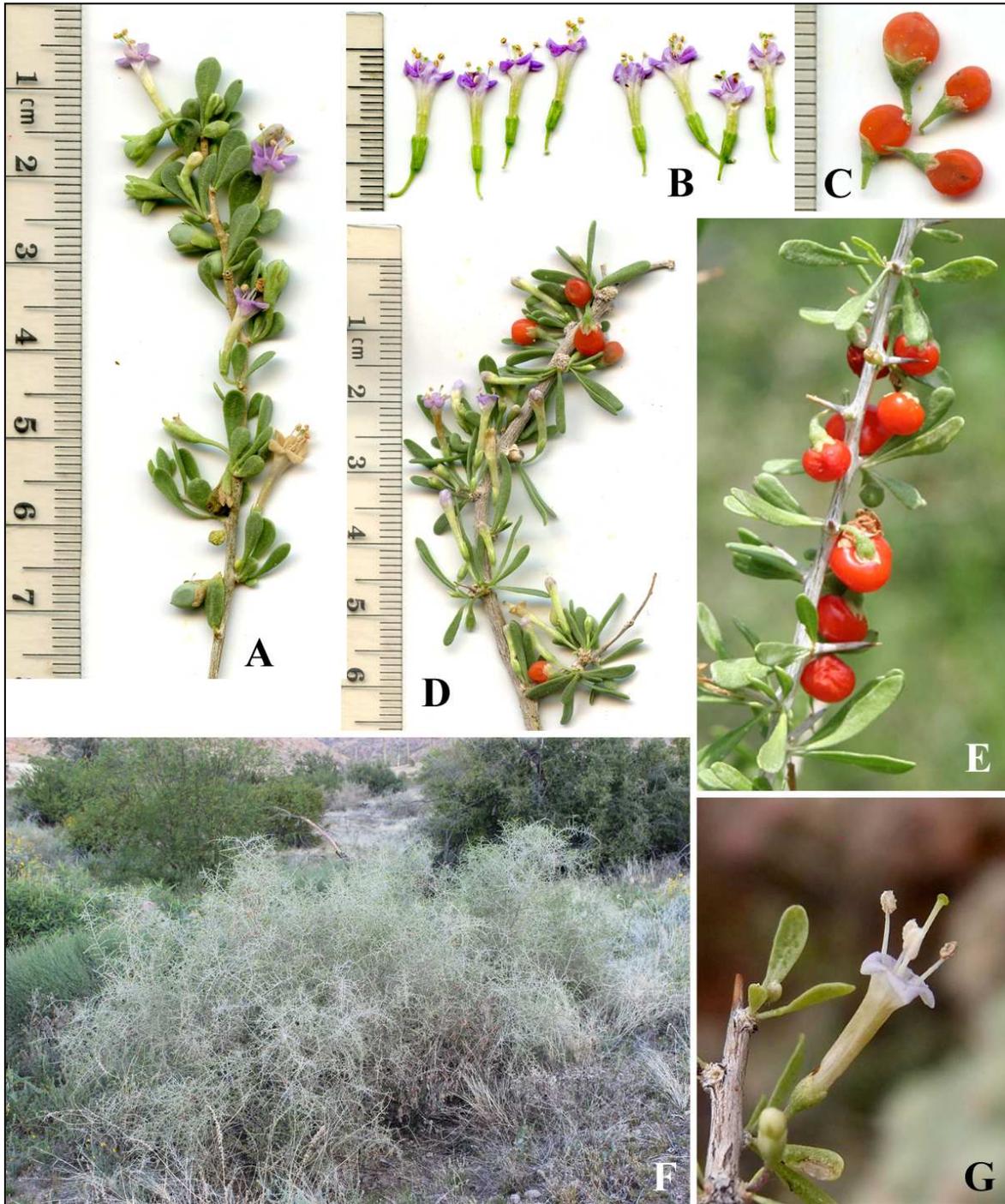


Figure 6. *Lycium andersonii* var. *andersonii*. (A) Bonito Well, 12 Mar 2015. (B–D) Sierra Blanca, Pinacate Biosphere Reserve, Sonora, 18 Feb 2015. Hat Mountain, Saucedo Mts, Maricopa Co.: (E) 20 Aug 2006; (F) 22 Mar 2014. (G) Tubac Foothills Ranch, Santa Cruz Co., 18 Jul 2015, photo by Sue Carnahan.

***Lycium berlandieri* Dunal var. *longistylum* C.L. Hitchcock**
Bachata, salicieso. Figure 7.

Spinescent woody shrubs often 1–2+ m tall, often somewhat sparsely or openly branched. Resembling *L. andersonii* but distinguished in part by smooth and dark reddish-brown bark, pale yellow-white flowers, conspicuously wider (campanulate) corollas, and longer corolla lobes. Leaves mostly 5–30 mm long, linear to spatulate-obovate, glabrous. Flowers solitary or 2 or 3 in fascicles in leaf axils. Pedicels 3–20 mm long. Calyx cup-shaped, 3–5 lobed. Corollas white, constricted above

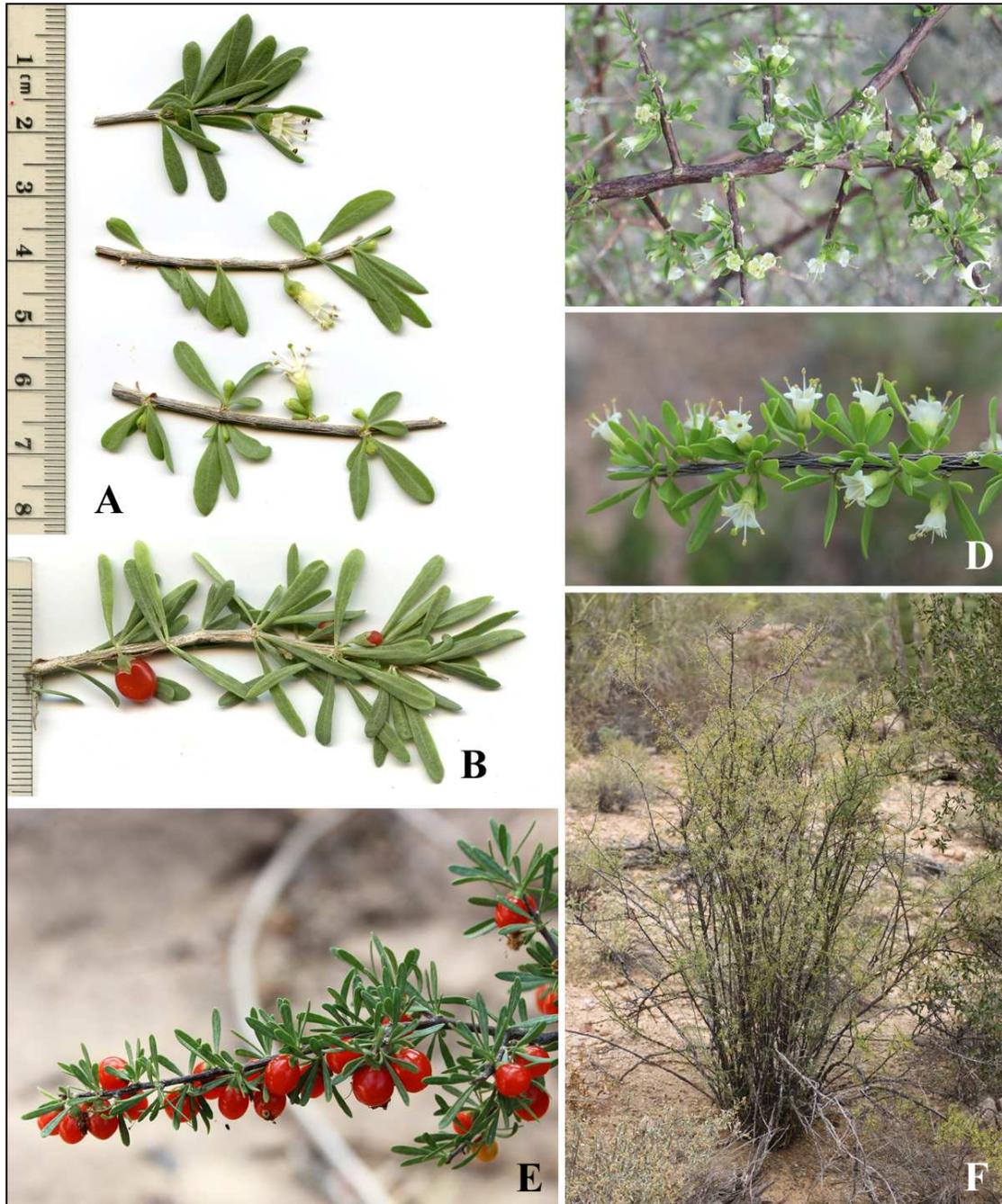


Figure 7. *Lycium berlandieri* var. *longistylum*. Ajo Scenic Loop, Little Ajo Mts: (A) 31 Jul 2014; (B) 23 Aug 2014. (C) Ajo, 5 Sep 2011. (D) Ajo Mountain Drive, 2 Aug 2013. (E) Gunsight Hills, 10 Sep 2013. (F) Senita Basin, 10 May 2010.

the ovary, campanulate, as wide as or wider than long, 4–9 mm long, with 4 or 5 lobes. Stamens shorter than the tube or long-exserted, filaments densely hairy at base of free portion. Fruits globose, 5 mm wide, fleshy and red-orange, edible, and many-seeded. Apparently flowering at various seasons with sufficient soil moisture, at least in March and fall.

Widespread in Organ Pipe and the eastern part of Cabeza Prieta. Rocky slopes and low hills, coarse soils and sometimes in cracks in bedrock, as well as along washes. This or a similar species has been in Organ Pipe for more than 7500 years.

Four varieties in northern Mexico and Arizona to Texas. Variety *longistylum* in southern Arizona and western Sonora.

OP: Ajo Mt Drive 5.1 mi by road NE of Visitor Center, 5 Nov 1977, *Bowers 908*. 1 mi SW of Visitor Center, 13 Sep 1978, *Bowers 1522*. 1.5 mi N of Twin Peaks, Puerto Blanco Mts, 30 Mar 1980, *Stimson 205*. Arch Canyon, *Rutman 14 Aug 1996* (ORPI). †*L. cf. berlandieri*: Puerto Blanco Mts, on ridge, twigs, leaves, seeds, modern (30) to 7560 ybp (11 samples).

CP: Christmas Pass, *Van Devender 9 Mar 1980*. Lower end of Agua Dulce Pass, 19 Mar 1987, *Elias 10229*.

Lycium brevipes* Bentham var. *brevipes

[*L. richii* A. Gray]

Saliciso. Figure 8.

Densely branched shrubs to 2+ m tall. Leaves, pedicels, and calyces conspicuously glandular pubescent. Leaves broadly to narrowly spatulate or oblanceolate, 6–40 × 4–8 mm. Flowers and fruits commonly many and crowded at the branch tips. Pedicels 3–5 mm long. Calyx, corolla, and stamens 4- or 5-merous, even on the same branch. Flowers pale lavender, calyx and corolla lobes usually long relative to the tube. Calyx tube and lobes often 4- or 5-keeled, especially when dried, the tube 2.5–3.5 mm long, the lobes 1.5–4.5 mm long, the sinuses (gaps) rounded between the lobes. Corolla tube (2.2) 4.5–5.5 mm long, the lobes lavender, spreading, (2.5) 3–4 mm long. Stamens well exserted, the anthers conspicuous, the free base of the filaments hairy. Fruits fleshy and edible, orange or red, the seeds many, 1.5–2.2 mm long. Flowering in warmer months except during drought.

Possibly occurring locally in the southern margin of Organ Pipe at Senita Basin, and known from collections nearby in the Río Sonoyta valley in Sonora south of Quitobaquito (Felger 2000). This species has been reported from Organ Pipe by Chiang (1981) and others, but we have not found identifiable specimens and it is otherwise not known to be native in Arizona. In a later publication, Chiang and Landrum (2009) make no mention of this species for Arizona.

Gulf of California region including islands, western Sonora and Sinaloa, and both Baja California states, and southern California. Generally in xeroriparian or alkaline semi-riparian habitats. It might be confused with *L. parishii*; *L. brevipes* usually has larger flowers, often larger and greener leaves, and stouter twigs and branches, and densely crowded flowers.

Another variety of *L. brevipes* occurs in coastal areas and the Channel Islands of southern California.

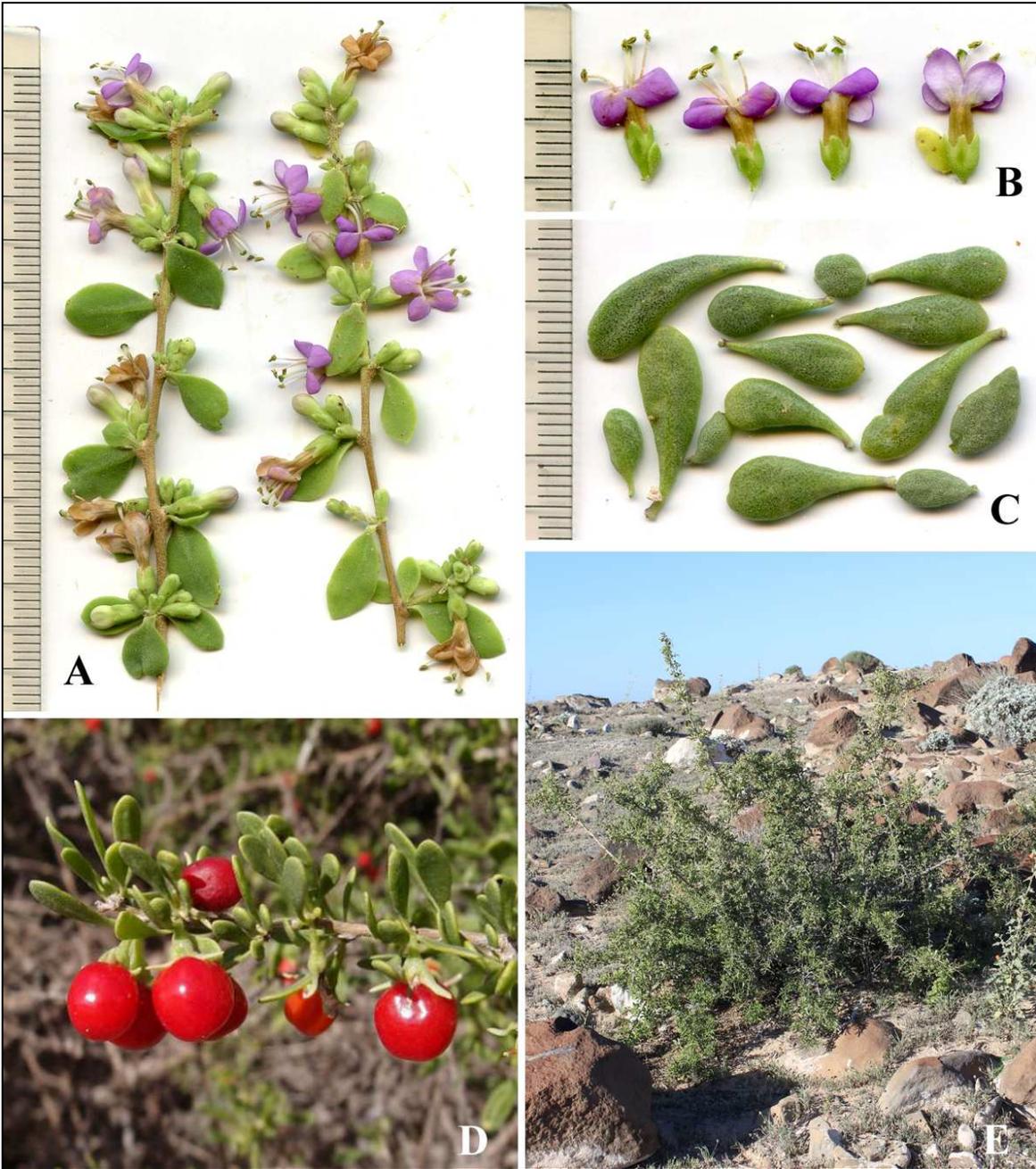


Figure 8. *Lycium brevipes* var. *brevipes*. (A–C & E) Puerto Peñasco, Sonora, 19 Feb 2015. (D) San Carlos, Sonora, 30 Oct 2013, photo by Sue Carnahan.

Lycium californicum* Nuttall ex A. Gray var. *californicum

[*L. californicum* var. *arizonicum* A. Gray. *L. carinatum* S. Watson. *L. californicum* var. *carinatum* (S. Watson) F. Chiang. *L. californicum* subsp. *carinatum* (S. Watson) Felger & C.H. Lowe]

California desert-thorn. Figure 9.

Low, spreading and densely branched shrubs, as wide as or wider than tall, mostly less than 1 (1.3) m tall; mostly branching at right angles, the twigs relatively short, very rigid, stout, and thorn-tipped. Short-shoot (fascicled) leaves mostly 2.5–8 mm long, very succulent, terete, often bead-like and pear-shaped to globose; larger long-shoot leaves often 6.5–21.5 × 1.7–3.5 mm, often linear-terete

to linear-oblong or spatulate or narrowly oblanceolate. Flowers subsessile, 6.5–7 mm long when fresh, including stamens and the short pedicel. Fresh calyces 2.6–4.3 mm long, succulent, the angles of the tube and lobes rounded, often becoming keeled upon drying; calyx lobes 4, or occasionally 2, opposite lobes reduced. Corollas white, 4-lobed, 4–5.3 mm wide, the lobes spreading, sometimes with lavender near the throat. (Occasional flowers have a 2- or 3-lobed perianth.) Stamens conspicuously exserted, the filaments white; anthers and stigma yellow-green. Style white, well exserted. Flowering in late winter and early spring. Fruits 3–4 mm long, orange, rounded to oval, the pericarp thin and scarcely fleshy; fruits 2-seeded, the seeds embedded in a bony endocarp; the endocarps 2.5–3.5 mm long, whitish, oblong-obovoid, grooved along the lower $\frac{2}{3}$ of their common surface, the outer surfaces convex and smooth.

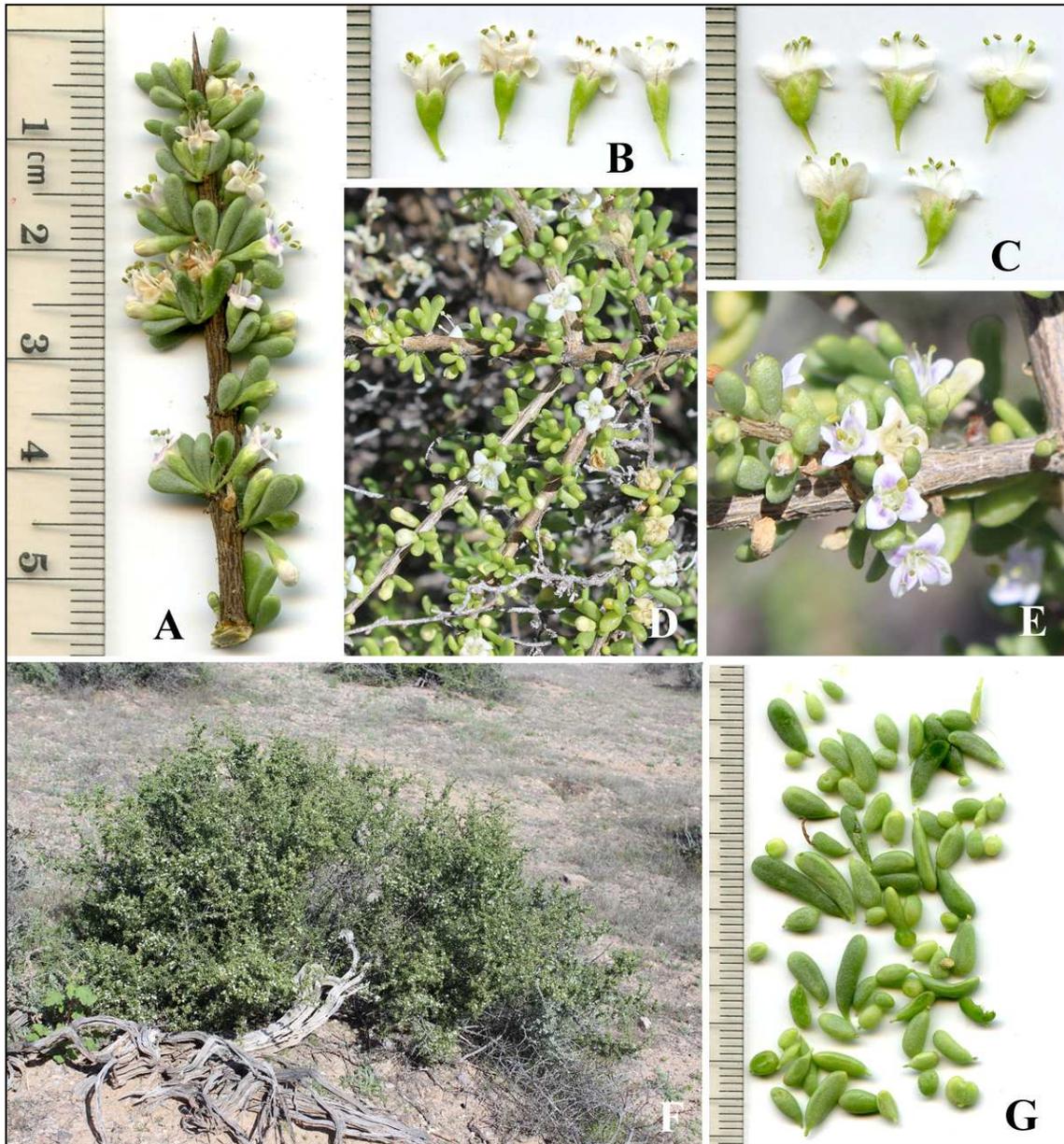


Figure 9. *Lycium californicum* var. *californicum*. La Abra Plain near South Puerto Blanco Drive: (A, B, D–F) 25 Feb 2015; (C) 23 Sep 2014; (G) 15 Mar 2015.

An extensive but geographically isolated population occurs on the La Abra Plain in Organ Pipe and adjacent Sonora near the international border 5–7 km east of Quitobaquito. It is locally common on this sandy desert plain dissected by small washes and low, broad floodplains, where it grows with *Lycium fremontii*, *L. parishii*, and *Atriplex polycarpa*. Another population, apparently much smaller, occurs in Cabeza Prieta west of Tule Tank.

Yeung et al. (2005) indicate that *L. californicum* in the flora area is diploid, and that diploid populations have bisexual flowers. Populations at the periphery of the geographic range of *L. californicum* var. *californicum* tend to be polyploids with male and female flowers on separate plants (Yeung et al. 2005).

Variety *californicum* (including var. *arizonicum* and var. *carinatum*) ranges from central Arizona to coastal Sonora nearly to Sinaloa, and is disjunct in southwestern California and both Baja California states. Variety *interior* F. Chiang is geographically isolated in the southern reaches of the Chihuahuan Desert in northern Mexico.

OP: La Abra Valley near Santa [sic] Domingo (probably in Sonora; there was no border fence or border road at that time), 13 Apr 1941, *McDougall 87*. La Abra Plain, 3.5 mi E of Aguajita Wash on South Puerto Blanco Drive, 24 Oct 1990, *Felger 90-472*.

CP: Wash that crosses Camino del Diablo 1½ mi W of Tule Tank, uncommon, 15 Jan 2005, *Rutman 2005-0115-8*.

***Lycium exsertum* A. Gray**

Arizona desert-thorn; *salicieso*. Figure 10.

Densely-branched shrubs often reaching about 2.5 m tall. Leaves, pedicels, and calyces glandular hairy and viscid. Leaves 1.5–4 cm long, spatulate to obovate. Pedicels 4–12 mm long, flowers usually pendulous. Male and female flowers on separate plants, or some plants with morphologically bisexual flowers. Calyx tube 3.5–4 mm long, the lobes 0.5–2 mm long and unequal; calyx rupturing and spreading as the fruit develops. Corollas, filaments, anthers (before anthesis), and style mostly white, or the corollas tinged with pale violet, the stigma green. Corolla tube 7.5–8.5+ mm long, hairy inside, narrowed below, moderately flared above, the lobes 1.5 mm long and spreading. Stamens exerted on staminate plants; free portion of filaments very densely hairy below. Fruits fleshy, orange, and edible; many-seeded. Flowering at least in February.

Locally common in or near the Ajo Mountains, extending to higher elevation generally above other lyciums, and occasional in the Puerto Blanco Mountains (e.g., Senita Basin).

Much of Arizona except the northeastern of the state, western Sonora, and Baja California Sur.

This species and *L. fremontii* are reliably distinguished only when in flower. *Lycium exsertum* is generally functionally dioecious in a manner similar to *L. fremontii*, to which it is closely related. *L. exsertum* can be distinguished by its usually pendent flowers, shorter pedicels, more campanulate (less tubular) calyx, dirty white and more flaring corollas, long-exserted stamens (on male flowers) and densely hairy filaments. As in *L. fremontii*, the male flowers are larger than the female flower. It is a species with diploid and tetraploid members, with $n = 12$ or 24 , whereas *L. fremontii* is polyploid (Chiang-Cabrera 1981; Chiang & Landrum 2009). *Lycium exsertum* is readily distinguished from *L. brevipes* by its often unisexual flowers, longer pedicels, non-keeled calyces, white and more slender and elongated corollas, and non-congested flowers. *Lycium exsertum* and *L. fremontii* occur side-by-side in Organ Pipe at least in Alamo Canyon near the well, Aguajita Wash near Bonito Well, and Kuakatch Wash along the eastern 1 mile within the Monument.

OP: Along wash at Senita Basin, flowers white, pendulous, 26 Feb 1978, *Bowers 1092* (ORPI). Alamo Canyon, canyon bottom, 2600 ft, 16 Feb 1979, *Bowers 1564*. Arch Canyon, *Wirt 27 Feb 1991*. Kuakatch Wash, 0.5 mi W of E boundary of Organ Pipe, *Rutman 25 Feb 1994* (ORPI).

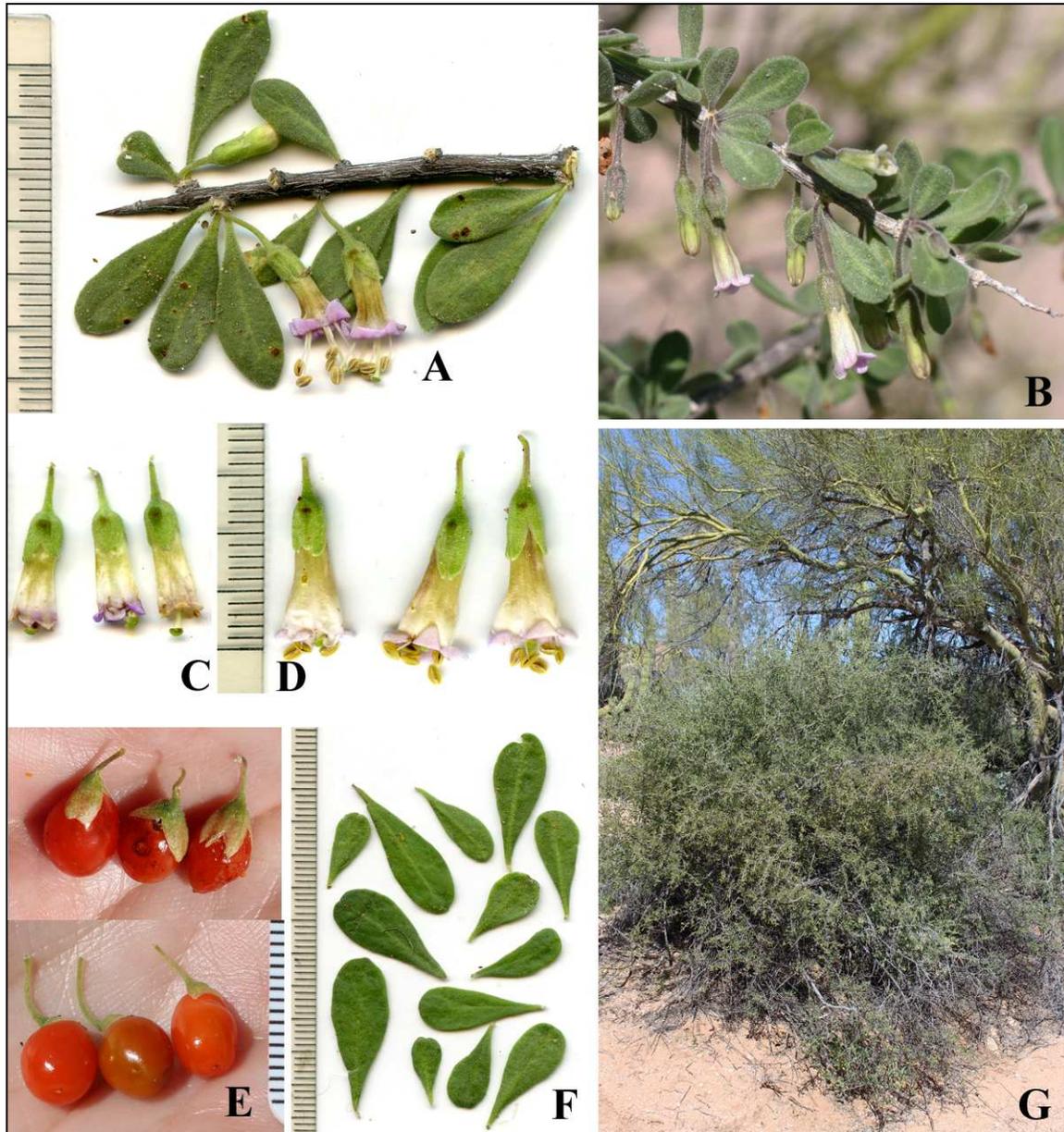


Figure 10. *Lycium exsertum*. Alamo Canyon: (A, C, F) 14 Feb 2015; (E) 4 Apr 2015. (B) Kuakatch Wash near E boundary of ORPI, 13 Mar 2010. (D) Estes Canyon, 25 Feb 2015. A & D, male flowers; C, female flowers.

Lycium fremontii* A. Gray var. *fremontii

Frémont wolfberry, desert goji-berry; salicieso; kuavulī. Figure 11.

Densely branched shrubs 1.5–2.5 m tall (to 4 m growing up under mesquite trees along washes such as south of Aguajita Spring), the twigs mostly thorn-tipped. The younger leaves, especially petioles, and leaves among inflorescences, as well as inflorescences and calyces have a mixture of short gland-tipped hairs as well as multi-celled non-glandular hairs, which at low

magnification look glandular, but high magnification shows they are not glandular. As these parts mature or age, they tend become glabrate or glabrous, or at least lack glandular hairs. Most leaves 1–5 (6) cm long, spatulate to obovate or elliptic; older leaves often succulent.

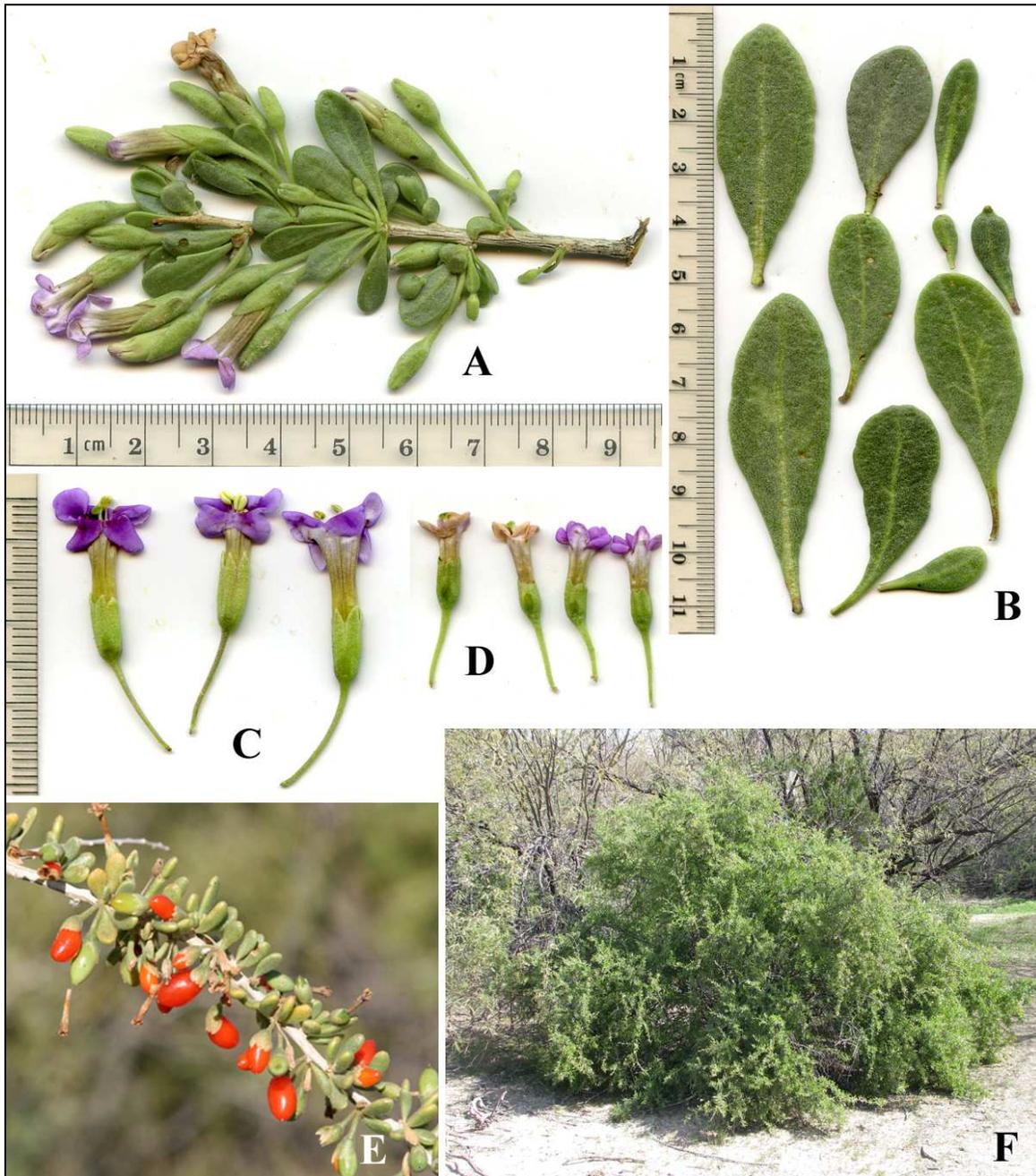


Figure 11. *Lycium fremontii* var. *fremontii*. (A) Plant with male flowers, Alamo Canyon, 14 Feb 2015. (B) Kuakatch Wash near E boundary of ORPI, 11 Mar 2015. Quitobaquito: (C) Male flowers, 25 Feb 2015; (E) 9 Mar 2008; (F) 1 Jun 2010. (D) Female flowers, Rio Sonoyta, 15 miles W of Sonoyta, Sonora, 8 Feb 2015.

Male and female flowers on separate plants. The male flowers are larger, have fertile, exserted stamens and included and reduced sterile styles and stigmas, and do not produce fruit. The female flowers are smaller, have exserted styles and stigmas, included sterile anthers, and produce

fruits. This species also has plants with morphologically bisexual but mostly functionally female flowers (Miller & Venable 2002). Among all flowers: pedicels 6–18 mm long; calyx tube 3.5–7 mm long; corolla tube 4–15 mm long, glabrous inside, the lobes spreading, pale to dark lavender. Stamens (male flowers) with free portion of the filaments glabrous or moderately hairy. Calyx (female flowers) rupturing and spreading as the fruit develops. Fruits orange, juicy, and edible, usually longer than wide, and many-seeded. Seeds 1.7–2.1 mm long, light tan, compressed, the surfaces minutely pitted and tuberculate (closely resembling those of *L. parishii*). Flowering (January) February and March (May), and often also October and November; fruiting about one month after flowering.

Widely scattered and locally common, mostly along washes and low-lying alkaline-soil flats from Organ Pipe to Tinajas Altas.

Arizona except the northern and eastern portions, deserts in southern California, both states of Baja California, and western Sonora. Another variety occurs on the Baja California Peninsula.

This lycium is readily recognized by the glandular hairs on the herbage, pedicels, and calyx, long pedicels, dimorphic as well as bisexual lavender flowers, and relatively large, soft, and fleshy fruits.

The fruits were an important food resource, eaten fresh but especially cooked, and also dried like raisins (Felger & Moser 1985; Felger et al. 1992; Rea 1997). Rea likened the fruits to cranberries. Most people added sugar to cooked lycium fruits. This species produces larger fruits and probably larger yields than most other regional lycium species. The fruits are similar to goji berries, and Richard has advocated developing this lycium as a desert-adapted agronomic crop, giving it the name “desert goji-berry.” The Tohono O’odham made hunting bows from the wood (Casterter & Underhill 1935).

OP: Quitobaquito: *Nichol* 28 Mar 1939; 7 Jun 1975, *Chiang* 664 (ASU, DES); 10 Mar 2001, *Miller* 01-6. Wash near Dos Lomitas, 28 Jan 1978, *Bowers* 1011. 3.5 mi E of Aguajita Wash on south Puerto Blanco Drive, 24 Oct 1990, *Felger* 90-468 (ARIZ, ASU).

CP: Near Cabeza Prieta, 21 Mar 1933, *Shreve* (label damaged, number missing). 7.8 mi on Camino del Diablo W of Pinta Sands, 1 Feb 1992, *Felger* 92-42. Daniels Arroyo, 26 Sep 1992, *Harlan* 327. Heart Tank, 27 Feb 1993, *Felger* 93-168. Tule Well, 27 Feb 1993, *Felger* 93-170.

TA: Below Tinajas Altas, wash, 19 Feb 1979, *McLaughlin* 1967. Coyote Water, 25 Oct 2004, *Felger* 04-48.

Lycium macrodon* A. Gray var. *macrodon

Desert wolfberry; s-cuk kuavulī. Figure 12.

Spinescent shrubs 1.2–2.3 m tall, usually with stout rigid branches and twigs, the long-shoot nodes often bearing stout spines. Leaves (especially their bases), pedicels, and calyces minutely and sparsely to relatively densely glandular hairy, or the leaves glabrous or glabrate. (Better-watered plants tend to be glabrous or less pubescent.) Leaves linear-spatulate to obovate or oblong, narrowed to a short petiole or sessile. Long shoots often with relatively large, glaucous-blue succulent leaves, the larger ones 25–50 × 8–13+ mm; short-shoot leaves mostly smaller, thinner (less succulent), and greener, the larger ones 16–46 × 4–7 mm. Pedicels often 3 mm long. Calyx about $\frac{2}{3}$ as long as the corolla tube, the lobes slender and much longer than the tube. Corolla tube 8.5–10.5 mm long, white with green veins in the throat, the lobes white, often with a slight bluish tinge, triangular and reflexed. Stamens and style scarcely or not at all protruding from the corolla; filaments glabrous; stigma green. Fruits (pericarp) hard, 1 cm long when ripe, conspicuously glaucous, constricted (appearing pinched off) below the middle, notched at the tip, with 2 chambers (locules),

the upper part of each locule producing 1 or 2 seeds enclosed in an endocarp; lower part of fruit producing ovules but these aborting. Endocarps often 5.5–6 mm long, bony and sculptured, not grooved and not flattened, the seeds often 3.5–4 mm long, flattened, orbicular to oblong. Flowering mostly February and March, the fruits ripening early April to early May. The green and white flowers and the hard, green fruits are unique among the regional lyciums.

Washes, sand flats, and alluvial flats, often locally common in widely scattered sites across Organ Pipe and Cabeza Prieta, and at Tinajas Altas where it was also present at least 8200 years ago.



Figure 12. *Lycium macrodon* var. *macrodon*. (A) Ajo, 8 Mar 2015. (B) Hwy 8, 35 km S of Sonoyta, Sonora, 9 Mar 2015. (C) Unripe fruits, Hwy 86, mile 95, 16 Apr 2015. (D) Sierra Los Tanques, Sonora, 17 Feb 2008. (E) Crater Range, Maricopa Co., 7 Jan 2014. (F) Quitobaquito, 20 Mar 2005. (G) Ajo, 27 May 2015. (H) Kuakatch Wash near Hwy 85, 13 Mar 2010.

Variety *macrodon* in southwestern and central Arizona and northwestern Sonora. Another variety in central to southwestern Sonora.

OP: Quitobaquito: 28 Jan 1894, *Mearns 2740* (CAS); 6 Apr 1988, *Felger 88-311*. Bates Well, 23 Apr 1942, *Cooper 574*. Puerto Blanco loop, 1.3 mi S of junction with Bates Well Road, 7 Jun 1975, *Chiang 663* (ASU). Armenta Ranch, *Wirt 25 Mar 1990* (ORPI). Kuakatch wash near E boundary, 9 Feb 2001, *Rutman*, observation.

CP: Monreal Well, *Simmons 20 Oct 1962* (CAB). Papago Well, 10 Apr 1978, *Lehto 22453*. Pinta Sands, 1 Feb 1992, *Felger*, observation. Road to Lower Well, 25 Feb 1993, *Felger 93-68*. Heart Tank, 27 Feb 1993, *Felger 93-168*. Chinamans Flat, 15 Mar 1993, *Harlan 376*.

TA: Tinajas Altas: 29 Mar 1930, *Harrison 6571*; *Van Devender 25 Mar 1980*. Coyote Water, 25 Oct 2004, *Felger*, observation. †Butler Mts, twigs, leaves, seeds, 8160 ybp.

Lycium parishii* A. Gray var. *parishii

Parish wolfberry; *salicieso*. Figure 13.

Shrubs often 1.2–2 m tall, the twigs often thorn-tipped. Herbage, pedicels, and sepals conspicuously glandular pubescent. Older twigs and stems often light grayish and striate (occasionally dark colored), and relatively slender. Leaves ovate to obovate or spatulate, narrowly to broadly so, 3–18 mm long; foliage often grayish green. Pedicels 2–5 mm long. Calyx tube 1.5–3.5 mm long; lobes mostly more than $\frac{2}{3}$ to nearly twice as long the tube, blunt-tipped, usually (1) 1.8–6.5 mm long; calyx sinuses mostly acute in flower, obtuse in fruit. Corollas lavender, sometimes becoming white with age; corolla tube 4.5–8.5 mm long, the lobes 1.3–3.5 mm long and lavender. Stamens exerted and readily visible due to spreading of corolla lobes, the free portion of filaments glabrate or sparsely hairy near base. Fruits 5–9 mm long, globose-ovoid, fleshy, orange, and many-seeded. Seeds 1.7–2.2 × 1.3–2 mm, pale tan, compressed, variable in shape, somewhat D-shaped, the surfaces minutely tuberculate (closely resembling those of *L. fremontii*). Flowering after rains, especially February and March, sometimes also August–November; fruiting about one month after flowering.

Widespread and very common across the flora area; washes, flats, canyons, and rocky slopes.

Southwestern and south-central Arizona, inland southern California, Baja California, and northwestern Sonora. Another variety occurs in northeastern Mexico.

Readily recognized by the pale-colored stems, pale gray-green foliage, and pale lavender flowers with highly variable calyx lobes often much longer than the calyx tube.

OP: Growler Valley, 30 Mar 1933, *Shreve 6208*. Canyon Diablo, 21 Mar 1935, *Kearney 10828*. Tres Alamos Canyon, 2700 ft, *Nichol 24 Feb 1939*. Organ Pipe headquarters area, 10 Apr 1941, *McDougall 74*. Dripping Springs, 15 Apr 1952, *Parker 7913*. Arch Canyon, 28 Mar 1965, *Niles 540*. Darby Well Road, at Bates Well, 7 Jun 1975, *Chiang 661* (ASU). Quitobaquito, 10 Nov 1987, *Felger 87-292*.

CP: Papago Well, 23 Nov 1934, *Goodding 210*. O'Neil Hills, *Darrow 14 Apr 1941*. 2.4 mi W of the eastern boundary of Cabeza Prieta on the Bates Well–Papago Well Rd, San Cristobal Wash, 16 Apr 1976, *Engard 875* (ASU, annotated 1989 by Fernando Chiang, $n = 12$; DES). Daniels Arroyo at Charlie Bell Rd, 18 Aug 1992, *Felger 92-662*. Road to Lower Well, 25 Feb 1993, *Felger 93-69*. **TA:** Tinajas Altas, near bottom tank, 19 Feb 1979, *Bowers 1584*. Tinajas Altas, *Van Devender 9 Mar 1980*. Coyote Water, abundant, 25 Oct 2004, *Felger 04-49*.

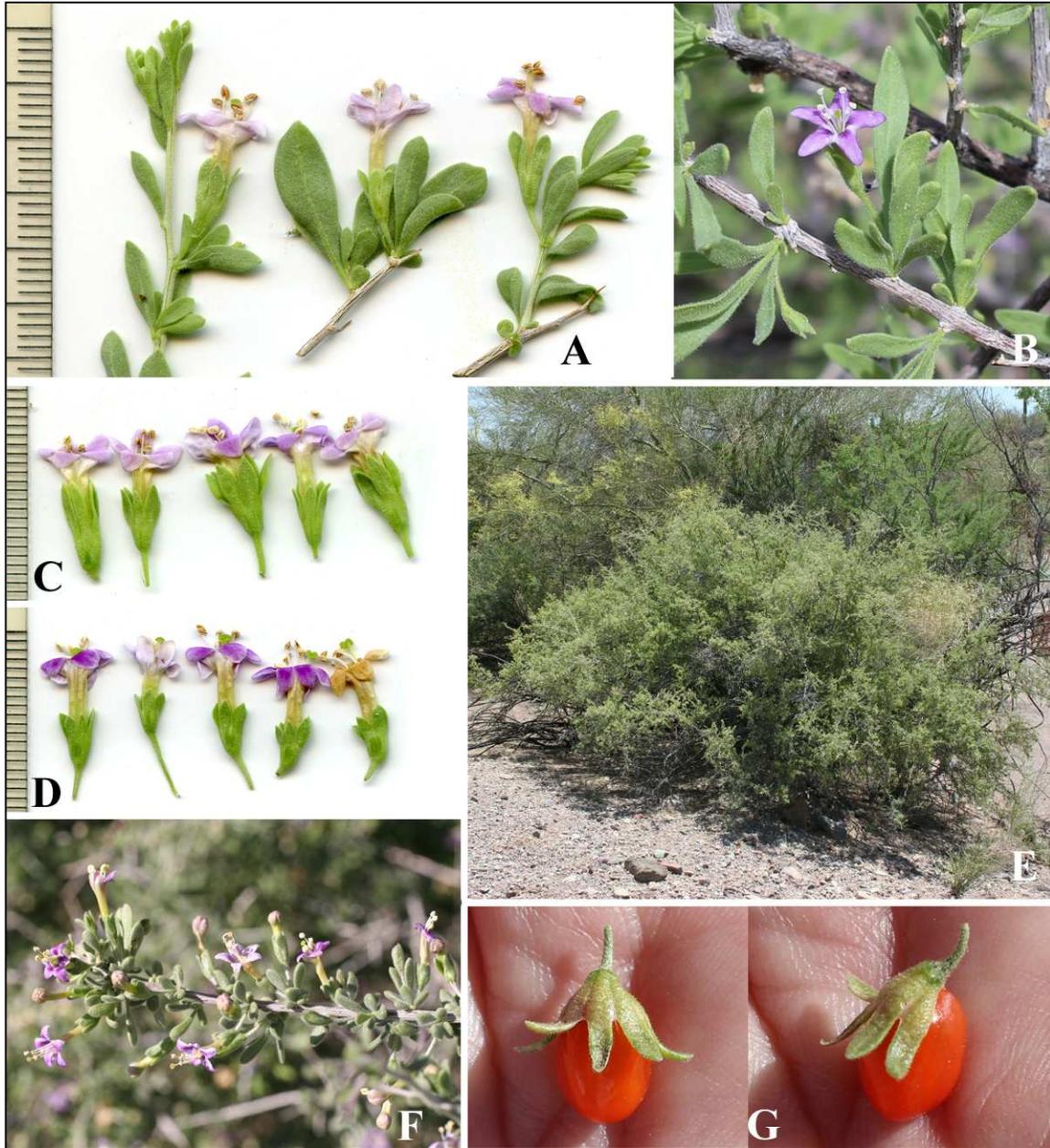


Figure 13. *Lycium parishii* var. *parishii*. (A, D) Ajo Scenic Loop, 31 Jul 2014. Bates Well Road, N of Bates Mts: (B) 24 Feb 2008; (C) 4 Aug 2014; (E) 7 May 2006. (F) Kuakatch Wash near Hwy 85, 13 Mar 2010. (G) Bluebird Mine, 9 Mar 2014.

†*Lycium* sp./spp.

These fossil samples may represent more than one species but demonstrate that members of this genus have been in the Ajo Mountains since at least the middle Wisconsin times.

OP: †Alamo Canyon, twigs, leaves, seeds, 1150 to 32,000 ybp (3 samples). Montezuma's Head, seeds, 17,830 ybp. Puerto Blanco Mts, on ridge, seeds, 7580 to 10,540 ybp (3 samples).

TA: †Tinajas Altas, seeds, 4010 to 10,950 ybp (4 samples).

Nicotiana – Tobacco

Annuals or perennial herbs, rarely shrubs. Leaves mostly entire, usually viscid pubescent, rarely glabrous. Flowers often opening and fragrant at night. Calyx 5-lobed, persistent. Corollas 5-lobed, with a well-developed tube. Fruit a capsule; seeds minute and numerous. Mostly in the Americas, tropical and warm temperate; 60 species. Includes commercial tobacco, *N. tabacum*, and ornamental garden annuals.

Traditional Native American tobacco included *N. rustica* and *N. tabacum*. Smoking was largely ceremonial, often restricted to use by shamans (Castetter & Bell 1951; Rea 1997). “The Cahuillas’ use of both wild and cultivated tobacco, however, extended to men and women, especially older people, who smoked it almost daily when the plant was available. Tobacco was considered a relaxing euphoriant as well as a medicinal and ritualistic plant” (Bean & Saubel 1971: 93). Tobacco was smoked in cane pipes (see *Phragmites*) or less often in clay pipes in historic times (Castetter & Bell 1951). Alarcón in 1540 and Hardy in 1826 found tobacco used at the Colorado delta, but it is not possible to know if this was wild or cultivated (Felger 2007; Flint & Flint 2005; Hardy 1829). Childs (1954: 29) wrote that the Hia-Ced O’odham “smoked it from time immemorial. That is why they killed so many immigrants coming and going to California in 1848 and 1849—they wanted to get what tobacco they carried along with them.” These events occurred before Tom Childs was born, and perhaps the reasons for these attacks were more complex (Felger 2007).

- 1. Glabrous shrubs; corollas yellow..... **Nicotiana glauca**
- 1. Glandular-pubescent annual or perennial herbs; corollas white or cream-white.
 - 2. Spring ephemerals; leaves sessile to short-petioled, the stem leaves not clasping; flowers pure white, nocturnal..... **Nicotiana clevelandii**
 - 2. Perennials, sometimes flowering in the first season; leaves all sessile, the stem leaves clasping (the leaf base wraps around the stem); flowers cream-white, diurnal..... **Nicotiana obtusifolia**

Nicotiana clevelandii A. Gray

Desert tobacco; *tabaquillo del coyote*; ban vivga. Figure 14.

Winter-spring ephemerals, 10–75 cm tall, mostly with a single main axis, or the more robust plants often with several axes. Stems and leaves viscid (sticky) hairy. Leaves variable, quickly wilting, lanceolate to elliptic or ovate, the larger ones (4) 5–13 cm long, the leaf tip acute to sometimes obtuse. Early leaves in a basal rosette; lower leaves with winged petioles, the stem leaves reduced upward and sessile. Calyx lobes slender, 1 lobe wider than the others and conspicuously longer than the capsule, the other lobes about as long as to shorter than the capsule. Corollas white, 12–20 mm long, nocturnal, closing in the morning depending on temperature. Capsules 5.8–8 mm long.

Often along washes and beneath large shrubs or trees; mostly sandy to gravelly soils of washes, bajadas, and desert plains. Southwestern part of Organ Pipe, lowlands across much of Cabeza Prieta (probably not in the northeastern part), and Tinajas Altas.

Southern Arizona to the Guaymas Region of Sonora, and southern California to Baja California Sur.

The leaves were smoked but considered inferior to cultivated tobacco, as indicated by its “coyote” name (Bean & Saubel 1972; Felger & Moser 1985).

OP: Aguajita, 11 Feb 1978, *Bowers 1044* (ORPI).

CP: Pinta Sands, *Phelps, Dale, & Edwards 11 Jan 1978 (ASU)*. 5.6 mi E of Tule Well, 9 Mar 1980, *Reichenbacher 478*. Papago Well: 12 Mar 1983, *Daniel 2673 (ASU)*; 26 Feb 1993, *Felger 93-136*. 7.8 mi on Camino del Diablo W of Pinta Sands, 1 Feb 1992, *Felger 92-44*. Pinta Sands, 11 Apr 1993, *Felger 93-432*.

TA: Tinajas Altas, 26 Mar 1935, *Kearney 10913*. 4 mi E of Tinajas Altas, 16 Apr 1941, *Benson 10810*.

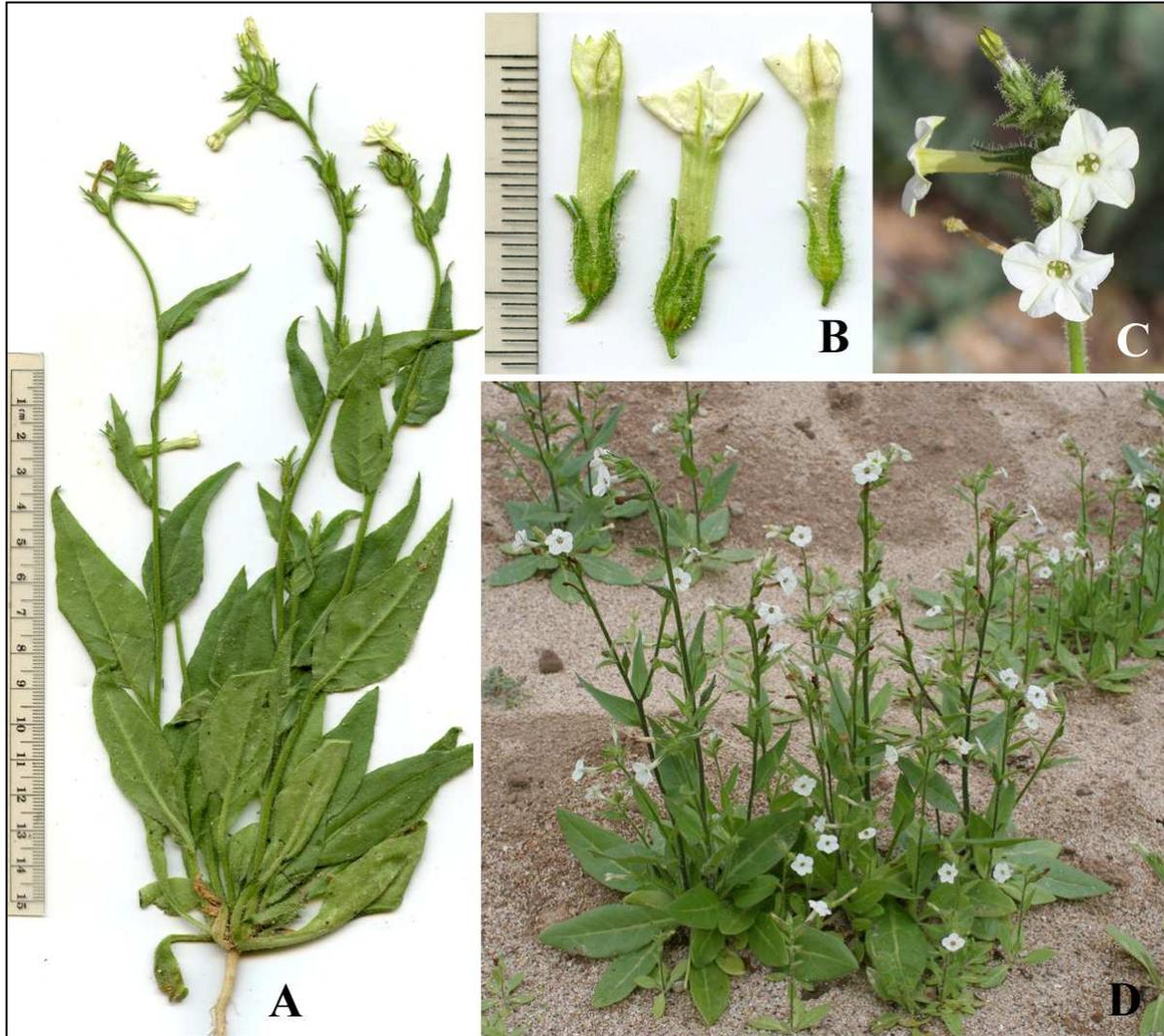


Figure 14. *Nicotiana clevelandii*. (A–C) Dunes near Maya Palace, E of Puerto Peñasco, Sonora, 20 Feb 2015. (D) Puerto Peñasco, Sonora, 19 Feb 2005.

*****Nicotiana glauca* Graham var. *glauca***

Tree tobacco; *palo loco*, *juan loco*. Figure 15.

Open, sparsely branched glabrous and unarmed shrubs 2–3 m tall. Leaves ovate, often 5–20 cm long, glaucous, smooth and somewhat thick. Flowers frequented by hummingbirds, the calyces green, the corollas tubular, yellow, 3–4 cm long.

Urban and agricultural weed in nearby Mexico. One plant was found near the Visitor Center and removed; it has not established in Organ Pipe.

Native to northwestern Argentina and southern Bolivia, now adventive in warm regions of the world. Another variety occurs in South America.

OP: Hwy 85, near Visitor Center, one plant, growing from seed brought with straw mulch for highway construction area revegetation, *Rutman 5 Sep 2005*, observation.

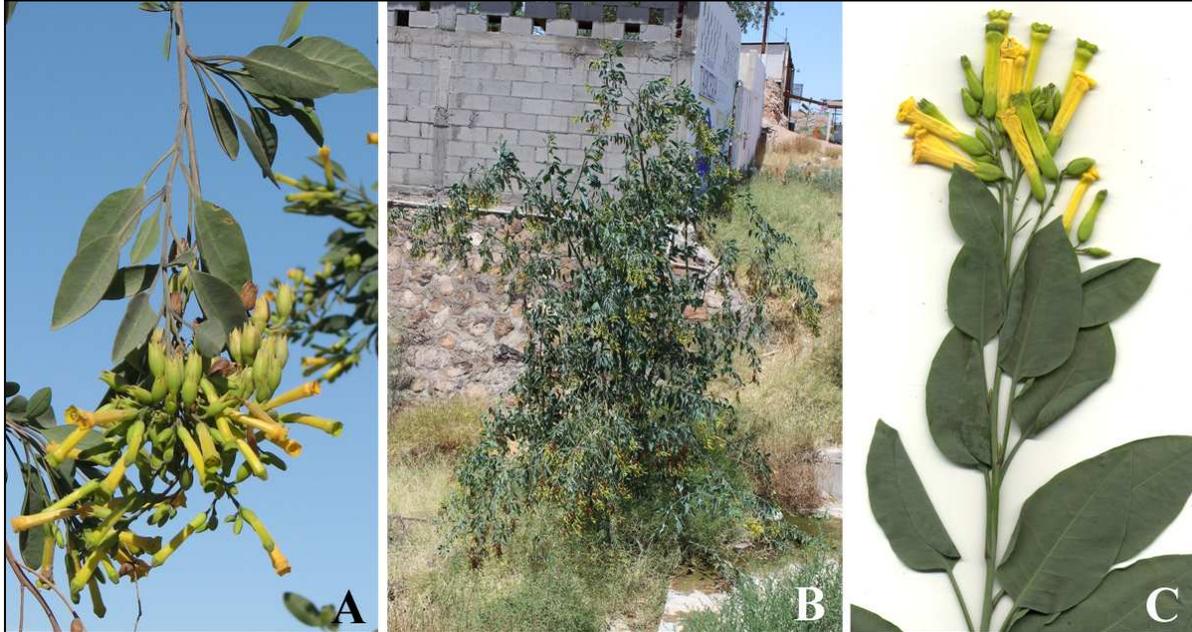


Figure 15. *Nicotiana glauca* var. *glauca*. (A) Puerto Peñasco, Sonora, Feb 2007. (B) Sonoyta, Sonora, 18 May 2015. (C) Ajo, 1 Apr 2013.

Nicotiana obtusifolia M. Martens & Galeotti

[*N. trigonophylla* Dunal. *N. palmeri* A. Gray]

Coyote tobacco, desert tobacco; *tabaco de coyote*; ha-vivga. Figure 16.

Herbaceous perennials, sometimes flowering in the first season, often 0.8–1 m tall. Herbage sticky, glandular-pubescent. Leaves sessile, mostly 6–12.5 cm long, the lower stem leaves oblanceolate with winged petioles and the bases clasping (wrapping around the stem), the upper leaves reduced, sessile and mostly not clasping. Flowers diurnal, open all day. Calyx and its lobes as long as to much longer than the capsules. Corollas 15–22 mm long, cream-white. Capsules 5.8–8 mm long. Growing and reproductive almost any time of year depending on soil moisture, the plants dying back severely during drought. Apparently germinating during the winter-spring season.

Widespread across the flora area; washes, bajadas, canyons, and rocky slopes, often on mountains to their summits. It has been in Organ Pipe for more than 14,000 years.

California deserts to Nevada and Texas, and southward to Nayarit.

The leaves were smoked as tobacco (Felger et al. 1992). “They used to smoke it. I remember my grandmother, she smoked the desert tobacco. Just anybody can smoke the tobacco” (Betty Melvin in Zepeda 1985: 55). The leaves were smoked by people across the Sonoran Desert, although it was universally considered inferior to cultivated tobacco, as indicated by its “coyote” name (Bean & Saubel 1972; Castetter & Bell 1951; Castetter & Underhill 1935; Felger & Moser 1985; Betty Melvin in Zepeda 1985:55; Rea 1997).

OP: Quitobaquito: 30 Jan 1894, *Mearns 2744* (CAS); 10 Nov 1987, *Felger 87-293*. Alamo Canyon, 18 Apr 1942, *Cooper 571*. 2 mi SE of Walls Well, 30 Aug 1945, *Gould 3220*. Dripping Springs, 16 Apr 1952, *Parker 7967*. Arch Canyon, 28 Mar 1965, *Lockwood 152*. Puerto Blanco Drive, 2.5 mi W of AZ Hwy 85, 6 Nov 1977, *Bowers 958*. †Puerto Blanco Mts, capsules, seeds, 9860 & 14,120 ybp.

CP: Heart Tank (Simmons 1966). Salazaria Wash, 11 Apr 1992, *Harlan 202*. Antelope Tank, Cabeza Prieta Tanks, Tuseral Tank, 13–15 Jun 1992, *Felger* (observations). Childs Mt, 18 Aug 1992, *Felger* (observation). Cabeza Prieta Peak, 2550 ft, N facing side of summit, 24 Mar 1995, *Yeatts 3651* (CAB). 0.5 mi S of Sunday Pass, *Cain 15 Nov 2003*.

TA: Base of Tinajas Altas, 28 Mar 1930, *Harrison 6568*.

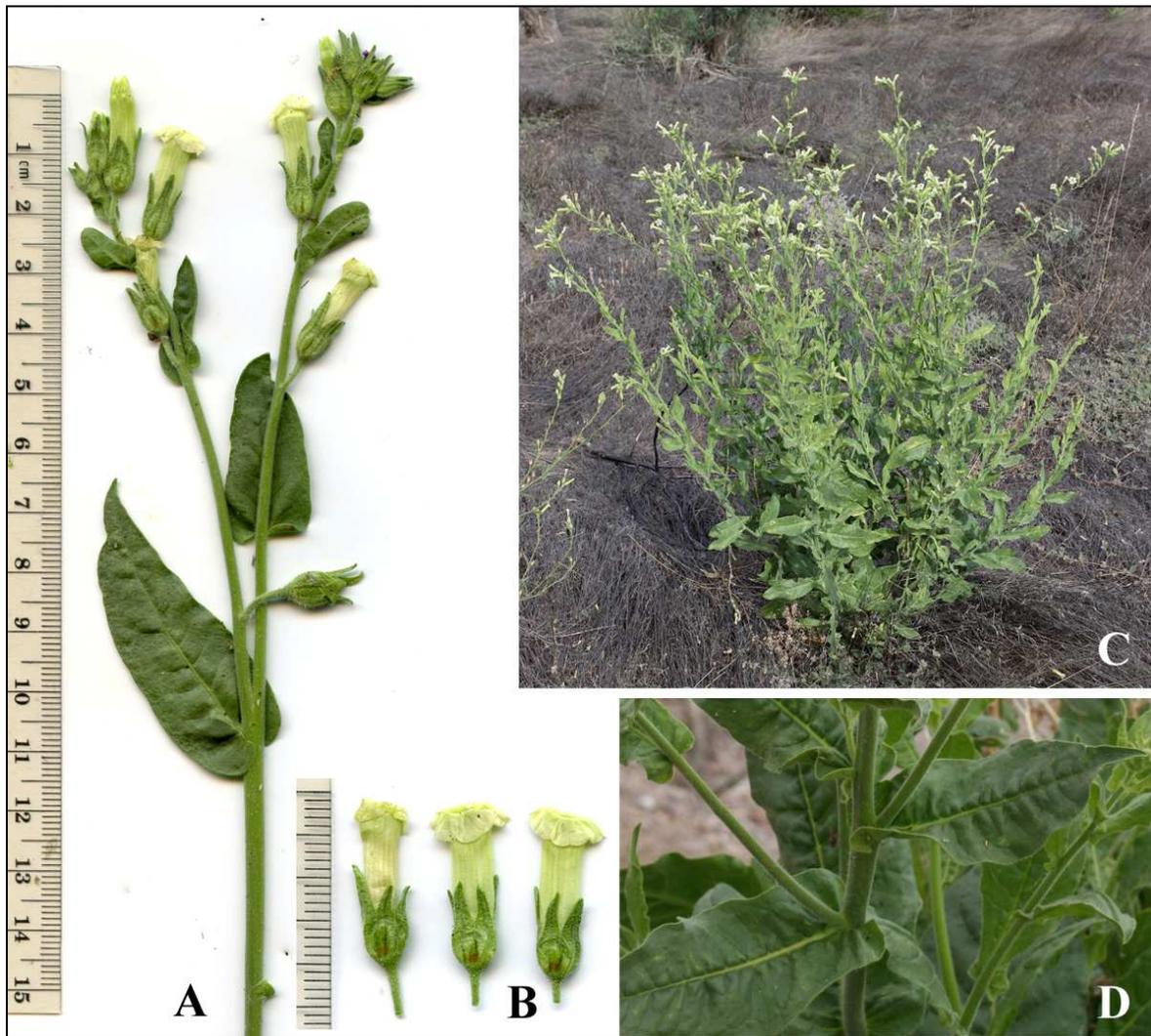


Figure 16. *Nicotiana obtusifolia*. (A & B) Sandy wash crossing at Hwy 85 mile 58.3, near N boundary of Organ Pipe, 25 Feb 2015. (C) Valley E of Childs Mountain, 12 May 2015. (D) Ten Mile Wash at Hwy 85, 8 Mar 2008.

Physalis – Ground cherry, husk tomato; *tomatillo*

Annual or perennial herbs. Leaves petioled. Flowers mostly solitary in leaf axils, pendent, and pedicelled. Calyx conspicuously 10-veined, enlarging and growing over the fruit to form a bladder-like structure like a miniature paper lantern. Those in the flora area: Corollas rotate, often yellowish or white, usually dark-spotted and hairy toward the center. Anthers yellow or bluish to purplish, opening by longitudinal slits. Fruit a globose, many-seeded berry.

Fruits of the wild species in the region are edible fresh and resemble the domesticated tomatillo (*P. philadelphica* Lamarck) in taste but are much smaller. Worldwide; 85 species.

1. Annuals, usually with a single main axis, the plants generally taller than wide; leaves thin, 5–18 cm long; corollas white with a yellow center; anthers bluish..... **Physalis acutifolia**

1. Perennials and sometimes flowering in the first season; plants often as wide as or wider than tall; leaves often slightly thickened, 1.5–10 cm long; corollas and anthers dull yellow.
..... **Physalis crassifolia**

***Physalis acutifolia** (Miers) Sandwith

[*P. wrightii* A. Gray]

Sharp-leaf ground cherry. Figure 17.

Warm-weather annuals, often 25–60+ cm tall, with a well-developed main axis. Younger herbage, flowering calyces, and fruiting calyx bases with short thick white hairs, the younger plants sometimes with elongated simple hairs near the base of the stem, the plants otherwise glabrous or glabrate. Leaves relatively thin, lanceolate, coarsely and often deeply toothed, the larger ones often 5–18 cm long (including petioles). Pedicels slender and elongate, the fruiting pedicels 2–5 cm long. Corollas 10–15 mm wide, white with a yellow center. Anthers blue-gray, the pollen yellow.



Figure 17. *Physalis acutifolia*. (A) W of Tejano Spring, Salero Ranch, 8 mi ESE of Tubac, Santa Cruz Co., photo by Sue Carnahan. (B) Verde Valley near Cottonwood, Yavapai Co., 3 Sep 2012, photo by Max Licher.

Agricultural weed in the Sonoyta region in Sonora and sometimes spreading into the southeastern margin of Organ Pipe where it is probably not well established. It is probably not native to the flora area, although it is native in the Southwest. Gila River Pima children ate the fruits fresh (Rea 1997).

Southeastern California, Arizona, Texas, Chihuahua, Sonora, and Sinaloa; weedy over most of its range.

Physalis acutifolia may be synonymous with *P. lanceifolia* Nees (*P. angulata* var. *lanceifolia* (Nees) Waterfall) of southwestern United States and Mexico.

OP: Dos Lomas, Warren 17 Nov 1979.

CP: Reported from the E edge of Las Playas (Simmons 1966), no specimen located; it occurs in nearby northwestern Sonora (Felger 2000).

***Physalis crassifolia* Bentham**

[*P. versicolor* Rydberg. *P. crassifolia* var. *versicolor* (Rydberg) Waterfall]

Desert ground-cherry; *tomatillo del desierto*. Figure 18.

Perennial herbs often slightly woody at the base and sometimes flowering in the first season. Plants drought deciduous, the stems dying back severely in drought. Stems slender, spreading, and much-branched. Leaves highly variable, 1.5–9 cm long (including petioles), the petioles from half as long as to mostly longer than the blades. Corollas and anthers dull yellow, the corollas 15–22 mm wide. Fruiting calyx (2) 2.5–3.5 cm long. Fruits edible, resembling the domesticated tomatillo (*P. philadelphica*) but much smaller and the flavor inferior. Flowering and fruiting response non-seasonal.



Figure 18. *Physalis crassifolia*. (A) Sierra del Águila near Mex Hwy 2, Sonora, 17 Mar 2015. (B) Sierra Pinacate, near Red Cone Campground, Pinacate Biosphere Reserve, Sonora, 3 Mar 2009. Alamo Canyon: (C) 12 Jan 2014; (D) 17 Oct 2013; (E) 1 Feb 2014.

Widespread across the flora area, mostly on rocky slopes, but also in arroyos or larger washes; probably in all mountains in the flora area.

Arizona, southeastern California, southern Nevada, southern Utah, both states of Baja California, Chihuahua, Sinaloa, and Sonora.

OP: Walls Well, *Nichol 28 Apr 1939*. Alamo Canyon, 7 Oct 1951, *Parker 7731*. Estes Canyon, *Hesselberg 16 Oct 1966*. Cherioni Wash, *Warren 10 Oct 1983*. Bull Pasture, *Wirt 13 Aug 1990*.

CP: Tule Tank, 26 Mar 1932, *Shreve 5930*. O'Neil Hills, *Darrow 14 Apr 1941*. Agua Dulce Mts, 14 Apr 1941, *Benson 10764*. Cabeza Prieta Mts, *Van Devender 9 Mar 1980*. 2 mi W of Little Tule Well, 18 Aug 1992, *Felger 92-653*.

TA: Tinajas Altas, 1 Dec 1938, *Goodding 4902*.

†*Physalis* sp./spp.

These specimens show that *Physalis* has been a widespread member of the local flora for more than 37,000 years. The seeds are diagnostic only to genus.

OP: †Alamo Canyon, seeds, 1150 to 32,000 ybp (7 samples). Montezuma's Head, seeds, 20,490 & 21,840 ybp. Puerto Blanco Mts, 980 to 10,540 ybp (18 samples; *P. crassifolia* occurs at this site).

TA: †Butler Mts, seeds, 740 to 11,250 ybp (5 samples). Tinajas Altas, seeds, 1230 to > 37,000 ybp (20 samples).

Quincula

This genus has a single species.

Quincula lobata (Torrey) Rafinesque

[*Physalis lobata* Torrey]

Chinese lantern. Figure 19.

Low perennial herbs from a deep, thick root; growth apparently non-seasonal. Stems herbaceous, rather weak, often 18–26 cm long, spreading to decumbent. Herbage granular scurfy with rounded white hairs or trichomes, especially dense on young herbage, pedicels, and calyces. Leaves relatively thick and sometimes semi-succulent, commonly ovate to spatulate, 4–10 cm long, the margins undulate or shallowly to deeply lobed or parted, the petioles prominent and winged. Corollas lavender, 2–3 cm wide, the center with a star-shaped pad of white hairs. Filaments lavender, the anthers yellow. Style pale white, the stigma capitate, yellow. Fruiting calyx 2 cm long. Flowering spring and summer-fall.

Locally common in silty-clay soils of playas and charcos, and sometimes in large washes and on sand flats.

Northern Mexico and Arizona, California, Colorado, Kansas, Nevada, Oklahoma, New Mexico, and Texas.

OP: Dripping Springs, 20 Mar 1941, *McDougall 5*. Near Cherioni Well, 9 Apr 1941, *McDougall 62*. Wash near old ranch by Kuakatch Wash, 31 Mar 1978, *Bowers 1161* (ORPI).

CP: Las Playas, 31 Jan 1992, *Felger 92-14*. San Cristobal Wash, 14 Sep 1992, *Felger 92-685*. Jose Juan Tank, 26 Feb 1993, *Felger 93-101*.



Figure 19. *Quincula lobata*. (A) S of Sierra Blanca, Pinacate Biosphere Reserve, Sonora, 18 Feb 2015. Pinacate Junction, Sonora: (B & C) 5 Mar 2014; (D) 17 Mar 2014.

Solanum – Nightshade

Annual or perennial herbs and shrubs (elsewhere also vines and small trees), spiny or unarmed, with simple or stellate hairs, or glabrate. Leaves alternate (sometimes sub-opposite), simple (those in the flora area), and petioled. Flowers often showy, the calyx usually 5-lobed, the corollas 5-lobed, rotate, and radial. Filaments short; anthers longer than filaments, connivent (close together but not united) in a cone around the style, each anther cell opening by a terminal pore (part of the buzz-pollination syndrome), or sometimes opening by longitudinal slits. (Other buzz-pollinated genera in the flora include *Senna* in Fabaceae, and *Krameria* in Krameriaceae.) Fruit a rounded berry. Seeds many. The combination of anthers opening by terminal pores and fleshy fruits sets *Solanum* apart from all other plants in the flora area.

Worldwide, especially in tropical America; 1500 species. This large genus includes many economic plants including potato, tomato, eggplant, and a wide range of garden plants.

- 1. Shrubs, usually spiny; herbage with stellate hairs; corollas lavender, 3–6 cm wide; fruits 2 cm wide, green-mottled..... **Solanum hindsianum**
- 1. Herbaceous annuals/ephemerals or perennials, without spines; sparsely to densely hairy, the hairs simple or with some branched hairs but not stellate; corollas white or purple, 0.5–2.5 cm wide; fruits to 1 cm wide.
 - 2. Corollas dark lavender or purple, 1.5–2.5 cm wide; fruits green, 1 cm in diameter..... **Solanum umbelliferum**
 - 2. Corollas white and sometimes tinged with lavender, 0.5–2 cm wide; fruits blackish or purplish when ripe, 5–9 mm wide.
 - 3. Flowers about 0.5 (1) cm wide, often tinged with lavender; anthers less than 2 mm long; styles up to 0.5 mm longer than the anthers..... **Solanum americanum**
 - 3. Flowers about (0.7) 1–2 cm wide, white; anthers (2.5) 3–4+ mm long; styles 2–2.5 mm longer than the anthers..... **Solanum nigrescens**

***Solanum americanum** Miller

[*S. nodiflorum* Jacquin]

Black nightshade; *chichiquelite*; *cuvi vupui*. Figure 20.

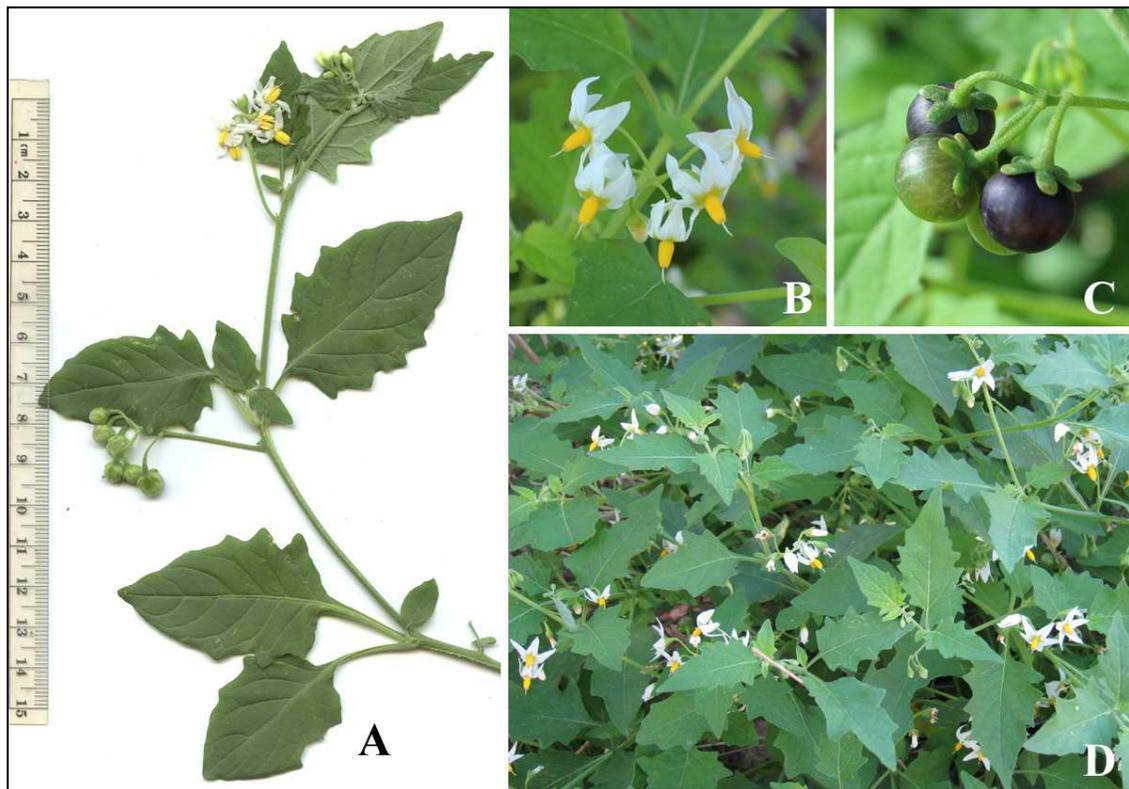


Figure 20. *Solanum americanum*. Alamo Canyon above the well: (A) 3 Sep 2014; (B & C) 9 Sep 2014; (D) 15 Sep 2015.

Annuals or sometimes short-lived herbaceous perennials, relatively open and sparsely branched, often 50–80 cm tall; unarmed. Herbage, especially new growth, inflorescences, outer calyces, and portion of corollas exposed in bud with sparse to moderately dense, short, white, unbranched hairs; older herbage and especially the larger leaves becoming glabrate. Leaves often 5–

20 cm long, the blades variable, mostly ovate, green and thin, the margins usually irregularly blunt-toothed, the petioles prominent. Inflorescences of short umbellate clusters. Corollas white, 5 (10) mm wide, star-shaped with the lobes longer than the short tube. Anthers pale yellow, 1.2–1.3 mm long before dehiscence, 1.5–1.6 mm after dehiscence; style longer than the anthers. Fruiting calyx covering $\frac{1}{3}$ or less of the fruit. Berries globose, 5–8 mm wide, dark purplish or blackish.

Growing and flowering with warm weather, frost sensitive and dormant during cooler weather. Aguajita Spring and Quitobaquito in moist, often shaded places. Also an urban and agricultural weed in the nearby Sonoyta region and widely cultivated or protected in Sonoran dooryard gardens.

Nearly worldwide, probably native to South America.

It has been extensively used in Arizona and Sonora as *quelites* (greens) and the small fruits, blackish when ripe, are eaten fresh or cooked (Felger 2007; Hodgson 2001). Gila River Pimas used the ripe fruits as a purple dye (Rea 1997). The plants can be toxic (Kingsbury 1964), although cooking the leaves and shoots can remove the toxin, and upon ripening the toxicity of the berries is greatly reduced (Edmonds & Chweya 1997). Proper identification of the black nightshades is important to avoid poisoning by the more toxic, closely related ones (Kingsbury 1964).

OP: Quitobaquito: In moist soil, 13 Jun 1978, *Bowers 1329*; 28 Apr 1990, *Felger 90-73*. Aguajita, Warren 10 Nov 1983.

†***Solanum hindsianum*** Bentham

Hind's nightshade, Baja nightshade; *tomatillo espinoso*. Figure 21.

Sparsely branched shrubs to 2.5 m tall; densely stellate pubescent. At least some stems, petioles, leaf midribs, and calyces bear straight, relatively slender prickles to stout "spines." Leaves mostly 3–13 cm long, mostly lanceolate to ovate or oblong, thinner and larger during periods of high soil moisture and warm weather; margins entire or nearly so, or with irregular shallow teeth or lobes. Flowers showy, the corollas 3–6 cm wide, and lavender (plants with white corollas are rare in nearby Sonora); anthers 7–10.5 mm long, bright yellow or yellow-orange; stigma green; flowers largest during times of warm weather and high soil moisture. Fruits round, 2 cm wide, mottled dark and light green. Seeds flat, smooth, and gray. Flowering at various seasons depending on soil moisture and temperature.

Sandy alluvial soil to shallow soils over bedrock in the Puerto Blanco Mountains and at Senita Basin, which are the only known occurrences of this species in the United States. Discovered in Organ Pipe in 1986. It is widespread and common in nearby Sonora.

Endemic to the Gulf of California region: Organ Pipe and southward in western Sonora to the Guaymas Region, most of the Baja California Peninsula, and Gulf islands. The northern limit seems to be determined by freezing weather. Freeze damage is commonplace in the northern populations and plants near Sonoyta are sometimes freeze killed nearly to the ground. The only other spiny *Solanum* in the region is *S. elaeagnifolium* Cavanilles, an herbaceous perennial and common weed in nearby northwestern Sonora.

Seeds of fossil specimens indicate this nightshade was a widespread member of the local flora from 11,000 to 20,500 years ago. Seeds of *S. hindsianum* are similar to those of *S. elaeagnifolium* and the fossils could be either species, although *S. hindsianum* seems a more logical choice. *Solanum elaeagnifolium* is a weedy species in southwestern and midwestern United States and northern Mexico.

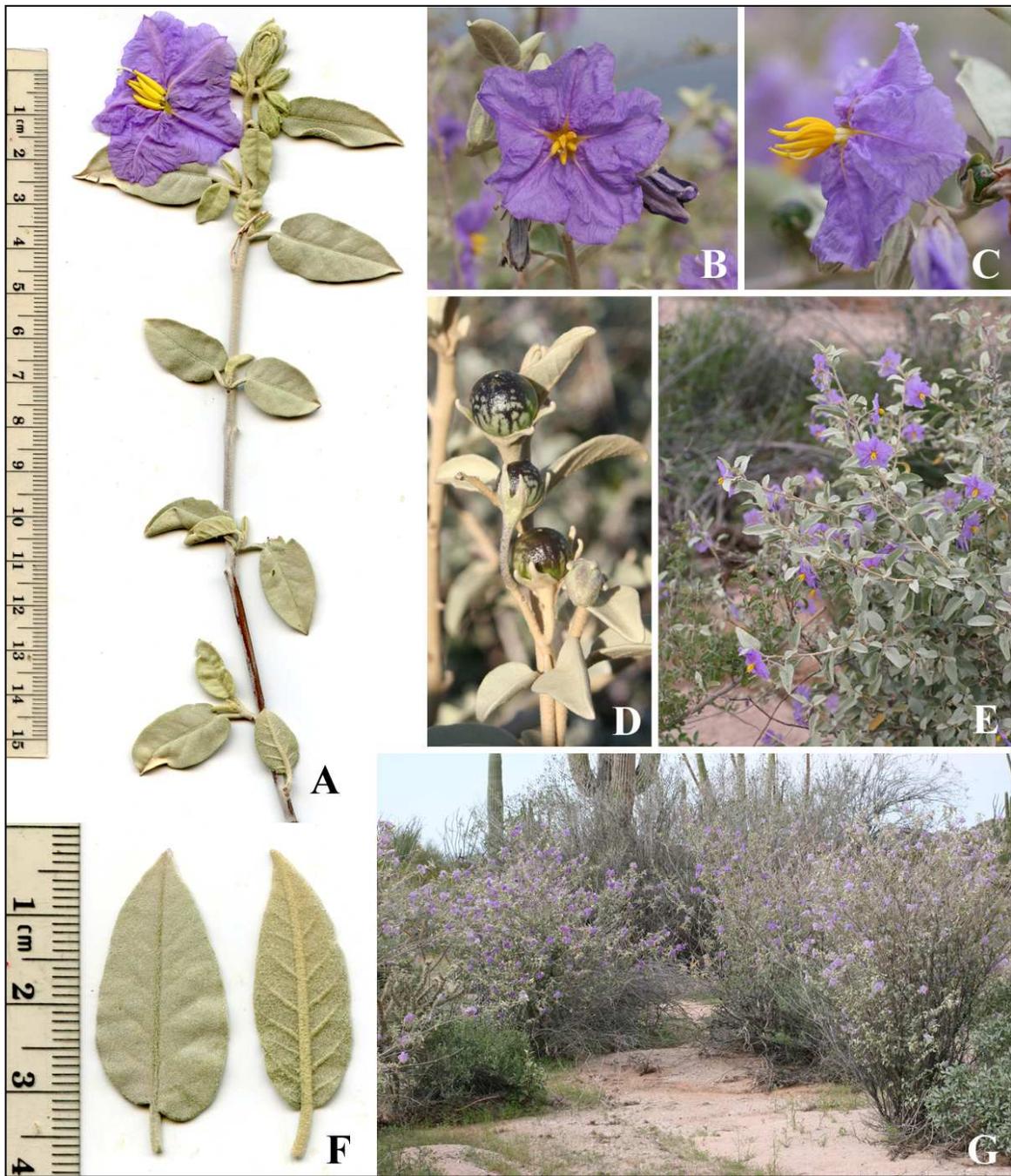


Figure 21. *Solanum hindsianum*. Bajada of Sierra Cubabi, near Mex Hwy 8, Sonora: (A) 12 Sep 2014; (B, C, E, & G) 19 Mar 2010; (D) 18 Jan 2009; (F) 12 Sep 2014.

OP: 1.5 km S of Pinkley Peak, 585 m, *Lechner 28 Jan 1986*. Puerto Blanco Mts, 1 km S of Pinkley Peak, 545 m, shrub to 2 m tall, abundant here, 18 Oct 1987, *Baker 7568* (ASU, ORPI). Puerto Blanco Mts, 1.8 km NW of Red Tank Well, side of wash, about 30 individuals, to 2.5 m tall, 5 Mar 1988, *Baker 7581* (ASU, ORPI). Senita Basin, *Rutman 29 Jan 2002* (ORPI). †Alamo Canyon, seeds, 9570 ybp. Montezuma's Head, seeds, 13,500 & 20,490 ybp.

TA: †Tinajas Altas, seeds, 10,950 ybp.

Solanum nigrescens M. Martens & Galeotti[*S. douglasii* Dunal]

Douglas nightshade, greenspot nightshade. Figure 22.

Herbaceous to sub-shrubby perennials, also flowering in the first year, usually less than 1 m tall; glabrous or variously pubescent. Leaves alternate or sub-opposite, 2–9 cm long, petioled, the blades ovate to lanceolate-elliptic, margins entire to coarsely toothed. Inflorescences umbel-like racemes. Flowers on pedicels 2–12 mm long. Calyx 1.5–2.5 mm long. Corollas 8–25 mm wide, rotate, white or tinged with purple, sometimes gland-dotted. Styles 3 mm longer than the anthers. Fresh berries blackish, 6–9 mm wide.

Canyons and higher elevations, especially north-facing slopes in the Ajo, Bates, and Diablo mountains.

Generally at elevations above the desert in Arizona. Southern California to Alabama, and Mexico including both Baja California states, and southward to South America.

Differing in part from *S. americanum* by its larger flowers and anthers, and longer styles, indicating an out-crossing rather than selfing mode of reproduction.

OP: Alamo Canyon: *Nichol* 4 May 1939; 17 Dec 1945, *Goodding & Supernaugh* 482-45. Kino Peak, canyons, 18 Mar 1944, *Clark 11416* (ORPI). Canyon Diablo, 15 Apr 1951, *Supernaugh* 443. Arch Canyon, 2 Dec 1990, *Felger* 90-506. Boulder Canyon, *Tewksbury* 11 Sep 2004.



Figure 22. *Solanum nigrescens*. (A) Whiting Ranch Wilderness Park, Orange Co., CA, 19 Jan 2014, photo © by Ron Vanderhoff (<http://nathistoc.bio.uci.edu/plants/>). (B) Gaviota State Park, Santa Barbara Co., CA, 14 Apr 2003, photo © 2003 by Brent Miller (CalPhotos).

Solanum umbelliferum Eschscholtz[*S. xanti* A. Gray]

Purple nightshade. Figure 23.

Herbaceous perennials (shrubs and subshrubs elsewhere); with small hairs mostly on stems and leaf veins. Leaves 2–6 cm long, the blades elliptic, ovate or lanceolate, with petioles to 1.5 cm long. Inflorescences of several-flowered umbel-like panicles. Flowers on pedicels 5–15 mm long. Calyx to 7 mm long and wide with lobes shorter than the tube. Corollas dark blue to purple, 1.5–3 cm wide. Anthers longer than the filaments and opening by short slits. Style longer than the stamens. Berries about 1–1.5 cm in diameter, green to yellowish and smooth.

Known in the flora area from a single record.

Western North America from Oregon to Baja California, and eastwards to Nevada and Arizona (Knapp 2013), and undoubtedly also in northern Sonora. Knapp treats *S. xanti* as a synonym of *S. umbelliferum*.

OP: Alamo Canyon, *Tinkham* 1 Apr 1942.



Figure 23. *Solanum umbelliferum*. (A) Quail Springs Ranch, 3 mi SW of Cottonwood, Yavapai Co., 20 Apr 2010, photo by David C. Thornburg (SEINet). (B) Oak Creek Canyon, 16 May 2001, photo by Max Licher (SEINet).

STERCULIACEAE, see MALVACEAE (Felger et al. 2015c, Flora of Southwestern Arizona, part 16).

TALINACEAE – Talinum Family

Three genera; Americas and Africa; 27 species.

Talinum

Herbs and shrubs, often succulent. Africa and Americas; 15 species.

Talinum paniculatum (Jacquin) Gaertner

Pink baby’s-breath, jewels of Opar. Figure 24.

Perennial herbs from thick, fleshy, tuberous roots, and also flowering in the first season. Growing during the summer rainy season, dying back to the rootstock when the rains cease, at which time virtually no trace of the plants is evident. Stems and leaves succulent; leaves alternate, falling quickly as the soil dries after the summer rains, the lower leaves (3) 5–15 cm long, elliptic to obovate, the upper stem leaves reduced. Stems 15–60+ cm tall, with terminal inflorescences of open, slender-branched panicles. Flowers on very slender pedicels; open for about three hours in the late afternoon; sepals soon deciduous; petals 3–6 mm long, pink to dark red-purple. Fruits of capsules 3–5 mm wide with many small black seeds 1 mm wide.

Locally abundant on shaded rocky slopes at mid-elevations and especially higher elevations of the Ajo Mountains.

Eastward in southern Arizona to southeastern United States, Baja California Sur, and to South America and West Indies.

OP: Bull Pasture, 3200 ft, *Wirt 8 Aug 1990* (ORPI). Arch Canyon, bedrock/shallow soil NE of the arch, *Rutman 8 Oct 1999* (ORPI). NE-facing slope against wall of bedrock, along the trail below Bull Pasture, *Juniperus coahuilensis*, *Berberis harrisoniana*, *Viguiera*, *Simmondsia chinensis* and many grasses and forbs, 22 Oct 2006, *Rutman 2006-1022-14*.

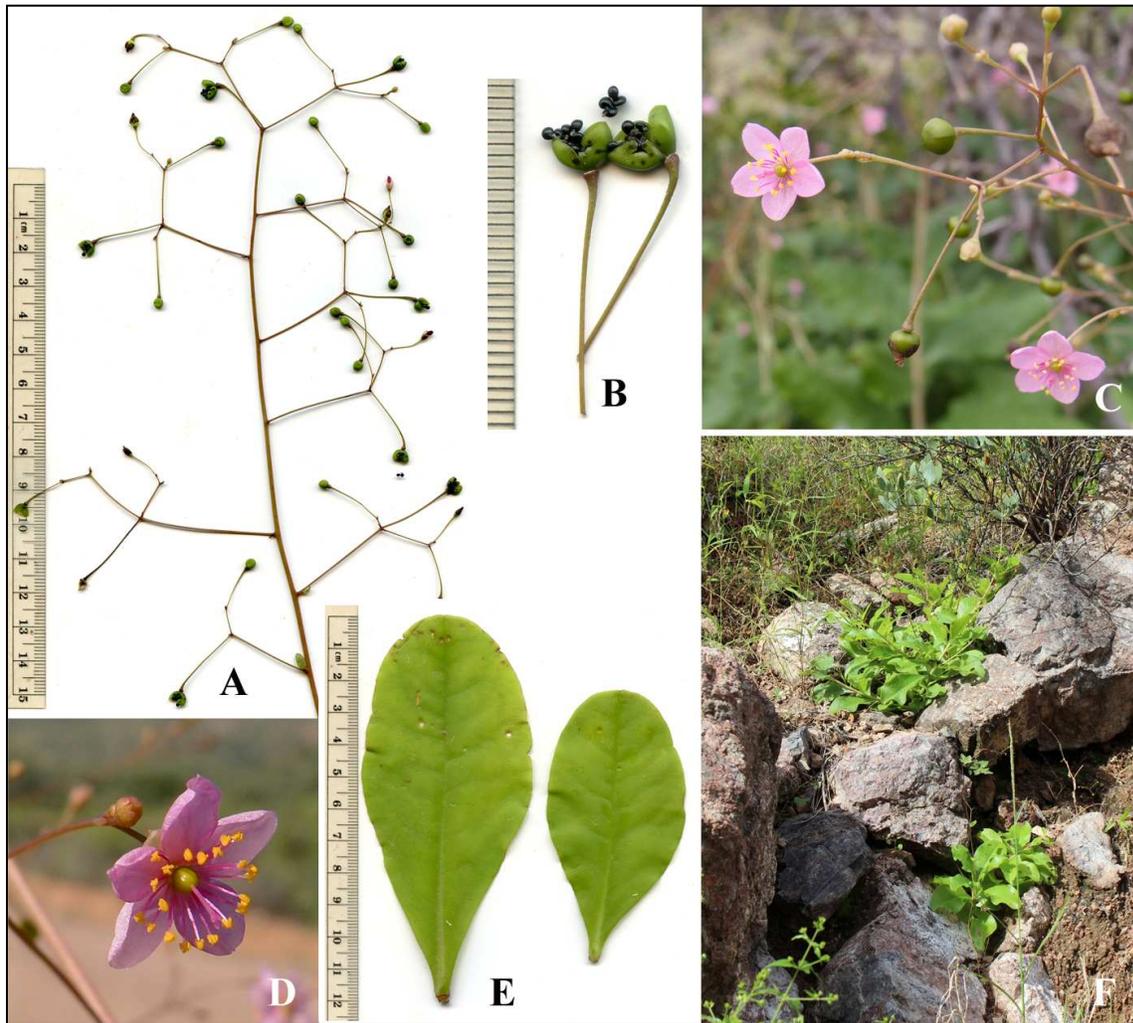


Figure 24. *Talinum paniculatum*. (A, B, E & F) Trail to Bull Pasture, 8 Sep 2014. Salero Ranch, Santa Cruz Co.: (C) 17 Aug 2011; (D) 7 Aug 2013; photos by Sue Carnahan.

TAMARICACEAE – Tamarisk Family

Trees or shrubs. Native to the Old World, mostly xerophytes and halophytes in arid and semi-arid regions; 5 genera, 90 species (Stevens 2012).

Tamarix – Tamarisk

Trees and shrubs. Leaves alternate, scale-like, mostly with salt-excreting glands, clasping or sheathing the stem; without stipules. Flowers in dense racemes or spikes, usually with bracts; flowers small, white or pink, radial, and with a fleshy nectar-producing disk. Fruit a capsule; seeds many, minute, and with a tuft of feathery hairs.

Native to Eurasia and Africa; 55 species.

1. Trees with a massive trunk and limbs, attaining more than 5 m in height; leaves completely encircling the stem, the blades reduced to a cusp less than 0.5 mm long; flowers white, sessile.

..... **Tamarix aphylla**

1. Shrubs, rarely small trees, seldom more than 3–4 m tall; leaves not completely encircling stem, the blade scale-like but evident, 0.7–3 mm long, triangular-ovate; flowers usually pink, sometimes white but becoming pink with age, with pedicels 0.6–0.8 mm long..... **Tamarix chinensis**

****Tamarix aphylla** (Linnaeus) H. Karsten

Athel tree, salt cedar; *pino salado*. Figure 25.

Large trees with a well-developed trunk and thick limbs, and persistent, grayish-green branchlets giving an evergreen aspect. Flowers small and white; flowering in fall.

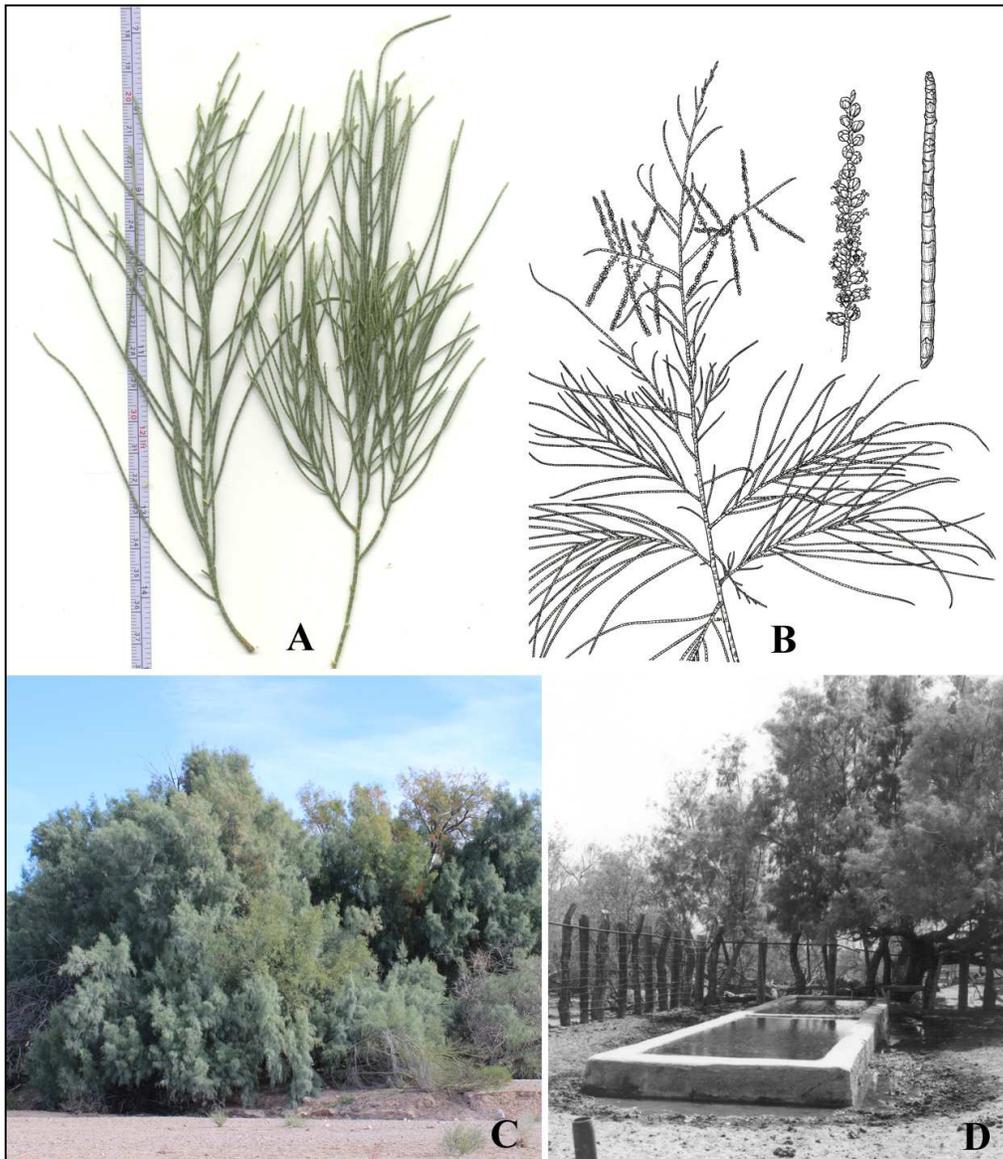


Figure 25. *Tamarix aphylla*. (A & C) El Papalote, Aguajita Wash, Sonora, 6 Feb 2014. (B) By Lucretia Breazeale Hamilton. (D) Pozo Salado, La Abra Plain, Apr 1967, photo by Bill Brown (Organ Pipe Cactus National Monument archives, accession #714).

Formerly planted at ranches and waterholes; once established the trees may survive for decades but are not reproducing in the flora area. As these trees age and become senescent they will be extirpated from the flora area.

Extensively planted in the Sonoran Desert Region; native to North Africa and the Eastern Mediterranean.

OP: Bates Well, one tree next to Henry Gray's house, *Rutman 20 Apr 2001* (ORPI). Observations: Dowling Ranch, one scrawny tree, 11 Nov 1987, *Felger*; Gachado Camp, one tree, 16 Nov 2001, *Rutman*.

CP: Tule Tank (Simmons 1966). Eagle Tank, 31 May 1997, *Bill Broyles* (observation). Tule Well, one tree, 7 m tall, 10 Jan 2002, *Felger 02-15*.

****Tamarix chinensis*** Loureiro

[Or perhaps hybrids with *T. ramosissima* Ledebour (see Gaskin 2015)]

Salt-cedar, tamarisk; *pino salado*; 'onk 'u'us. Figure 26.

Woody shrubs to about 2.5 m tall. Branchlets (short shoots) or ultimate twigs winter- and tardily drought-deciduous, the internodes shorter than, and obscured by, the overlapping scale leaves. Long shoots perennial. Leaves and young stems with regularly spaced, alkali- or salt-excreting glands (the glands seen with 10× magnification); these glands, glistening gold when fresh and first developing, soon becoming white with the buildup of alkali or salt. Scale leaves of ultimate branchlets (short shoots) 0.7–1.4+ mm long, those of the long shoots mostly 2.3–3 mm long. Flowers 5-merous, the perianth 1.5–2 mm long, pinkish white or pink, the petals longer than the sepals; filaments pink, the anthers white; ovary often dark rose-purple; style yellow or pink, the stigma 3-lobed and white; floral disk glands or nectary maroon, producing glistening nectar droplets; pedicels 0.5–0.8 mm long. Capsules 3.7–4.5 mm long. Seeds 0.5 mm long, yellow-brown. Flowering mostly January–October.

Invasive, weedy, and well established and reproducing on alkaline/saline wet soils at several widely scattered wetland habitats in the flora area, and continuing to appear at new localities. Single plants occasionally are found at dry sites with no indication of supplemental subsurface water, such as near the Mexico border east of Lukeville (e.g., Gachado Line Camp). Park Service personnel have been actively removing tamarisk shrubs. Large populations occur in nearby Sonora, especially along the Río Sonoyta.

Widespread in western North America.

OP: Quitobaquito: 30 Sep 1961, *West 96*; 25 Jul 1978, *Bowers 1391*. Alamo Canyon, *Cole 30 Nov 1988* (ORPI). Gachado Line Camp, dry habitat, one plant, removed, 14 Mar 1995, *Rutman*, observation. South boundary just W of Pozo Salado road, dry habitat, one plant, removed, 14 Mar 1995, *Rutman*, observation. Vicinity of Williams Spring, plants removed, 4 Jan 2002, *Rutman*, observation. Ditch along S boundary road, La Abra Plain near Pozo Salado, dry habitat with no indication of subsurface water, one plant, removed, *Rutman 6 Jan 2002* (ORPI).

CP: Eagle Tank: *Simmons 28 Oct 1962* (CAB); One large shrub in sandy canyon bottom, 13 Jun 1992, *Felger*, observation; No tamarisk seen at Eagle Tank in 2004, Curtis McCasland, pers. comm. to Felger, 2004. Tule Mts, granite bedrock canyon, 6–10 plants less than 2 m tall, all appeared drought-stressed, *Rutman 16 Feb 2002* (CAB).



Figure 26. *Tamarix chinensis*. (A, C & D) Ajo Scenic Loop, Little Ajo Mts, 31 Jul 2014. (B) By Lucretia Breazeale Hamilton. (E) Stem of 1-year old plant, Alamo Well, 17 Oct 2013. (F) Gila Box, Greenlee Co., 27 Mar 2004.

URTICACEAE – Nettle Family

Annual to perennial herbs, shrubs, and trees; often with stinging hairs. Stamens spring-loaded, the pollen explosively ejected. Fruits of achenes. Worldwide, mostly tropical and subtropical; 54 genera, 2625 species (Stevens 2012).

- 1. Delicate annual herbs, without stinging hairs..... **Parietaria**
- 1. Coarse herbs with stinging hairs..... **Urtica**

Parietaria – Pellitory

Annual or perennial herbs. Worldwide, mostly temperate and subtropical; 20 species.

Parietaria hespera* B.D. Hinton var. *hespera

Desert pellitory. Figure 27.

Delicate winter-spring ephemerals, the root system relatively small. Sparsely to densely hispid, the hairs with enlarged bases. Herbage rapidly wilting when cut. Stems erect to spreading or semi-prostrate, semi-succulent, often 8–60 cm long. Leaves alternate, petioled; leaf blades (5) 8–30 mm long, thin, soft, mostly broadly lanceolate to ovate, and dotted with punctiform cystoliths that appear as minute blisters under magnification; stipules none. Flowers in small axillary clusters, subtended by green bracts (1.4) 2–5 (7) mm long, with bisexual and unisexual flowers in the same cluster. Flowers green, inconspicuous; calyx 4-parted, green to brownish; petals none. Male flowers with 4 stamens, the filaments inflexed in bud, straightening suddenly and elastically to fling the dry, mature pollen from the anthers. Seed-bearing calyces brown, variable in size even on the same stem, 11–26 mm long. Achenes 0.9–1.2 mm long, hard and shiny, ovoid, and enclosed in the persistent calyx.

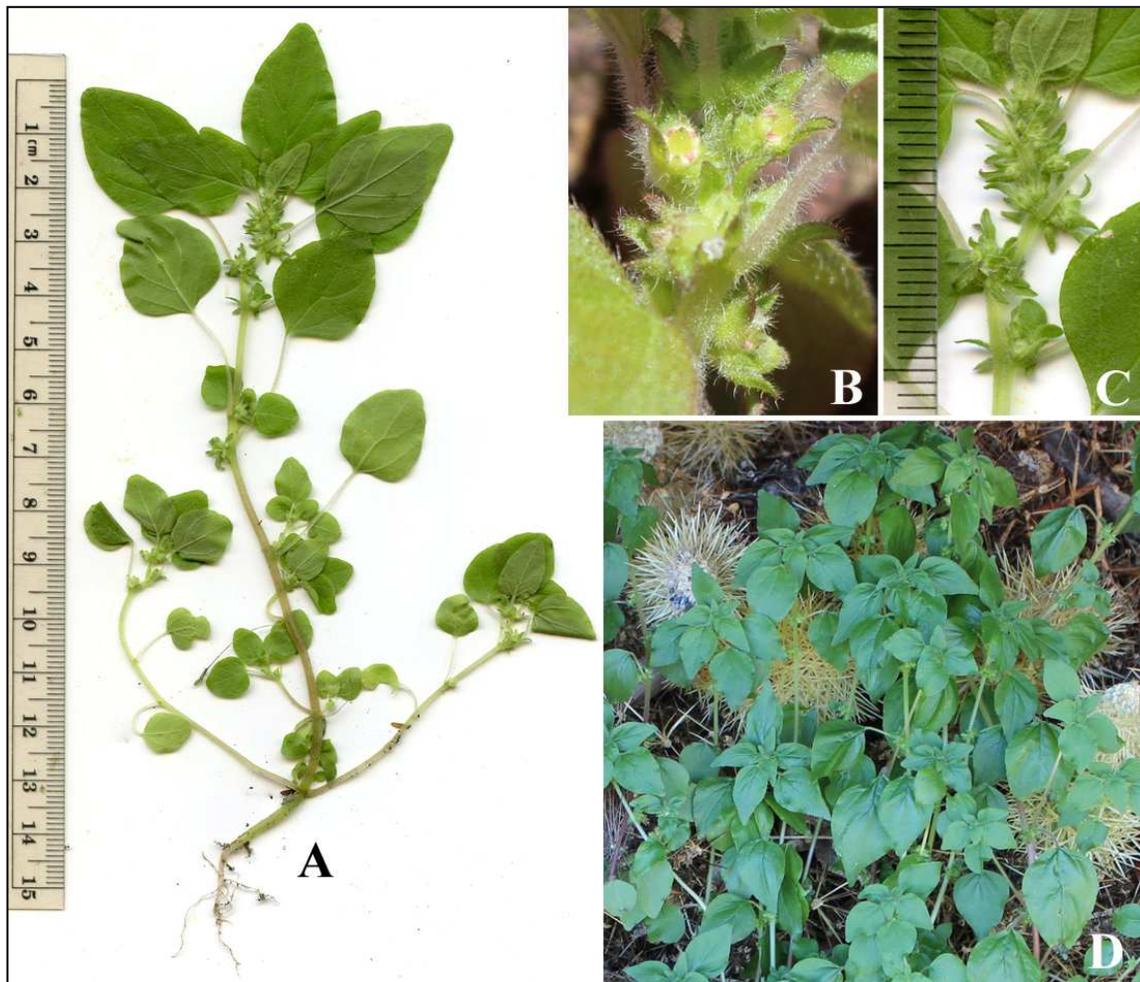


Figure 27. *Parietaria hespera* var. *hespera*. (A & C) Ajo, 6 Mar 2015, C shows female flowers. (B) Male flowers, Alamo Wash, 26 Feb 2014. (D) Bajada E of Charlie Bell Pass, 16 Mar 2015.

Widespread across the flora area at all elevations, except not found on sand flats and dunes. Washes, waterholes, canyons, slopes, and flats, but mostly in protected niches such as among rocks and beneath spiny shrubs and trees. *Parietaria* has been in the Ajo Mountains for at least 32,000 years.

Variety *hespera* in southwestern United States and northwestern Mexico; var. *californica* B.D. Hinton in California and Baja California.

OP: Alamo Canyon, 2 Apr 1944, *Clark 11585* (ORPI). Aguajita Spring, 6 Apr 1988, *Felger 88-298*. Sierra Santa Rosa, 12 Mar 2003, *Felger 03-371*. †Alamo Canyon, fruits, seeds, 1150 to 32,000 ybp (6 samples).

CP: Childs Mt, 25 Feb 1993, *Felger 93-43*. Agua Dulce Spring, 26 Feb 1993, *Felger 93-90*. Jose Juan Tank, 26 Feb 1993, *Felger 93-103* (CAB). Heart Tank, 27 Feb 1993, *Felger 93-151*. Las Playas, clayish soil with mesquite shrubs, 11 Jan 2002, *Felger 02-39*.

TA: Coyote Water, 25 Oct 2004, *Felger 04-55*. Tinajas Altas, 28 Mar 2010, *Felger 10-192* (ARIZ, DES). Canyon ca. 0.1 km below Raven Tank, 29 Mar 2010, *Felger 10-236*.

Urtica – Nettle

Annual or perennial herbs; with stinging hairs, the hairs long, sharp pointed, and with a bulbous or cylindrical base. Temperate regions worldwide; 45 species.

Urtica gracilenta Greene

Mountain nettle. Figure 28.

Herbaceous annuals to 0.5 m tall, growing with warm weather. Leaves opposite; prominently petioled; leaf blades ovate to circular or ovate-lanceolate, about 8–15 cm long, the margins coarsely toothed. Male and female flowers in separate inflorescences, or a few female flowers sometimes at tip of male inflorescences. Flowers green and white, small, and with 4 tepals. Achenes ovoid, 1.5 mm long.

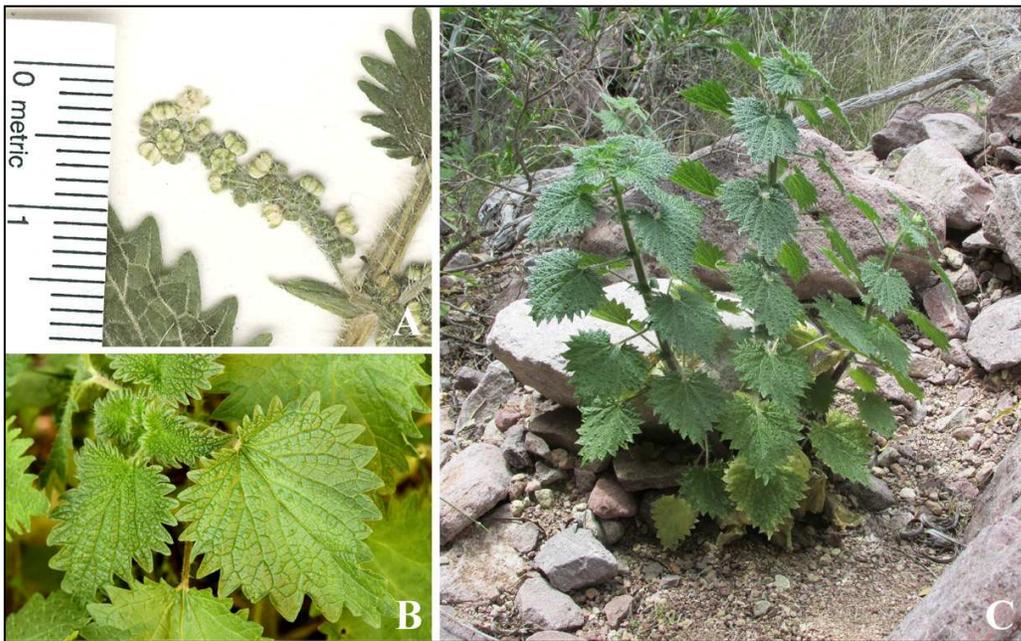


Figure 28. *Urtica gracilenta*. (A) Devil’s Chasm, Sierra Ancha Wilderness Area, Gila Co, 6 Aug 1991, *Imdorf 27* (ASU, SEINet). (B) Aguirre Springs, Organ Mts, NM, 22 Apr 2007, photo by Patrick Alexander (SEINet). (C) Arch Canyon, 23 Apr 2015, photo by Peter Holm.

An isolated population discovered by Peter Holm in remote, upper reaches of Arch Canyon. The nearest population is in the Baboquivari Mountains.

Arizona to Texas and northern Mexico.

OP: Arch Canyon, canyon bottom shaded by steep canyon walls and broadleaf trees, main canopy trees are *Sapindus drummondii* and *Quercus turbinella*, understory trees are *Ptelea trifoliata*, *Frangula betulifolia*, and *Morus microphylla*, shrubs include *Ribes quercetorum* and *Rhus aromatica*, and herbs include *Thalictrum fendleri*, *Phanerophlebia auriculata*, *Urtica gracilentia*, and *Phacelia ramosissima*, Holm 29 Mar 2015.

VERBENACEAE – Verbena Family

Annuals, perennial herbs and shrubs (those in the flora area; elsewhere also trees and vines). Stems 4-angled (square in cross-section). Leaves opposite, simple or compound; stipules none. Calyx 4- or 5-lobed or toothed. Corollas 4- or 5-lobed, usually bilateral. Stamens 4. Ovary superior; style 1, the stigma often 2-lobed. Fruits variable, 1- or 2-seeded or separating into four 1-seeded nutlets.

Worldwide, mostly New World, and mostly tropical to warm temperate; 31 genera, 920 species.

1. Shrubs; fruits 1- or 2-seeded.

- 2. Plants without spines or prickles; flowers white; fruits 1-seeded..... **Aloysia**
- 2. Stems with scattered prickles; flowers pink (or yellow or red); fruits 2-seeded..... **Lantana**

1. Annual or perennial herbs; fruits of four 1-seeded nutlets.

- 3. Plants foul-smelling; flowers white or pinkish, in axillary clusters..... **Tetraclea** (formerly in Verbenaceae, now in Lamiaceae, see Felger & Rutman 2015b, Flora of Southwestern Arizona, part 15)
- 3. Plants not stinky; flowers blue or pink, in terminal spikes, head-like clusters, or racemes.
 - 4. Flowering calyx more than 5 mm long; corollas pinkish, 8–14 mm wide; style more than 5 mm long; nutlets 2.5–3.5 mm long, the ventral surfaces brown or blackish, not white-papillate. **Glandularia**
 - 4. Flowering calyx to 3.5 mm long; corollas pinkish or blue, 2.5–5 mm wide; style 1.5 mm long or less; nutlets 1.7–2.2 mm long, the ventral surfaces white-papillate..... **Verbena**

Aloysia

Shrubs; 35 species in the Americas.

Aloysia wrightii (A. Gray) A. Heller ex Abrams

Oreganillo. Figure 29.

Shrubs often 1–1.5 m tall and about as wide, with 4-angled, very slender, brittle stems with thin bark peeling in long strips. Leaves pleasantly aromatic (like oregano); petioles 1–4 mm long or leaves sessile, the blades often 5–12 mm long, ovate to circular, densely tomentose below, the margins crenate. Inflorescences of slender terminal or lateral spikes mostly 2–6 cm long, densely tomentose, the flowers crowded, and with bractlets shorter than the calyx. Flowers small, bilateral, white, and fragrant. Calyx 4-toothed, 1.5–3 mm long. Corollas 2.5–3.5 mm long, 5-lobed, moderately 2-lipped, white with rounded lobes, the upper 2 larger. Stamens 4. Fruits to 3 mm long with 2 nutlets.

Generally in canyons and especially on rocky, north-facing mountain slopes to upper elevations in Organ Pipe including the Ajo, Growler, Puerto Blanco, and Santa Rosa mountains. Also on Childs Mountain.

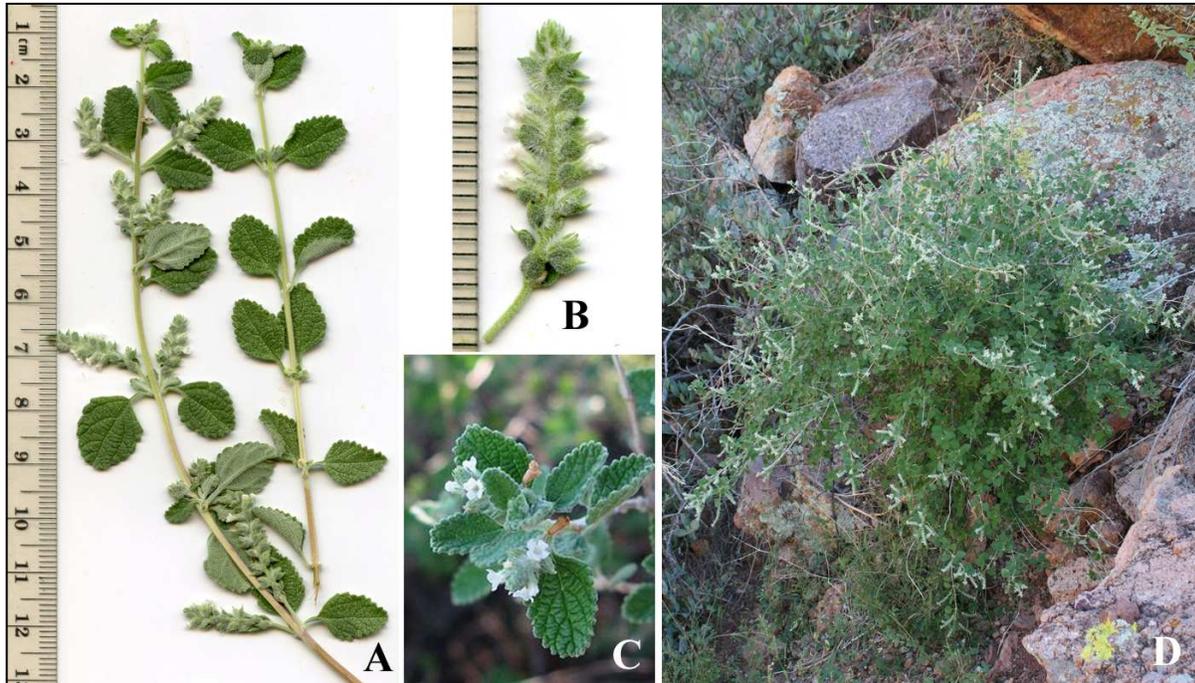


Figure 29. *Aloysia wrightii*. (A & B) Arch Canyon, 26 Aug 2014. (C) Salero Ranch, Santa Cruz Co., 8 Aug 2010, photo by Sue Carnahan. (D) Trail to Mount Ajo, above Bull Pasture, 24 Sep 2006.

Inland southern California to southern Utah, Arizona, New Mexico, Texas, and northern Mexico in Sonora and the Chihuahuan Desert Region.

OP: Sierra de Alamos, *Nichol 16 May 1937*. Puerto Blanco Mts, 22 Oct 1964, *Ranzoni 361* (ORPI). Alamo Canyon, 3 Dec 1977, *Bowers 973*. Gunsight Hills near Kuakatch, *Rutman 22 Mar 1998* (ORPI). E side of Growler Mts, W of Growler Pass, 7 Mar 2003, *Rutman 2003-296* (ORPI). Trail from The Cones to Mount Ajo, 4090 ft, 10 Apr 2005, *Felger*, observation.

CP: Childs Mt, rocky, N-facing slopes near top, 2240 ft, 25 Feb 1993, *Felger 93-39*.

Glandularia

Ephemerals, annuals or short-lived perennials. Branches and leaves opposite. Leaves simple to bipinnatifid, the leaves or segments usually toothed to cleft, with stiff, simple and sometimes glandular hairs. Inflorescences spicate, not especially slender or elongated in fruit. Each flower subtended by a bract. Calyx tubular, 5-angled, irregularly 5-toothed. Corollas 5-lobed, salverform (the tube abruptly expanded into a flat limb), moderately bilateral and showy. Fruits splitting into four nearly cylindrical 1-seeded nutlets.

Twenty-two species in North America and 50 in South America. A genus segregated from *Verbena*. *Glandularia* originated in South America and can be distinguished from *Verbena* by differences in seed morphology, chromosome number, style length, and reproductive modes.

- 1. Calyx prominently stipitate (stalked) glandular; nutlets 3.3–3.5 mm long and blackish.
..... **Glandularia gooddingii**
- 1. Calyx glandular or not, but not stipitate; nutlets 2.5–3 mm long and light to dark brown.
..... **Glandularia latilobata**

Glandularia gooddingii (Briquet) Solbrig[*Verbena gooddingii* Briquet]

Desert verbena. Figure 30.

Short-lived herbaceous perennials or non-seasonal ephemerals, but generally occurring in spring; pilose with relatively long, spreading, white hairs plus stalked and sessile glands on the herbage and calyces. Leaves petiolate, 2.5–4.5+ cm long, broadly ovate, highly variable, deeply toothed to laciniately parted. Inflorescences reaching 5–8.5 cm long, the flowers fragrant, crowded into 1 to 3 head-like spicate clusters. Floral bracts 5–7.5 mm long. Calyx 5.5–7 mm long. Corollas lavender-pink, the tube longer than the calyx, with hairs inside and outside, the flat limb (“face”) 8–14 mm wide, the lobes notched, the throat white and yellow-green, nearly closed by a dense ring of white hairs guarding the entrance; inner surface of corolla tube with downward-pointing white hairs, these dense just below the anthers and along a line extending inward from the sinus between the 2 larger, lower corolla lobes. Style 5.5–7+ mm long. Nutlets 3.3–3.5 mm long, dark brown to nearly black, the dorsal side resembling a miniature ear of corn with an alveolate pattern and smooth ridges.

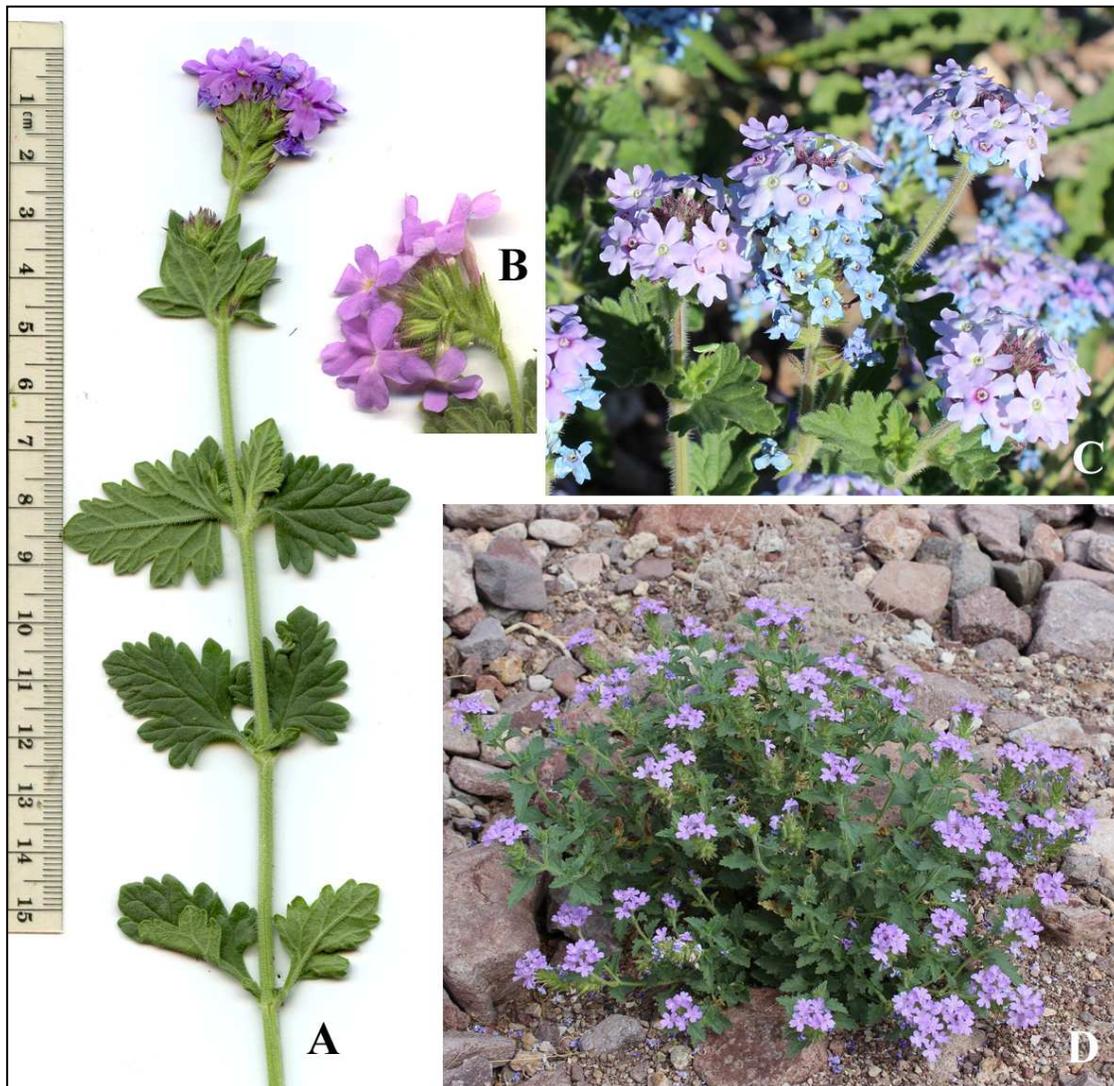


Figure 30. *Glandularia gooddingii*. (A) Estes Canyon trailhead, 25 Feb 2015. (B) Bull Pasture Trail, 10 Sep 2008. (C) Alamo Canyon, 29 Jan 2014. (D) Arch Canyon, 2 Aug 2013.

Widespread across Organ Pipe and scarce in the eastern part of Cabeza Prieta; washes, canyons, and rocky slopes.

Southeastern California to western Texas and southwestern Utah, Baja California, Baja California Sur, and Sonora (Nesom 2010a).

OP: Diablo Canyon, 21 Mar 1935, *Kearney 10842*. Alamo Canyon, 2400 ft, 3 Dec 1977, *Bowers 971*. Growler Wash, 0.5 mi E of Bates Well, *Rutman 22 Mar 1998* (ORPI). Bull Pasture: *Wirt 5 May 1989* (ORPI); 3215 ft, 9 Apr 2005, *Felger 05-187* (det. G.L. Nesom; Phytoneuron 2010-54).

CP: Basaltic hill, 0.2 km S of Chico Shunie temporal, 25 Feb 1993, *Felger 93-65*.

Glandularia latilobata (L.M. Perry) G.L. Nesom

[*Verbena bipinnatifida* (Nuttall) Nuttall var. *latilobata* L.M. Perry. *Glandularia bipinnatifida* (Nuttall) Nuttall var. *latilobata* (L.M. Perry) B.L. Turner]

Figure 31.

Ephemerals to short-lived perennials, with harsh hairs (hirsute-hispid), stems becoming decumbent. Leaves subsessile or short-petioled, 1–2-pinnatifid, the ultimate divisions narrow (linear); however, leaves of young plants or lower nodes may have broad lobes. Inflorescences 6–20 cm long, compact, with many, crowded, showy flowers; spikes elongating in fruit. Flowers subsessile to short-stalked. Bractlets shorter than the calyx; calyx 7–8 mm long, glandular, with teeth 1–4 mm long. Corollas bright lavender-purple, the tube 10 mm long, the limb 6–8 mm wide. Nutlets 2.5–3 mm long. Flowering in spring and probably also with summer rains.



Figure 31. *Glandularia latilobata*. 3.3 km W of Agua Prieta on Mex Hwy 2, Sonora, 24 Apr 2004, *Van Devender 2004-328* (ASU 47736).

Organ Pipe in the Ajo and Bates mountains; washes and canyon bottoms, apparently localized and not common. Also just east of the northeast boundary of Cabeza Prieta.

Widespread in Arizona, mostly above the desert including high-elevation forests, New Mexico, northeastern Sonora to Chihuahua, and Durango (Nesom 2010b).

OP: Alamo Canyon, *Tinkham Apr 1942*. Bates Well, sandy bottoms, 18 Mar 1944, *Clark 11427* (ORPI). Growler Wash, about 0.5 mi E of Bates Well, uncommon, *Rutman 22 Mar 1998* (ORPI).

†**Glandularia** sp./spp.

One or more species of *Glandularia*, probably one or both of the present-day species, have long been in Organ Pipe and Tinajas Altas, as shown by fossil nutlets.

OP: †Alamo Canyon, seeds, 1150 to 32,000 ybp (3 samples). Montezuma's Head, nutlets, 13,500 to 21,840 ybp (3 samples, including: one nutlet 3.0 mm long, brown, 20,490 ybp; one nutlet 2.4 mm long, 21,840 ybp; one nutlet 3.1 mm long, dark brown, 21,840 ybp). Puerto Blanco Mts, nutlets, 9070 & 9720 ybp.

TA: †Tinajas Altas, nutlets, 8660 ybp.

Lantana

Tropical and subtropical regions, worldwide but mostly in the Americas; 150 species.

****Lantana camara** Linnaeus

Lantana; *confiturilla negra*. Figure 32.

Shrubs with brittle, prickly stems and scabrous leaves. Flowers in a head-like globose cluster, the corollas bicolorous. The one specimen has pink and yellow corollas. Fruits of small, round, fleshy drupes, black when ripe.

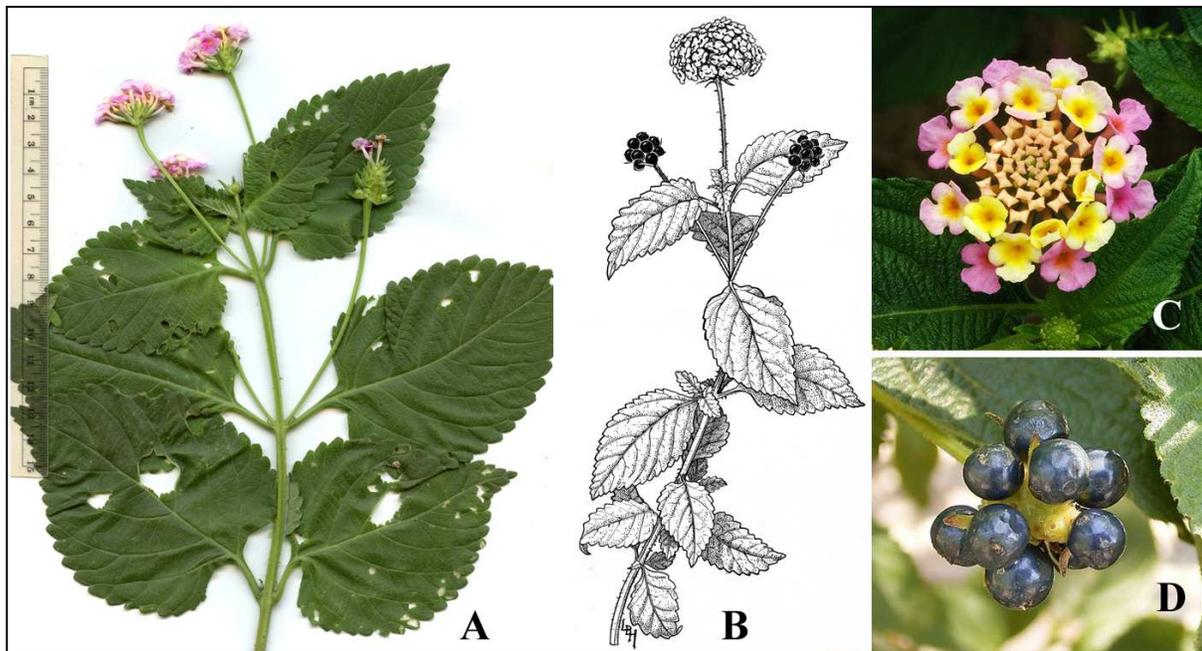


Figure 32. *Lantana camara*. (A) Tucson, 28 Sep 2014. (B) By Lucretia Breazeale Hamilton. (C) Mauritius, October 2006, photo by Joaquim Alves Gaspar (SEINet and Wikipedia). (D) 11 Jan 2008, photo by Frank Vincentz (Wikipedia).

Garden plant in the Organ Pipe residence area; first noticed escaping in 1997, but it has not spread. It is a common landscape plant in southern Arizona and this color form is a horticultural selection. This species is native to Central and South America.

OP: Planted in yards of residence and escaping into the wash interior to the residence loop road, Rutman 24 Mar 2003.

Verbena

Herbaceous perennials. Leaves toothed to dissected. Flowers in terminal, usually elongated, densely flowered spikes, each flower subtended by a narrow bract. Corollas usually funnellform, sometimes nearly salverform, with a flat, 5-lobed, weakly bilateral limb. Style 3 mm or less in length. Fruits separating into four 1-seeded nutlets (similar to those of *Glandularia*), the nutlets usually falling as a unit, brown or blackish, small (1–2 mm long), the common faces angled.

Mostly in North and South America with greatest diversity in North America, where it seems to have originated (see *Glandularia*); 70 species.

- 1. Stems usually sprawling or spreading; floral bracts 3.5–6+ mm long; corollas pink.
..... **Verbena bracteata**
- 1. Stems erect; floral bracts 1.7–3 mm long; corollas blue.
- 2. Inflorescences of paniculate (many branched) spikes..... **Verbena menthifolia**
- 2. Inflorescences of 1 or mostly 3 long spikes..... **Verbena xylopoda**

Verbena bracteata Lagasca & Rodriguez

Bigbract verbena. Figure 33.

Spring ephemerals, low-growing, spreading to prostrate, the stems and inflorescences 25–40 cm long, with coarse spreading white hairs (hirsute or strigose). Leaves, flowers, and fruits crowded. Leaves 2–6 cm, more or less lanceolate, deeply toothed or cleft. Inflorescences of several-branched spikes less than 12 cm long. Bracts 6–10.5 mm long. Calyx 2.6–3 mm long. Corollas 2.5–3 mm wide, pink, inconspicuous and nearly hidden by the bracts. Style 0.6+ mm long. Nutlets brown, 2.1–2.2 mm long, resembling a miniature ear of corn, the ventral side white papillate, the dorsal side striate and alveolate.



Figure 33. *Verbena bracteata*. (A) Bear Canyon Lake, Coconino Co., 11 Jul 2005, photo by Patrick Alexander. (B) Quail Springs, SW of Cottonwood, Yavapai Co., 5 Oct 2013, photo by D.C. Thornburg.

Known in the flora area by a single record from a well-established, localized population.

Southern Arizona mostly in disturbed habitats, and often found at dirt cattle tanks (*represos*). The Sonoran Desert populations are few and often widely separated, and likely result from dissemination by birds visiting waterholes. Southern Canada to northern Mexico.

CP: Jose Juan Represo, 12 Jun 1992, *Felger* 92-555.

Verbena mentifolia Benth

Mint verbena. Figure 34.

Non-seasonal ephemerals to short-lived perennials; few-branched, slender and erect, often 60–100 cm tall, the leaves, flowers, and fruits rather widely spaced. Leaves with sparse to moderately dense pubescence of appressed, stiff white hairs, the stems glabrate or sparsely hairy. Larger, lower leaves 7–8+ cm long, once- or twice-pinnatifid. Inflorescences of several to many slender, mostly erect spikes often 15–30 cm long; bracts 1.7–2.7 mm long. Calyx 2.4–3.5 mm long, hirsute with short, appressed non-glandular white hairs. Corollas bright blue, 4–5 mm wide. Style 1.1–1.5 mm long. Nutlets 1.7–1.8 mm long, brown, and the common ventral surfaces white papillate. Flowering various seasons including spring and summer.

Localized at charcos, playas, alkaline wet soils including Quitobaquito and Jose Juan Represo, and in the Ajo Mountains at least in Arch Canyon on north-facing slopes at higher elevations.



Figure 34. *Verbena mentifolia*. (A) S edge of Las Playas, 3 Jun 1965, *Lehto* L22466 (ASU 74831). (B) Lake Pleasant Regional Park, Maricopa Co., 10 Apr 1978, *Lehto* 5126 (ASU 97014).

California to southeastern United States and Mexico southward to Oaxaca and Veracruz, and both states of Baja California. Attributions of *V. halei* to Arizona, New Mexico, and northwestern Mexico are based on misidentifications of *V. menthifolia* (Nesom 2010c).

OP: Beneath mesquite in old fields just below pond at Quitobaquito, 14 Sep 1988, *Felger 88-454*.

CP: Jose Juan Represo: 19 Mar 1987, *Elias 10254*; 12 Jun 1992, *Felger 92-556*. Las Playas, 14 Mar 1993, *Harlan 365*. Redtail Tank, *Cutler 3 Mar 1995* (CAB).

Verbena xylopoda (L.M. Perry) G.L. Nesom
 [*V. neomexicana* (A. Gray) Small var. *xylopoda* L.M. Parry]
 Arizona vervain. Figure 35.

Perennial herbs often 20–50 cm tall with slender, erect, flowering stems (spikes). Herbage with hispid to hispidulous covering of short, stiffly spreading hairs like a bed of glassy tack points and also short, glandular hairs. Leaves mostly basal and on lower stem areas, often deciduous by flowering time, the blades 2–5 (7) cm long, mostly ovate to subspatulate, obovate, or oblanceolate in outline, pinnatifid to deeply pinnately toothed, the upper stem leaves linear and much smaller. Inflorescences of spikes, solitary or 3 (5); 4–20+ cm long in fruit. Floral bracts 3–4 mm long. Calyces 2.5–3.5 (4) mm long. Corollas blue to violet, the tube 4–5 mm long, limb 4–7 (8) mm wide. Nutlets 1.6–2.2 mm long, the outer surfaces reticulate.

Organ Pipe on rocky slopes and in canyons of the Ajo and Diablo mountains. Generally a plant of upper slopes and one lowland record in a sandy wash north of the park headquarters.

Arizona except the northern part, southwestern corner of New Mexico, eastern Sonora, and western Chihuahua (Nesom 2010d).



Figure 35. *Verbena xylopoda*. Alamo Canyon: (A) 7 Sep 2013; (B) 26 Feb 2014; (C) 15 Sep 2013.

OP: Canyon Diablo, 21 Mar 1935, *Kearney 10846*. Alamo Canyon, *Nichol 4 May 1939*. Sandy wash N of headquarters, *Ranzoni 26 Mar 1965 (ORPI)*. Arch Canyon, 3500 ft, 28 Mar 1965, *Niles 551*. Rocky slopes along Bull Pasture Trail, 3000 ft, 9 May 1979, *Bowers 1704*. Bull Pasture, 2315 ft, rocky, shallow soil, 9 Apr 2005, *Felger 05-177*.

VISCACEAE, see SANTALACEAE (Felger & Rutman 2016, Flora of Southwestern Arizona, part 19).

ZYGOPHYLLACEAE – Caltrop Family

Herbs and shrubs (elsewhere also trees). Those in the flora area: Leaves opposite, with 1–10 leaflet pairs, or leaflets 3, the leaflet margins entire; stipules well developed. Flowers solitary in leaf axils, radial, and 5-merous. Ovary 1, superior; style 1, the stigmas 1 to several. Sepals and petals separate; nectary disk usually well developed. Stamens 10. Fruits of capsules or schizocarps, with 5 carpels (splitting into 5 or 10 mericarps); seeds 1 to several per carpel or mericarp. (See Porter 2016.)

Worldwide, mostly tropical and subtropical, and prominent in semi-arid to desert regions; 27 genera, 250 species. Zygophyll shrubs and trees have very hard wood.

- 1. Shrubs with hardwood stems, often to 1 m or more tall; leaves with two fused leaflets appearing as one..... **Larrea**
- 1. Ephemerals or herbaceous or scarcely woody perennials less than 1 m tall; leaves with 3 or more leaflets.
 - 2. Perennials and also flowering in first season; stipules spinescent; leaflets 3 (or fewer when some or all leaflets are shed in drought); flowers pink or purple..... **Fagonia**
 - 2. Summer-fall ephemerals; stipules not spinescent; leaves even-pinnate with 6 or more leaflets; flowers yellow or orange.
 - 3. Fruits knobby but not spiny, separating into 10 segments (rarely fewer), these leaving a persistent axis after falling..... **Kallstroemia**
 - 3. Fruits with sharp spines, separating into 5 tack-shaped mericarps (rarely fewer), these leaving no central axis after falling..... **Tribulus**

Fagonia

Herbaceous perennials and often flowering in the first season. Stems slender, brittle, and striate. Leaves digitately compound with 3 leaflets (those in the flora area) and spinescent stipules; one or more leaflets sometimes drought deciduous. Flowers on prominent pedicels. Petals pink or purple, clawed and often twisted at the claw to stand perpendicular to the flower axis. Fruit a capsule resembling a miniature onion dome, ovoid, moderately inflated, deeply 5-lobed and 5-chambered, the persistent style forming a prominent beak. Seeds 1 per chamber, flat, glistening with a hard, nearly transparent surface, becoming mucilaginous (slimy) when wet and adhering tenaciously when dry. Flowering with warm weather at various seasons except in extreme drought. The three fagonias in the flora area tend to occur in open, xeric sites, often on rocky slopes but also along washes, bajadas, and sometimes on sand flats.

Deserts and semi-arid regions of North and South America, Africa and the Mediterranean region to India and Pakistan; 35 species (Beier 2005; Beier et al. 2004).

- 1. Leaflet tips not spinose; stipules straight, the longer ones 5–12+ mm long.
..... **Fagonia pachyacantha**
- 1. Leaflet tips spinose; stipules moderately curved (at least some on each plant), 1.5–6 mm long.
 - 2. Herbage nearly or entirely glabrous; lateral leaflets often narrower than the middle leaflet; fruiting pedicels not more than 7 mm long; capsules not glandular **Fagonia laevis**
 - 2. Herbage obviously glandular pubescent; lateral leaflets about the same width as middle leaflet; fruiting pedicels 8–20 mm long; capsules glandular..... **Fagonia longipes**

Fagonia laevis Standley

[*F. californica* subsp. *laevis* (Standley) Wiggins]

Smooth-stem fagonia. Figure 36.

Plants often reaching 30–50 cm across, much-branched with very slender stems. Plant mostly glabrous or glabrate, except the stems scabrous. Leaflets 1–2.5 mm wide, the middle one usually larger and wider than the lateral leaflets; leaflets spinose-tipped. Stipules mostly 1.5–6 mm long and mostly moderately curved. Flowers about 1 cm wide; petals pink to purple; pedicels up to 7 mm long. Capsules often minutely hairy but not glandular; fruiting pedicels less than 7 mm long. Seeds (2.7) 2.9–3.2 × 1.9–2.3 mm, broadly ovate, pale tan to dark brown with age.

Widespread in the western and drier part of the flora area (Shreve’s [1951] Lower Colorado Valley vegetation region of the Sonoran Desert): Cabeza Prieta except the eastern margin and the Tinajas Altas Region. Rocky, arid slopes, canyons, and washes near hills and mountains; not on open desert flats.

Southwestern Arizona, southeastern California, both Baja California states, and western Sonora south to the Sierra Seri.



Figure 36. *Fagonia laevis*. (A) Tinaja de los Papagos, Pinacate Biosphere Reserve, Sonora, 24 Feb 2013, photo by Sue Carnahan. (B) Sierra el Águila near Mex Hwy 2 at km 93 west of Sonoyta, Sonora, 17 Mar 2014.

Fagonia laevis and *F. longipes* appear to be closely related, and sometimes have been treated as subspecies of *F. californica*, an apparently related taxon occurring farther south in the Sonoran Desert in Mexico. We follow Porter (1963, 2016) and list *F. laevis* and *F. longipes* as separate species. They do not occur together (sometimes have close but different geographic ranges). In

addition to the key differences, the herbage of *F. laevis* tends to be dark green and that of *F. longipes* grayish green.

CP: Tule Tank, 21 Mar 1933, *Shreve 6229*. Tule Well, 6 March 1940, *Goodding A-9953* (ASU). S end of Cabeza Prieta Mts, 8 mi from Tule Wells, Camino del Diablo, 22 Mar 1979, *Yatskievych 79-253*. Cabeza Prieta Tank, canyon, 6 Apr 1979, *Lehto 23512* (ASU). W side of Surprise Canyon, 1/4 mi E of Cabeza Prieta Pass, Cabeza Prieta Mts, 10 Mar 1984, *Hodgson 2737* (DES). N side of Tule Mts, 2 Feb 1992, *Felger 92-53*. Salazaria Wash, 12 Apr 1992, *Harlan 208*.

TA: Tinajas Altas Mts, 5 Dec 1935, *Goodding 1741* (ARIZ 103622 & 103624). Borrego Canyon, 27 Feb 1993, *Felger 93-195*. Surveyors Canyon, 29 Mar 2010, *Felger 10-202*. Canyon below Raven Butte Tank, 29 Mar 2010, *Felger 10-230* (ARIZ, DES).

***Fagonia longipes* Standley**

[*F. californica* subsp. *longipes* (Standley) Felger & C.H. Lowe]

Thin-stem fagonia. Figure 37.

Plants generally resembling *F. laevis*, differing in part as follows: Herbage, especially the stems, and capsules obviously glandular pubescent with minute stalked glands, but sometimes becoming glabrate with age. Plants light green to grayish green. Middle and lateral leaflets about the same width. Pedicels variable in length, but mostly 8 or more mm long (drought stressed plants may have some shorter pedicels) and elongating in fruit.

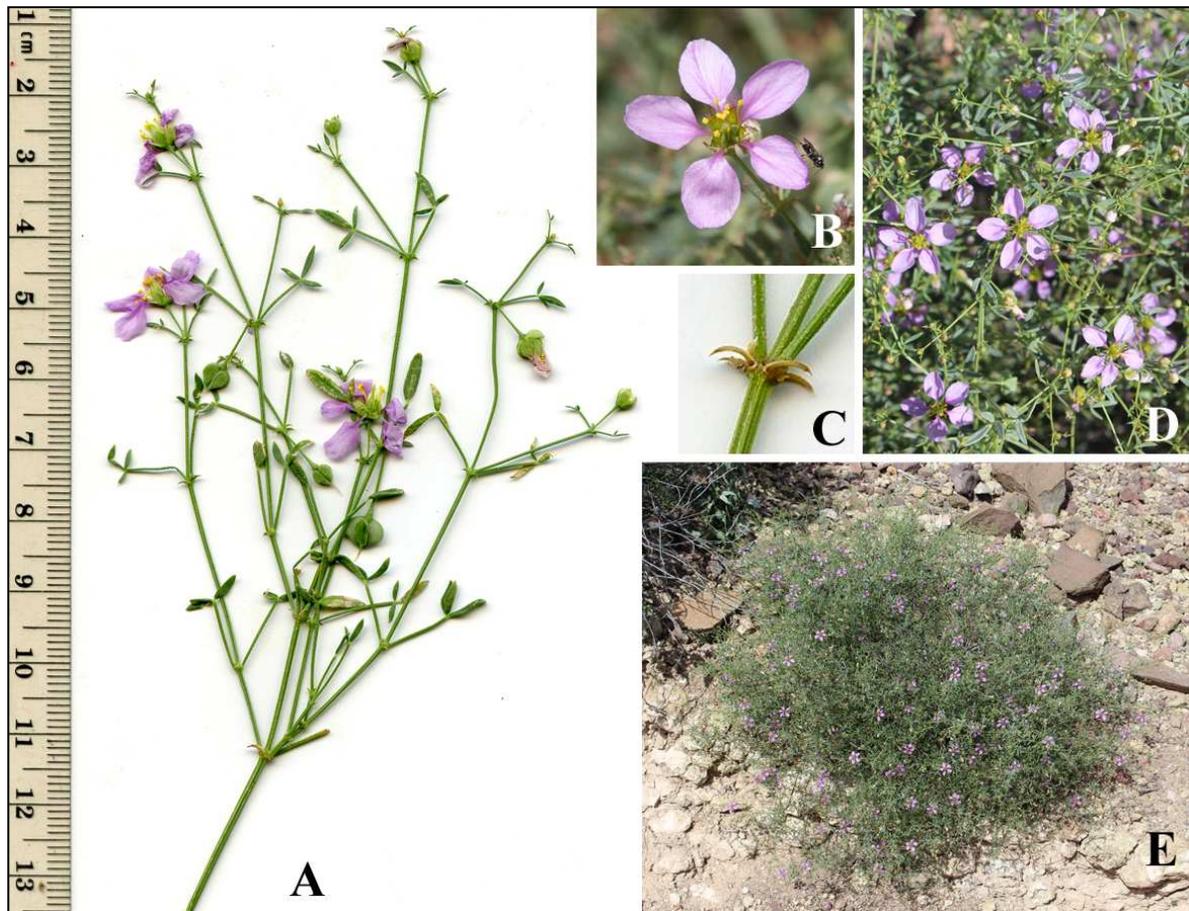


Figure 37. *Fagonia longipes*. (A & C) Ajo Scenic Loop, 31 Jul 2014. (B) Organ Pipe headquarters, 7 May 2006. (D) Acuña Valley, 12 Mar 2015. (E) Western Puerto Blanco Mts, near Puerto Blanco Drive, 15 Mar 2015.

Fagonia longipes replaces *F. laevis* in the eastern margin of Cabeza Prieta and in Organ Pipe—at the western margin of the Arizona Upland vegetation region of Shreve (1951).

Mojave and Sonoran deserts in western Arizona, northwestern Sonora, southeastern California, southern Nevada, and southwestern Utah.

OP: Senita Pass, 8 Apr 1941, *McDougall 51*. 3 mi W of Dripping Springs, *Steenbergh 3 Mar 1962* (ORPI). Quitobaquito, 29 Mar 1988, *Felger 88-131* (ARIZ, DES, UCR). E end of Quitobaquito Hills, 24 Oct 1990, *Felger 90-485*. Red Tanks Wash, Puerto Blanco Mts, 21 Sep 2013, *Rutman 20130921-3*.

CP: Agua Dulce Pass, 13 Jun 1992, *Felger 92-572*. “B” Canyon, 32.06938°N, 113.2026°W, 1 Nov 1992, *Harlan 354*. Charlie Bell Road 1.9 km NE of Little Tule Well, 5 Mar 1994, *Felger 94-30*.

***Fagonia pachyacantha* Rydberg**

[*F. californica* var. *glutinosa* Pringle ex Vail]

Thick-leaf fagonia. Figure 38.



Figure 38. *Fagonia pachyacantha*. Sierra el Águila, near Mex Hwy 2 at km 93, Sonora, 7 Mar 2015.

Low, spreading perennials, often forming semi-prostrate mats to 1–1.5+ m across during favorable times. New growth with golden-yellow glands (rarely glabrous or glabrate during times of

high rainfall); leaves bright yellowish-green, often glabrate with age. Leaflets lanceolate, ovate, obovate, or elliptic, often becoming semi-succulent during favorable seasons, the middle leaflet 1.5–2.5 × 0.5–1.2 cm, the lateral leaflets usually smaller; leaflet tips obtuse to acute, and not spinose. Stipular spines straight, at least some on each plant 5–12+ mm long, often stout, and with age bending downward toward the stem but not curved. Flowers often 1.5 cm wide. Pedicels 1.5–5+ mm long. Capsules glandular. Seeds dark brown, 2.6–2.7 × 1.9–2 mm.

Arid, rocky slopes of canyons, hills, and mountains, bajadas, and occasionally on sand flats; western half of Cabeza Prieta and the Tinajas Altas Region.

Southwestern Arizona, southeastern California, Baja California, Baja California Sur, and northwestern Sonora. Plants of *F. pachyacantha* are generally larger and more robust than those of *F. laevis* and *F. longipes*.

CP: Davidson Canyon, Agua Dulce Mts, 8 Apr 1979, *Lehto 23598* (ARIZ, ASU). Near Pinta Sands, 17 Mar 1992, *Yeatts 3253* (CAB). Senita Tank, 27 Feb 1993, *Felger 93-169*. Cabeza Prieta Peak, 2550 ft, S facing side of summit, 24 Mar 1995, *Yeatts 3662*.

TA: Tinajas Altas Mts, 1200 ft, *Lindquist 25 Mar 1983*.

Kallstroemia – Summer poppy

Summer ephemerals with pinnate leaves, the plants highly variable in size. Leaves opposite or occasionally alternate at the first several nodes of seedlings; leaves pinnate with 2–10 leaflet pairs, those of each pair often of different sizes or sometimes one aborts, those of the lowermost pair often markedly different. Stipules slender and green. Flowers opening shortly after sunrise and withering later in the day (except in cool weather). Nectaries present in the center of the flower at the stamen bases. Petals yellow or orange. Pollen and stigmas maturing simultaneously and capable of self-pollination. Fruits with 5 carpels, each divided by a septum to form half-carpel segments (mericarps); fruits breaking into ten mericarps, these 1-seeded, knobby (tuberculate) but not spiny, and falling away from the persistent axis and beak; the beak formed from the persistent style.

New World, dry tropical to arid regions; 17 species, 3 in the Sonoran Desert. This is the largest genus of Zygophyllaceae in the New World. *Kallstroemia* has been present in the flora region for more than 29,000 years.

1. Petals yellow to yellow-orange, of a single color, 4–6 mm long; sepals usually deciduous; beak of fruit less than 5 mm long; fruiting pedicels 1–2.3 cm long..... **Kallstroemia californica**

1. Petals bright orange with a darker base, (15) 20–35 mm long; sepals persistent; beak of fruit (5) 8–12 mm long; fruiting pedicels (2) 3–7 cm long..... **Kallstroemia grandiflora**

Kallstroemia californica (S. Watson) Vail

Baiburín, mal de ojo. Figure 39.

Stems generally trailing, often 20–50 cm long, sometimes to 1 m. Plants pubescent (strigose) or glabrate or glabrous especially with age. Leaves 2–4.5 (6) cm long, with 3–6 (7) pairs of leaflets. Petals 4–6 mm long, yellow to yellow-orange and of a single color. Fruiting pedicels often 1–2.3 cm long. Body of fruit ovoid, 4–5 mm long, the beak usually shorter than to about as long as the body.

Widespread across the desert lowlands, especially washes, sand flats, and dunes.

Southeastern California and southern and western Arizona to western Texas, southern Nevada and southern Utah, and northern Mexico including both states of Baja California Sur and southward to Nayarit and Zacatecas.

OP: Growler Valley, 2 Nov 1951, *Supernaugh 452*. Armenta Well Ranch, 13 Sep 1978, *Bowers 1529*. Aguajita Wash, 14 Sep 1988, *Felger 88-411*.

CP: Daniels Arroyo at Charlie Bell Rd, 18 Aug 1992, *Felger 92-674* (ARIZ, ASU). N of Jose Juan Tank, 15 Sep 1992, *Felger 92-738*. East Pinta Sands, 15 Sep 1992, *Felger 92-762*. Small wash near hills N of Agua Dulce Mts, along the Camino del Diablo, 6.6 mi W of Organ Pipe/Cabeza Prieta boundary, 26 Sep 2013, *Rutman 20130926-18*.

TA: Coyote Water, 25 Oct 2004, *Felger 04-47*

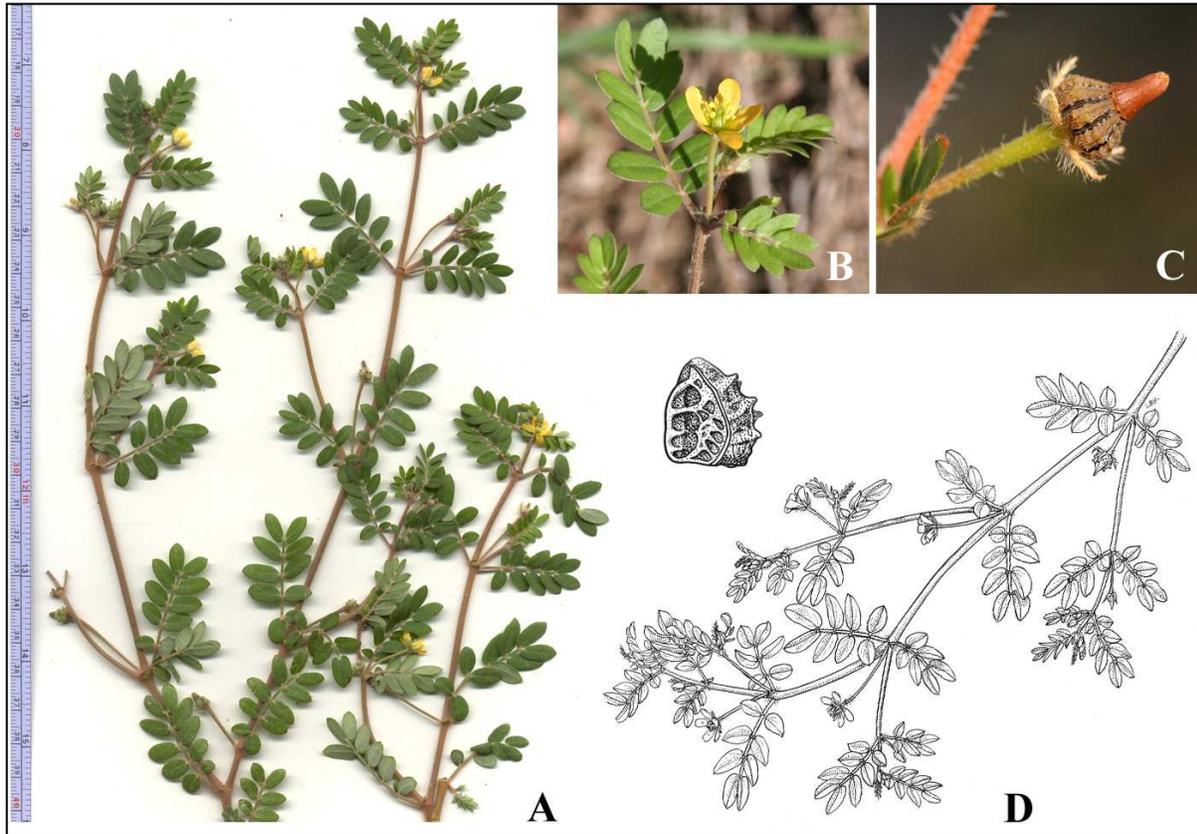


Figure 39. *Kallstroemia californica*. (A) Sandy soil near N boundary of Organ Pipe, 17 Sep 2013. (B) La Abra Plain, 12 Sep 2006. (C) S of Punta Bufeo, Baja California, 18 Oct 2006, photo by Patrick Alexander (SEINet). (D) By Lucretia Breazeale Hamilton.

Kallstroemia grandiflora Torrey ex A. Gray
Summer poppy; *baiburín*, *mal de ojo*. Figure 40.

Stems variously ascending, spreading or ultimately trailing with upturned tips, 15–100 (150) cm long; with soft to bristly hairs. Leaves 4.5–12 cm long, with 5–9 pairs of leaflets. Sepals green in bud, becoming pale orange after the flowers open. Flowers showy, opening about an hour after dawn and fading by mid-afternoon (or remaining open all day on cloudy days). Nectaries greenish; ants and a variety of flying insects eagerly feed at the nectaries. Corollas (3) 5–7 cm wide, orange with high color saturation; fading to pale yellow-orange or sometimes whitish usually by mid-afternoon. Corolla center and filaments dark orange-red (darker than the rest of the corolla); individual petals often (15) 20–35 mm long and 2–3.6 cm wide. Anthers yellow, often open by 8 a.m. Ovary and style green. Fruiting pedicels (2) 3–7 cm long. Body of fruits 4–5+ mm long and knobby; fruiting beak (5) 8–12 mm long (or as short as 5 mm when drought stressed).

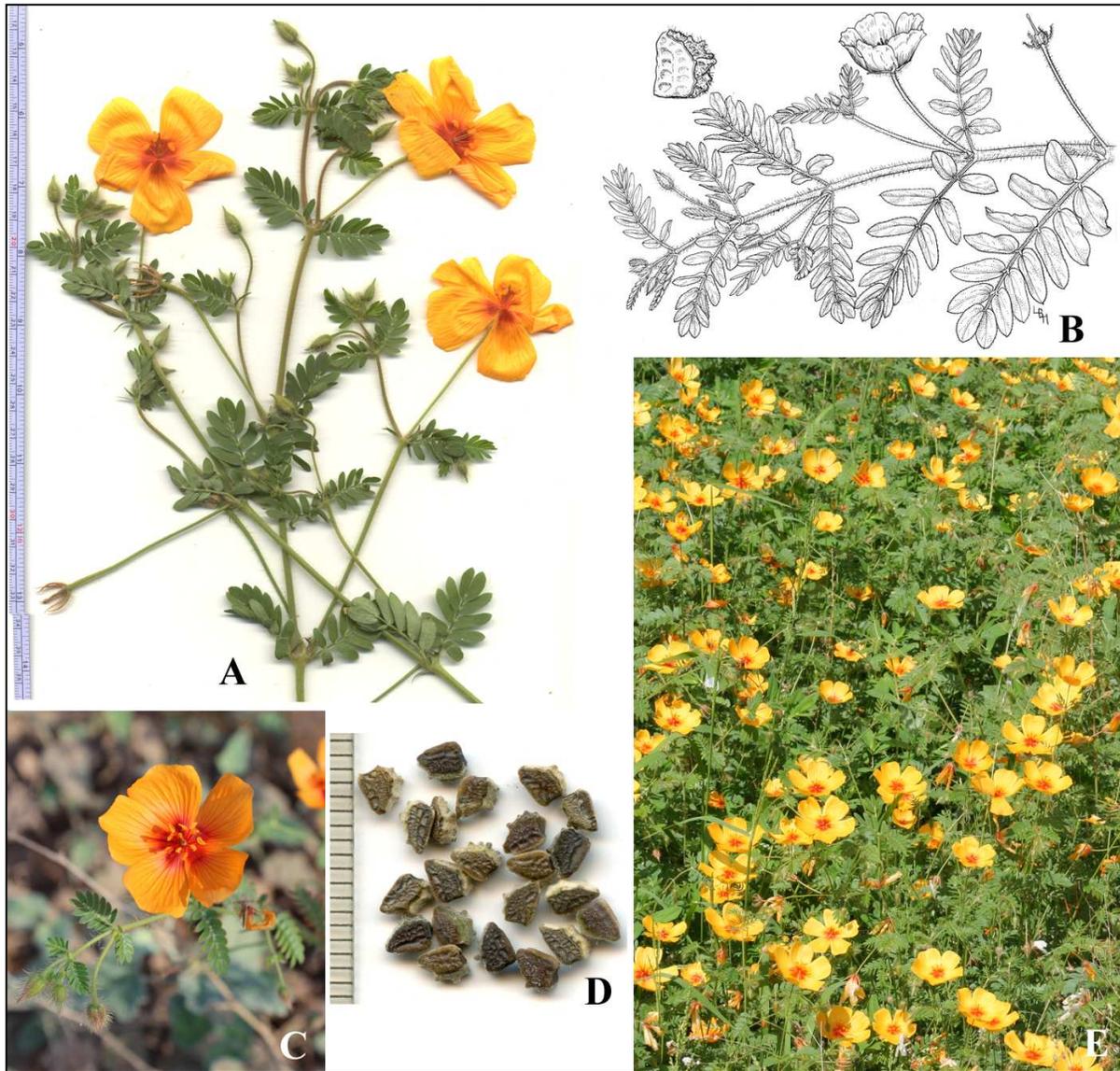


Figure 40. *Kallstroemia grandiflora*. (A) N boundary of Organ Pipe, 17 Sep 2013. (B) By Lucretia Breazeale Hamilton. (C) Hwy 85 at mile 20, 6 Sep 2013. (D) Why, 23 Aug 2014. (E) Hwy 86, mile marker 62, E of Why, 20 Aug 2006.

One of the most common and attractive summer wildflowers across the desert lowlands in Organ Pipe and Cabeza Prieta, especially larger washes, arroyo bottoms, playas, roadsides, alluvial flats, sand flats, and also on slopes; sometimes carpeting the desert with orange. Plants on dunes and sand soils can become exceptionally large in seasons with generous rains.

Southeastern California and southern Arizona to western Texas and Mexico southward Oaxaca; not known from the Baja California Peninsula. The name “summer poppy” often applied to this summer wildflower is unfortunate because it is not a poppy (Papaveraceae).

OP: Armenta Well, 13 Sep 1978, *Bowers 1528*. Ambrosia flats, T18S, R5W, sec 14, 18 Aug 1988, *Baker 7618* (ORPI). Growler Wash, *Wirt 2 Aug 1990* (ORPI). Cuerda de Leña near N boundary, *Rutman 20 Aug 2001* (ORPI).

CP: San Cristobal Wash, 14 Sep 1992, *Felger 92-686*. Sand over lava, E side Pinacate flow, 28 Nov 2001, *Felger*, observation.

†**Kallstroemia** sp./spp.

One or more species have been in the area for more than 29,000 years.

OP: †Alamo Canyon, seeds, 1150 to 29,110 ybp (5 samples). Montezuma's Head, seeds, 13,500 & 20,490 ybp. Puerto Blanco Mts, fruit fragments, 1910 & 3400 ybp.

Larrea

Shrubs. Leaves with 2–17 leaflets. Five species, 4 in South America and 1 in North America. *Larrea* is South American in origin and the single most widespread woody genus across the major warm deserts of the New World in Argentina, Chile, Bolivia, Peru, Mexico, and southwestern United States (e.g., Laport et al. 2012; Lia et al. 2001; Mabry et al. 1977; Porter 2016).

Larrea tridentata (Sessé & Moçino ex de Candolle) Coville var. **tridentata**

[*L. divaricata* Cavanilles subsp. *tridentata* (Sessé & Moçino ex de Candolle) Felger & C.H. Lowe] Creosotebush; *hediondilla*, *gobernadora*; segai, segoi. Figures 41 & 42.

Highly aromatic and long-lived multiple-stemmed, trunkless shrubs often 0.8–2+ m tall with very hard, brittle wood. Stems slender, the nodes swollen with dark rings or bands formed of resin secreted by the inner surfaces of the stipules. Young stems and leaves with white hairs, the hairs soon submerged in gummy, varnish-like glandular exudate, the exudate especially thick and viscid during dry seasons. (Also see *Ambrosia deltoidea* and *Baccharis sarothroides*, Asteraceae, which show a somewhat similar pattern of hairs holding or “trapping” gummy exudate and “drowning” in the exudate.)

Leaves opposite, 5–12 mm long, subsessile or with short petioles, and 2 sessile leaflets, each more or less lanceolate to broadly ovate, moderately curved (falcate), and united at their broad bases (appearing as one simple leaf). Stipules 1.2–2.2 mm long, persistent after the leaves fall; broadly triangular-lanceolate to ovate-triangular or sometimes orbicular, with an acute to narrowly obtuse, short-acuminate tip; cordate at the base and often overlapping and tightly appressed to the stem (appearing stuck to the stem by the sticky glandular exudate) to somewhat spreading. Glands on the inner (adaxial) surface of the stipules secrete resin, making the plants highly glutinous. Youngest stipules at the growing stem tips are green, clasping, leafy-glandular organs protecting the enclosed apical meristem and are more viscid than the emerging leaf pair. These young green stipules soon become yellow and then red-brown, gland-like, and covered with resin.

Fresh flowers 2.5–3 cm wide. Sepals 5. Petals 5, separate, narrowed below to a claw, the claw often twisted and the petal blades held perpendicular to the flower axis like propeller blades. Petals, stamens, and filament scales bright yellow; sepals and style green. Stamens 10, at first often spreading or hanging down between the petals, soon standing up with the anthers close together; filaments each with a prominent yellow scale or appendage, these serving to contain nectar produced at the base of the style. Style at first equaling the stamens, with age projecting beyond them. Ovary and fruits covered with silky white hairs; capsules obovoid, appearing as small fuzzy white balls with 5 mericarps tardily separating or remaining together; mericarps (5) 6–8 (10) mm long, 1-seeded, densely hairy, often becoming reddish brown with age (Figure 41 & 42). Seeds 3.6–5 mm long, dark brown to blackish, and sometimes green, and not producing mucilage (Figure 41).

To germinate the seeds for growing purposes, Sue Rutman and associates at Organ Pipe soaked the seeds within the mericarps in water for 24–48 hours, changing the water several times. The water turned rusty brown. Radicals began to emerge at about 24–36 hours. After the seedlings

were about 10 days old, there would be some die-off, and other growers have reported similar die-off. Soil fungi are important to *Larrea*, and Sue suspects the seedlings did not make a mycorrhizal association and could not survive without it. For this reason, Sue grew the plants with native, not sterilized, soil. *Larrea* are sensitive to root disturbance. When taking them out of nursery pots to plant in the field, it was important to make sure the root ball did not fall apart. If the root ball collapsed, the plant would surely die. Also see Barbour (1968) and Cagiwa et al. (2005).



Figure 41. *Larrea tridentata*. Mericarps (A) and seeds (B), Boulder Canyon, 30 Sep 2014.

Along with the common species of *Ambrosia*, *Larrea* is one of the most abundant and widespread shrubs in the flora area. It extends across the desert floor and hills and rocky slopes to summit elevations of all but the highest peaks such as in the Ajo Mountains.

Larrea tridentata is the most widespread shrub in the three major warm deserts of North America and one of the primary elements in mapping or defining these deserts. The similar-appearing *L. divaricata* occupies deserts in South America. The dune creosotebush, *Larrea tridentata* var. *arenaria* L.D. Benson [*L. divaricata* subsp. *tridentata* var. *arenaria* (L.D. Benson) Felger] occurs on wind blown sands and dunes in the Gran Desierto nearly adjacent to the present flora area and also in southeastern California and northwestern Baja California (e.g., Felger 2000; Laport et al. 2012).

Creosotebush is the most important and universal medicinal plant in the flora area and nearby regions and its highly aromatic herbage continues to be extensively employed: “The Desert Smells Like Rain” (Nabhan 1982). It is likewise an important medicinal plant in other regions. The herbage has been used in childbirth and to treat many conditions, including congestion, sore eyes, snake and spider bites, and scorpion stings (Bean & Saubel 1972; Betty Melvin in Bell et al. 1980; Castetter & Underhill 1935; Felger & Moser 1985; Kearney & Peebles 1960; Moerman 1998, 2003; Nabhan 1982; Rea 1997 Betty Melvin in Zepeda 1985).

“If you have a sore, you boil it and wash with it . . . the leaves, all that is green, and then you put it on (like a plaster). That is the way my grandmother used to do it . . . the leaves, the brand new ones, and they would put it on a sore. I’ve seen it when they boil it. My cousin . . . one time he started bleeding from the nose. . . he almost died from it . . . after he left the doctor he started bleeding again and so he went home to Phoenix and got some of that creosote and he drank it and washed and washed with it and after awhile he forgot about it and it was all well . . . and then . . . he had a pain in his stomach. Some kind of infection the doctor said and again he drank the creosote and he got all

better. . . . But now the White People have gotten it now, that creosote, because it is good for many things” (Betty Melvin in Zepeda 1985: 81; also in Felger 2007).

The wood is very hard, and its uses include arrow foreshafts and arrows for small game hunting (both with a fire-hardened tip), basketry awls, crosspieces of saguaro fruit-gathering poles, drills for the fire-drill, rope twisters (for horsehair and/or mesquite-root twine), and tool handles. The leafy branches were used for roofing and to cover the sides of the traditional O’odham “grass houses” (Miguel Velasco in Zepeda 1985: 23). A dark reddish lac, from the scale insect *Tachardiella larreae*, is sometimes found on the stems. This lac is plastic when heated and served as an important all-purpose sealant for sealing pottery vessels for food storage and hafting arrows; it was also used for medicinal purposes (e.g., Felger 2007; Felger & Moser 1985; Kondo & Gullan 2011).

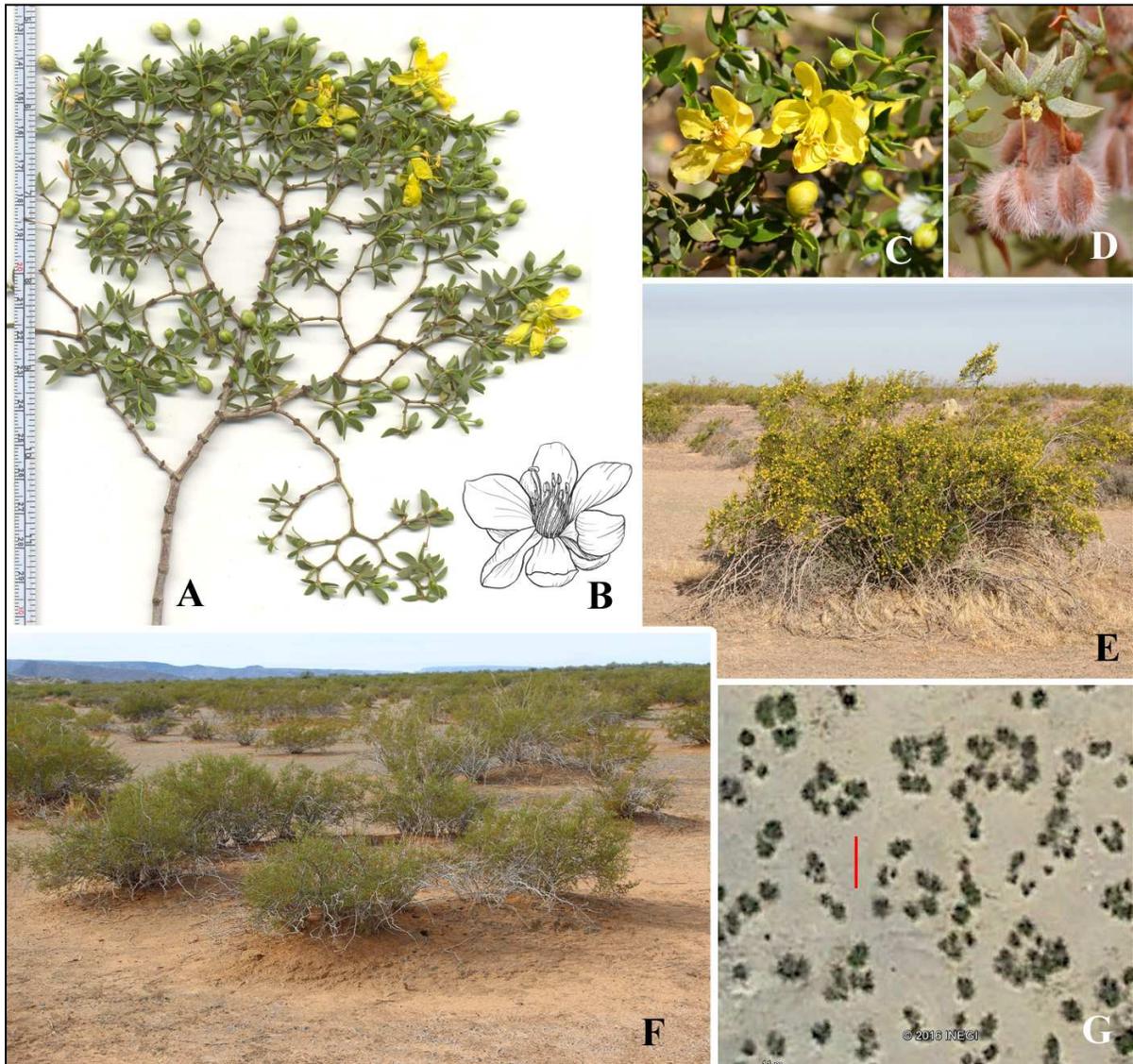


Figure 41. *Larrea tridentata*. (A) N boundary of Organ Pipe, E of Hwy 85, 7 Mar 2008. (B) By Lucretia Breazeale Hamilton. (C) Little Ajo Mts, 27 Mar 2005. (D) Ajo, 7 Jul 2006. (E) Growler Valley, 25 Apr 2006. (F) Daniels Valley, 5 Dec 2014. (G) Valley of the Ajo, E of Bates Mts, Google Earth imagery by Digital Globe, scale 1:527m, Oct 2013; red bar = 5 m, note the clonal “fairy ring” pattern of several of the plant clusters.

There has been controversy over the taxonomic rank of the North American *Larrea*. Most botanists confine *L. divaricata* to South America and call the North American plants *L. tridentata*. Morphologic (Porter 1963) and molecular (Lia et al. 2001) data confirm that they are closely related. Because of their similarities, Felger treated the North American population as *L. divaricata* subsp. *tridentata* (Felger 2000; Felger & Lowe 1976; see discussion below). Although a case could be made for recognizing the *tridentata* taxon either as a subspecies or distinct species (e.g., Laport et al. 2012), current consensus leans towards recognizing the two taxa as separate species (e.g., Porter 2016).

Most *Larrea divaricata* from South America have obtuse to somewhat orbicular stipules whereas the North American populations tend to have acuminate stipules. Hybrids between them have stipules of intermediate morphology, as does *L. divaricata* from Peru. South American creosotebushes are diploid ($2n = 26$) and North American creosotebushes include three chromosome races: diploid, $2n = 26$ in the Chihuahuan Desert; tetraploid, $2n = 52$ in the Sonoran Desert; and hexaploid, $2n = 78$ in the Mojave Desert. Among the North American chromosome races there is some overlap and no discernable morphological differences apart from stomatal size correlated with ploidy (Hunter et al. 2001).

Differences in leaflet shape and pubescence for North and South American populations have been reported, but the full span of this variation occurs in the current flora area and seems to be influenced at least in part by environmental conditions. The variation in stipule shape seems to be the “best” morphological feature by which the North and South American populations can realistically be distinguished. These resin-producing organs undoubtedly have played a significant role in the success of *Larrea* in aridlands with intense herbivore pressure. It seems reasonable to attach taxonomic and evolutionary importance to these structures.

Some botanical taxonomic intrigue and history is repeated here. In 1970, Richard and his major professor Charles Lowe changed the taxonomic rank of *Larrea tridentata* to a subspecies of *L. divaricata*, a seemingly logical course of action. Lowe knew that members of the International Biological Program (IBP) were planning to publish a similar taxonomic change, but in Lowe’s opinion, he and Richard had come up with the idea first and he encouraged Richard to rush into print with the nomenclature change. Having done so much work on *Larrea*, the IBP group was obviously annoyed. Several years later, after presenting detailed analyses, various authors of the IBP group (Mabry et al. 1977) concluded that *L. divaricata* and *L. tridentata* are “semispecies” but resisted the subspecific status (also see Felger 2000).

Some people wonder how *Larrea* got from South America to North America, but this one case of intercontinental disjunction is no more amazing than many others (e.g., Bray 1898; Porter 1974; Solbrig 1972). Although many of the North and South American intercontinental disjuncts are small, sticky-seeded herbaceous plants (e.g., *Fagonia* and various Polemoniaceae), others have larger, non-sticky seeds comparable in size to those of *Larrea* (e.g., *Atamisquea emarginata*, Capparaceae).

OP: Alamo Canyon, *Nichol* 26 Mar 1939. Quitobaquito, 14 Sep 1988, *Felger* 88-467. 2 mi NW of Lukeville, 19 Jun 1989, *Felger* 89-226.

CP: Papago Well: 11 Apr 1978, *Lehto* 22496 (ASU); 24 Mar 2010, *Felger* 10-108 (ARIZ, ASU). Cabeza Prieta Peak, 2550 ft, N side of summit, 24 Mar 1995, *Yeatts* 3657. Sierra Pinta, summit, 15 Nov 2003, *James Cain*, photo.

TA: Camino del Diablo, SE of Raven Butte, 25 Oct 2004, *Felger* 04-17. Tinajas Altas, 22 Nov 2008, *Felger* 08-187. †Butler Mts, twigs, leaves, fruits, 740 to 11,250 ybp (7 samples). †Tinajas Altas, twigs, leaves, fruits, 4010 to 18,700 ybp (10 samples).

***Tribulus** – Caltrop

Herbaceous annuals and perennials. Native to the Old World, mostly Africa and southwestern Asia; 25 species.

***Tribulus terrestris** Linnaeus

Puncture vine, goathead, caltrop; *torito*, *toboso*. Figure 43.

Hot-weather ephemerals with sprawling, prostrate stems. Leaves pinnate, 1–4.5 cm long, with 4–7 leaflet pairs, the leaflets of the lower pair unequal in size. Flowers yellow, the petals 5 mm long or less, with 5 glands between the stamens at the base of the ovary. Ovary with 5 carpels. Fruits 15–18 mm wide, horizontally flattened, at maturity breaking into 5 intricately sculptured spiny mericarps (or fewer by abortion), each with (1) 2 larger tack-like spines, which invariably land with the largest spine pointed up.

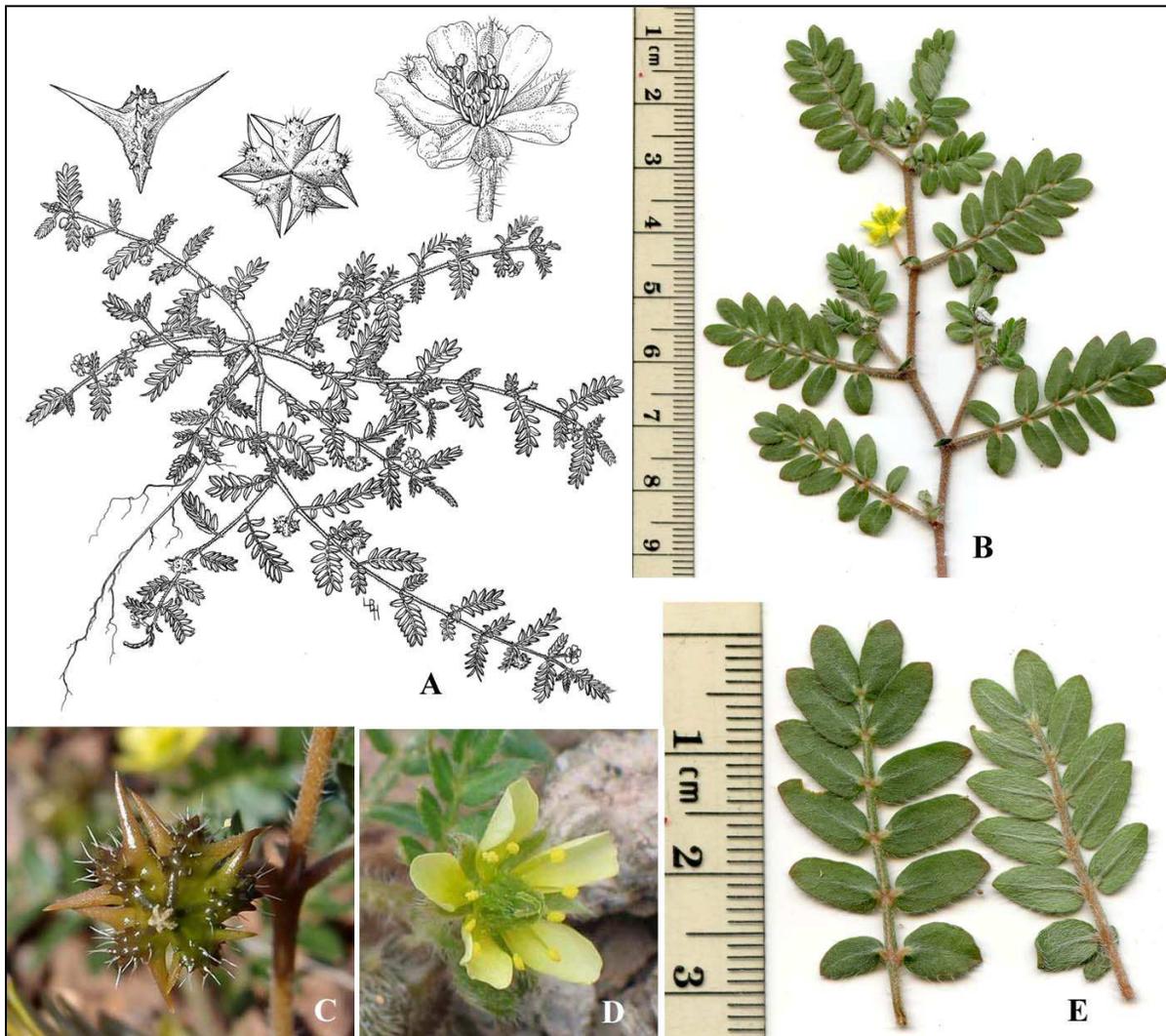


Figure 43. *Tribulus terrestris*. (A) By Lucretia Breazeale Hamilton. (B & E) Why, 31 Jul 2014. (C) San Carlos, Sonora, 10 Mar 2015, photo by Sue Carnahan. (D) San Pedro Riparian National Conservation Area, 9 Sep 2006, photo by Liz Makings (SEINet).

Occasional in the flora area and apparently not established although it is common in adjacent disturbed areas. We predict that it will become established in the flora area.

Native to the Old World, now naturalized and weedy worldwide.

CP: Tule Desert, Silt Valley, 3 Oct 1963, *Simmons 7*.

ACKNOWLEDGEMENTS

In addition to the gratitudes provided in Part 1 in this flora series, we thank Susan Davis Carnahan (ARIZ) for copyediting expertise, information, and photos. Significant information and reviews were provided by Lynn Bohs (Univ. of Utah), George McNeil Ferguson (ARIZ), Walter Frank Fertig (ASU), Peter Alfred Holm (Organ Pipe Cactus National Monument), Richard (Rick) Alan Johnson (Silver City, New Mexico), Duncan MacNair Porter (Virginia Polytechnic Institute), Andrew M. Salywon (DES), Andrew C. Sanders (UCR), Janet R. Sullivan (Hodgdon Herbarium, Univ. of New Hampshire), Thomas R. Van Devender (ARIZ), James (Jim) Thomas Verrier (ARIZ), and George Yatskievych (TEX). For the use of photographs we thank Patrick Alexander, Bill Brown, Joaquim Aves Gaspar, Peter Holm, Max Licher, Liz Makings, Brent Miller, Keir Morse, David C. Thornburg, Ron Vanderhoff, Jim Verrier, and Frank Vincentz. RSF thanks the Wallace Research Foundation for financial support.

LITERATURE CITED

- Angiosperm Phylogeny Group. 2009. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. *Bot. J. Linn. Soc.* 161: 105–121. doi:10.1111/j.1095-8339.2009.00996.x
- Angiosperm Phylogeny Group. 2016. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. *Bot. J. Linn. Soc.* 181: 1–20. DOI: 10.1111/boj.12385
- Averett, J.E. 1973. Biosystematic study of *Chamaesaracha* (Solanaceae). *Rhodora* 75: 325–565.
- Averett, J.E. 2010. The status of *Chamaesaracha coniodes* and *C. coronopus* (Solanaceae). *Phytoneuron* 2010-57: 1–5.
- Barbour, M.G. 1968. Germination requirements of the desert shrub *Larrea divaricata*. *Ecology* 49: 915–923.
- Bean, L.J. and K.S. Saubel. 1972. *Temalpakh: Cahuilla Indian Knowledge and Usage of Plants*. Malki Museum, Banning, California.
- Beier, B.-A. 2005. A revision of *Fagonia* (Zygophyllaceae). *Syst. Biodivers.* 3: 221–263.
- Beier, B.-A., J.A.A. Nylander, M.W. Chase, and M. Thulin. 2004. Phylogenetic relationships and biogeography of the desert plant genus *Fagonia* (Zygophyllaceae), inferred by parsimony and Bayesian model averaging. *Molec. Phylogen. Evol.* 33: 91–108.
- Bell, F., K.M. Anderson, and Y.G. Stewart. 1980. *The Quitobaquito Cemetery and its history*. Western Archeological Center, National Parks Service, Tucson.
- Bray, W.L. 1898. On the relation of the flora of the Lower Sonoran Zone in North America to the flora of the arid zones of Chile and Argentina. *Bot. Gaz.* 26: 121–147.
- Cagiwa, J., D. Timms, K. Hunter, and R. Hunter. 2005. Improving germination and establishment of *Larrea tridentata* (Zygophyllaceae). *Botany 2005*. <Abstract/2005.botanyconference.org/engine/search/index.php?func=detail>
- Castetter, E.F. and W.H. Bell. 1951. *Yuman Indian Agriculture*. Univ. of New Mexico Press, Albuquerque.
- Castetter, E.F. and R. Underhill. 1935. The Ethnobiology of the Papago Indians. *Univ. of New Mexico Bull.* 275, Biol. Ser. 4(3): 3–84.
- Chiang-Cabrera, F. 1981. A taxonomic study of the North American species of *Lycium* (Solanaceae). Ph.D. diss., Univ. of Texas, Austin.
- Chiang, F. and L.R. Landrum. 2009. Vascular Plants of Arizona: Solanaceae part three, *Lycium*. *Canotia* 5: 17–26.
- Childs, T. 1954. Sketch of the “Sand Indians” (as written to Henry F. Dobyns). *Kiva* 19: 27–39.

- Edmonds, J.M. and J.A. Chweya. 1997. Black nightshades (*Solanum nigrum* L.) and related species. Promoting the conservation and use of underutilized and neglected crops, 15. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome.
- Felger, R.S. 2000. Flora of the Gran Desierto and Río Colorado of northwestern Mexico. Univ. of Arizona Press, Tucson.
- Felger, R.S. 2007. Living resources at the center of the Sonoran Desert: Native American plant and animal utilization. Pp. 147–192, in Felger and B. Broyles (eds.), Dry Borders: Great Natural Reserves of the Sonoran Desert. Univ. of Utah Press, Salt Lake City.
- Felger, R.S. and C.H. Lowe. 1970. New combinations for plant taxa in northwestern Mexico and southwestern United States. J. Arizona Acad. Sci. 6: 82–84 .
- Felger, R.S. and M.B. Moser. 1985. People of the Desert and Sea: Ethnobotany of the Seri Indians. Univ. of Arizona Press, Tucson.
- Felger, R.S. and S. Rutman. 2015a. Ajo Peak to Tinajas Altas: A flora of southwestern Arizona: Part 14. Eudicots: Fabaceae – Legumes. Phytoneuron 2015-58: 1–83.
- Felger, R.S. and S. Rutman. 2015b. Ajo Peak to Tinajas Altas: A flora of southwestern and Arizona: Part 15. Eudicots: Fagaceae to Lythraceae. Phytoneuron 2015-59: 1–54.
- Felger, R.S. and S. Rutman. 2016. Ajo Peak to Tinajas Altas: A flora of southwestern and Arizona: Part 19. Eudicots: Polygalaceae to Simmondsiaceae. Phytoneuron 2016-47: 1–71.
- Felger, R.S., S. Rutman, C.J.S. Davis, and R. Lindley. 2015c. Ajo Peak to Tinajas Altas: A flora of southwestern Arizona: Part 16. Eudicots: Malpighiaceae to Moraceae. Phytoneuron 2015-60: 1–54.
- Felger, R.S., S. Rutman, J. Malusa, and T.R. Van Devender. 2013a. Ajo Peak to Tinajas Altas: Flora of southwestern Arizona: an introduction. Phytoneuron 2013-5: 1–40.
- Felger, R.S., S. Rutman, J. Malusa, and T.R. Van Devender. 2013b. Ajo Peak to Tinajas Altas: A flora of southwestern Arizona: Part 3: ferns, lycopods, and gymnosperms. Phytoneuron 2013-37: 1–46.
- Felger, R.S., S. Rutman, and N.C. Taylor. 2015a. Ajo Peak to Tinajas Altas: A flora of southwestern Arizona: Part 13. Eudicots: Euphorbiaceae – Spurges. Phytoneuron 2015-26: 1–65.
- Felger, R.S., P.L. Warren, S.A. Anderson, and G.P. Nabhan. 1992. Vascular plants of a desert oasis: flora and ethnobotany of Quitobaquito, Organ Pipe Cactus National Monument, Arizona. Proceed. San Diego Soc. Nat. Hist. 8: 1–39.
- Felger, R.S. and B.T. Wilder with H. Romero-Morales. 2012. Plant Life of a Desert Archipelago: Flora of the Sonoran Islands in the Gulf of California. Univ. of Arizona Press, Tucson.
- Flint, R., and S. Flint. 2005. Documents of the Coronado Expedition, 1539–1542: They Were Not Familiar with His Majesty, Nor Did They Wish to Be His Subjects. Southern Methodist Univ. Press, Dallas.
- Gaskin, J.F. 2015. Tamaricaceae Link. Pp. 423–417, in Flora of North America, Vol. 6. Oxford Univ. Press, New York.
- Hardy, R.W.H. 1829. Travels in the interior of Mexico in 1825, 1826, 1827, and 1828. Colburn & Beatley, London. Reprinted 1977, Rio Grande Press, Glorieta, New Mexico.
- Henrickson, J. 2009. New names in *Chamaesaracha* (Solanaceae). Phytologia 91: 186–188.
- Hodgson, W.C. 2001. Food Plants of the Sonoran Desert. Univ. of Arizona Press, Tucson.
- Hunter, K.L., J.L. Betancourt, B.R. Riddle, T.R. Van Devender, K.L. Cole, and W.G. Spaulding. 2001. Ploidy race distributions since the last glacial maximum in the North American desert shrub, *Larrea tridentata*. Global Ecol. Biogeogr. 10: 521–533.
- Kearney, T.H. and R.H. Peebles. 1960. Arizona Flora, 2nd ed., supplement by J.T. Howell and E. McClintock. Univ. of California Press, Berkeley.
- Kingsbury, J.M. 1964. Poisonous Plants of the United States and Canada. Prentice-Hall, Englewood.

- Knapp, S. 2013. A revision of the Dulcamaroid Clade of *Solanum* L. (Solanaceae). *PhytoKeys* 22: 1–432. doi: 10.3897/phytokeys.22.4041
- Kondo, T. and P.J. Gullan. 2011. Taxonomic review of the genus *Tachardiella* Cockerell (Hemiptera: Kerriidae), with a key to species of lac insects recorded from the New World. *Neotrop. Entomol.* 40: 345–367. <<http://dx.doi.org/10.1590/S1519-566X2011000300009>>
- Laport, R.G., R.L. Minckley, and J. Ramsey. 2012. Phylogeny and cytogeography of the North American creosote bush (*Larrea tridentata*, Zygophyllaceae). *Syst. Bot.* 37: 153–164.
- Lia, V.V., V.A. Confalonieri, C.I. Comas, and J.H. Hunziker. 2001. Molecular phylogeny of *Larrea* and its allies (Zygophyllaceae): Reticulate evolution and the probable time of creosote bush arrival to North America. *Molec. Phylog. Evol.* 21: 309–320.
- Mabry, T.J., J.H. Hunziker, and D.R. DiFeo. 1977. *Creosote Bush: Biology and Chemistry of Larrea in New World Deserts*. Dowden, Hutchinson, & Ross, Stroudsburg, Pennsylvania.
- Miller, J.S., A. Kamath, B.C. Husband, and R.A. Levin. 2016. Correlated polymorphism in cytotype and sexual system within a monophyletic species, *Lycium californicum*. *Ann. Bot.* 117: 307–317.
- Miller, J.S. and D.L. Venable. 2002. The transition to gender dimorphism on an evolutionary background of self-incompatibility: An example from *Lycium* (Solanaceae). *Amer. J. Bot.* 89: 1907–1915.
- Moerman, D.E. 1998. *Native American Ethnobotany*. Timber Press, Portland, Oregon.
- Moerman, D.E. 2003. *Native American Ethnobotany Database*. <<http://naeb.brit.org>> (Viewed 15 Jul 2016).
- Nabhan, G.P. 1982. *The Desert Smells Like Rain*. North Point Press, San Francisco.
- Nesom, G.L. 2010a. *Glandularia gooddingii* (Verbenaceae): Notes on distribution and variation. *Phytoneuron* 2010–54: 1–9.
- Nesom, G.L. 2010b. Taxonomy of the *Glandularia bipinnatifida* group (Verbenaceae) in the USA. *Phytoneuron* 2010-46: 1–19.
- Nesom, G.L. 2010c. A new species of *Verbena* (Verbenaceae) from northeastern Mexico and an overview of the *V. officinalis* group. *Phytoneuron* 2010-13: 1–14.
- Nesom, G.L. 2010d. Taxonomic revision of *Verbena* series *Tricesimae* (Verbenaceae). *Phytoneuron* 2010-35: 1–38.
- Porter, D.M. 1963. The taxonomy and distribution of the Zygophyllaceae of Baja California, Mexico. *Contrib. Gray Herb.* 192: 99–135.
- Porter, D.M. 1974. Disjunct distributions in the New World Zygophyllaceae. *Taxon* 23: 339–346.
- Porter, D.M. 2016. Zygophyllaceae. Pp. 28–43, *in* *Flora of North America*, Vol. 12. Oxford Univ. Press, New York.
- Rea, A.M. 1997. *At the Desert's Green Edge: An Ethnobotany of the Gila River Pima*. Univ. of Arizona Press, Tucson.
- Shreve, F. 1951. *Vegetation of the Sonoran Desert*. Carnegie Inst. Washington Publ. 591. Washington, D.C. Reprinted: Pp. 1–186 + 37 plates, *in* F. Shreve and I.L. Wiggins. 1964. *Vegetation and Flora of the Sonoran Desert*, Vol. 1. Stanford Univ. Press, Stanford.
- Simmons, N.M. 1966. Flora of the Cabeza Prieta Game Range. *J. Ariz. Acad. Sci.* 4: 93–104.
- Solbrig, O.T. 1972. The floristic disjunctions between the Monte in Argentina and the Sonoran Desert in Mexico and the United States. *Ann. Missouri Bot. Garden* 59: 605–614.
- Stevens, P.F. 2012 (onwards). *Angiosperm Phylogeny Website*, version 12, July 2012 onward. <<http://www.mobot.org/MOBOT/research/APweb/>>
- Thiers, B. 2016 [continuously updated]. *Index Herbariorum: A global directory of public herbaria and associated staff*. New York Botanical Garden's Virtual Herbarium. <<http://sweetgum.nybg.org/ih/>>
- Turner, B.L. 2015. Taxonomy of *Chamaesaracha* (Solanaceae). *Phytologia* 97: 226–245.
- Yeung, K., J.S. Miller, A.E. Savage, B.C. Husband, B. Iqic, and J.R. Kohn. 2005. Association of ploidy and sexual system in *Lycium californicum* (Solanaceae). *Evolution* 59: 2048–2055.

Zepeda, O. 1985. The Sand Papago Oral History Project. Division of Archeology, Western Archeological and Conservation Center. National Park Service, Tucson.

Previously published parts of the Flora of southwestern Arizona, Ajo Peak to Tinajas Altas:

INTRODUCTION. *Phytoneuron* 2013-5: 1–40.

Part 2. CHECKLIST. *Phytoneuron* 2013-27: 1–30.

Part 3. FERNS, LYCOPODS, & GYMNOSPERMS. *Phytoneuron* 2013-37: 1–46.

Part 4. MAGNOLIIDS. *Phytoneuron* 2013-38: 1–9.

Part 5. MONOCOTS EXCEPT GRASSES. *Phytoneuron* 2013-76: 1–59.

Part 6. POACEAE – GRASS FAMILY. *Phytoneuron* 2014-35: 1–139.

Part 7. CACTACEAE – CACTUS FAMILY. *Phytoneuron* 2014-69: 1–95.

Part 8. ACANTHACEAE – APOCYNACEAE. *Phytoneuron* 2014-85: 1–74.

Part 9. CONVULVULACEAE – MORNING GLORY FAMILY. *Phytoneuron* 2015-2: 1–22.

Part 10. BERBERIDACEAE, BIGNONIACEAE, BORAGINACEAE, & BURSERACEAE.
Phytoneuron 2015-1: 1–60.

Part 11. BRASSICACEAE – MUSTARD FAMILY. *Phytoneuron* 2015-6: 1–48.

Part 12. CAMPANULACEAE to CUCURBITACEAE. *Phytoneuron* 2015-21: 1–39.

Part 13. EUPHORBIACEAE – SPURGES. *Phytoneuron* 2015-26: 1–65.

Part 14. FABACEAE – LEGUMES. *Phytoneuron* 2015-58: 1–83.

Part 15. FAGACEAE to LYTHRACEAE. *Phytoneuron* 2015-59: 1–53.

Part 16. MALPIGHIACEAE to MORACEAE. *Phytoneuron* 2015-60: 1–54.

Part 17. EUDICOTS: NYCTAGINACEAE TO PLUMBAGINACEAE. *Phytoneuron* 2016-34: 1–77.

Part 18. EUDICOTS: POLEMONIACEAE – PHLOX FAMILY. *Phytoneuron* 2016-35: 1–24.

Part 19. EUDICOTS: POLYGALACEAE – SIMMONDSIACEAE. *Phytoneuron* 2016-47: 1–71.