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AJO PEAK TO TINAJAS ALTAS: A FLORA OF SOUTHWESTERN ARIZONA PART 17. EUDICOTS: NYCTAGINACEAE TO PLUMBAGINACEAE

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ABSTRACT

A floristic and natural history account is provided for nine eudicot families as part of the vascular 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: Nyctaginaceae, Oleaceae, Onagraceae, Orobanchaceae, Oxalidaceae, Papaveraceae, Phrymaceae, Plantaginaceae, and Plumbaginaceae. We report *Menodora scabra* seeds having mucilaginous myxotesta, which is a potential means of seed dispersal that may be related to the unusual distribution of the genus on three continents.

This is the seventeenth contribution of our flora in southwestern Arizona and includes 9 eudicot families: Nyctaginaceae (17 species, 6 genera), Oleaceae (4 species, 3 genera), Onagraceae (11 taxa, 5 genera), Orobanchaceae (4 species, 2 genera), Oxalidaceae (1 species), Papaveraceae (4 species, 2 genera), Phrymaceae (2 species, 1 genus), Plantaginaceae (13 species, 10 genera), and Plumbaginaceae (1 species, 1 genus). (*Rivina* is moved from Phytolaccaceae to Rivinaceae in a forthcoming part of this flora series.) The flora area covers 5141 km^2 (1985 mi^2) of contiguous protected areas in the heart of the Sonoran Desert (Figure 1). This publication is also available open-access on the website of the University of Arizona Herbarium (ARIZ 2016).

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 plants as well as fossils from packrat middens. Explanation of the format for the flora series is provided in part 3 (Felger et al. 2013b). Family designations follow APG III (Angiosperm Phylogeny Group 2009) and the Angiosperm Phylogeny Website (Stevens 2012). The two non-natives in the flora area are not established as reproducing populations and are marked with double asterisks (**). Fossil specimens are indicated with a dagger symbol (†) and ones no longer present in the flora area are 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) and one by Bobbi Angell. Descriptions and keys pertain to taxa and populations as they occur in the flora area.

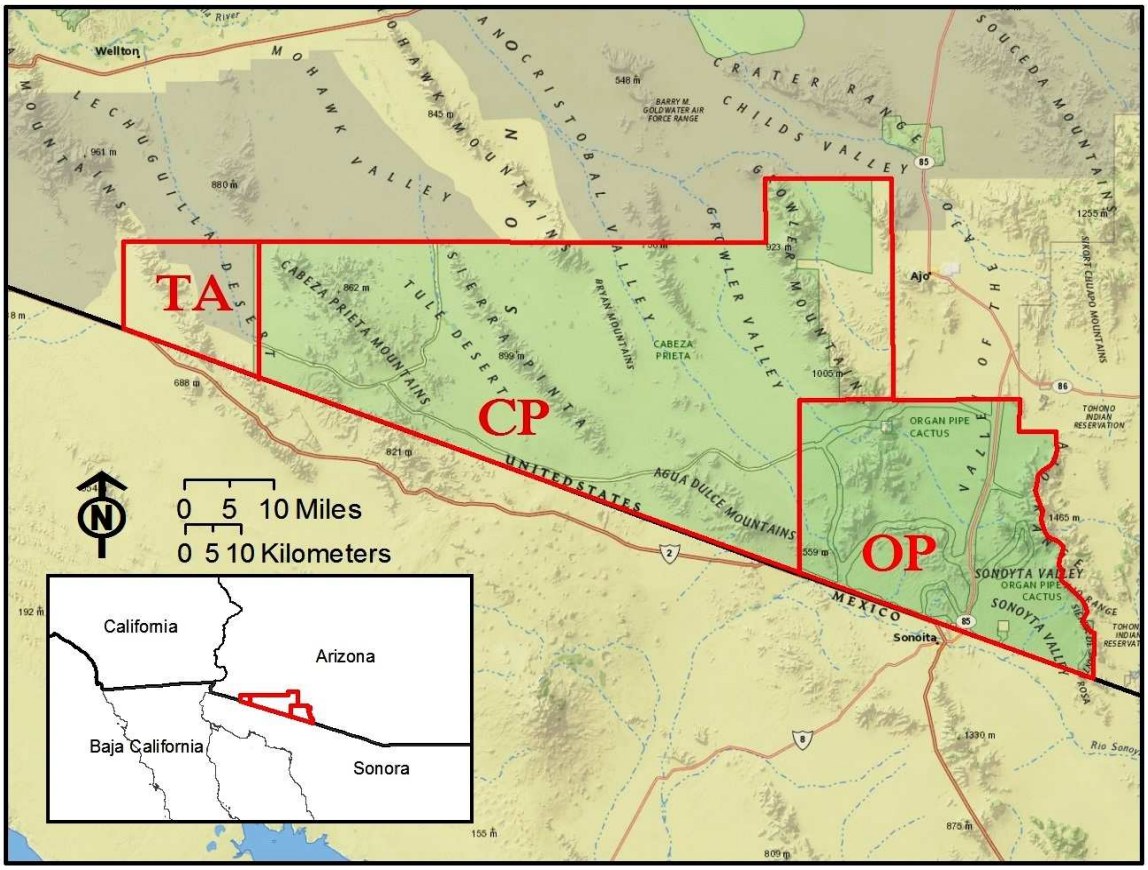

Figure 1. Flora area in southwestern Arizona. OP = Organ Pipe Cactus National Monument; CP = Cabeza Prieta National Wildlife Refuge; TA = Tinajas Altas Region. Green shading indicates approximate boundaries of federally designated wilderness.

Table 1. Local distributions and growth forms of Nyctaginaceae, Oleaceae, Onagraceae, Orobanchaceae, Oxalidaceae, Papaveraceae, Phrymaceae, Plantaginaceae, and Plumbaginaceae. † = Modern taxa also represented by a fossil specimen(s); †† = taxa represented by fossil(s) no longer present in the flora area; ** = non-native taxa not established in the flora area. OP = Organ Pipe Cactus National Monument; CP = Cabeza Prieta National Wildlife Refuge; TA = Tinajas Altas. SU = summer/warm-season ephemerals; WI = cool-season/winter-spring ephemerals; NS = non-seasonal ephemerals; AP = facultative annuals or perennials; PR = perennials. Localities and growth forms in parenthesis are taxa not locally established (not reproducing) or fossils no longer present.

Taxon	Region			Growth Form				
				Ephemerals			Facultative Annuals or Perennials	Perennials
	Organ Pipe	Cabeza Prieta	Tinajas Altas	Summer	Winter	Non-Seasonal		
NYCTAGINACEAE								
Abronia villosa		CP	TA		WI			
Acleisanthes longiflora		CP						PR
†*Allionia incarnata*	OP	CP	TA				AP	
Boerhavia coccinea	OP	CP	TA				AP	
Boerhavia erecta	OP	CP	TA	SU				
Boerhavia megaptera	OP			SU				
†*Boerhavia* cf. *megaptera*	(OP)			(SU)				

Boerhavia pterocarpa	OP			SU				
Boerhavia spicata	OP	CP	TA	SU				
Boerhavia triquetra	OP	CP		SU				
†*Boerhavia wrightii*	OP	CP	TA	SU				
†*Boerhavia* sp.	(OP)							
Commicarpus scandens	OP	CP						PR
Mirabilis coccinea	OP							PR
††*Mirabilis coccinea/ M. linearis*	(OP)							(PR)
†*Mirabilis laevis*	OP	CP	TA					PR
Mirabilis multiflora	OP							PR
Mirabilis tenuiloba			TA					PR
OLEACEAE								
†*Forestiera phillyreoides*	OP							PR
††*Forestiera* cf. *pubescens*	(OP)							(PR)
***Fraxinus velutina*	(OP)							(PR)
Menodora scabra	OP	CP						PR
†*Menodora* sp.	(OP)							(PR)
ONAGRACEAE								
Chylismia arenaria		CP	TA		WI			
Chylismia claviformis ssp. *peeblesii*	OP	CP	TA		WI			
Chylismia claviformis ssp. *rubescens*	OP	CP			WI			
Epilobium canum	OP							PR
Eremothera boothii	OP	CP			WI			
Eremothera chamaenerioides	OP	CP	TA		WI			
Eulobus californicus	OP	CP	TA		WI			
Oenothera arizonica	OP	CP			WI			
Oenothera curtiflora	OP	CP		SU		NS		
Oenothera deltoides		CP			WI			
Oenothera primiveris	OP	CP	TA		WI			
OROBANCHACEAE								
Castilleja exserta	OP	CP			WI			
Castilleja lanata	OP	CP						PR
†*Castilleja* sp./spp.	(OP)		(TA)					
†*Orobanche cooperi*	OP	CP	TA		WI			
Orobanche fasciculata	OP				WI			
OXALIDACEAE								
Oxalis albicans	OP							PR
PAPAVERACEAE								
Argemone gracilenta	OP	PR					AP	
***Argemone ochroleuca*	(OP)						(AP)	
Eschscholzia californica	OP				WI			
Eschscholzia minutiflora	OP	CP	TA		WI			
PHRYMACEAE								
Erythranthe cordata	OP				WI			
Erythranthe rubella	OP				WI			
PLANTAGINACEAE								
Keckiella antirrhinoides	OP	CP						PR
Maurandella antirrhiniflora	OP	CP				NS		
Neogaerrhinum filipes	OP	CP			WI			

Nuttallanthus texanus	OP				WI			
Penstemon parryi	OP	CP	TA				AP	
Penstemon pseudospectabilis	OP	CP	TA					PR
†*Penstemon* sp.			(TA)					
†*Plantago ovata*	OP	CP	TA		WI			
Plantago patagonica	OP				WI			
Pseudorontium cyathiferum	OP	CP	TA			NS		
Sairocarpus nuttallianus	OP				WI			
Sairocarpus watsonii	OP				WI			
Stemodia durantifolia	OP							PR
Veronica peregrina	OP	CP			WI			
PLUMBAGINACEAE								
Plumbago zeylanica	OP							PR

NYCTAGINACEAE – Four-O'clock Family

The 6 genera and 15 species in the flora area are ephemerals or annuals, perennial herbs, or subshrubs. Leaves simple and opposite (sometimes subopposite in *Boerhavia*); stipules none. Flowers radial or bilateral, single or several in a cluster, subtended by one or more bracts, the bracts sometimes deciduous or sometimes forming an involucre. Perianth of one whorl (calyx) united basally, often constricted above the ovary, the upper part corolla-like; petals none. Fruits 1-seeded and indehiscent, resembling an achene or nut, often enclosed in the persistent, fleshy to hard (or leathery) base of the calyx tube, the collective structure an anthocarp, referred to here as the "fruit." Most or perhaps all those in the flora area have fruits that produce mucilage when wet.

Worldwide, mostly tropical and subtropical including deserts; 30 genera, 395 species.

1. Floral tube at least 10 cm long; mature herbage glabrous or glabrate……..…… **Acleisanthes**
1. Floral tube not more than 2 cm long (or to 6 cm in *Mirabilis multiflora*); herbage and flowering branches variously pubescent, often viscid-glandular, or sometimes glabrous.

2. Involucral bracts united into a persistent tube with 5 teeth; fruits rounded, nearly smooth. ……... **Mirabilis**
2. Involucral bracts separate, 1 to 5, sometimes reduced and/or soon deciduous; fruits not rounded and smooth—variously winged, angled, club-shaped, or grooved.

3. Flowers pink and very showy, in clusters (3) 4–5 cm wide; fruits 7–9 mm long (including the wings), with 5 wings, each wing as wide or wider than the fruit body; stigmas longer than wide (fusiform)……. **Abronia**
3. Flowers various colors including pink, solitary or in clusters less than 3.5 cm wide, or if 3.5 cm or larger then the flowers not pink; fruits not winged, or if winged then the fruits less than 5 mm long; stigmas as wide as long (capitate or peltate).

4. Stems mostly weak and trailing; flowers in clusters of 3, resembling a single flower; fruits with a single longitudinal cavity or groove formed by in-rolled wings……... **Allionia**
4. Stems erect to spreading, sometimes decumbent but not trailing; flowers often clustered but each flower conspicuously separate; fruits not grooved or with 3 to 5 furrows or grooves.

5. Fruits less than 4 mm long, without peg-like glands; ephemerals or weakly perennial herbs; herbage or flowering branches pubescent and/or glandular-sticky; plants mostly less than 1 m tall; flowers pinkish white or red-purple…… **Boerhavia**

5. Fruits 8–10 mm long, with large, peg-like sticky glands; perennials, usually semi-woody at base; stems and leaves glabrous; plants often 1 m or more tall; flowers yellow-green. ……. **Commicarpus**

Abronia – Sand verbena

North America including Mexico; 20 species of annuals and herbaceous perennials with succulent or semi-succulent herbage.

Abronia villosa S. Watson

Desert sand-verbena; *verbena de la arena*. Figure 2.

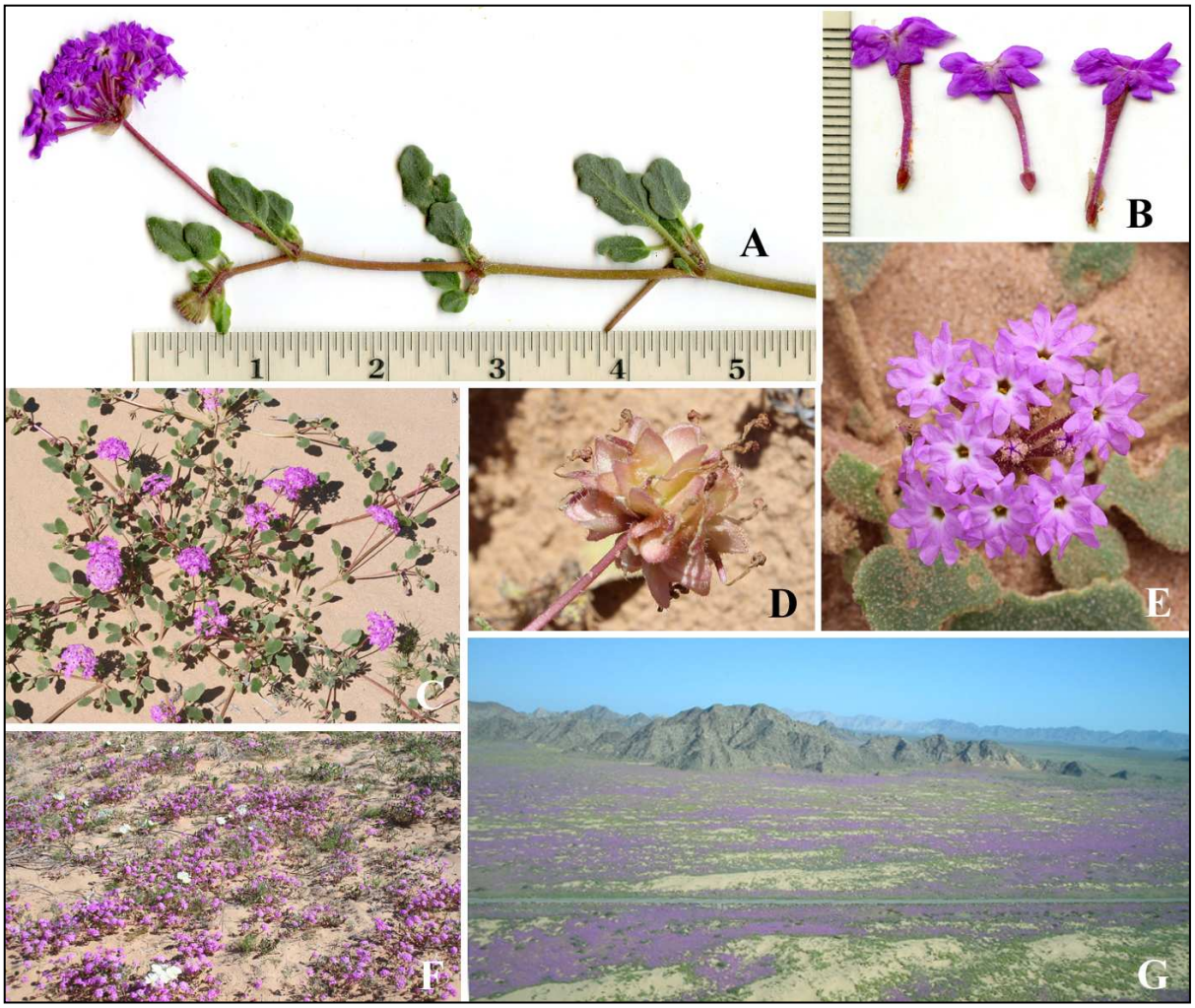

Figure 2. *Abronia villosa*. Dunes S of Sierra Blanca, Pinacate Biosphere Reserve, Sonora: (A & B) 18 Feb 2015; (C) 16 Feb 2008. (D) Gran Desierto along Mex Hwy 2, 5 Mar 2014. (E) Dunes about 27 km SW of Sonoyta on Mex Hwy 8, 6 Feb 2014. (F) Puerto Peñasco, Sonora, 17 Feb 2008. (G) Aerial view from Mexico to the NE, with the Tule Mts in the background, 8 Feb 2005, photo by Timothy J. Tibbitts.

Spring ephemerals; highly variable in size depending upon soil moisture, the stems 15–100 cm long, the larger plants with trailing-decumbent stems. Stems and leaves semi-succulent; herbage glabrate to viscid glandular-pubescent. Opposite leaves at a node unequal in size; leaves 2.5–7 cm long, the petiole often as long as or longer than blade; blades more or less ovate, the margins mostly

crenulate to shallowly sinuate or sometimes entire. Flowers showy, very fragrant, in umbellate clusters 4–5 cm wide, subtended by 5 (4 or 6) separate bracts. Perianth 1–1.5 cm wide, pinkish purple to pale magenta or pale purple, the lobes 5 and deeply notched. Fruits winged and beaked.

Common and widespread on sand flats, dunes, and washes in Cabeza Prieta and west of the Tinajas Altas area in the Butler Mountains. Although not documented for the Tinajas Altas core area, it is common and widespread on sandy soils in the nearby areas.

Mojave and Sonoran deserts; western Arizona, northwestern Sonora, southern Nevada, southwestern Utah, southern California, and Baja California.

The Sonoran Desert populations are var. *villosa*. Variety *aurita* (Abrams) Jepson occurs in southern California and is rare in Baja California. The infraspecific taxa, however, "seem not to mean much" (Richard Spellenberg, pers. comm. to Felger, 3 May 2012).

CP: Dunes 8 mi NW of Las Playas, 15 Apr 1941, *Benson 10783*. 3 mi E of Pinacate Lava Flow, 14 Apr 1964, *Niles 348*. E of Pinacate Lava, *Simmons 14 Apr 1964* (CAB). Pinta Sands, 1 Feb 1992, *Felger 92-29*.

TA: Butler Mts, *Van Devender 27 Mar 1983*.

Acleisanthes

Southwest USA and northern Mexico, mostly Chihuahuan and Sonoran desert regions, with 16 species, and one species endemic to Somalia in northeast Africa.

Acleisanthes longiflora A. Gray

Angel's trumpets. Figure 3.

Suffrutescent perennials from thickened, knotty roots; the herbage frost-sensitive. Stems slender and brittle, erect-ascending to sometimes prostrate. Youngest herbage with very short white hairs (more scurfy than hair-like); mature herbage essentially glabrous or glabrate, or lower leaf surfaces often with thinly distributed small, appressed hairs. Mature stems and leaves often glaucous (shiny white waxy). Leaves often 1.5–3.5 cm long, held upright, opposite leaves at a node nearly equal, petioled, the blades triangular to lanceolate, moderately thickened, the margins entire to wavy. Flowers nocturnal, the perianth pure white with a slender tube 10.5–13.5 cm long, and a 5-lobed limb often 1.8 cm wide. Anthocarps narrowly cylindrical-ellipsoid and shallowly 5-ribbed or angled. Sometimes also producing short, cleistogamous flowers (non-opening and self-fertilizing). Leafy and flowering in early March depending on soil moisture and especially with summer rains.

Agua Dulce Mountains on north- and south-facing slopes in talus-like fractured metamorphic rock. Also highly localized in nearby northwestern Sonora where it occurs on granitic hills and mountains.

Sonoran and Chihuahuan deserts and Tamaulipas thornscrub; southeastern California to Texas, and northern Mexico from Sonora to Durango, Coahuila, and Tamaulipas.

CP: Vicinity of Agua Dulce Pass, 13 Jun 1992, *Felger 92-564*.

Figure 3. *Acleisanthes longiflora*. Sierra Los Tanques, 11 km SW of Sonoyta, Sonora, on Mex Hwy 8: (A, B, & D) 7 Sep 2014; (C, E & F) 27 Mar 2010, about 6:00 a.m.

Allionia

Southwest USA to South America and the West Indies; 2 species (as interpreted here).

Allionia incarnata Linnaeus

[*A. incarnata* var. *nudata* (Standley) Munz. *A. incarnata* var. *villosa* (Standley) Munz]

Windmills, trailing four o'clock. Figure 4.

Short-lived perennials and also flowering in the first season as facultative ephemerals, with a stout taproot, and dying back to the roots during drought, growing and flowering non-seasonally (mostly April to November) except during colder weather and extreme drought; glandular hairy and sticky viscid throughout except the flowers, often with sand sticking to the herbage. Stems slender and becoming prostrate-trailing with forked branching, sometimes reaching more than 1 m long but usually much shorter. Leaves petioled, variable, the larger ones (1.7) 2.5–7.2 cm long, the blades usually ovate; opposite leaves of a pair unequal in size.

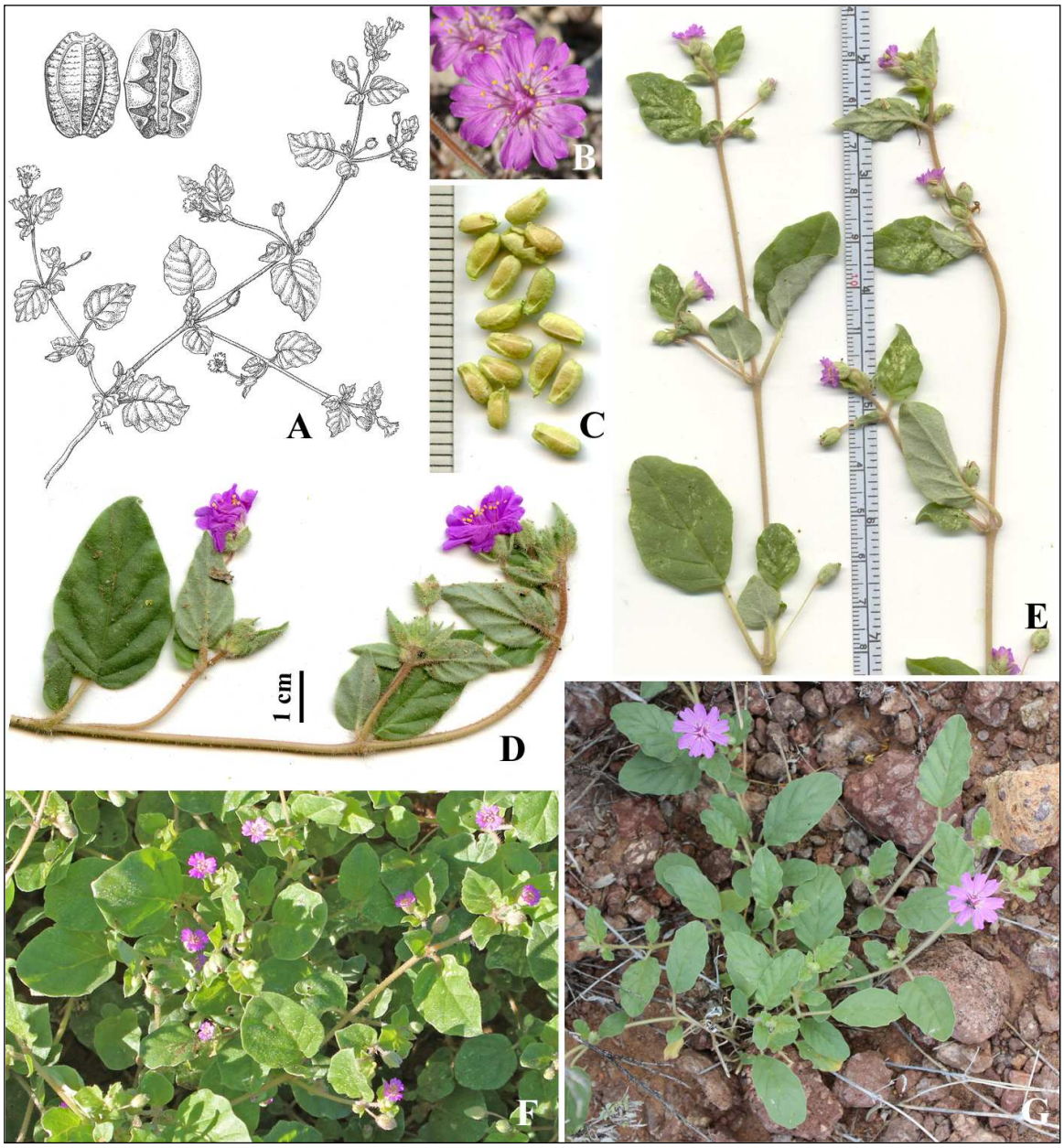

Figure 4. *Allionia incarnata*. (A) By Lucretia Breazeale Hamilton. (B) Saddle between Boulder and Arch canyons, 14 May 2006. (C) Diablo Canyon, 30 Sep 2014. (D) Darby Arroyo near Hwy 85, 28 Jul 2014. (E) Hwy 85 near N boundary of Organ Pipe, 17 Aug 2008. (F) Daniels Arroyo near Charlie Bell Road, 24 Aug 2014. (G) Alamo Canyon, 9 Sep 2013.

Flowers in 3s, the easily separated flowers resemble a single flower, the trios axillary on slender peduncles. Each flower in the trio subtended by a sepal-like bract; perianth of each flower forming a wedge-shaped third of the cluster, showy, bright lavender-pink; perianth trios often 1–2 cm wide; flower size and peduncle length highly variable. Stamens exserted, the filaments and style lavender-pink, the anthers yellow. Flowers opening in the early morning and wilting by late morning on hot days. Fruits 3–4.8 mm long, tan, firm, ellipsoid and sausage-shaped, one side convex, the other side with a pair of broad, in-rolled wings forming a deep cavity, the wings toothed or not; all 3 fruits in the cluster often developing; the fruits exude copious mucilage when wet. The fruits are

unique among Sonoran Desert nyctages in being bilaterally rather than radially symmetrical. Larger- and smaller-flowered plants occur in the flora area.

Widespread across the flora area; in many habitats including gravelly floodplains, washes, canyons, flats, and rocky slopes. It has been a member of the local flora for at least 8600 years.

Southwestern North America to Argentina and Chile; with larger- and smaller-flowered forms and much variation in fruit ornamentation. Three weakly differentiated varieties are generally recognized (Spellenberg 2003; Turner 1994). Variety *villosa*, distinguished in having larger flowers and slightly larger fruits, is reported for the flora area. Walter Fertig noted, "I've wondered about some of the putative variability in *Allionia*. I have seen large flowered plants growing in among small-flowered ones. They look striking in the field, but much less so when pressed and the only real difference seems to be flower size. I tend towards being more generous with polymorphism perhaps than some taxonomists."

OP: Alamo Canyon, *Nichol 14 Mar 1939*. Sonoyta road 1 mi S of N entrance, *McDougall 10 Apr 1941*. Armenta Well, *Warren 16 Nov 1974*. Aguajita Wash, 14 Sep 1988, *Felger 88-403*. †Alamo Canyon, seeds, 1150 & 8590 ybp. †Puerto Blanco Mts, seeds, 3440 ybp.

CP: S of Las Playas Lava Field, 10 Apr 1978, *Reeves 6767* (ASU). Pinacate Lava flow, 21 Mar 1992, *Telewski & Harlan 72*. Agua Dulce Pass, 12 & 14 Jun 1992, *Felger* (observation). Childs Mt, 2845 ft, 18 Aug 1992, *Felger* (observation). Bates Well Road at ORPI boundary, 14 Sep 1992, *Felger 92-678*.

TA: Tinajas Altas, bajada, 19 Mar 1998, *Felger* (observation). Coyote Water, 25 Oct 2004, *Felger 04-23*.

Boerhavia – Spiderling, *juanipili, juanimipili*

Summer ephemerals and one herbaceous perennial in the flora area; usually branched from the base and pubescent with glandular-sticky areas at least on the stems. Leaves opposite or subopposite, usually petioled, the opposite leaves of a pair often unequal in size. Inflorescences of long, slender branches, and small bracts below the flowers. Flowers open in the early morning and wilt with daytime heat—stamens collapsing onto the stigma, apparently self-fertilizing if the flower has not been cross-pollinated. Perianth white, pink, purple, or reddish. Fruits obovoid or obpyramidal, 3–5-angled and/or grooved (furrows or sulci), exuding mucilage when wet and adhering when dry.

The Seris have prepared certain young *Boerhavia* plants as greens (Felger & Moser 1985).

Warm-temperate, arid and tropical regions worldwide; 40 species. "At the species level, there is variation that is often difficult to treat taxonomically, especially among annuals of the Sonoran Desert….Many species probably are highly autogamous (Spellenberg 2000)" (Spellenberg 2003: 17–18).

1. Perennials or annuals; flowers dark red-purple; fruits sticky and densely pubescent with glandular hairs……. **Boerhavia coccinea**
1. Hot-weather ephemerals; flowers white or pale pink; fruits glabrous, not sticky.

2. Flowers in umbellate or sub-umbellate clusters.

3. Fruits angular but not winged (or not prominently winged), 5-angled.

4. Fruits (2.9) 3.4–4.7 mm long, often with a stipe-like base……..….. **Boerhavia erecta**
4. Fruits 2–2.9 (3.2) mm long, the base sessile……..... **Boerhavia triquetra**

3. Fruits prominently winged, 3–5 angled.

5. Fruits 5-winged, the fruit body smooth…….. **Boerhavia megaptera**
5. Fruits 3- or 4-winged, the body coarsely and transversely rugose ("corrugated").
……...… **Boerhavia pterocarya**

2. Flowers on elongated racemose branches.

6. Fruits 2.1–2.5 (2.7) mm long, slender (narrowly obovate), 5-angled or ridged, the furrows variously open to closed, mostly narrow to nearly closed……... **Boerhavia spicata**
6. Fruits 2–3 mm long, chunky (broadly obovate), all or most fruits 4-angled, the furrows broad, open, and roughened inside……... **Boerhavia wrightii**

Boerhavia coccinea Miller
[*B. caribaea* Jacquin]
Scarlet spiderling. Figure 5.

Short-lived herbaceous perennials growing with warm to hot weather and also flowering in the first season, openly branched and sprawling, sometimes reaching 1–1.5 m across, the roots thickened. Stems densely hairy, glabrate, or glabrous. Reproductive in warmer months with sufficient soil moisture. Inflorescences diffuse and much branched, the branches very slender, glabrous or glandular hairy; flowers in sub-umbellate clusters at ends of thread-like branchlets. Flowers bright red-purple, remaining open longer in the day than the other boerhavias in the region. Fruits 2.8–3.5 mm long, very sticky with exudate from glandular hairs; immature fruits rounded, the mature ones narrowly obovoid, prominently ribbed (the ribs raised and smooth), the tip rounded.

Roadsides and other disturbed habitats, washes, and near waterholes, and sometimes in natural habitats including canyon bottoms.

Southern USA to South America and the Caribbean; native in the New World and widespread and weedy in warm regions worldwide.

OP: Walls Well, *Nichol 28 Apr 1939*. W of Bates Mts, 31 Mar 1978, *Bowers 1165* (ORPI). Ajo Mt Loop Road 2.3 mi E of Visitor Center, 9 May 1985, *Van Devender 85-114*.
CP: Childs Mountain, 18 Aug 1992, *Felger 92-637*.
TA: Tinajas Altas, near lower tinaja, 15 Jun 1992, *Felger 92-609*.

Boerhavia erecta Linnaeus
Spiderling; makkumĭ ha-jeved. Figure 6.

Summer-fall ephemerals; herbage glabrous or with minute hairs, the flowering branches with glandular-sticky bands. Stems, petioles, and sometimes leaf blades with moderately to densely glandular patches. Stems mostly 20–100 cm long. Leaf blades ovate to narrowly lanceolate. Flowers white or pale pink, 2 to several in umbellate or sub-umbellate clusters with at least some of the pedicels attached well below others. Fruits (2.9) 3.4–4.7 mm long, 5-angled, often bright green to red-green when fresh, often sub-stipitate (base of fruits weakly differentiated into a narrowed and nearly terete stalk), the tip blunt (truncated). The plants are often more robust than those of *B. triquetra*.

Mostly in the larger washes and drainageways in valleys and major canyons; often locally abundant.

Warm regions of Latin America and southern USA, and weedy in the Old World.

OP: 2 mi SE of Walls Well, 30 Aug 1945, *Gould 3214*. Alamo Canyon, 17 Oct 1987, *Baker 7559* (ASU, ORPI). Aguajita Wash, with var. *intermedia* [= *B. triquetra*, *88-413*], 14 Sep 1988, *Felger 88-424*.

CP: 4 mi W of Papago Well Road gate, *Simmons 1 Oct 1963*. San Cristobal Wash, road from Bates Well, 14 Sep 1992, *Felger 92-692*. Road from Bates Well 2.4 mi SW of Refuge boundary, 15 Sep 1992, *Felger 92-745*.

TA: Coyote Water, 25 Oct 2004, *Felger 04-28* (ARIZ, ASU).

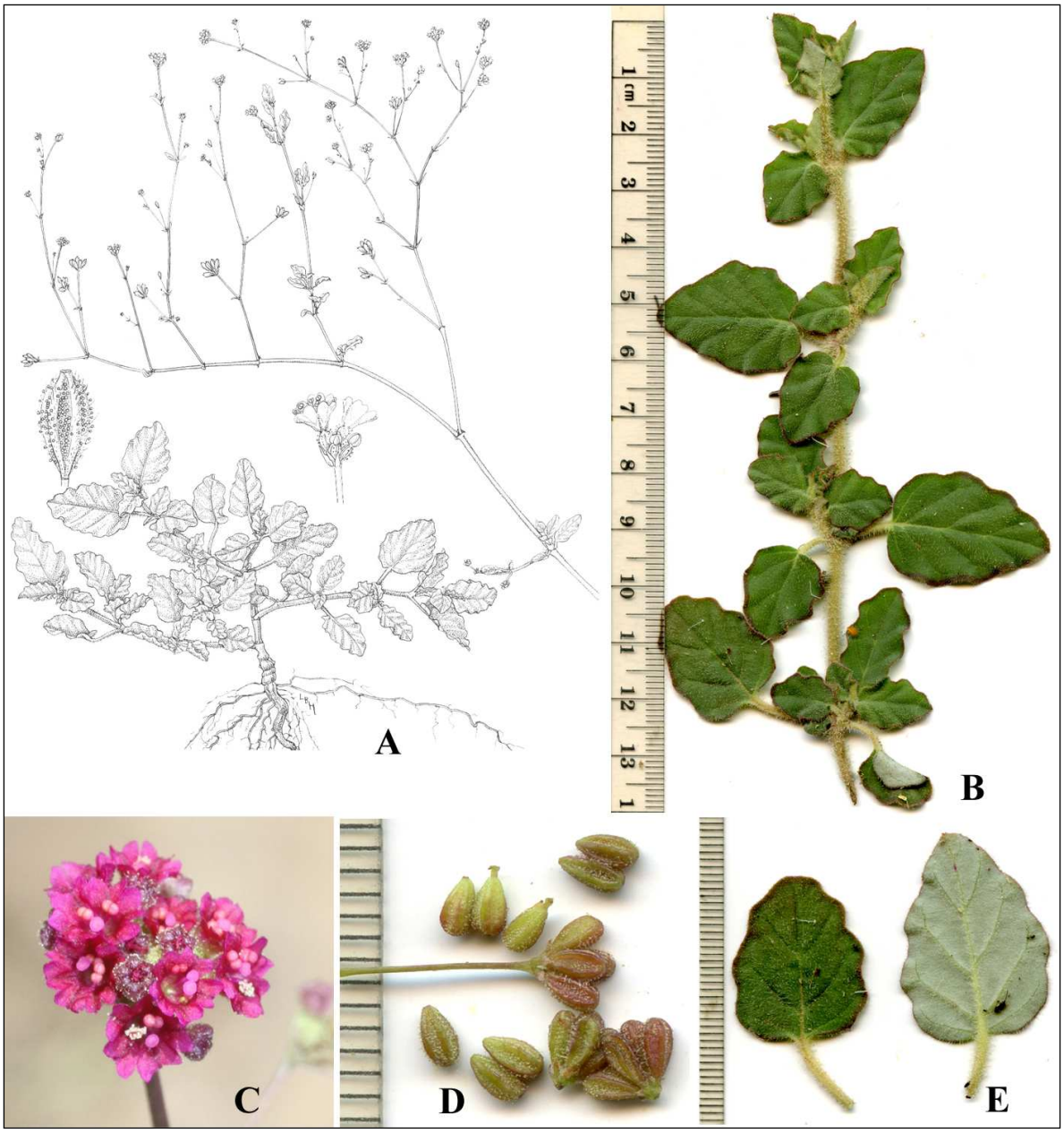

Figure 5. *Boerhavia coccinea.* (A) By Lucretia Breazeale Hamilton. (B & E) Estes Canyon, 17 May 2015. (C) Valley of the Ajo, 6 Oct 2012. (D) Ajo, 23 Aug 2014.

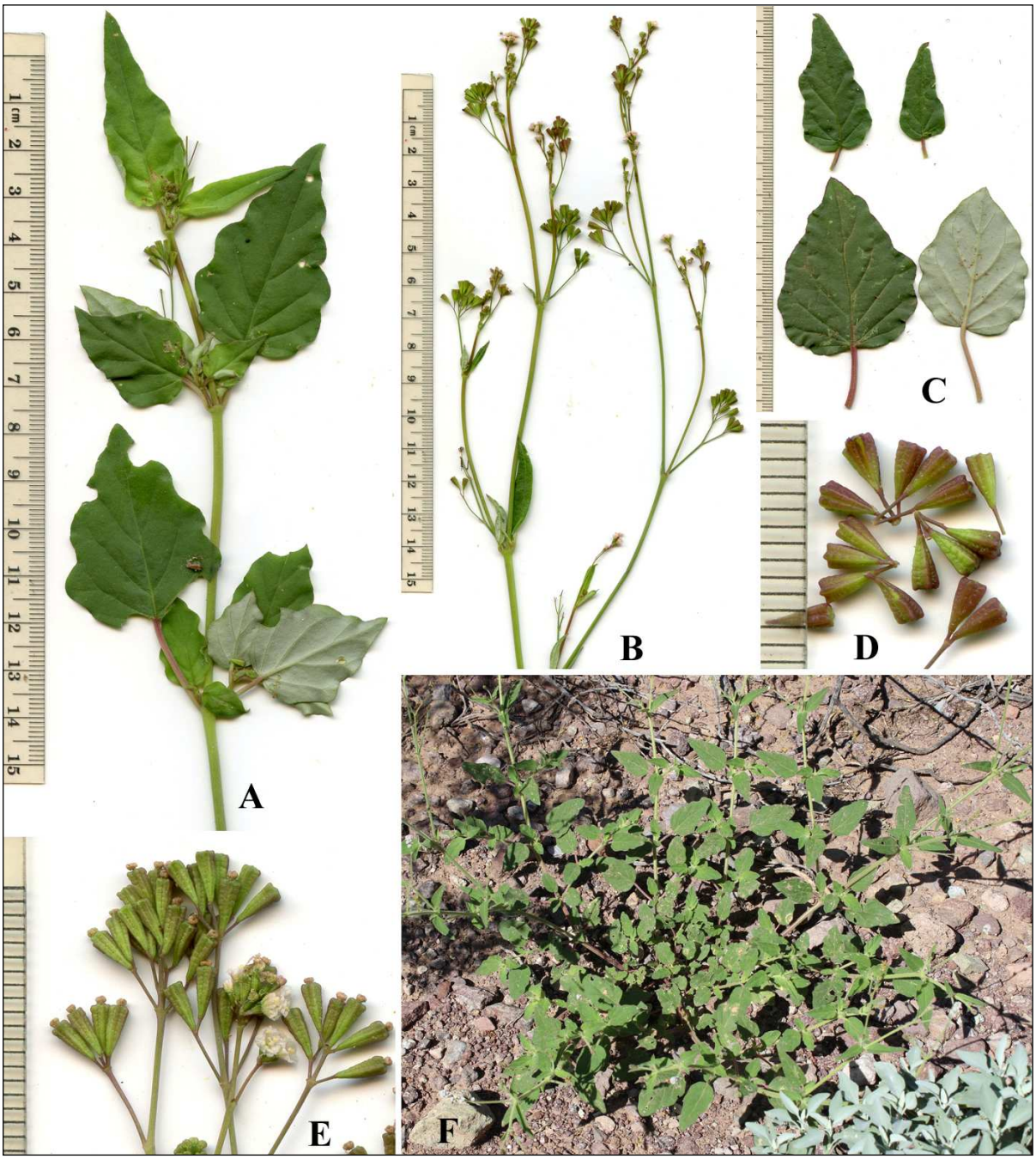

Figure 6. *Boerhavia erecta*. (A) Bates Well Road, N of Bates Well Ranch, 4 Aug 2014. (B) Cuerda de Leña, 4 Aug 2014. (C & D) Kuakatch Wash at Hwy 85, 11 Aug 2014. (E) E of Why on Hwy 86 near mile 62, 1 Aug 2014. (F) Arch Canyon, 26 Aug 2014.

Boerhavia megaptera Standley
Large-winged spiderling. Figure 7.

Summer ephemerals; herbage minutely hairy, the flowering branches with glandular sticky bands. Flowers in small umbellate clusters, white or pale pink. Fruits broadly obconic, 3.2–3.8 mm long, prominently 5-winged, the wings about as wide as the body, the fruit body smooth.

Locally in the Ajo and Diablo mountains. This or a similar species was in the Ajo Mountains up to at least 13,500 years ago.

This species is known only from southern Arizona, northward and eastward from the Ajo Mountains. *Boerhavia megaptera* is "part of or very closely related to" the *B. triquetra* complex (Spellenberg 2007: 874).

OP: Bull Pasture Trail, 5 Nov 1977, *Bowers 954*. Arch Canyon, 3000 ft, *Rutman 14 Aug 1998* (ORPI); Shady slope N of the Arch, with *Selaginella*, 26 Aug 2014, *Rutman 20140826-5*. Diablo Mts, grassy slope, 12 Sep 2013, *Rutman 20130912-6*. †*B.* cf. *megaptera*: Alamo Canyon, fruits, 9570 ybp; Montezuma's Head, fruits, 13,500 ybp.

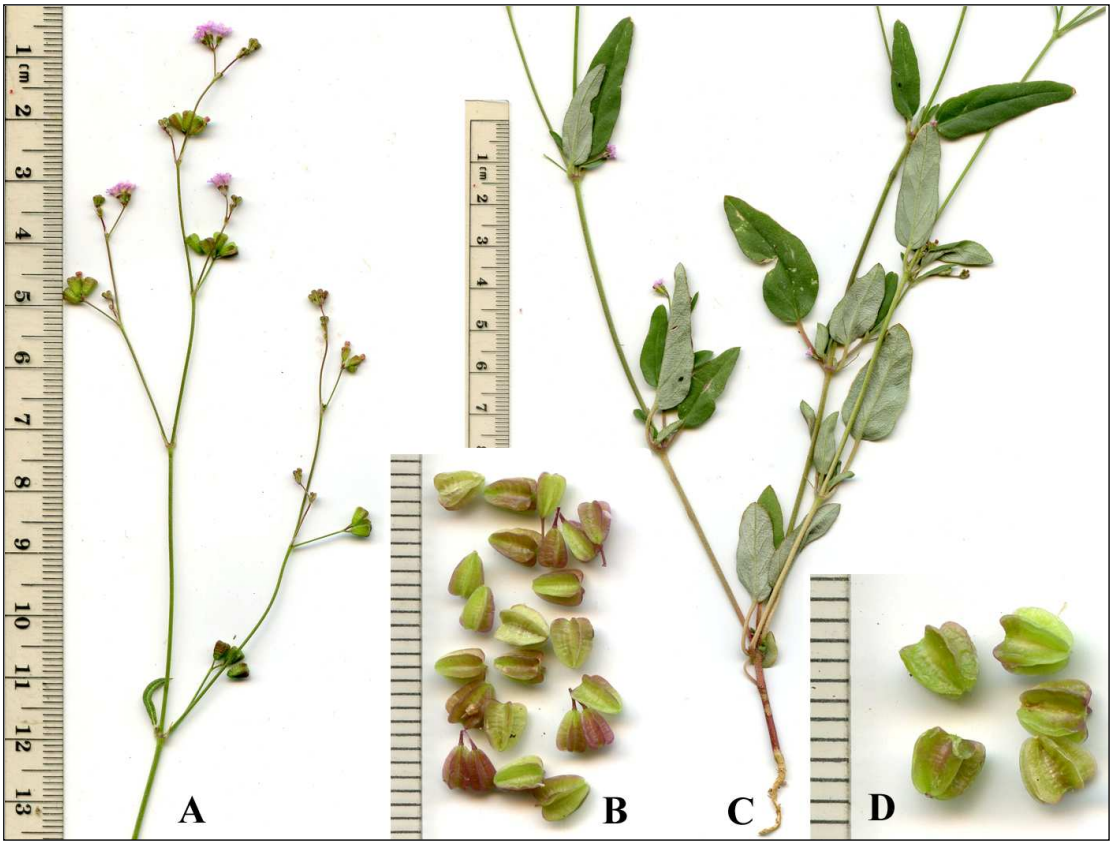

Figure 7. *Boerhavia megaptera*. (A, C, & D) N-facing slope with *Selaginella*, Arch Canyon Trail, 26 Aug 2014. (B) Wash crossing near N end of Ajo Mountain Drive, Diablo Mts, 30 Sep 2014.

Boerhavia pterocarpa S. Watson
Wing-fruit spiderling. Figure 8.

Summer ephemerals; herbage pubescent with minute hairs, the flowering branches without glandular sticky bands. Flowers in small umbellate clusters, white or pale pink. Fruits 2.9–3.4 mm long, broadly obpyramidal with a stipe-like base, and unique among the boerhavias in the region with 3 or 4 prominent broad wings and the fruit body coarsely and transversely rugose (corrugated).

Known from a single record in the flora area. Southern Arizona and adjacent northern Sonora, and rare in southwestern New Mexico.

OP: Old fields at Armenta Well Ranch, 1700 ft, 13 Sep 1978, *Bowers 1533* (ORPI).

Figure 8. *Boerhavia pterocarpa*. Bajada 6 miles W of Little Florida Mts, NM, 26 Aug 2009, photo by Gene Jercinovic (SEINet).

Boerhavia spicata Choisy, 1849
[*B. spicata* Choisy var. *palmeri* S. Watson, 1889. *B. palmeri* S. Watson, 1889, not *B. palmeri* S. Watson, 1883. *Senkenbergia coulteri* Hooker f., 1880. *B. coulteri* (Hooker f.) S. Watson, 1889. *B. coulteri* var. *palmeri* (S. Watson) Spellenberg, 2002. *B. watsonii* Standley, 1909.]
Spiderling. Figure 9.

Summer-fall ephemerals. Stems often 30–50+ cm long. Leaves often 3–6+ cm long, the blades ovate to ovate-deltate. Herbage moderately glandular-sticky, the flowering branches conspicuously glandular-sticky, sticking to shoes, socks, and pant legs. Flowers on slender, spicate branches; bracts beneath flowers deciduous. Flowers white or pale pink. Fruits 2.1–2.5 (2.7) mm long, narrowly obovoid, the furrows nearly closed to open and roughened (rugulose) inside, the ridges 5, broad, rounded or broadly obtuse (more angled when immature), the tip rounded.

Widespread and often very common across the region in various habitats, sandy to rocky soils, washes, bajadas, flats, and rocky slopes.

Southeastern California to western Texas and southwestern Utah, Sonora, Sinaloa, Chihuahua, and the Gulf side of the Baja California Peninsula.

Several taxa of annual (ephemeral) boerhavias with spicate inflorescences in the Sonoran Desert form a taxonomically difficult group and are variously interpreted, with *B. coulteri* and its two varieties often recognized as distinct from *B. spicata* (e.g., Spellenberg 2003). "These taxa are often sympatric, either in mixed populations, or with *B. coulteri* var. *palmeri* inhabiting slightly drier sites. Though most specimens are easily placed in one variety or the other, they intergrade and hybridization is likely" (Spellenberg 2003: 26). If *B. spicata* and *B. coulteri* are maintained as distinct species, then the southwest Arizona population would be *B. coulteri* var. *palmeri*.

OP: Armenta Well, *Warren 16 Nov 1974*. Aguajita, wash, 14 Sep 1988, *Felger 88-415*. 1 mi E of Senita Basin road, *Wirt 25 Jul 1990*. W of Cuerda de Leña and S of N boundary of park, loamy *Larrea* flat where water settles, *Rutman 7 Oct 2006*.

CP: Daniels Arroyo at Charlie Bell Rd, 18 Aug 1992, *Felger 92-656*. Bates Well Road at E Refuge boundary, 18 Aug 1992, *Felger 92-676*. E Pinta Sands, 15 Sep 1992, *Felger 92-752*.

TA: Coyote Water, 25 Oct 2004, *Felger 04-29* (ARIZ, ASU).

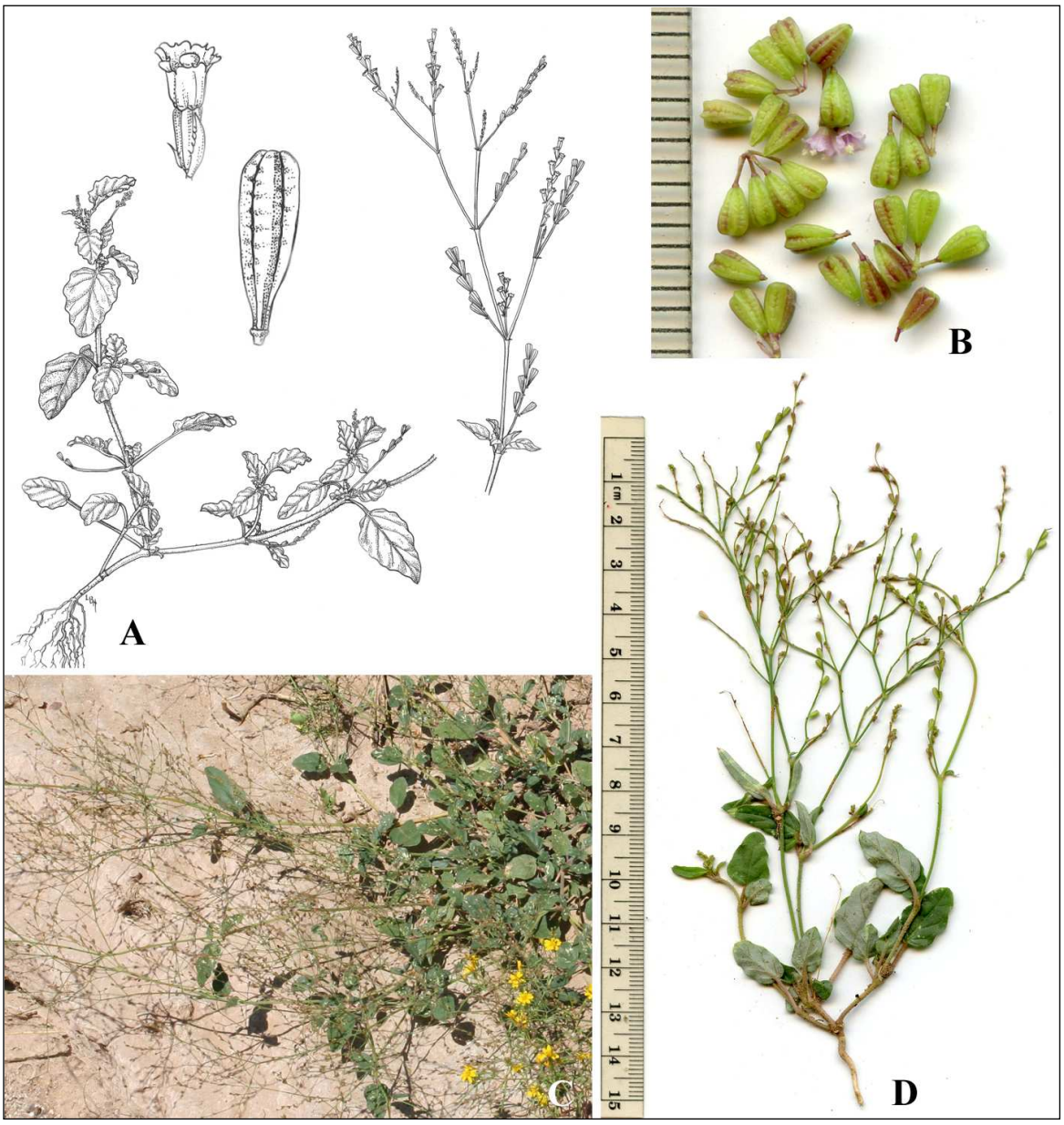

Figure 9. *Boerhavia spicata.* (A) By Lucretia Breazeale Hamilton. (B) Kuakatch Wash at Hwy 85, 11 Aug 2014. (C) Growler Wash near Bates Well, 30 Sep 2006. (D) Cuerda de Leña, 4 Aug 2014.

Boerhavia triquetra S. Watson
[*B. intermedia* M.E. Jones. *B. triquetra* var. *intermedia* (M.E. Jones) Spellenberg. *B. maculata* Standley]
Spiderling. Figure 10.

Summer ephemerals. Leaves oblong to narrowly lanceolate, mostly 1–3 cm long, paler beneath, often glandular-punctate. Flower clusters umbellate or sub-umbellate; perianth whitish or pale pink. Fruits 2–2.9 (3.2) mm long, 5-angled, the angles or ridges acute, the intervening grooves (sulci) open, coarsely and deeply rugose, the fruit tip blunt (truncate); fruit lacking a stipe-like base. Distinguished from *B. erecta* by the smaller fruits without a stipitate base, the fruits generally duller, not as dark green when fresh, and browner at maturity, and the plants usually more delicate.

Widespread in Organ Pipe and Cabeza Prieta in various habitats including washes, bajadas, canyon, and rocky slopes.

Southeastern California to Texas and northern Mexico.

Boerhavia triquetra var. *intermedia* and *B. triquetra* var. *triquetra* are narrowly defined and both may intergrade and occur intermixed, including at the type locality for *B. triquetra* in Baja California. *B. maculata*, from southern Sonora and Sinaloa, apparently only differs in size from *B. triquetra* var. *triquetra*. *Boerhavia triquetra*, published in 1889, has priority over the other taxa. (Murdock 2012; Spellenberg 2003, 2007).

OP: Dos Lomitas, *Warren 11 Aug 1975*. Diablo Mts, wash, along Ajo Mt Drive, 12 Sep 2013, *Rutman 20130912-13*. Aguajita Wash, abundant, 14 Sep 1988, *Felger 88-413* [with *B. erecta*, *88-424*].
CP: N side of Tule Mountains, 2 Feb 1992, *Felger* (observation). Las Playas, 28 Nov 2001, *Felger 01-572*.

Figure 10. *Boerhavia triquetra*. Bahía San Pedro, Sonora, 12 Dec 2014, photos by Sue Carnahan.

Boerhavia wrightii A. Gray
Large-bract spiderling. Figure 11.

Summer-fall ephemerals, sometimes persisting until freezing weather; highly variable in size, flowering as small as 10 cm high, although the plants often rather robust and sometimes reaching 1 m in height and 1.5+ m in width. Herbage extremely glandular-sticky throughout, including the flowering branches. Larger (lower) leaves often 2.5–7.5 cm long, the blades ovate to oblong or lanceolate, darker green above, the margins crenulate. Inflorescences of glandular-sticky racemose or sometimes spicate branches. Flowers pale pinkish white to pink. Flowers and fruits subtended by deciduous or semi-persistent bracts often ⅔ as long as or longer than the fruits. Fruits broadly ovoid, relatively short, squat, and chunky, 2–3 mm long, 4 (5)-angled, the angles sharp-edged, the furrows open, broad, and often roughened inside.

Sandy to rocky soils in many habitats; nearly ubiquitous and often abundant across the flora area. It has been part of the local flora for at least 21,800 years.

Southeastern California to western Texas, southwestern Utah, and southern Nevada to northern Sonora, Chihuahua, and northeastern Baja California.

OP: Alamo Canyon, *Van Devender 31 Aug 1978*. Armenta Ranch, old fields, 13 Sep 1978, *Bowers 1530*. Aguajita Wash, 14 Sep 1988, *Felger 88-412*. 1.5 mi W of State Route 85 and 0.15 mi S of Armenta Ranch Road, 30 Sep 2006, *Rutman 20060930-14*. †Montezuma's Head, fruits, 13,500 & 21,840 ybp. †Puerto Blanco Mts, fruits, 1910 to 9720 ybp (5 samples).

CP: Papago Well, Camino del Diablo, 27 Oct 1937, *Gentry 3505* (DES). Childs Mt, 2845 ft, 18 Aug 1992, *Felger 92-638*. Daniels Arroyo at Charlie Bell Rd, 18 Aug 1992, *Felger 92-655*. Bates Well Road at E Refuge boundary, 14 Sep 1992, *Felger 92-677*. 1 mi E of Namer's Grave, 15 Sep 1992, *Felger 92-765*.

TA: Tinajas Altas, 26 Oct 2003, *Felger* (observation). Camino del Diablo, SE of Raven Butte, 25 Oct 2004, *Felger 04-08*. Coyote Water, 25 Oct 2004, *Felger*, observation. †Butler Mts, fruit, 8160 ybp.

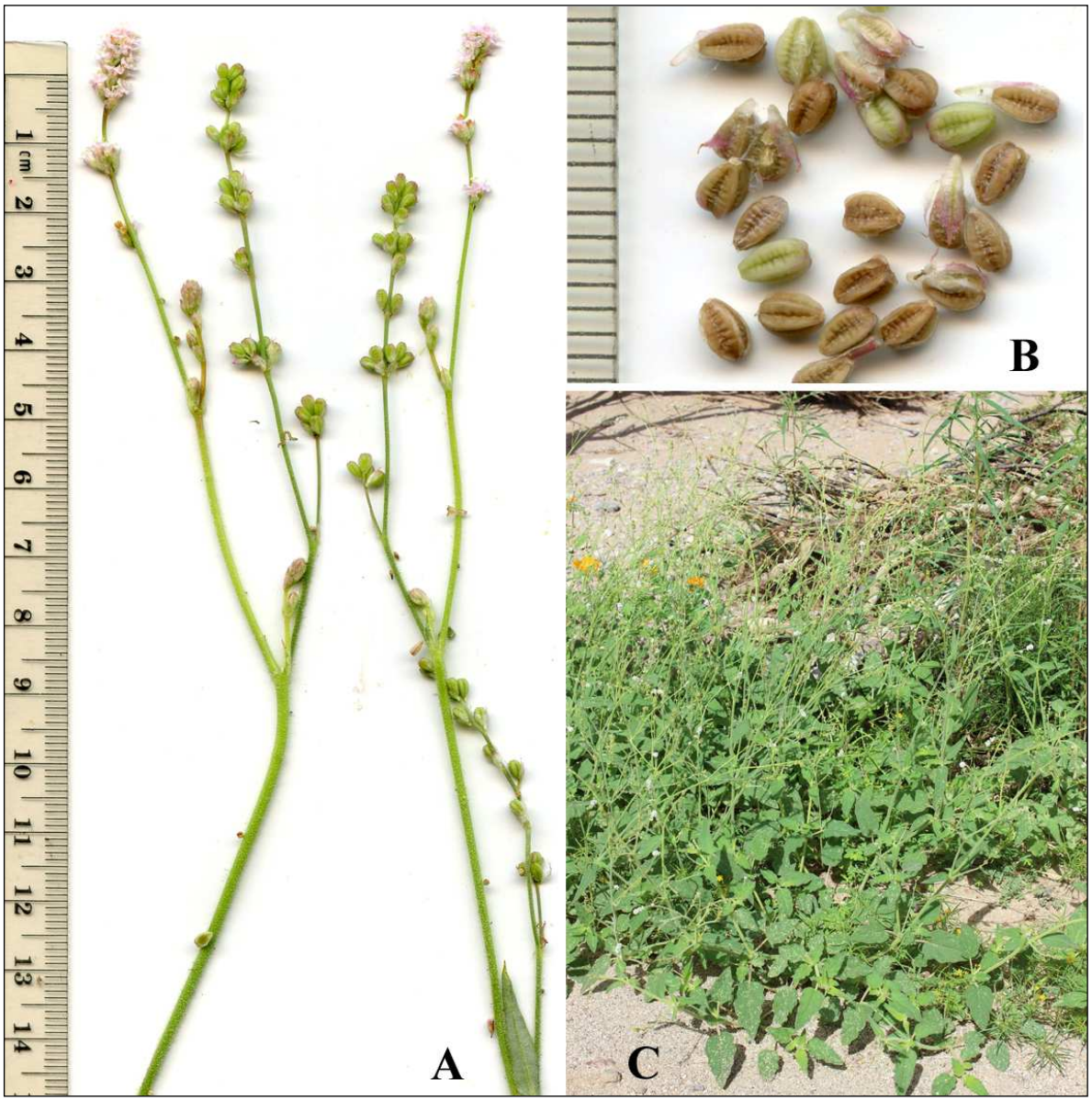

Figure 11. *Boerhavia wrightii*. (A & B) Bates Well Road, N of Bates Well, 4 Aug 2014. (C) Gunsight Wash at Why, 2 Aug 2014.

†**Boerhavia** sp.

OP: †Puerto Blanco Mts, fruits, 980 to 8790 ybp (4 samples).

Commicarpus

Americas, Africa, Australia, and Eurasia; 35 species. Although *Commicarpus* is sometimes placed within *Boerhavia*, "Meikle (1978) discussed [that] the funnelform perianth, the long-exserted stamens and style, the obscurely 10-ribbed, fusiform or clavate fruits with the large viscid glands, and the semiwoody nature of the plants all distinguish *Commicarpus* from *Boerhavia*" (Spellenberg 2003: 33).

Commicarpus scandens (Linnaeus) Standley
[*Boerhavia scandens* Linnaeus]
Climbing wart-club. Figure 12.

Figure 12. *Commicarpus scandens.* (A) Daniels Arroyo, W channel, 5 Sep 2014. (B & D) Ajo Mountain Drive, W slope of Ajo Mts, 27 Sep 2006. (C) Ajo Scenic Loop, Little Ajo Mts, 31 Jul 2014. (E) Diablo Mts, N part of Ajo Mountain Drive, 14 Sep 2013.

Perennial herbs or shrubs, often woody at base, reaching 1.5–1.8 m tall growing through other shrubs; glabrate. Stems slender, straight, and brittle, the internodes usually long. Leaves often

3–7.5 cm long, the petioles prominent, the blades nearly triangular to ovate and semi-succulent. Flowers in umbellate clusters; perianth 7–8 mm wide, white or whitish with a pale yellow-green center; flowering in the warmer seasons, especially with summer rains. Fruits club-shaped, 8–10 mm long, 10-ribbed, terete or nearly so, with viscid, knobby glands causing the fruit to stick to fur, feathers, and clothing. Fruits producing relatively small amounts of mucilage when wet.

Organ Pipe including the Ajo Mountains and along the southwestern margin of the Monument, and the east side of Cabeza Prieta; mostly washes, arroyos, and canyons.

Eastward and northward in southern Arizona to Texas, Mexico including both Baja California states, to South America and the West Indies.

OP: Estes Canyon Wash, 20 Aug 1950, *Supernaugh 446*. Quitobaquito, *Nabhan 17 May 1982*. Aguajita Wash, 14 Sep 1988, *Felger 88-401*. 1 mi W of Lukeville at international boundary fence, 18 Nov 1991, *Felger 91-136*. Senita Basin, 1 Dec 2001, *Beale & Beale 203*. Diablo Mts, 2405 ft, flowers visited by wasps, 12 Sep 2013, *Rutman 20120112-17*.

CP: E margin of Cabeza Prieta, 23 Feb 2003, *Rutman*, observation. Chico Sunie Wash near Chico Sunie Village, 5 Aug 2014, *Rutman*, observation. Daniels Arroyo, 5 Sep 2014, *Rutman*, photo.

Mirabilis – Four-o'clock; *maravilla*

Herbaceous perennials; the stems often forking. Leaves entire, the lower ones usually petioled, the upper ones reduced. Involucral bracts united, calyx-like, 5-lobed; 1–many flowers per involucre; involucres often clustered at stem tips. Flowers collapsing with daytime heat. Calyx petal-like, longer than the involucre. Stigmas capitate. Fruits rounded to elongated, smooth to slightly angled or ridged.

Americas, mostly temperate and tropical regions, and at least one in south Asia; 60 species. This is the most diverse genus in the family.

1. Flowers dark pink to red-purple, often 5–6 cm long……. **Mirabilis multiflora**
1. Flowers white, pale pink, or bright red-purple, not more than 2 cm long.

2. Leaves linear to linear-lanceolate, subsessile or petioles not prominent; flowers bright red-purple; Ajo Mts…… **Mirabilis coccinea**
2. Leaves deltate to ovate, the petioles prominent; flowers white to pale pink.

3. Involucres 6–9 mm long, the lobes 2–3 (4) mm long……. **Mirabilis laevis**
3. Involucres 10–15 mm long, the lobes 5–9 mm long…… **Mirabilis tenuiloba**

Mirabilis coccinea (Torrey) Bentham & Hooker f.
Scarlet four-o'clock. Figure 13.

Herbaceous perennials, growing and flowering with warmer months with sufficient soil moisture. Stems slender, forked and openly branched, generally erect-growing. Leaves linear to linear-lanceolate, not more than 10 cm long, subsessile or the petioles not more than 3 mm long. Flowers 1–3 in a cluster, bright red-purple, probably 1–2 cm wide, withering in morning heat. Fruits about 5 mm long. The plants are inconspicuous when the flowers are not open.

Known from a single collection in the Ajo Mountains.

Southeastern California, southern Nevada, New Mexico, northern Sonora, and northern Chihuahua (S of Gallego, *Shreve 9045-A*, ARIZ).

OP: Base of bedrock cliff, near crestline of Ajo Mts, 1155 m, few plants under a *Juniperus* at base of cliff in deep shade, 22 Oct 2006, *Rutman 20061022-7*.

Figure 13. *Mirabilis coccinea.* Alto Gulch, Salero Ranch, Santa Cruz Co., 4 May 2014, photos by Sue Carnahan.

†**Mirabilis coccinea** and/or **M. linearis** (Pursh) Heimerl
[*Oxybaphus linearis* (Pursh) B.L. Robinson]
Narrow-leaf four o'clock

Herbaceous perennials growing and flowering during the warmer months.

One or both of these species occur in the fossil record from the Ajo Mountains. *Mirabilis linearis* is presently widespread in Arizona to the north and east of the Sonoran Desert; the nearest populations are in the Pajarito and Santa Rita mountains. Three varieties range from Canada to Mexico; var. *decipiens* (Pursh) Heimerl ranges from Utah to Arizona, New Mexico, Chihuahua, and northeastern Sonora.

OP: †Montezuma's Head, anthocarps, 13,500 & 20,490 ybp.

Mirabilis laevis (Bentham) Curran var. **villosa** (Kellogg) Spellenberg
[*M. bigelovii* A. Gray]
Desert four o'clock. Figure 14.

Stems erect to spreading, slender, often dying back to rootstock during drought. Leaves semi-succulent, tardily drought deciduous, larger ones 2–4+ cm long including petioles, the blades deltate to ovate. Involucres green, enlarging moderately as fruits develop, reaching 6–9 mm long, the lobes 2–3 (4) mm long. Perianth white to pale pink; anthers yellow, the filaments and style white. Fruits seed-like, 3.8–4.4 × 2.5–3 mm, ovoid, faintly reticulate to mottled dark brown and gray, sometimes faintly glaucous. Flowering various seasons except during cold weather. Flowers often visited by honeybees.

Widespread in the region but often not conspicuous; rocky slopes and canyons, as well as washes or arroyos including valley floors and bajadas. Extending to the summits of mountains at least in Cabeza Prieta and Tinajas Altas. It has been part of the local flora for more than 29,000 years.

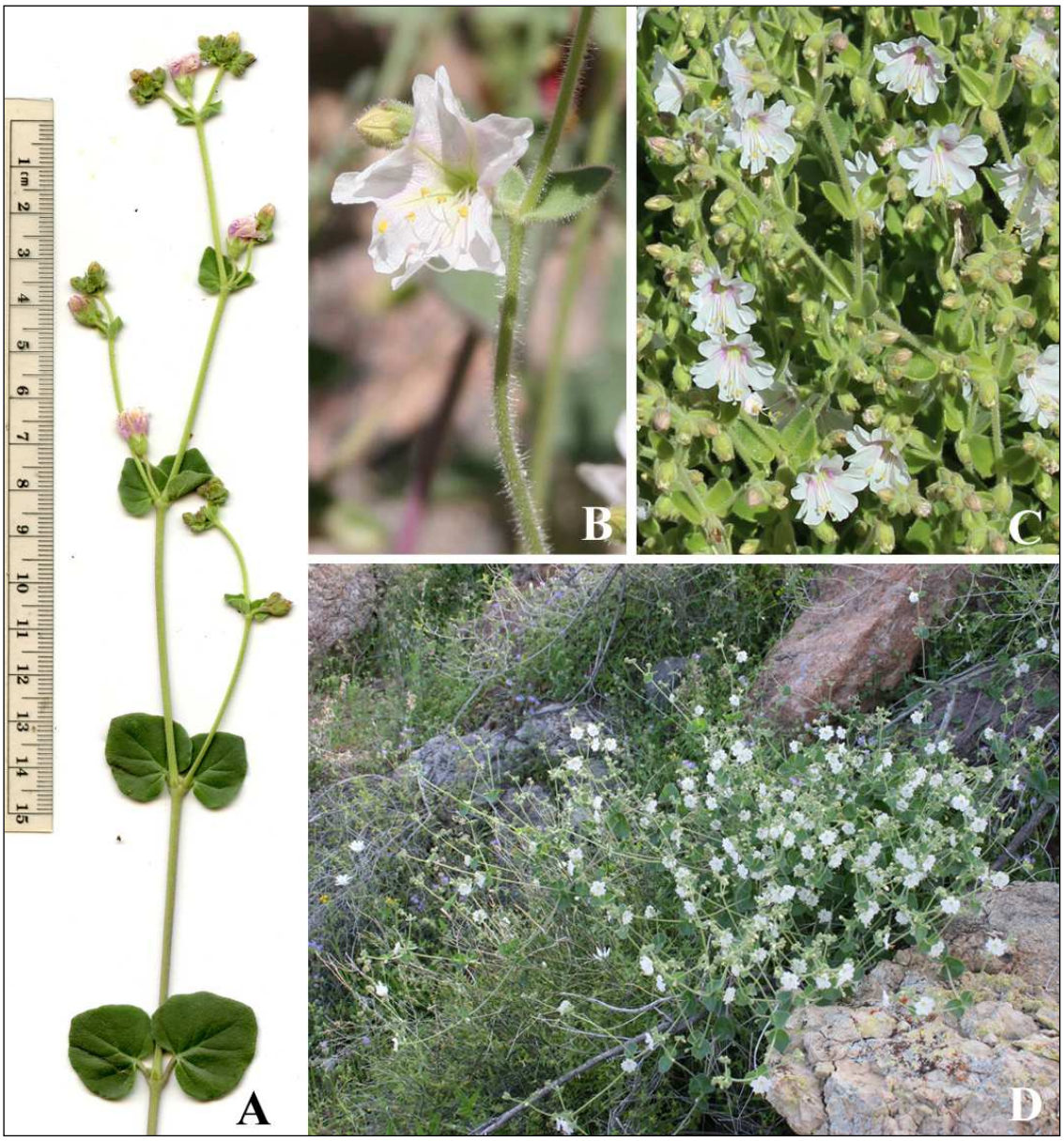

Figure 14. *Mirabilis laevis* var. *villosa*. (A) North slopes of the Puerto Blanco Mts, 15 Mar 2015. (B & D) Estes Canyon, 15 Mar 2008. (C) Alamo Canyon, 1 Feb 2014.

Variety *villosa* occurs in Arizona, northwestern Sonora, Baja California, and southern California to Nevada, and southwestern Utah. Three other varieties range from Baja California Sur to Oregon, Nevada, southwestern Utah, and northwestern Arizona.

OP: Ajo Mts, 21 Nov 1934, *Goodding 1515*. Alamo Canyon, 14 Mar 1941, *Benson 10678*. Dripping Springs, 18 Mar 1945, *Gould 3013*. Aguajita, wash, 6 Apr 1988, *Felger 88-286*. †Alamo Canyon, anthocarps, 8590 & 29,110 ybp. †Montezuma's Head, anthocarps, 20,490 ybp. †Puerto Blanco Mts, anthocarps, 7560 to 14,120 ybp (3 samples).

CP: Tule Tank, 26 Mar 1932, *Shreve 5931*. Eagle Tank, *Simmons 24 Feb 1964* (CAB). 6 mi E of Papago Wells, 28 Feb 1976, *McLaughlin 1031*, *Fugate & McManus* (ARIZ, SNM). Agua Dulce Pass, *Vetault*

29 Feb 1988. Cabeza Prieta Peak, 2550 ft, N side of summit, 24 Mar 1995, *Yeatts 3659*. W of Bluebird Mine, E Growler Mts, 22 Mar 2003, *Rutman 2003-378*.

TA: Tinajas Altas, 5 Dec 1935, *Goodding 1517*. Borrego Canyon, 16 Jun 1992, *Felger 92-614*. Coyote Water, 18 Mar 1998, *Felger 98-119*. Camino del Diablo, SE of Raven Butte, bajada, 25 Oct 2004, *Felger* (observation). †Butler Mts, anthocarp, 11,060 ybp.

Mirabilis multiflora (Torrey) A. Gray var. **multiflora**
Colorado four o'clock. Figure 15.

Herbaceous perennials with sprawling stems from tuberous roots; winter dormant, new shoots appearing in April. Leaves petioled; blades 5–10 cm long, mostly ovate, often asymmetric. Floral involucres often 2–3 cm long. Flowers usually 6 per involucre, the perianth often 3–5 cm long, bright dark pink to red-purple, closing in the early morning; flowering in summer. Fruits 6–10 mm long, dark brown to blackish, ovoid to rounded.

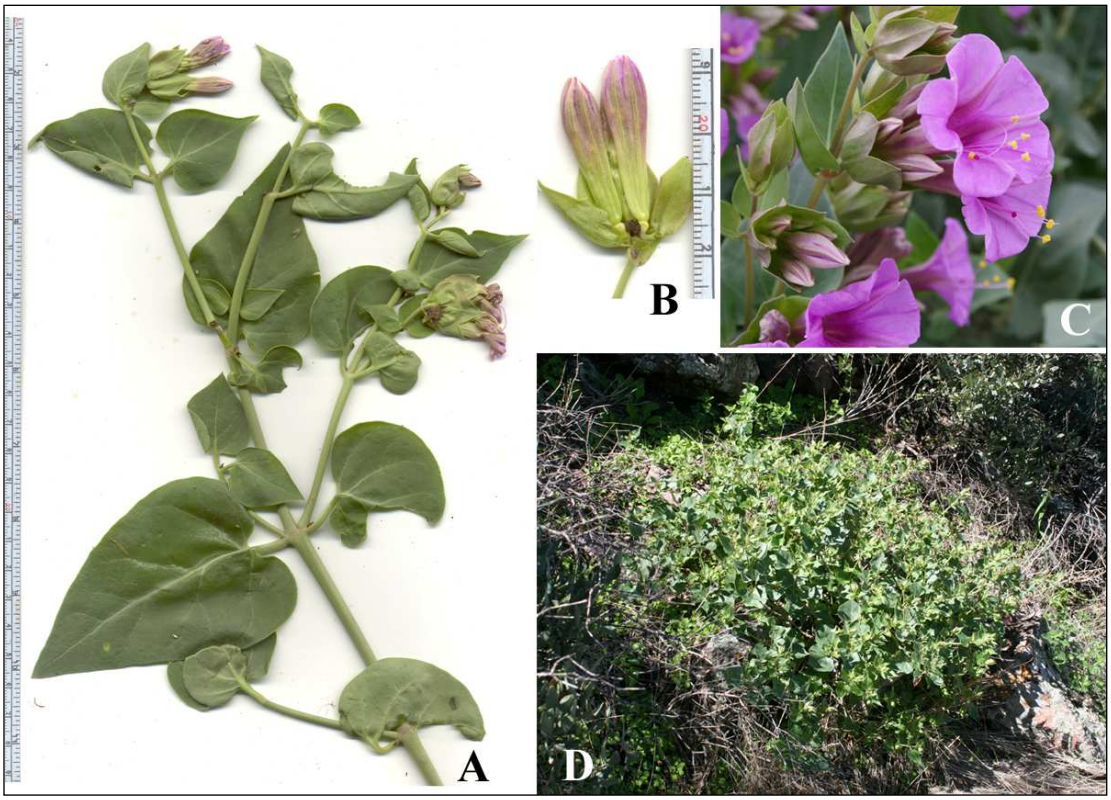

Figure 15. *Mirabilis multiflora*. (A & B) Arch Canyon, 21 Sep 2008. (C) Camp Creek, Tonto National Forest, 22 Apr 2010, photo by Elizabeth Makings. (D) Near saddle between Arch and Boulder canyons, 16 Sep 2006.

In the flora area known only from the Ajo Mountains; canyons and higher elevations in shaded microsites on rocky slopes often among oaks (*Quercus*) and rosewoods (*Vauquelinia*).

Mirabilis multiflora occurs in Arizona, generally above the desert, to Colorado, western Texas, Utah, California, Baja California, and northern Sonora to San Luis Potosí. Variety *multiflora* is the most widespread of the three varieties (Spellenberg 2003; Welsh et al. 1993).

OP: Boulder Canyon, rocky slopes, 2600 ft, 3 May 1978, *Bowers 1279*. Abundant on shaded, very steep N-facing slope below cliff, E of saddle between Arch and Boulder canyons, 26 Oct 2003, *Rutman 2003-1026-43*.

Mirabilis tenuiloba S. Watson
Long-lobed four o'clock. Figure 16.

Herbaceous perennials, sometimes flowering in the first year, often dying back to rootstock during drought; roots stout, somewhat thickened. Plants densely glandular-pubescent, especially the new growth and inflorescences. Leaves tardily drought deciduous, often 3–6+ cm long including petioles, the blades thick and semi-succulent, mostly deltate. Involucres green, enlarging moderately to 10–15 mm long as the fruits develop, the lobes 5–9 mm long. Perianth white. Fruits 4.4–5.4 × 3–3.6 mm, oval, brown, nearly smooth when fresh, to moderately reticulated or with low ridges when dry. Reproductive at various seasons except during colder weather. The plants are generally larger, more robust, and with larger, thicker, and more yellowish leaves and larger fruits than those of *M. laevis*.

Figure 16. *Mirabilis tenuiloba.* Palm Canyon, Kofa Mts, Yuma Co., 8 Oct 1977, *Harrison 11* (ASU 100323, from SEINet).

In Arizona known only from the Kofa Mountains and the flora area in the Tinajas Altas Mountains, including Borrego, Frontera, and Surveyors canyons where it is common on rocky slopes and canyon bottoms, often growing intermixed with *M. laevis* (Felger 1993). Canyons in the larger granitic mountains in the western part of Cabeza Prieta should be searched for this species.

In the USA known otherwise in the western part of the Colorado Desert in southern California. In Sonora known only from the Sierra del Rosario (Felger 2000); also the Baja California Peninsula and islands in the Gulf of California.

TA: Tinajas Altas Mountain, *Goodding 7 Mar1940*. Borrego Canyon, 16 Jun 1992, *Felger 92-613*. Frontera Canyon, 18 Mar 1998, *Felger 98-108*. Surveyors Canyon, 29 Mar 2010, *Felger 10-200*.

OLEACEAE – Olive Family

Trees, shrubs, or perennial herbs. Leaves opposite and decussate (alternate above in *Menodora*), simple or pinnately compound; stipules none. Flowers radial, bisexual or unisexual. Calyx 4 (–15)-parted or sometimes none. Corollas sympetalous, 4–6 lobed, or none. Stamens usually 2 or 4. Fruits highly variable, the seeds 1 (2–4) per chamber.

Mostly trees and shrubs, also vines and some herbaceous perennials. Worldwide; 24 genera, 615 species.

1. Trees; leaves pinnately compound…… **Fraxinus**
1. Perennial herbs or shrubs; leaves simple.

2. Woody shrubs with rigid branches; leaves and twigs smooth or with small but not rough hairs (not scabrous); flowers inconspicuous; fruits fleshy……... **Forestiera**
2. Perennial herbs to subshrubs with slender, brittle stems; leaves scabrous like sandpaper; flowers bright yellow; fruits dry (capsules)…….. **Menodora**

Forestiera

Hardwood shrubs; Americas with 20 species.

Forestiera phillyreoides (Bentham) Torrey
[*F. shrevei* Standley. It seems a shame to lose this double pun named for the famous desert ecologist Forrest Shreve.]
Desert olive. Figure 17.

Multiple-stemmed hardwood shrubs 1.5–4 m tall. Branches rigid, opposite and decussate, with short spur-branches. Leaves winter- and drought-deciduous, mostly 1.5–2.8 cm long, oblong-elliptic to narrowly oblanceolate, glandular punctate, at first densely pubescent with soft, spreading hairs, becoming glabrate or glabrous with age; margins entire. Flowers small, yellow, 3–5 in axillary clusters, male and female flowers on separate plants, or perhaps some flowers bisexual, perianth absent or with a greatly reduced calyx; male flowers with 4 stamens, the anthers dark purple. Flowering in January and February before or with first leaves. Fruits of drupes, 7–10 mm long, fleshy, glaucous purplish-black, ellipsoid, moderately curved, 1-seeded; ripening in May.

Ajo Mountains and locally in the Puerto Blanco Mountains, mostly at higher elevations and in canyon bottoms above 750 m, often with oaks, and on rocky, especially north-facing slopes. It was in Alamo Canyon 1200 years ago.

Southern Arizona and northern and western Sonora, characteristically at the upper elevation range of the Sonoran Desert to lower oak woodland and chaparral-like vegetation. Also in north-central Mexico.

Fresh, ripe fruits of *Forestiera* are edible but were not widely used (e.g., Castetter & Opler 1936).

OP: Alamo Canyon: Above Alamo Ranch, 19 Apr 1933, *Shreve 6201* (isotype of F. shrevei); Large shrub 10–15 ft high, common in rocky soil on dry canyon floor with turbinella oak, mesquite, desert broom, 2500 ft, 17 Apr 1952, *Parker 7996*. Boulder Canyon, 2800 ft, canyon bottom, to 8 ft, 3 May 1978, *Bowers 1295*. Arch Canyon, shrub to 3 m tall, 12 May 1988, *Baker 7609* (ASU). Middle fork Alamo Canyon near crestline of Ajo Mts, 15 Mar 2003, *Rutman 2003-329*. Large wash draining NE slopes of Pinkley Peak, 1800 ft,

locally common, 31 Oct 2003, *Rutman 20031031-5*. †Alamo Canyon, seeds, 1150 ybp (the specimen probably represents this species because it was in a modern assemblage of Sonoran Desert/chaparral species).

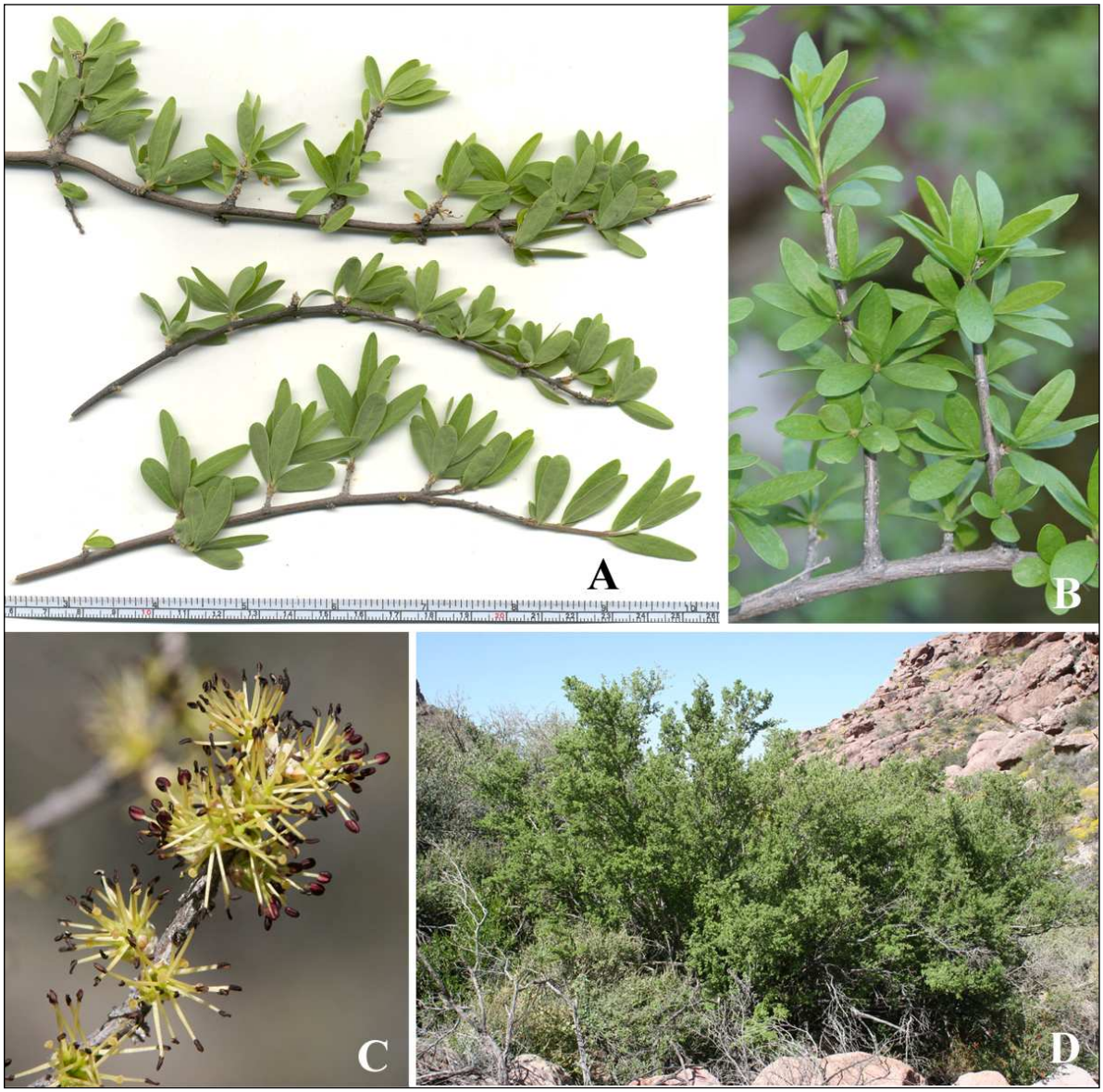

Figure 17. *Forestiera phillyreoides.* Alamo Canyon: (A) 21 Mar 2008; (B) 12 Mar 2005. (C) Staminate flowers, Tillotson Wash, S of confluence with Alamo Wash, 26 Jan 2009. (D) Wash NE of Pinkley Peak, Puerto Blanco Mts, 24 Mar 2008.

†**Forestiera** cf. **pubescens** Nuttall
[F. *neomexicana* A. Gray]

Winter-deciduous shrubs. The Alamo Canyon samples, from a pinyon-juniper-oak woodland midden assemblage, are likely to be *F. pubescens* rather than the present-day desert-edge species. The nearest present-day populations of *F. pubescens* are in Yavapai County in north-central Arizona. It ranges from California to Colorado and Texas, and northern Mexico.

OP: †Alamo Canyon, seeds, 32,000 ybp.

Fraxinus – Ash; *fresno*

Trees and some shrubs. Northern Hemisphere; 50 species.

****Fraxinus velutina** Torrey

Velvet ash; *fresno*

Winter-deciduous trees, the leaves becoming golden yellow in fall. Bark gray, with age deeply furrowed into forking ridges. Herbage velvety hairy, the leaves often glabrate with age. Leaves odd-pinnate, the leaflets (3) 5–9 per leaf. Male and female flowers mostly on separate trees; petals none. Flowers small, wind-pollinated. Fruits in pendulous clusters of samaras. Flowering probably in spring and perhaps sporadically through the summer.

Known from the flora area by a single specimen and not relocated in the field. It was often planted in the region as a shade tree at ranches and may have been planted in the canyon, or perhaps it was native and has since perished. The nearest naturally occurring population is in the Baboquivari Mountains.

Southwestern USA and northern Mexico.

OP: Alamo Canyon, 3000 ft, 14 Mar 1940, *Benson 10686*.

Menodora

Herbaceous perennials and shrubs. Two-dozen species in three disjunct regions; southwest North America (USA and Mexico), temperate South America (mainly Argentina), and southern Africa (Chumley 2007; Nesom in press; Turner 1991).

Menodora is monophyletic and forms a clade nested within *Jasminum* (Chumley 2007; Lee et al. 2007; Rohwer 1995, 1997; Wallander & Albert 2000). Chumley stated that the means of dispersal in *Menodora* is not known. However, we found that *M. scabra* seeds are sticky when fresh, and older, dry seeds become mucilaginous when wet and adherent upon drying (Walter Fertig, pers. comm. to Felger, Dec 2015), which may have a bearing on explaining the widely disjunct distributions among the species in this genus. In response to Felger's inquiry about *Menodora* seeds being mucilaginous, Prof. Jen Rohwer replied, "I am not surprised to hear that *M. scabra* has a myxotesta. This further underscores the close relationship with *Jasminum*. . . . *Jasminum* has a sarcotesta, i.e., a fleshy seed coat with greatly enlarged epidermal and/or subepidermal cells. Such a juicy tissue may also be sticky, and I guess that's the same in *Menodora*. It would certainly be worthwhile to study the development of the seeds in detail" (pers. comm. Dec. 2015).

Menodora scabra A. Gray

[*M. scoparia* Engelmann ex A. Gray]

Twinberry. Figure 18.

Subshrubs or perennial herbs, often 30–50 cm tall, the stems mostly erect, slender, leafy, and dying back in drought. Herbage and calyces with short, rough sandpaper-like hairs (scabrous puberulent). Leaves gradually drought deciduous, opposite below, alternate and reduced above; mostly 1.2–4.5 cm × 2–5 mm, sessile or subsessile, narrowly to broadly elliptic, narrowly oblong, or obovate, the tip acute; margins entire. Flowers solitary or inflorescences corymbose or paniculate; flowering during warm weather except in drought. Calyx deeply divided into 7–10+ linear lobes. Corollas bright yellow, 1.2–1.5 cm wide, 5- or 6-lobed. Stamens 2. Fruits of capsules with 2 inflated, membranous-papery hemispheres opening around the middle. Seeds 4 per chamber (8 total), 4–6 mm long, somewhat flattened; seed coat reticulate and pitted, with a spongy outer seed coat and a smooth hard, inner seed coat; fresh seeds very sticky, the dry seeds becoming mucilaginous when wet and adhering to a substrate upon drying.

Mostly north-facing slopes and canyons in ranges on the east side of Cabeza Prieta and widespread in Organ Pipe including the Ajo Mountains to the crestline.

Deserts and semi-arid regions in southwestern USA and northern Mexico.

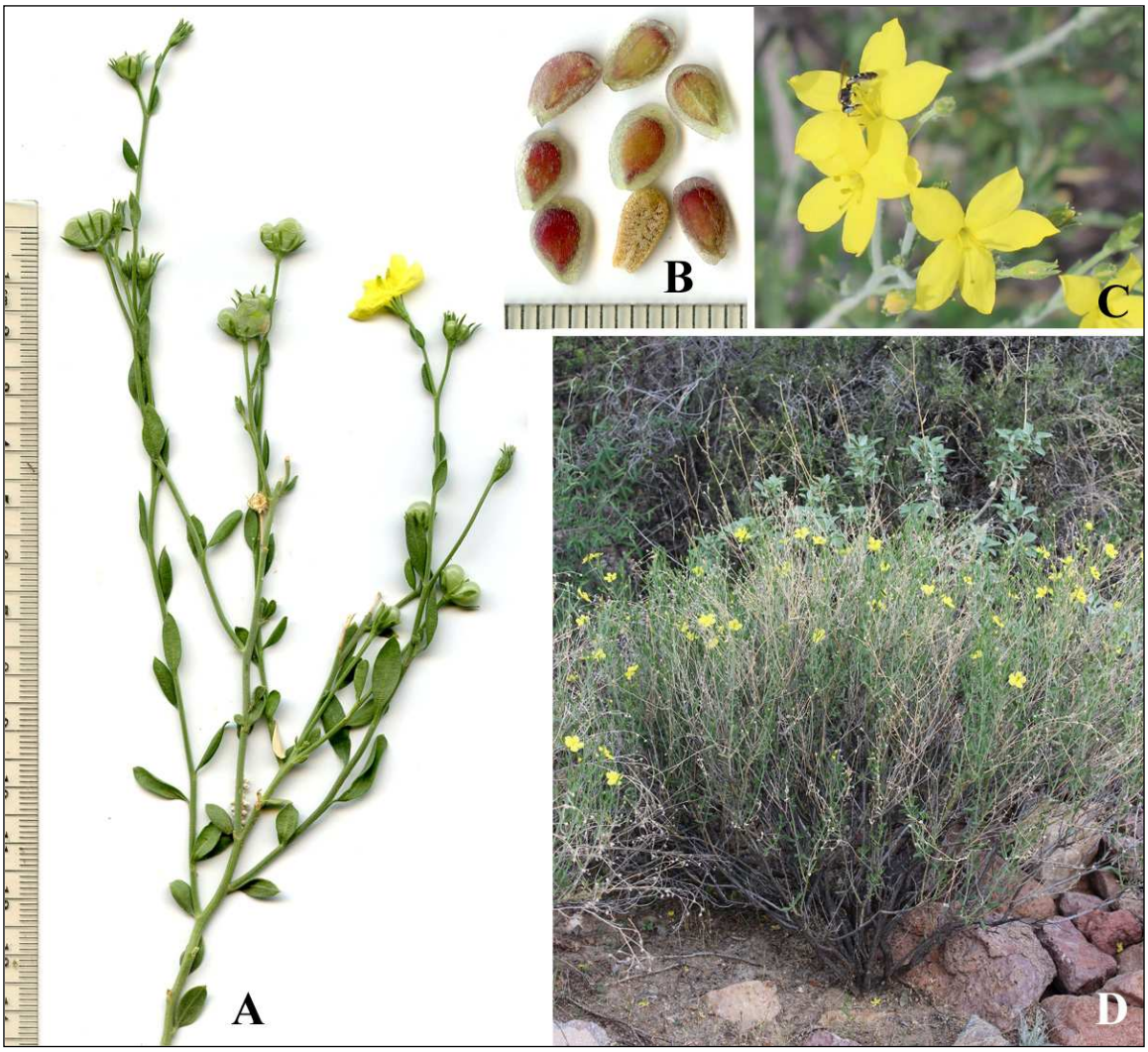

Figure 18. *Menodora scabra.* (A) Wash crossing Hwy 85 at mile 66.5, 2 Aug 2014. (B) Estes Canyon, 19 Sep 2014. (C) Sauceda Mts, 4 Aug 2013. (D) Between Arch and Estes canyons, Ajo Mountain Drive, 2 Aug 2013.

Nesom (in press) and Turner (1991) include *M. scoparia* as a synonym of a broadly interpreted *M. scabra*. Chumley (2007) treats them as separate species, restricting the range of *M. scoparia* mainly to regions east of the Continental Divide. In his dissertation, Chumley proposes four varieties of *M. scabra*, one of which, *M. scabra* var. *glabrescens* A. Gray, occurs in the flora area, and another one (not validly published) that occurs near the flora area. However, the distinction of var. *glabrescens* is rather weak (description incomplete) and we choose to recognize a broadly interpreted *M. scabra*. Evidently, more research is needed to understand the relationships among these plants.

OP: Senita Pass, 13 Apr 1941, *McDougall 85.* 1.5 mi SE of Bates Well, 18 Mar 1945, *Darrow 2429*. Dripping Springs, *Hesselberg 10 Apr 1966*. Ajo Mt Drive, 11 Nov 1988, *Beal & Beal 194*.

CP: Sheep Peak, N side, mid-elevations to peak, 31 Jan 1992, *Felger* (observation). Tuseral Tank, 5 Apr 1993, *Harlan 392*. Childs Mt, 9 Apr 1993, *Felger 93-289*.

†**Menodora** sp.

The fossil specimens may be *M. scabra*, or possibly *M. spinescens* A. Gray, a more northern species that may have occurred with Ice Age woodland vegetation.

OP: Montezuma's Head, seeds, 13,500 to 21,840 ybp (3 samples).

ONAGRACEAE – Evening-Primrose Family

Ephemerals or perennial herbs (those in the flora area; includes shrubs to trees elsewhere). Leaves alternate, opposite, or in basal whorls. Flowers usually with a floral tube (hypanthium), often more or less elongated, above the ovary, the tube producing nectar near its base; floral parts above the ovary usually deciduous after flowering. Sepals and petals each 4, separate above the hypanthium (summit of floral tube; the terms *sepal* and *petal* refer to the lobes or free portions of the calyx and corolla). Ovary inferior. Pollen grains usually among cobwebby threads. Style 1, stigma 2- or 4-lobed or discoid, capitate or elongated. Fruit a capsule or nut-like. In spite of the common name, this family is not related to the primrose family.

Worldwide, especially diverse in western North America; 22 genera, 660 species.

1. Perennials; flowers bright red; seeds with a tuft of hairs at one end…….. **Epilobium**
1. Annuals/ephemerals or perennials; flowers variously colored but not bright red; seeds not hairy.

2. Petals (2) 2.5–6 cm long, uniformly (monochromatic) yellow or white without spots or other markings…….. **Oenothera**
2. Petals 0.2–1.7 cm long, color various, often with spots or other markings.

3. Non-seasonal ephemerals/annuals; flowers diurnal; stigma 4-lobed; fruits indehiscent, nut-like and hard, 8–10 mm long, widest above middle, 1- or 2-seeded. ……**Oenothera curtiflora**
3. Ephemerals or short-lived perennials, growing and flowering during cool seasons; flowers opening near dawn or dusk and withering in mid-morning or mid-day heat; stigma hemispherical or capitate; fruits dehiscent capsules, (12) 15 mm long or more, widest at base or about same thickness throughout, many-seeded……. **Camissonia** sensu lato:

4. Flowers and capsules pedicelled……... **Chylismia**
4. Flowers and capsules sessile.

5. Flowers minute, petals 2–2.5 mm long, white or pink…….. **Eremothera chamaenerioides**
5. Flowers small but not minute, petals 5–7.5 mm long, yellow or white.

6. Stems thick, the epidermis shiny whitish and peeling; inflorescences usually densely flowered, the flowers crowded, the petals white, the hypanthium 4.5–7 mm long; capsules woody, 12–20 mm long, 2–3 mm wide at base, abruptly tapering…..... **Eremothera boothii**
6. Stems slender, the epidermis green, not peeling; inflorescences few-flowered, the flowers not crowded, the petals bright yellow, the hypanthium 0.7–0.9 mm long; capsules not woody, (32) 40–85 mm long, 1–1.4 mm wide throughout……..... **Eulobus**

Camissonia sensu lato – Sun cup

Ephemerals or perennial herbs growing during cool seasons, segregated into several genera including *Chylismia*, *Eremothera*, and *Eulobus*. Leaves basal and/or along the stems, alternate, and

usually reduced upwards. Flowers 4-merous, opening near dawn or near sunset, withering with mid-morning or midday heat (remaining open longer on cooler days). Floral tube prolonged beyond the ovary, deciduous after flowering. Stigma almost always green. Stamens 8. Capsules straight or contorted, dehiscent, with many small seeds.

The smaller-flowered species, such as *Eremothera chamaenerioides*, are selfing (autogamous). The long, slender, nectar-filled floral tube (hypanthium) and evening-opening (vespertine) flowers of *Chylismia arenaria* suggest it is pollinated primarily by hawk moths, as in other evening primroses (e.g., certain *Oenothera*) with similar flower structure and biology. Other vespertine species, both white- and yellow-flowered, are undoubted visited by smaller moths. The outcrossing (allogamous) species open an hour or more before sunset and/or after sunrise, at which time they are pollinated by solitary, ground-dwelling bees. These bees tend to nest in sandy soils, and the lowland distribution of certain *Camissonia* may be largely controlled by the habitat needs of their pollinators. The female bees gather pollen to stock the larval cells in their underground nests.

Chylismia

Ephemerals to short-lived, herbaceous perennials, growing and reproductive during the cooler months. Abaxial (lower) leaf surfaces or margins with conspicuous (brown) oil cells. A genus segregated from *Camissonia*.

Western North America; 16 species.

1. Ephemerals or perennials; larger leaves on stems well above base of plant and not in a basal rosette; leaf blades about as wide as long, rounded to ovate or somewhat triangular, toothed or serrated. ……..…. **Chylismia arenaria**
1. Ephemerals; larger leaves in a basal rosette, stem leaves reduced; leaf blades more than 3 times longer than wide, the leaves pinnately lobed to divided……. **Chylismia claviformis**

Chylismia arenaria A. Nelson
[*Camissonia arenaria* (A. Nelson) P.H. Raven. *Oenothera arenaria* (A. Nelson) P.H. Raven]
Fortuna suncup. Figure 19.

Ephemerals, often robust, to short-lived subshrub perennials. Plants 15–60 cm tall, with soft, spreading, long white hairs. Stems leafy. Petioles (2.5) 3.5–6 cm long; leaf blades 2–5.5 cm long, orbicular to deltate, the bases cordate, the margins toothed. Flowers vespertine, 6.5–8 cm long including the pedicel; hypanthium often 25–35 mm long; petals often 10–16.5 mm long, bright yellow, drying pinkish. Capsules (2) 3–4.6 cm long, straight or nearly so; fruiting pedicels 2–20 mm long.

Rocky slopes and canyons in mountains at Tinajas Altas and the western part of Cabeza Prieta, often in rock crevices.

Western Arizona, southeastern California, and northwestern Sonora.

CP: Tule Tank, *Hinckley 26 Mar 1932*. 3.8 mi W of Tule Tank, *Van Devender 9 Mar 1980*.
TA: Tinajas Altas, 5 Mar 1927, *Harrison 3608*. Canyon above Tinajas Altas, 28 Oct 2004, *Felger 04-83*.

Figure 19. *Chylismia arenaria*. (A) Tinajas Altas, Yuma Co., 2 Mar 2014, photo by Sue Carnahan. (B) Chiraco Summit, Riverside Co., California, 9 May 2012, photo © by Keir Morse.

Chylismia claviformis (Torrey & Frémont) A. Heller
[*Camissonia claviformis* (Torrey & Frémont) P.H. Raven. *Oenothera claviformis* Torrey & Frémont]
Browneyes

Spring ephemerals. Stems branching mostly from the base, (10) 15–45+ cm long. Leaves in a basal rosette, reduced above; rosette and lower leaves (3.5) 6–30 cm long, the blades more or less elliptic, pinnately dissected, variously lobed or toothed, the lower segments of larger leaves often of separate lateral leaflets, the smaller and/or upper leaves often entire; basal leaves often withering by time of flowering and fruiting. Veins on lower leaf surfaces conspicuously brown due to crowded oil cells. Inflorescences ascending, nodding at tips. Flowers vespertine, pedicelled, attractive, often (12) 15–18 mm wide, the petals white or yellow, becoming pink with age and often purplish when dry, the stamens and style of the same color as petals; center (hypanthium) orange-brown. Fruiting pedicels and capsules spreading to erect-ascending; fruiting pedicels 4–20 mm long, the capsules 13.5–27 mm long, moderately club-shaped (slightly enlarged at apex), often 1.8–2 mm wide near apex, straight or slightly curved. (This description pertains to the species as it occurs in the flora area.)

Western USA, Baja California and Sonora. Two of the 12 subspecies occur in the flora area. Bean and Saubel (1972) report that the plants were eaten as greens.

1. Plants glandular hairy, especially the leaves and inflorescence; petals (corolla lobes) white, changing to pink, often drying purplish; sepals with caudate tips arising from the apex (tip). …….. **Chylismia claviformis** subsp. **peeblesii**
1. Plants glandular hairy or not; petals bright yellow, remaining yellow or becoming reddish with age; sepals with caudate tips arising below the apex…… **Chylismia claviformis** subsp. **rubescens**

Chylismia claviformis subsp. **peeblesii** (Munz) W.L. Wagner & Hoch
[*Camissonia claviformis* subsp. *peeblesii* (Munz) P.H. Raven]
Browneyes. Figure 20D–F.

Corollas white, sometimes pink-tinged, and with a red-brown center, the flowers becoming pink with age and often purplish when dry, the stamens, style, and stigma white.

Often on sandy to gravelly soils including dunes of the Pinta Sands; widespread across the flora area.

Arizona, northwestern Sonora, and New Mexico.

OP: Alamo Canyon, *Nichol 26 Mar 1939*. 0.5 mi N of Pozo Nuevo, 30 Mar 1978, *Bowers 1104*.
CP: Jacks Well, *Furlow 14 Mar 1979*. Cholla Pass, 11 Apr 1992, *Harlan 179* (CAB). Papago Well, 10 Apr 1993, *Felger 93-380*.
TA: Tinajas Altas, *Van Devender 5 Mar 1983*.

Chylismia claviformis subsp. **rubescens** (P.H. Raven) W.L. Wagner & Hoch
[*Camissonia claviformis* subsp. *rubescens* (P.H. Raven) P.H. Raven]
Browneyes. Figure 20A–C.
Corollas yellow, with age becoming red-orange, the throat maroon.

Common on sandy soils and dunes; especially in the western part of Cabeza Prieta and the western part of Organ Pipe.

Figure 20. *Chylismia claviformis* subsp. *rubescens*: (A & B) Puerto Peñasco, Sonora, 19 Feb 2015. (C) Growler Valley along Bates Well Road, 29 Feb 2008. Subsp. *peeblesii*: (D) Valley of the Ajo, W of Hwy 85, 5 Feb 2005. (E) Wash crossing Hwy 85 between Ajo and Gila Bend, 28 Feb 2015. (F) Sierra del Águila near Hwy 2, Sonora, 7 Mar 2015.

Southwestern Arizona and northwestern Sonora.

OP: ¼ mi by road N of junction of Bates Well Road and road to Cabeza Prieta Refuge, 30 Mar 1978, *Bowers 1138*. Flat N of Pozo Nuevo Hills, *Casper 14 Mar 2003* (ORPI).

CP: Pinacate Lava Fields, 20 Mar 1933, *Shreve 6211*. O'Neill Hills, 15 Apr 1941, *Benson 10774*. W side of S end of Sierra Pinta, *Monson 20 Mar 1958*. Pinta Sands, 1 Feb 1992, *Felger 92-34*.

Epilobium

Annual and perennial herbs and subshrubs; worldwide; 200 species.

Epilobium canum (Greene) P.H. Raven subsp. **latifolium** (Hooker) P.H. Raven
[*Zauschneria californica* Presl subsp. *latifolia* (Hooker) D.D. Keck]
California fuchsia, hummingbird trumpet. Figure 21.

Perennials with erect to decumbent stems and shredding bark. Leaves opposite, subsessile, 1–5 cm long, linear to ovate, toothed or entire. Flowers bright scarlet and bilateral, the hypanthium 2–3 cm long, tubular and moderately flared above, the petals 8–15 mm long; flowering at various seasons. Capsules 2–3.5 cm long, sessile or short-pedicelled. Seeds with deciduous white tufts of hairs.

Ajo Mountains, in moist or wet soils in canyon bottoms.

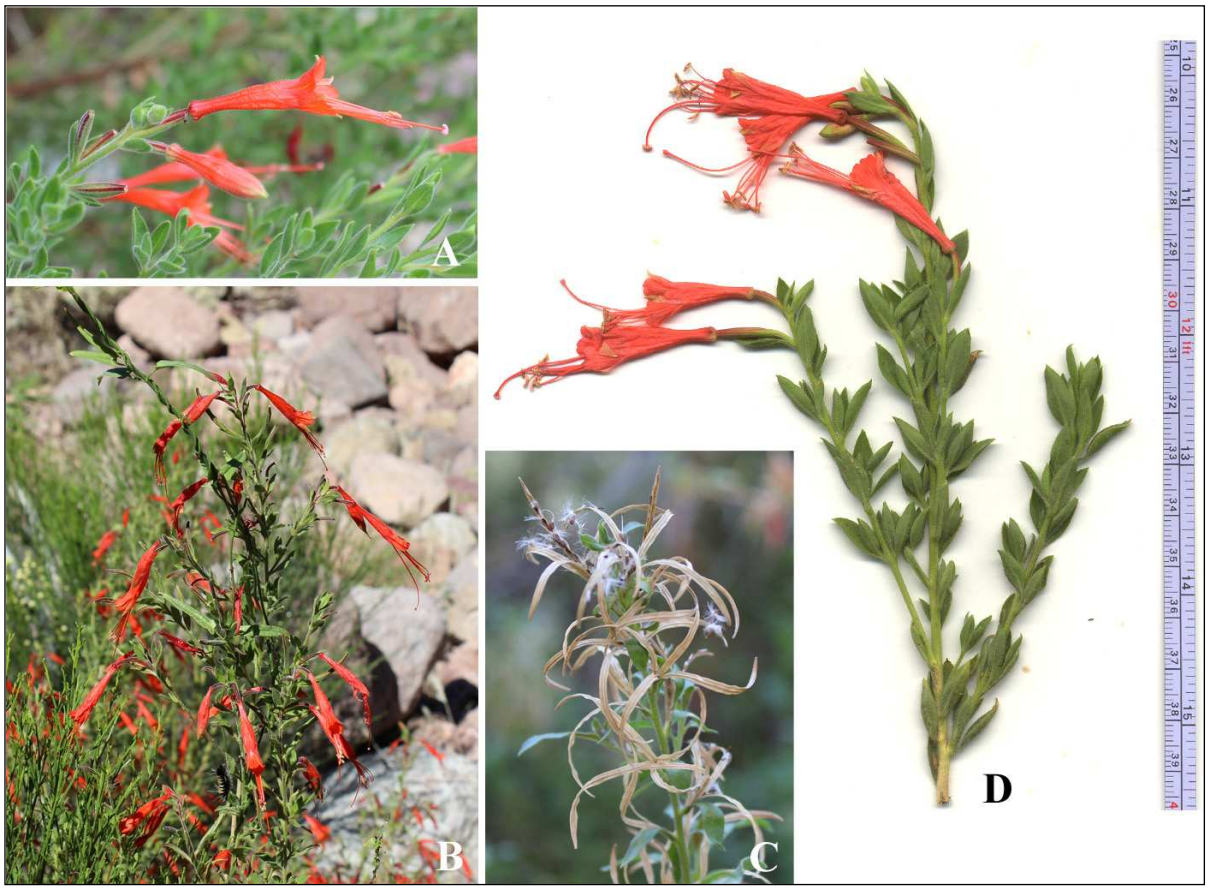

Figure 21. *Epilobium canum* subsp. *latifolium*. Alamo Canyon: (A & D) 7 Sep 2013; (B) 17 Oct 2013; (C) 12 Jan 2014.

Oregon and Wyoming to New Mexico, Baja California, northern and eastern Sonora, and Chihuahua. Five other subspecies occur within the same range.

OP: Alamo Canyon, *Nichol 14 Mar 1939*. Bull Pasture, *Henry 1978* (ORPI). S fork of Alamo Canyon, 7 Sep 2013, *Rutman 20130907-3*.

Eremothera

Ephemerals growing and reproductive during the cooler months. Leaf blades often red spotted or reddish. Flowers small and whitish. Capsules sessile. Western North America; 7 species. A genus segregated from *Camissonia*.

1. Stems relatively thick, the epidermis shiny whitish and peeling; petals 5–7.5 mm long; capsules thickest at the base and woody…….. **Eremothera boothii**
1. Stems slender, epidermis green, not peeling; petals 2–2.5 mm long; capsules uniformly slender and not woody. ……. **Eremothera chamaenerioides**

Eremothera boothii (Douglas) W.L. Wagner & Hoch subsp. **condensata** (Munz) W.L. Wagner & Hoch
[*Camissonia boothii* (Douglas) P.H. Raven subsp. *condensata* (Munz) P.H. Raven]
Woody bottle-washer. Figure 22.

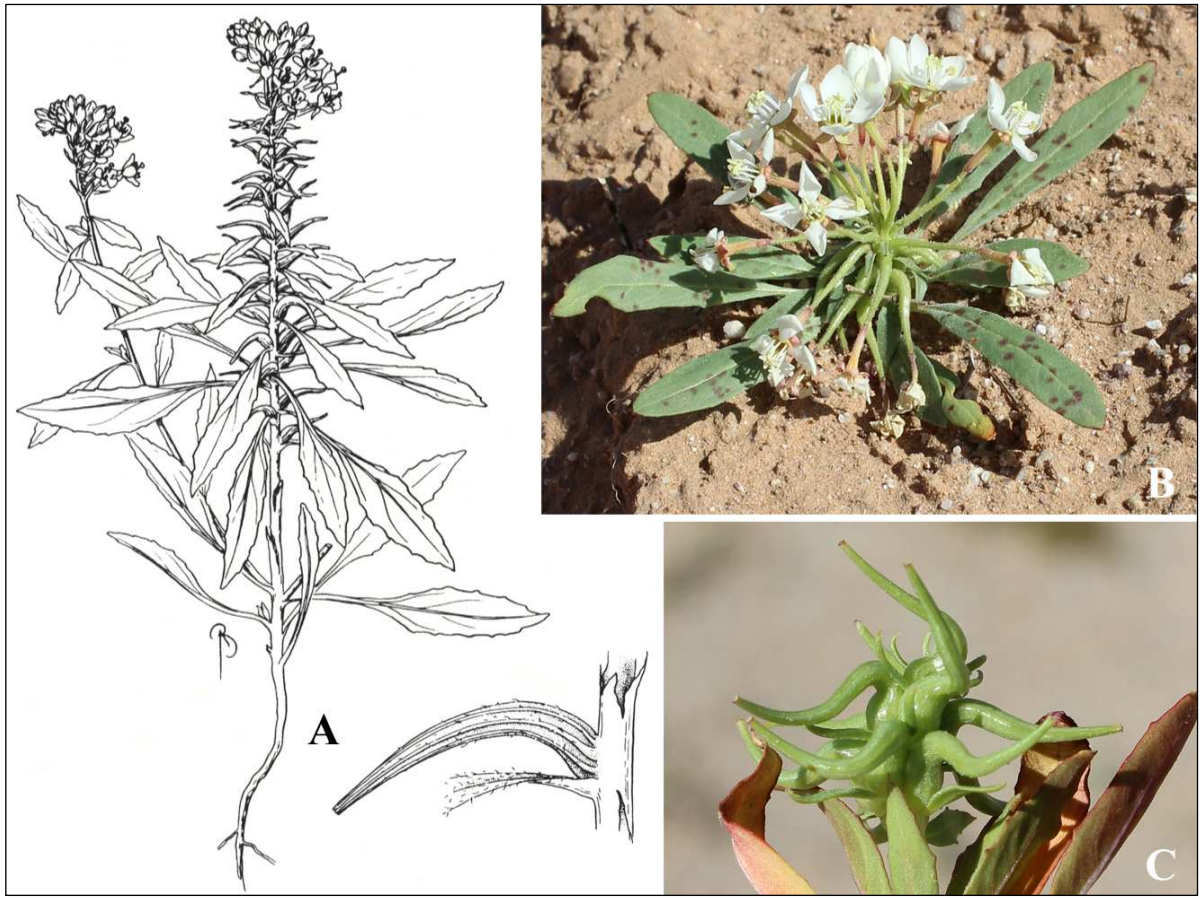

Figure 22. *Eremothera boothii* subsp. *condensata*. (A) By Bobbi Angell. (B) San Cristobal Valley, 13 Mar 2014. (C) Dunes S of Sierra Blanca, Pinacate Biosphere Reserve, Sonora, 15 Feb 2014.

Plants mostly (6) 8–23 cm tall. Stems relatively thick, the epidermis shiny silvery-white and peeling. Young herbage, lower leaf surfaces, and inflorescences sparsely to densely hairy with small glandular as well as larger non-glandular white hairs, becoming glabrate or glabrous with age. Leaves larger and petioled below, 3–14 cm long, becoming smaller and nearly sessile upwards; leaf blades mostly narrowly oblanceolate to narrowly elliptic, the margins minutely toothed or sometimes entire. Inflorescences densely flowered, buds on larger plants nodding. Flowers 16–29 mm long,

presumably vespertine, noticeably fragrant; hypanthium 4.5–7 mm long; sepals becoming pinkish with age; petals 5.6–7.5 × 3–4.2 mm, white, and narrowed at base. Capsules 12–20 mm long, abruptly tapering, 2–3 mm wide at the base, rigid and woody, obscurely 4-angled, bent downward and often twisted, and tardily dehiscent. Skeletons of stems and woody capsules persistent.

Scattered and generally not common, sandy soils of washes and desert plains; Cabeza Prieta especially in the western portion, and in the western part of Organ Pipe.

This subspecies occurs in southern and western Arizona, southern Utah, southern Nevada, southeastern California, northeastern Baja California, and northwestern Sonora; five other subspecies in western USA.

OP: NW corner of Monument, 21 Mar 1941, *McDougall 7*. 0.5 mi N of Pozo Nuevo, 30 Mar 1978, *Bowers 1097*.

CP: Between Bates Well and Papago Well, *Hinkley 25 Mar 1932* [or perhaps in Organ Pipe]. NE edge of Las Playas, 15 Apr 1964, *Niles 356*.

Eremothera chamaenerioides (A. Gray) W.L. Wagner & Hoch
[*Camissonia chamaenerioides* (A. Gray) P.H. Raven]
Willow-herb evening–primrose. Figure 23.

Plants (5) 12–50 cm tall, with glandular hairs and small coarse non-glandular hairs near the inflorescences. Herbage often reddish; stems very slender. Leaves 15–70+ × 1–15 mm, green or reddish with dark red spots, the blades more or less elliptic, entire to sparsely and shallowly toothed or crenulate. Flowers opening near sunset. Sepals reflexed, cream-white inside, pink outside. Petals often 2–2.5 mm long, whitish, often with a broad pink midstripe or markings, or becoming pink with age. Filaments white. Stigma at first white, becoming yellowish to pinkish by morning, surrounded by the anthers at anthesis, both at the same height, the anthers often touching the stigma. Capsules 2.8–6 cm × 0.7–1 mm, sessile, terete, and straight. This is the smallest-flowered evening primrose in the Sonoran Desert; the floral structure and modifications are characteristic of self-pollinated flowers.

Widespread across the flora area in many habitats, mostly at lower elevations.

Southeastern California to western Utah and western Texas, both Baja California states, and northwestern Sonora.

OP: Alamo Canyon, *Nichol 14 Mar 1939.* Quitobaquito Hills, 18 Mar 1945, *Darrow 2412*. 0.5 mi N of Pozo Nuevo, 30 Mar 1978, *Bowers 1106*.

CP: Charlie Bell Pass, 3 Apr 1992, *Whipple 3950* (CAB). San Cristobal Wash, 11 Apr 1992, *Harlan 162b*. Bassarisc Tank, 26 Feb 1993, *Felger 93-121*.

TA: Tinajas Altas, *Goodding 6 Mar 1940* (ASU). Tinajas Altas, rocky slope, 1900 ft, *Van Devender 5 Mar 1983.* Above the tinajas, 19 Mar 1998, *Felger* (observation). Surveyors Canyon, canyon bottom, 29 Mar 2010, *Felger 10-211.*

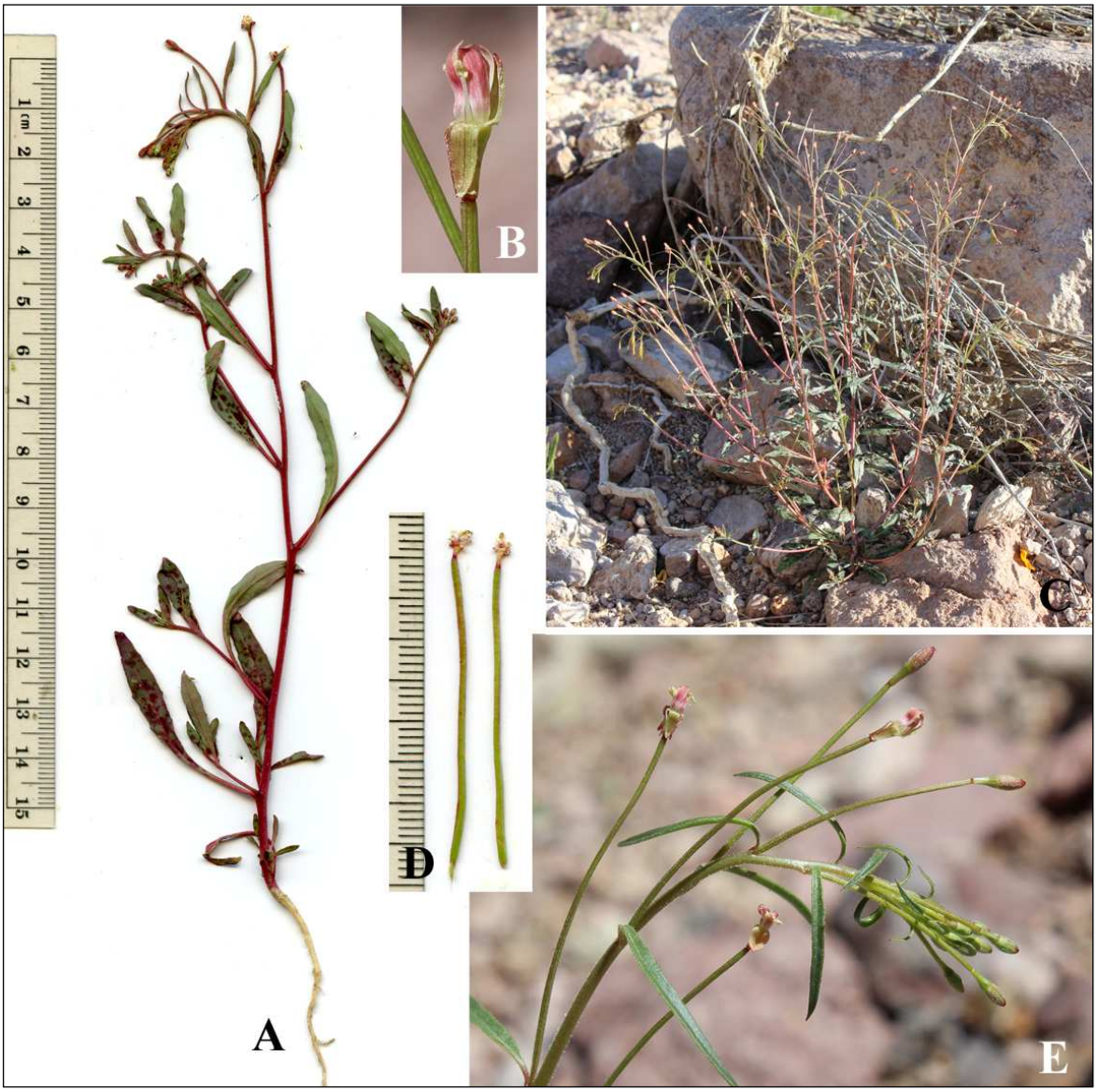

Figure 23. *Eremothera chamaenerioides*. (A) Ten Mile Wash at Ajo Picnic Area, 26 Feb 2015. (B & E) Alamo Canyon, 26 Feb 2015. (C) Hat Mountain, Sauceda Mts, 22 Mar 2013. (D) Sandy Wash near Hwy 85 near N end of Organ Pipe, 25 Feb 2015.

Eulobus

Annuals to subshrubs; southwestern USA and northwestern Mexico; 4 species. A genus segregated from *Camissonia*.

Eulobus californicus Nuttall ex Torrey & A. Gray
[*Camissonia californica* (Nuttall ex Torrey & A. Gray) P.H. Raven]
California suncup. Figure 24.

Spring ephemerals, 15–70+ cm tall, with an erect main axis and ascending straight branches, solitary, sparsely branched, or sometimes much branched. First leaves in a basal rosette or often not forming a basal rosette. Young herbage, buds, and immature fruits glabrate or sparsely pubescent with short white hairs as well as small glandular hairs, becoming glabrous with age. Larger (lower) leaves often 3–24 × 0.4–3.7 cm, petioled, the blades linear to narrowly elliptic, the margins pinnately

and coarsely lobed and/or toothed; stem leaves reduced above. Plants leafy when young, becoming leafless or nearly so with warmer, drier weather at flowering time. Flowers opening near dawn (observed to be closed until at least 10 p.m. and open at 5 a.m.) and withering in mid-morning or mid-day heat. Flowers often 15–18 mm wide; petals 5–7 mm long, bright yellow, sometimes with red flecks, changing to orange, drying pink. Style, stigma, anthers, and filaments bright yellow. As the flower matures the anthers collapse on top of the stigma. Ovary slender, 15–30 mm long; capsules (3.2) 4–8 cm × 1–1.4 mm, straight to slightly curved, and turning downward.

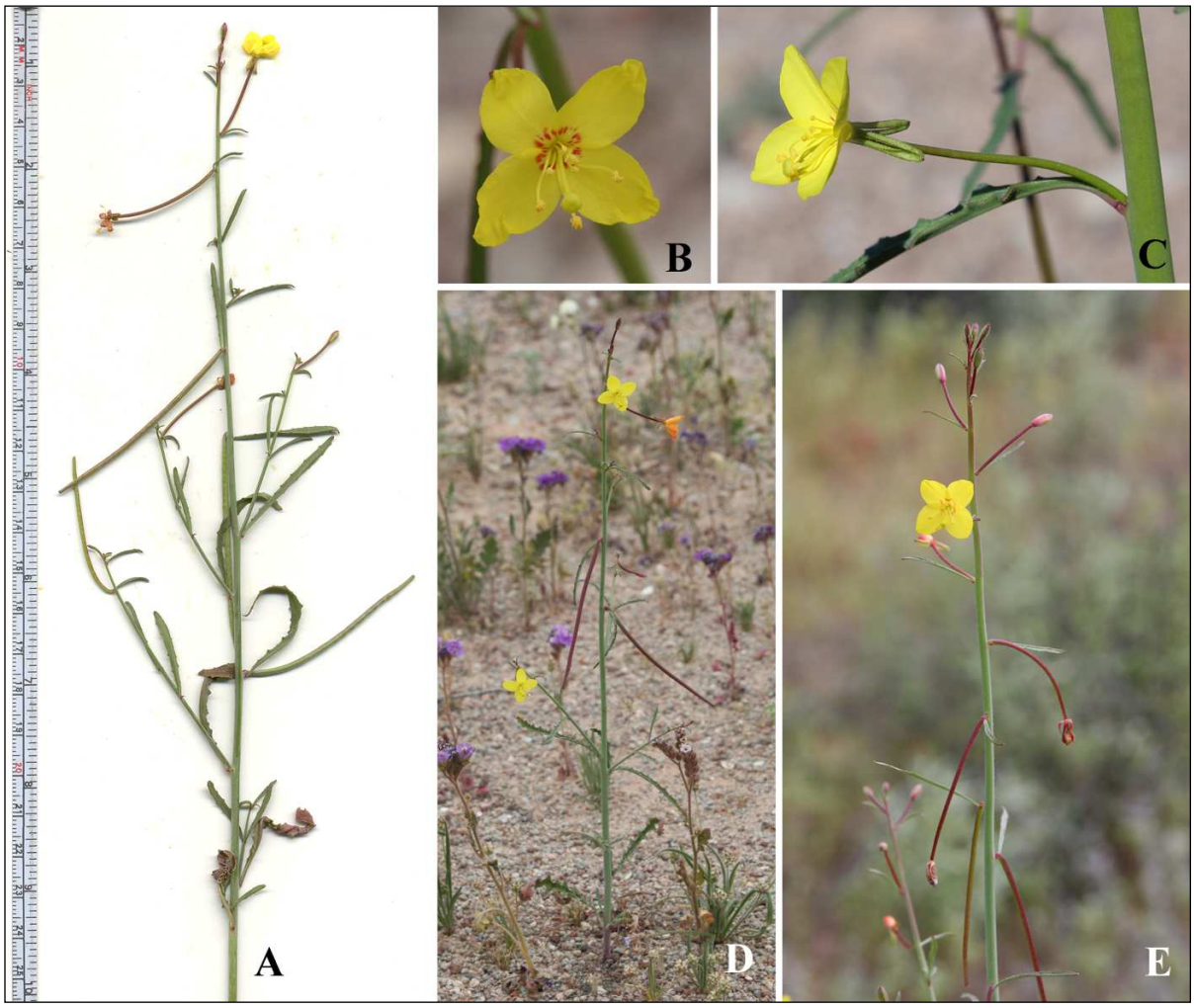

Figure 24. *Eulobus californicus.* (A) Kuakatch Wash, 21 Mar 2008. (B & D) Valley of the Ajo, 8 Mar 2008. (C) Alamo Canyon, 26 Feb 2014. (E) Estes Canyon, 18 Mar 2005.

Widespread and common across the flora area; washes, plains, bajadas, rocky slopes, canyons, and stabilized dunes.

Western Arizona, southern California, Baja California, Baja California Sur, and northwestern Sonora.

Eulobus californica is "mostly self-pollinating, and apparently always self-compatible" and "rarely visited by insects" (Raven 1969: 198). The four species of *Eulobus* share some striking similarities, such as general size and the leafless condition at flowering time.

OP: Puerto Blanco Mts, *Nichol 25 Feb 1939*. Alamo Canyon, *Nichol 14 Mar 1939*. 9 mi S of N of entrance on Sonoyta Road, 8 Apr 1941, *McDougall 45*. Quitobaquito, 6 Apr 1988, *Felger 88-312*.

CP: N Pinta Tank, *Simmons 7 Mar 1964*. Bassarisc Tank, Cabeza Prieta, *Furlow 14 March 1979*. Old ranch site 4.7 mi NE of Tule Well, 28 Mar 1985, *McLaughlin 2975*. Charlie Bell Pass, 3 Apr 1992, *Whipple 3914*. Pinta Sands, dunes, 11 Apr 1993, *Felger 93-417*.

TA: Tinajas Altas, *Van Devender 5 Mar 1983*. Tinajas Altas Canyon, above the tinajas, 19 Mar 1998, *Felger* (observation). Vicinity of Coyote Water, 25 Oct 2004, *Felger 04-34*. Surveyors Canyon, canyon bottom, 29 Mar 2010, *Felger 10-206*.

Oenothera – Evening-primrose

Winter-spring ephemerals (except *O. curtiflora*), with a well-developed taproot (those in the flora area, elsewhere includes small to large perennial herbs). Leaves in a basal rosette or alternate, with large, attractive, nocturnal (vespertine) flowers pollinated by hawk moths, fading within a day, and many-seeded woody capsules. Sepals 4, reflexed in anthesis. Petals 4. Stamens 8. Stigma of 4 linear lobes. *Oenothera curtiflora* differs in being non-seasonal and with small pink, diurnal flowers, and a nut-like fruit. Americas; 145 species.

1. Flowers diurnal; petals pink and less than 0.5 cm long; fruits indehiscent, nut-like and hard, 8–10 mm long, widest above middle, 1- or 2-seeded…… **Oenothera curtiflora**
1. Flowers nocturnal or variously remaining open on cool days, petals yellow or white and (2) 2.5–6 cm long.

2. Petals yellow; capsules (1.8) 2.8–4.6 cm long, 6.4–7.5 mm wide at base, erect, straight, and tapering to a conspicuously narrowed tip; ovary and fruits with papillate-based hairs, the papillae relatively large and usually reddish…….. **Oenothera primiveris**
2. Petals white when fresh, becoming pink with age; capsules 4–6.5+ cm long, 2–3.5 mm wide at base, often curved and usually moderately bent downward, tapering only slightly; fruits hairy but not papillate-based.

3. Buds (sepals) purple-spotted; petals 2.5–3.6 cm long……..…….... **Oenothera arizonica**
3. Buds (sepals) not purple-spotted, of one color; petals 2–5 (6) cm long….. **Oenothera deltoides**

Oenothera arizonica (Munz) W.L. Wagner
[*O. deltoides* Torrey & Frémont var. *arizonica* Munz. *O. californica* S. Watson subsp. *arizonica* (Munz) W. Klein. *O. avita* (W. Klein) W. Klein subsp. *arizonica* (Munz) W. Klein]
Arizona evening-primrose. Figure 25.

Cool-season ephemerals with basal rosettes and leafy stems; stems spreading to decumbent, larger stems often 30–60 cm long and 2.5–4 mm diameter, with whitish, smooth, peeling epidermis, the younger herbage and inflorescences often sparsely hairy. Leaves relatively slender and pinnatifid, somewhat regularly cleft to parted more than halfway to the midrib, the basal leaves often reaching 15–30 cm with very long, slender petioles, the stem leaves (3.5) 5.5–15+ × 0.5–3.8 cm. Leaves and bud sepals with both smaller and larger white hairs, the larger hairs 0.9–1.5 mm long, flat, and ribbon-like (pilose). Larger plants with flowers in upper stems. Buds with conspicuous purple spots usually surrounding the larger hairs. Petals 2.5–3.6 cm long, white, becoming pale pink with age. Capsules 5–7.5 cm × 2–2.3 mm at base, narrowly sub-cylindrical, nearly straight to moderately curved, spreading to downwardly bent, woody at maturity.

Locally common in sandy and deep loam soils of washes, flats, and dunes in the southern part of Cabeza Prieta, and the northwestern part of Organ Pipe and the adjacent eastern portion of Cabeza Prieta.

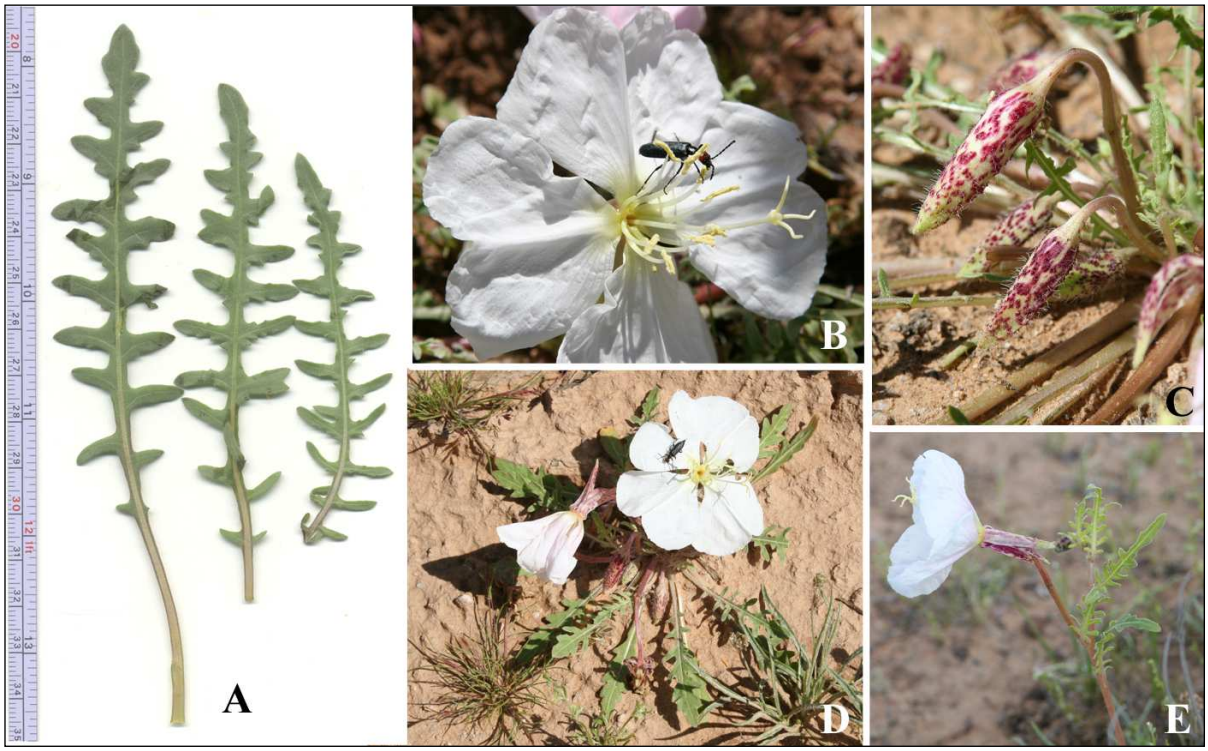

Figure 25. *Oenothera arizonica*. (A) Pinta Sands, 11 Feb 2014. (B–E) Near The Adobe, upper Daniels Valley, 26 Feb 2005.

Sandy soils in southern Arizona, Yuma to Cochise counties and western Sonora southward to Tastiota (28°20'N).

OP: Near Growler Pass, 22 Mar 1935, *Kearney 10856*. Wash near Sonoita Road, *McDougall 10 April 1941*. Cuerda de Leña wash, 31 Mar 1978, *Bowers 1156* (ORPI). W of Cuerda de Leña at N boundary of ORPI, *Rutman 6 Apr 1998* (ORPI). Growler Wash, 1.5 mi downstream from Bates Well, *Rutman 4 Mar 2001* (ORPI).

CP: 13 mi E of Tule Well, 30 Mar 1933, *Shreve 6222*. N of Las Playas, *Darrow 15 Apr 1941*. Pinta Sands, 1 Feb 1992, *Felger 92-36*. 0.2 mi W of San Cristobal Wash [at Camino del Diablo], 20 Mar 1992, *Harlan 15b*.

Oenothera curtiflora W.L. Wagner & Hoch
[*Gaura parviflora* Douglas ex Lehmann]
Lizard tail, velvet-leaf gaura. Figure 26.

Non-seasonal ephemerals, tall and slender, often reaching 1 (2) m tall, with a solitary axis or branched above the middle; herbage with glandular and long spreading non-glandular hairs. Leaves soft and velvety pubescent, elliptic to oblanceolate or obovate; first leaves, at least in winter-spring plants, in a basal rosette; stem leaves alternate 4–20 cm long and often deciduous by flowering time, narrowed to a winged petiole, the margins shallowly toothed to entire. Flowering during warmer months. Inflorescence a spike-like raceme, 19–33+ cm long, not leafy, erect, slender, densely and many-flowered. Flowers opening near sunset, withering within one day, bilateral, 4-merous; sepals 3.4–4.5 mm long, reflexed (at least in daytime); petals 2–3.6 mm long, clawed (narrowed) at base, and initially white, becoming bright pinkish-red; filaments, style, and stigma white to pink. Fruits 8.5–10 mm long, hard, indehiscent, nut-like, spindle-shaped, and widest above the middle; 1- or 2-seeded.

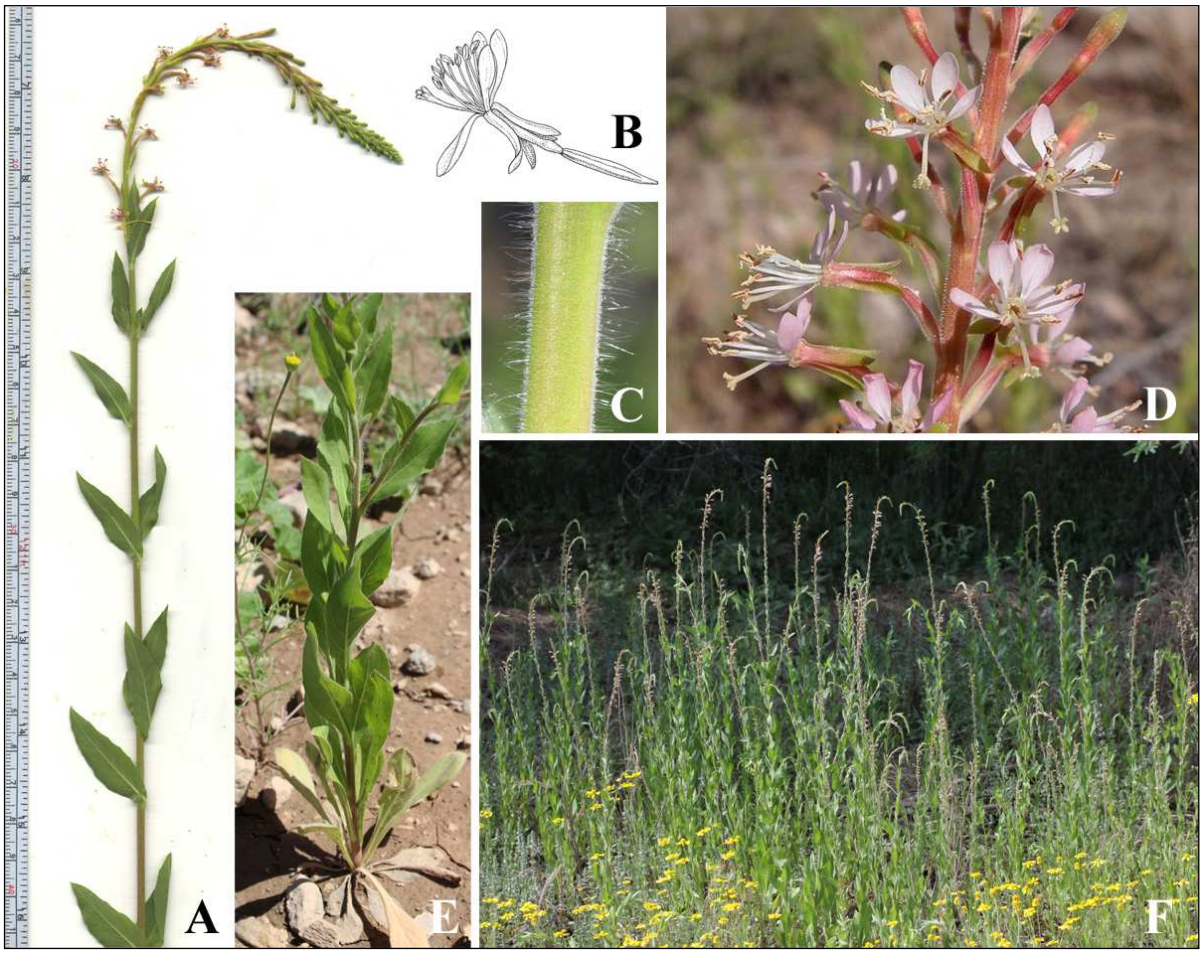

Figure 26. *Oenothera curtiflora*. Pinacate Junction, Pinacate Biosphere Reserve, Sonora: (A) 28 Mar 2013; (C) 5 Mar 2014; (E) 7 Mar 2015; (F) 8 Mar 2013. (B) By Lucretia Breazeale Hamilton. (D) Bond Canyon Creek, Salero Ranch, Santa Cruz Co., 21 May 2014, photo by Sue Carnahan.

In Organ Pipe at Quitobaquito and Cabeza Prieta on sandy to silty, or clayish soils of playas, charcos, arroyo beds, and waterholes.

Across much of the USA and northern Mexico, and adventive in many parts of the world. It was "probably originally native to the shortgrass prairie in the interior of the USA, and spread widely from there as a weed of cultivated and waste areas. Owing to its strict autogamy, it easily becomes established from a single fruit" (Raven & Gregory 1972: 26).

OP: Quitobaquito, 10 Apr 1986, *Felger 86-174A*.
CP: 11 mi W of Bates Well, 14 Apr 1941, *Benson 10748*. Las Playas, *Monson 25 Apr 1958* (CAB). Jose Juan Tank, 26 Feb 1993, *Felger 93-105.*

Oenothera deltoides Torrey & Frémont subsp. **deltoides**
Dune evening-primrose, white desert-primrose, devil's lantern. Figure 27.

Small to large plants, with a basal rosette and usually developing leafy stems. Stems of well-watered plants to 50+ cm long, stout, semi-succulent, and with silvery whitish, peeling epidermis. Young herbage and sepals (buds) densely pubescent with white hairs. Leaves 3.5–22 cm long, the blades lanceolate or elliptic to ovate (narrower in drought-stunted plants), often coarsely toothed or

lobed, sometimes nearly entire, or the lower segments sometimes distinct and the leaves lyrate-pinnatifid; petioles often longer than the blades. Leaves often reduced upward, but the stem leaves of large, robust plants scarcely or not at all reduced. Corollas white, often pale pink with age, with a pale yellow-green "eye" around the mouth of the tube, the petals 2–5.5 (6) cm long, broadly obovate, the tip notched. Capsules rigid and woody at maturity, nearly straight to curved, spreading to usually moderately bent downward, 4–6.5 cm long, 2–3.5 mm wide at the base, narrowly cylindrical (tapering slightly). The dry, dead plants form basket-like skeletons that may persist for several years, hence the name devil's lantern (Figure 27D).

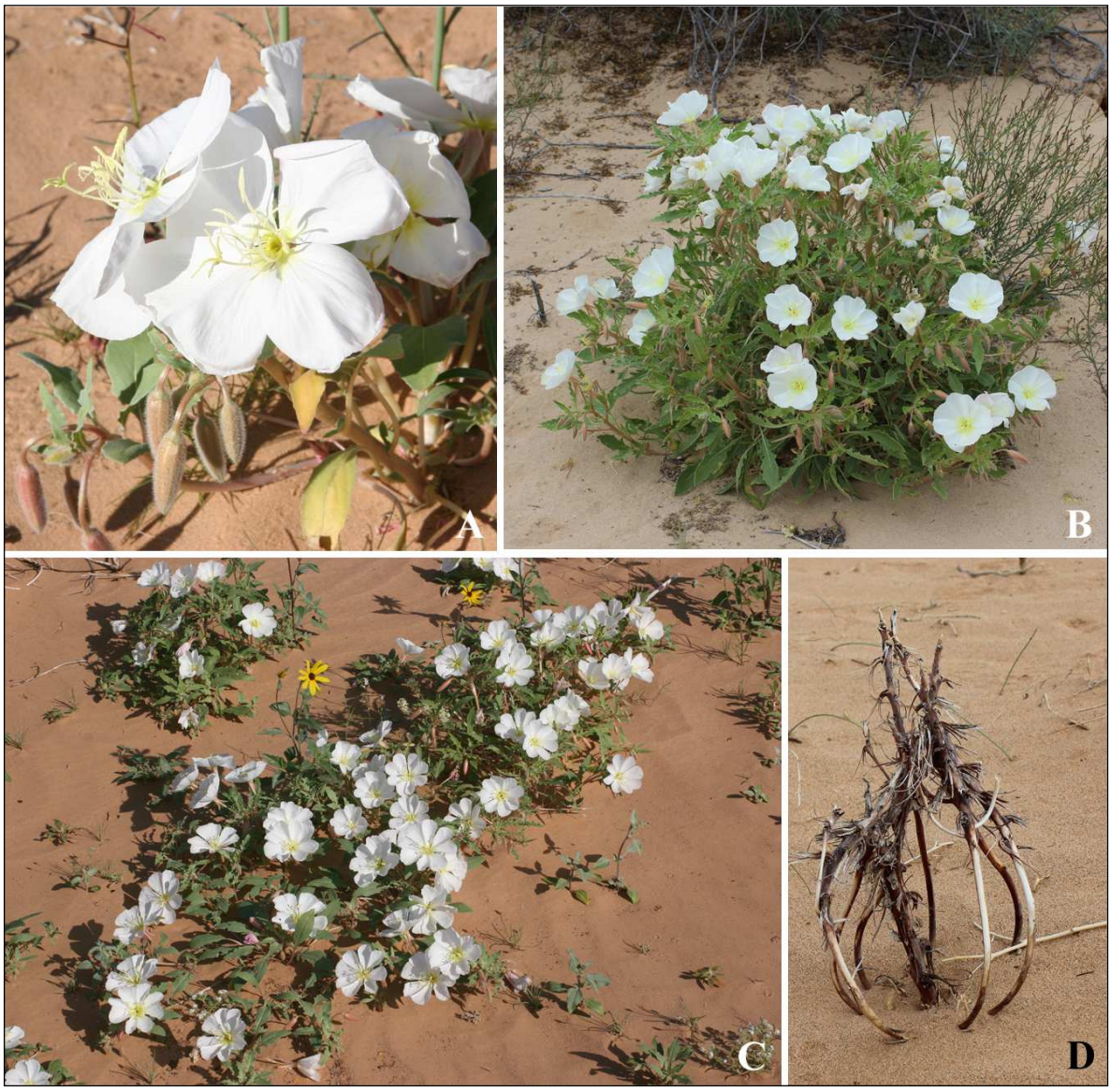

Figure 27. *Oenothera deltoides* subsp. *deltoides.* (A) Puerto Peñasco, Sonora, 16 Feb 2008. (B) Dunes near the Maya Palace, E of Puerto Peñasco, Sonora, 20 Feb 2015. (C) Dunes about 37 km SW of Sonoyta on Mex Hwy 8, Sonora, 27 Mar 2010. (D) Gran Desierto near Mex Hwy 2, 6 Feb 2014.

Especially common in the western part of Cabeza Prieta on sandy soils including dunes, also washes, sand hummocks, and roadsides. It is often abundant on dunes and sand flats during cooler seasons of wet years.

Western Arizona, southern Nevada, southeastern California, Baja California, and northwestern Sonora. Subspecies *deltoides* is the southernmost of the several subspecies that range northward to Oregon and Utah.

The large white flowers open shortly before dusk and remain open until about an hour after sunrise to late-morning, or nearly all day in cool weather. As with *O. primiveris*, when the flowers first open the stigmas and anthers are held away from each other, effectively preventing self-pollination. By morning the flowers on some plants still have the stigma and their lobes held well above the anthers, on other plants the style hangs down so that the stigma is away from the anthers, and on still others the stigma lobes arch down and touch the anthers.

This is one of the most conspicuous spring wildflowers in the sandy desert of southwestern Arizona and northwestern Sonora. During favorable years it can form a major portion of the biomass of the dunes. Towards the end of the season the plants are often ravaged by hoards of sphinx moth caterpillars (*Hyles lineata*). These caterpillars can destroy almost the entire fruit (seed) crop (Felger 2000).

Lumholtz (1912: 331) reports that this species was cooked as greens (he called it *O. trichocalyx*).

CP: 13 mi E of Tule Well, 20 Mar 1933, *Shreve 6222*. Pinta Sands, 1 Feb 1992, *Felger 92-35*. Charlie Bell Road at Daniels Arroyo, 10 Apr 1993, *Felger 93-353*. Las Playas, 11 Jan 2002, *Felger 02-41*.

Oenothera primiveris A. Gray
Yellow evening-primrose. Figure 28.

Winter-spring ephemerals; often developing a thick taproot. Leaves in basal rosettes, nearly stemless or developing a stout, erect, leafy stem sometimes 10–20 cm long. Pubescence of bristly, spreading, bulbous-based white hairs. Leaves (3.3) 5–27 cm long, the larger ones 3.5–7 cm wide, mostly pinnatifid into toothed or rounded lobes, narrowed into a long, winged petiole expanded at the very base. Flowers opening at dusk, closing the following morning. Petals and stigma bright lemon yellow, the petals (1.8) 3.5–5.5 cm long, notched at the tip (flower, leaf, and plant size correlated with soil moisture). Ovaries and fruits densely hairy with large, spreading white hairs, each from a large, conical, fleshy, translucent bulbous base (papilla or gland). Capsules (1.8) 2.8–4.6 cm long, 6.4-7.5 mm wide at base, thick and woody, upright, straight, 4-angled, tapering to a conspicuously narrowed tip. The dry skeletons, consisting of part of the taproot and stem and a cluster of woody capsules, may persist for several years.

Sandy-gravel or silty-clayish soils of washes, sand flats, lower dunes, and playas, also canyons and rocky slopes (to at least 3200 feet in the Ajo Mountains); widespread and common across the flora area.

Southern Arizona to western Texas, southwestern Utah to southeastern California, Baja California, and northern Sonora. Those in the flora area are generally identifiable as subsp. *bufonis* (M.E. Jones) Munz, distinguished by larger and generally cross-pollinated flowers, but smaller-flowered plants are also present.

OP: Tres Alamos Canyon, 2700 ft, *Nichol 24 Feb 1939*. 9 mi by road (2-way section of Puerto Blanco Drive) W of Hwy 85, 26 Feb 1978, *Bowers 1082* (ORPI). Rocky slopes NW of Kino Peak, 1782 ft, 20 Mar 2005, *Rutman 2005-0320-44* (ORPI).

CP: 13 mi E of Tule Well, 20 Mar 1933, *Shreve 6222*. Pinta Sands, 1 Feb 1992, *Felger 92-35*. Las Playas, 11 Jan 2002, *Felger 02-41*. Charlie Bell Road at Daniels Arroyo, 10 Apr 1993, *Felger 93-353*.

TA: Canyon below lowermost Tinajas Altas, 19 Mar 1998, *Felger* (observation). Coyote Water, 25 Oct 2004, *Felger 04-54*.

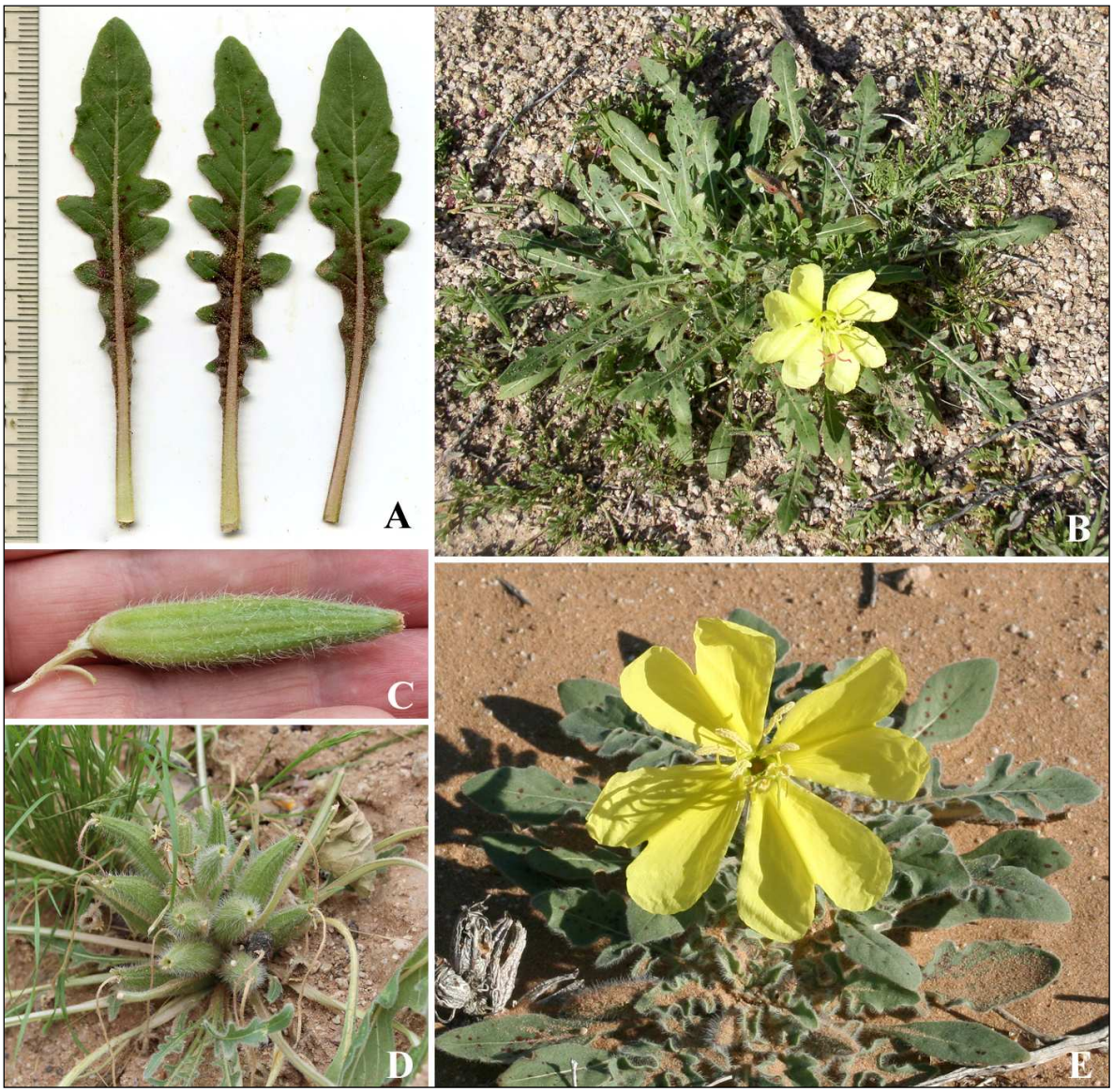

Figure 28. *Oenothera primiveris*. (A) Hwy 85 near N boundary of Organ Pipe, 14 Feb 2015. (B) Kuakatch Wash near Hwy 85, 6 Feb 2005. (C & D) Hwy 85 mile 28, between Ajo and Gila Bend, 8 Mar 2015. (E) Sand flats S of Sierra Blanca, Pinacate Biosphere Reserve, Sonora, 17 Feb 2008.

OROBANCHACEAE – Broomrape Family

Ephemerals and herbaceous perennials, with chlorophyll or root parasites lacking chlorophyll; often glandular. Leaves alternate, the stems leafy or leaves reduced to scales; stipules none. Flowers bilateral, calyx 4- or 5-lobed; corollas 5-lobed and 2-lipped. Stamens 4, sometimes with a rudimentary fifth stamen. Ovary superior. Fruit a capsule; seeds numerous and minute. Worldwide; 99 genera, 2060 species.

1. Stems not succulent; plants with chlorophyll; calyx 4-lobed…..... **Castilleja**

1. Stems succulent; root parasites without chlorophyll; calyx 5-lobed……. **Orobanche**
Castilleja – Paintbrush, owl's clover

Annual and perennial herbs; hemi-parasites on roots of grasses and herbaceous plants. Leaves alternate. Flowers sessile or essentially so, subtended by colorful bracts. Calyx 4-lobed, colored like the bracts. Upper lip of corolla forming a hood enclosing the anthers. Americas and northern Asia; 200 species.

1. Spring ephemerals, seldom more than 15 cm tall, with glandular hairs, not felt-like and not woolly; floral bracts lavender…….... **Castilleja exserta**
1. Perennial herbs, often 30+ cm tall, with white, felt-like woolly hairs; floral bracts red-orange.
…….. **Castilleja lanata**

Castilleja exserta (A. Heller) T.I Chuang & Heckard subsp. **exserta**
[*Orthocarpus purpurascens* Bentham]
Purple owl's-clover. Figure 29.

Attractive spring ephemerals, glandular puberulent and with long hairs. Leaves 1–5 cm long, pinnately cleft with linear to thread-like lobes. Flowers crowded in terminal spikes. Bracts, calyx, and petals showy, lavender, about 1–2+ cm long, the bracts multiple-lobed, the corollas with yellow and red spots terminally.

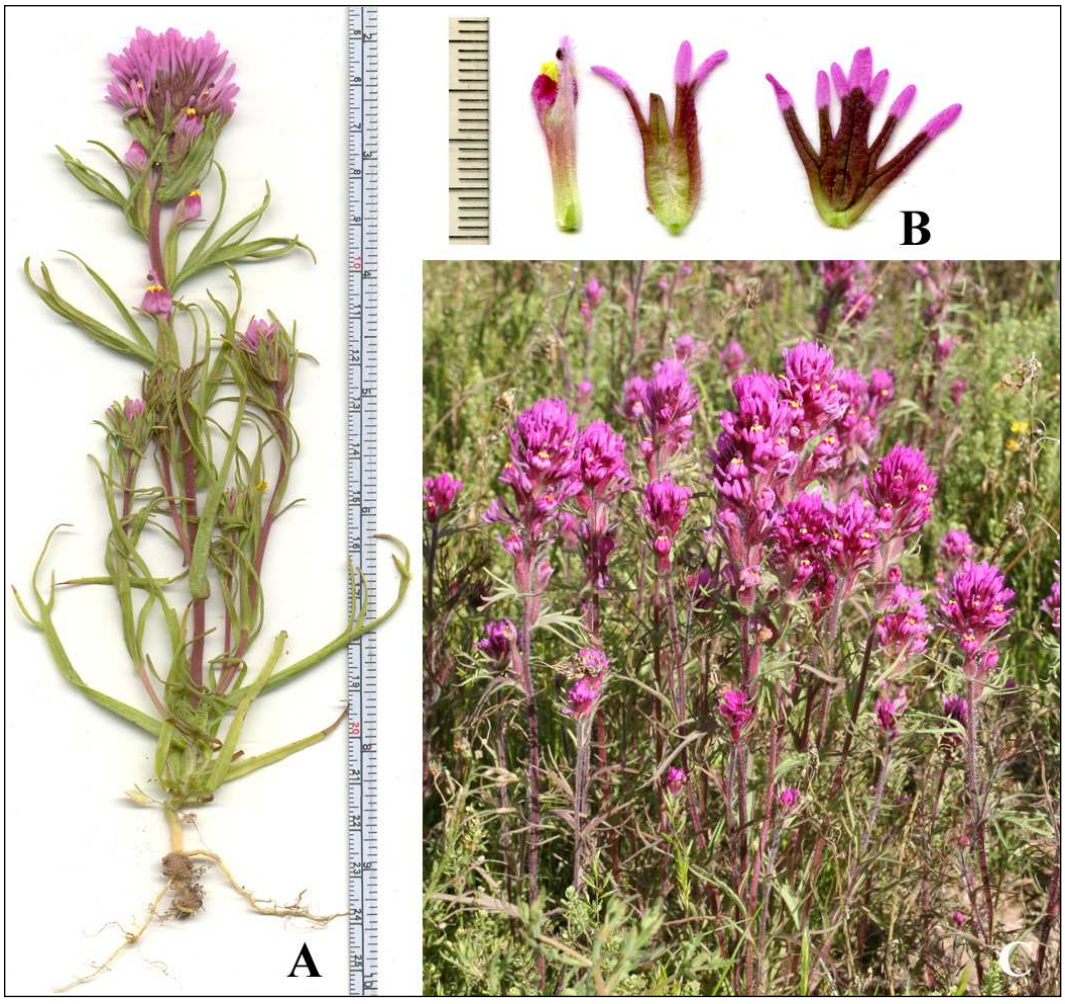

Figure 29. *Castilleja exserta* subsp. *exserta*. (A) Estes Canyon, 2 Mar 2008. (B) Left to right: corolla, calyx, and bract, Midway Wash near Hwy 85, 8 Mar 2015. (C) Near Hat Mountain, Sauceda Mts, 27 Feb 2005.

Bajadas and lower slopes in the eastern and central part of Organ Pipe; dense populations often localized; more common and widespread to the north and east of the Monument. Also a single record from the southeastern part of Cabeza Prieta.

This subspecies occurs in western and southern Arizona, southwestern New Mexico, California, Baja California, and northern Sonora. Two other subspecies occur in California.

OP: Alamo Canyon, 2500 ft, *Nichol 14 Mar 1939*. W base of Ajo Mts, 2500 ft, 14 Mar 1941, *Benson 10656*. Puerto Blanco Mts, beginning of trail to Dripping Springs, 4 Apr 1973, *Holmgren 6650* (ASU, DES). W flank of Bates Mts, 31 Mar 1978, *Bowers 1167* (ORPI). Below Dripping Springs, 30 Jan 1986, *Phillips 86-10* (MNA, ORPI).

CP: Jose Juan Charco, *Prosopis* and annual forbs, clay soil, *Cutler 17 Mar 1995* (CAB).

Castilleja lanata A. Gray
Indian paintbrush. Figure 30.

Perennial herbs, densely white to grayish woolly-pubescent. Stems often to 30+ cm tall. Longer leaves often 2–7 (8) cm long; leaves densely white to grayish woolly, mostly entire, linear or some with 3 slender lobes. Floral bracts deeply 3-cleft, the lobes broad, red-orange and showy, the corollas ca. 3.5 cm long, tubular and yellow.

Ajo and Diablo mountains in canyons, on rocky slopes, and sometimes shallow soils, at middle to upper elevations, and also higher elevations in the Puerto Blanco Mountains and occasional in the Growler Mountains.

Eastward in southern and central Arizona to west Texas, both Baja California states, and northern Sonora to Nuevo León, San Luis Potosi, and Zacatecas.

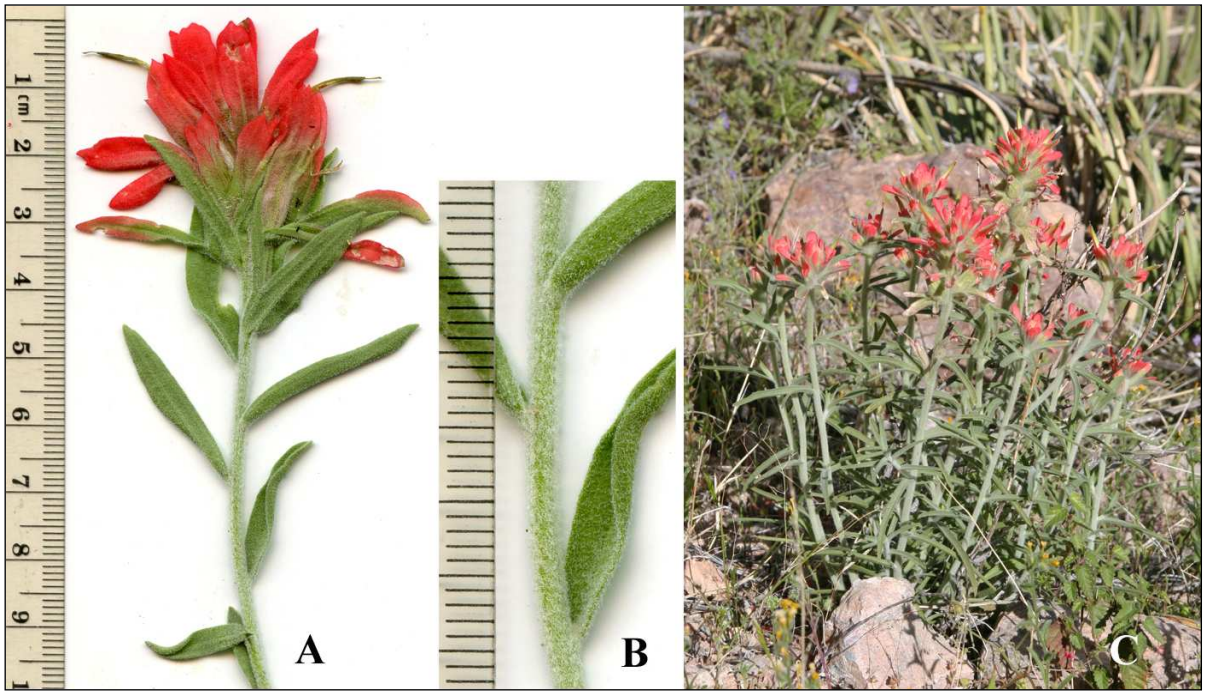

Figure 30. *Castilleja lanata*. (A) Trail to Bull Pasture, 8 Sept 2014. (B) Upper middle fork of Alamo Canyon, 15 Apr 2008.

OP: Alamo Canyon, *Nichol 4 May 1939*. Summit of Ajo Mts, 1 Apr 1944, *Clark 11526* (ORPI). Arch Canyon, *Fay 18 Feb 1978*. Boulder Canyon, 3 May 1978, *Bowers 1283*. NW of Pinkley Peak, *Rutman 24 Mar 2001* (ORPI). Diablo Mts, 807 m, shaded base of N-facing cliff, 22 Sep 2013, *Rutman 20130922-23*.
CP: Growler Mts, canyon on E side near base of mountain, 24 Mar 2009, *Holm 20090324-4*.

†**Castilleja** sp./spp.

There is one Ice Age record for Tinajas Altas, although no member of the genus presently occurs there. The Organ Pipe fossils are from the Ajo Mountains where both present-day species occur.

OP: †Alamo Canyon, seeds, 8130 to 29,110 ybp (4 samples). Montezuma's Head, seeds, 20,490 ybp.
TA: ††Tinajas Altas, seeds, 11,040 ybp.

Orobanche – Broomrape

Ephemerals (those in the flora area; elsewhere annual to perennial herbs), root parasites without chlorophyll, growing with cooler seasons, the roots short, stubby and coral-like, and without root hairs. Stems succulent. Leaves reduced to scales, alternate but tending to form a series of tight spirals. Flowers bilateral; calyx 5-lobed; corollas tubular, 5-lobed and 2-lipped. Stamens 4, sometimes with a rudiment of a fifth stamen. Capsules with numerous minute seeds. Worldwide; 150 species.

1. Plants more than 10 cm tall; inflorescence stalks thick and multiple-flowered, the flowers purple and white…….. **Orobanche cooperi**
1. Plants generally less than 10 cm tall; inflorescence stalks relatively slender, each with one or several flowers, the flowers yellow…… **Orobanche fasciculata**

Orobanche cooperi (A. Gray) A. Heller
[*O. ludoviciana* Nuttall var. *cooperi* (A. Gray) Beck]
Desert broomrape; *flor de tierra*; mo'otadk. Figure 31.

Stems very thick and succulent, the basal portion below ground, roots coral-like, the above-ground stem and inflorescence 10–37 cm tall, suffused with purple-brown, unbranched or with several branches usually from near the base. Plants, especially the flowers, glandular hairy. Shoots appearing in spring, flowering and withering by the end of April or earlier. Flowers 2–3 cm long, the lower ones pedicelled, the upper ones sessile. Corollas 5-lobed, purple and white, the throat marked with yellow. Stigmas peltate (shallowly cup-shaped) and often bilobed. Parasitic on roots of *Ambrosia* shrubs including *A. deltoidea*, *A. dumosa*, and probably sometimes *A. ilicifolia*. Wiggins' (1964) report of *Larrea* as a host plant seems unlikely (see Collins & Yatskievych 2015).

Often locally common on low hills, sandy flats, sandy-gravelly washes, and floodplains. Widespread across the flora region. *Orobanche cooperi* has been in the Puerto Blanco Mountains for at least 3500 years (Puerto Blanco Mts, capsules, 990 & 3440 ybp).

The young shoots, available in spring, were apparently widely used, often roasted in coals. The label on a specimen at the Gray Herbarium (Harvard University), collected by Carl Lumholtz in the Pinacate Region of northwestern Sonora, reads: "slightly bitter, Papago Indians toast and eat the plant at this stage. . . . called 'Camote' by Spaniards," indicating that non-Indians also knew of it being edible. The Cahuillas likewise ate them "before the plants blossom . . . roasted in the coals" (Barrows 1900: 66) and "peeled prior to eating" (Bean & Saubel 1972), and the Pimas prepared them in a similar manner (Moerman 2003). Richard and some friends roasted succulent but mature plants and found them very bitter: "Too bad we did not know to look for younger ones or to peel them." Caution: some people have adverse reactions to eating these plants (Amadeo Rea, pers. comm. to Felger 2003).

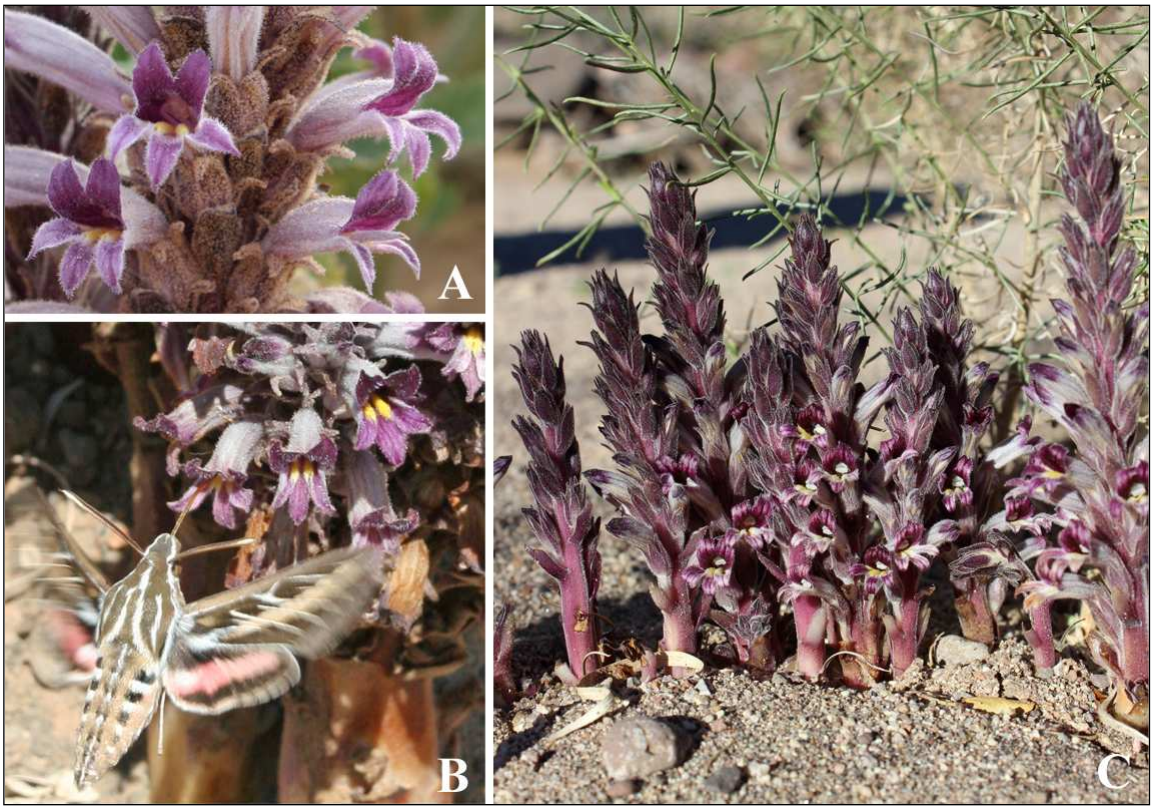

Figure 31. *Orobanche cooperi*. (A) Sikort Chuapo Mts near the Pipeline Road, 3 Mar 2009. (B) Five-lined sphinx moth (*Hyles lineata*) visiting flower, Kuakatch Wash near Hwy 85, 7 Mar 2009. (C) Kuakatch Wash near E boundary of Organ Pipe, 9 Feb 2014.

Collins and Yatskievych (2015) recognize three subspecies of *Orobanche cooperi*, one in the Chihuahuan Desert and two in the Sonoran Desert, both of which occur in the flora area.

1. Corollas (15) 18–22 mm long, lips 5–9 mm long, the lobes with or without an apiculate tooth; anthers glabrous or sparingly villous, stalked glands present or sometimes absent. ..... **Orobanche cooperi** subsp. **cooperi**
1. Corollas 22–32 mm, lips 6–10 mm, upper lobes with an apiculate tooth; anthers pubescent, with stalked glands on dorsal surface..... **Orobanche cooperi** subsp. **latiloba**

Orobanche cooperi subsp. **cooperi**

"The range of this subspecies is primarily in Arizona (south of the Mogollon Rim) and southern California and extends into the extreme northern part of Sonora and Baja California. It is sympatric with subsp. *latiloba* throughout almost its entire range" (Collins & Yatskievych 2015: 15). However, there are relatively few specimens from the flora area in southwest Arizona, and it is far more common in places farther north and east such as the Catalina Mountain region near Tucson, although there are a few Sonoran collections (George Yatskievych, pers. comm. to Felger, 14 Sep 2015).

The following specimens were determined as subsp. *cooperi* by L.T. Collins, A.E.L. Colwell, and G. Yatskievych, 2015:

OP: Aguajita Spring and vicinity, edge of wash, not common, 6 Apr 1988, *Felger 88-300*. **Pima Co.**: Gunsight, 3 mi E of Organ Pipe, 2000 feet, 14 Mar 1941, *Benson 10651*.

Orobanche cooperi subsp. **latiloba** (Munz) L.T. Collins
[*O. ludoviciana* Nuttall var. *latiloba* Munz. *O. multicaulis* Munz]

This subspecies is common across the flora area and elsewhere in southwest Arizona. It occurs in the Sonoran Desert in Arizona, California, Baja California, Baja California Sur, and Sonora. It differs from subsp. *cooperi* in part by having larger flowers.

The following specimens were determined as subsp. *latiloba* by L.T. Collins, A.E.L. Colwell, and G. Yatskievych, 2015:

OP: Bates Well, 28 Apr 1939, *Nichol 7791*. Sandy wash in *Cercidium–Hymenoclea* association, 1400 ft, 7 mi S of Bates Well, 17 Mar 1945, *Gould, Darrow & Haskell 2981*. Apparently on *Franseria ambrosioides*, deep sand, in wash, creosote bush, palo verde association, foothills of Growler Mts, 1300 ft, 16 Apr 1952, *Parker 7975*.

CP: Wash 10 mi S of Bates Well, Growler Mts, 1150 ft, 5 Mar 1940, *Benson 9922*. Silt valley, Camino del Diablo, 4 mi SE of Tuseral Tank road junction, *Franseria deltoides* (host), *Larrea*, *Simmons 3 Apr 1964*. Desert flats, 1 mi E of Papago Well on Camino del Diablo, 13 Mar 1983, *Eiber 22*. Sand dunes, E side of Pinacate lava flow–Camino del Diablo junction, 32º06'N, 113º27'W, 700 ft, 21 Mar 1992, *Harlan & Telewski 99*.

TA: W slope of Tinajas Altas Mts near junction of Camino del Diablo and Cipriano Pass Road. 870 ft, growing in *Ambrosia dumosa*, *Van Devender 6 Mar 1972*. In sand along the Camino del Diablo, near the tip of Vopoki Ridge, parasitic on the roots of *Franseria dumosa*, near Benchmark 809, *Halse 31 Mar 1973*. Sandy soil along wash with *Encelia farinosa*, 1 mi N, 4 mi W of Tinajas Altas Spring, Tinajas Altas Mts, *Lindquist & Van Devender 26 Mar 1983*.

The following specimens have not been determined to subspecies but are likely to be subsp. *latiloba*:

OP: Bates Well, Armenta Well, *Warren 6 May 1975*. 3.5 mi E of Dos Lomitas, 31 Mar 2003, *Rutman 2003-436* (ORPI).

CP: Heart Tank, *Monson 27 Mar 1955* (CAB). Lower slopes of Growler Mt, NE of Charlie Bell Pass, tributaries to Daniel's Arroyo, 20 Mar 1992, *Crawford 1 & Ayers* (ASC). Pinta Sands, *Mathes 21 Mar 1992* (ASC). 2 mi NW of Christmas Pass, *Rutman 18 Feb 2002*.

TA: Frontera Canyon, 18 Mar 1998, *Felger 98-104*.

Orobanche fasciculata Nuttall
Yellow broomrape, clustered broomrape. Figure 32.

Plants to 15 cm tall. Stems and flowers with stalked glands. Stems several and slender, branched or solitary, each bearing one to several bright yellow flowers in spring. Flowers pedicellate, 1.5–3 cm long.

In the flora area known from the Ajo Mountains, in Alamo Canyon and perhaps also occasionally in the middle to upper elevations. Generally not occurring elsewhere within the Sonoran Desert.

Western and central North America from Alaska to northern Mexico.

OP: Ridge due S of Alamo Canyon primitive campground, Apr 1991, *Marian Rohman* (photo, ARIZ, ORPI). Alamo Canyon, middle fork, 2863 ft, shallow soil on a N-facing bedrock bed-slope above the middle fork, immediately adjacent plants *Bouteloua repens*, *Eriogonum fasciculatum*, 25 Apr 2003, *Rutman 2003-497* (ORPI).

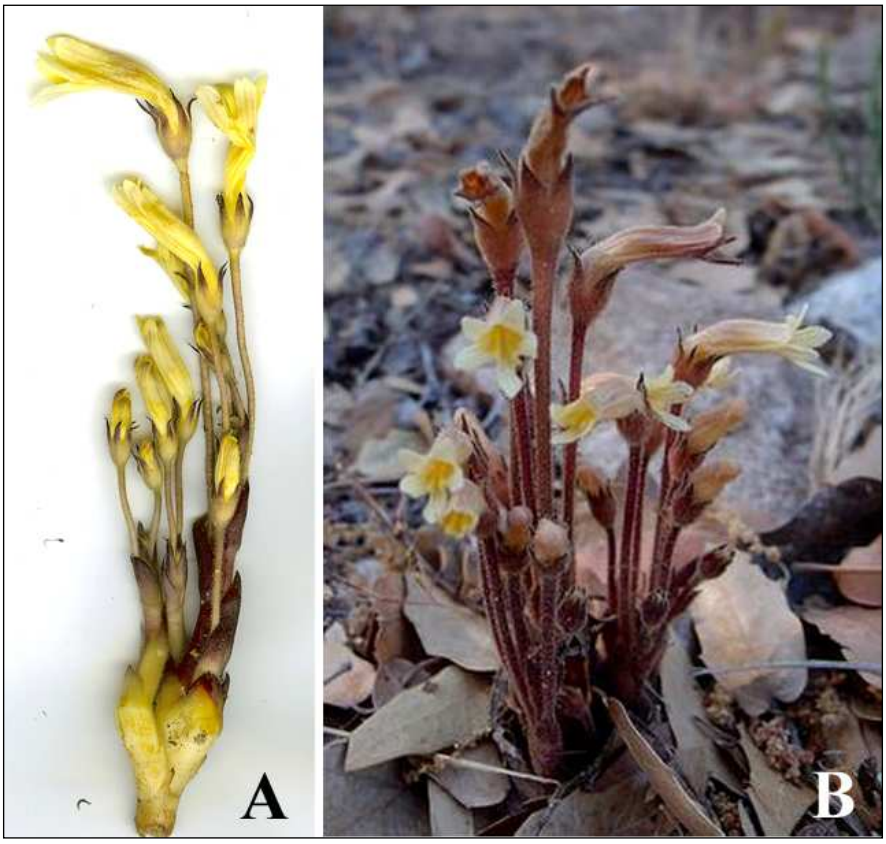

Figure 32. *Orobanche fasciculata*. (A) Upper middle fork of Alamo Canyon, 26 Mar 2005. (B) Miller Creek Trail, Rincon Mts, 15 Apr 2015, photo by Sue Carnahan.

OXALIDACEAE – Oxalis Family

Herbs and vines to trees. Worldwide; 6 genera, 770 species.

Oxalis – Wood-sorrel

Annual or perennial herbs, rarely succulent shrubs; worldwide; 700 species.

Oxalis albicans Kunth

Wood sorrel. Figure 33.

Semi-succulent, perennial herbs with a woody taproot, and slender, lax stems to 25+ cm long; plants with both large and small short hairs, many of them curled or crisped and 0.3–0.5 mm long. Leaves alternate, clover-like with 3 leaflets that fold along the midrib to close at night. Leaflets obcordate, to 1.5 cm long. Inflorescences slender, with 1–3 flowers. Flowers on slender pedicels, radial, with 5 sepals and 5 petals. Petals bright yellow, clawed, 1 cm long. Fruits cylindroid, fleshy and explosively dehiscing capsules. Reproductive spring to fall.

Canyon bottoms and moist, often shaded habitats at higher elevations in the Ajo Mountains.

Arizona to southwest Texas, and northern Mexico including Baja California Sur.

OP: N slope of canyon N of Alamo Canyon, 3500 ft, shaded slopes, 31 Mar 1948, *Darrow 3854*. Bull Pasture Trail, 11 Sep 1988, *Wilson 190*. Arch Canyon, beneath arch, *Rutman 26 Sep 2002* (ORPI). Bull Pasture, 9 Apr 2005, *Felger 05-174* (ARIZ, ASU).

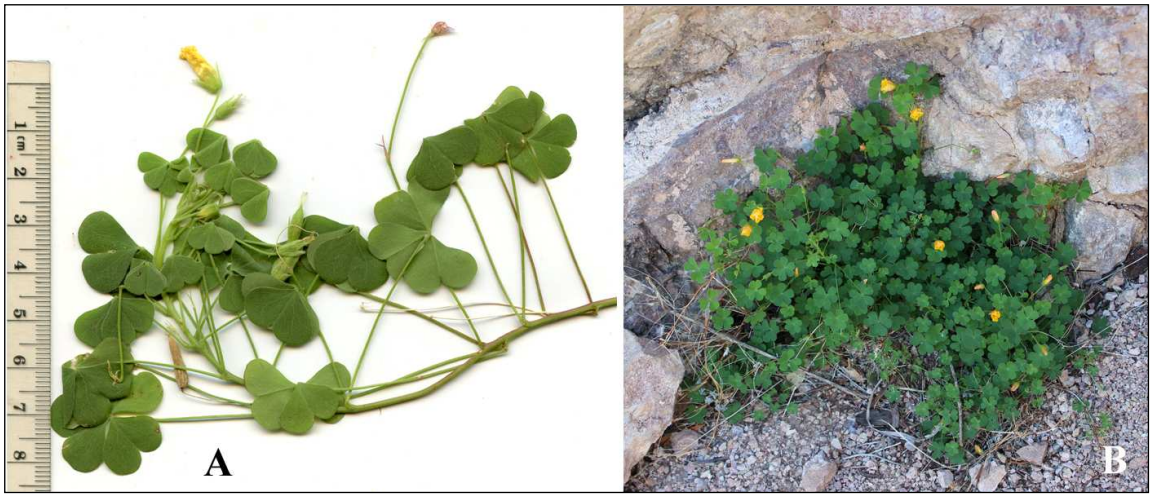

Figure 33. *Oxalis albicans*. Bull Pasture Trail: (A) 19 Sep 2014; (B) 7 Mar 2014.

PAPAVERACEAE – Poppy Family

Cool-season ephemerals and perennial herbs (those in the flora area; elsewhere sometimes also shrubs and small trees); with diverse alkaloids in milky (latex) colored or colorless sap. Leaves alternate; stipules none. Flowers radial. Sepals 2 or 3, enclosing the bud before it opens and falling as the flower opens. Petals separate, often twice as many as the sepals. Stamens many. Fruits of capsules. Seeds numerous.

Worldwide; 44 genera, 825 species.

1. Plants coarse and spiny throughout…… **Argemone**
1. Plants delicate and unarmed (spineless)…….. **Eschscholzia**

Argemone – Prickly poppy, *cardo*

Thistle-like herbaceous perennials or facultative annuals, often robust (rarely shrubs); herbage, sepals, and fruits glaucous and conspicuously prickly-spiny throughout, with toxic yellow or orange latex when fresh, black when dry. First leaves usually in a basal rosette; leaves sessile, the upper ones clasping. Flowers large. Sepals mostly 3, each with sub-terminal spinescent horns. Petals usually 6. Stamens numerous. Capsule valves opening terminally; seeds numerous. Americas and Hawaii; 30 species.

1. Sap (latex) pale lemon-yellow; petals white, 3–5 cm long; stamens 150 or more; capsules 3–4.5 cm long…….. **Argemone gracilenta**
1. Sap bright yellow; petals yellow, 2.5 cm long; stamens 40–75; capsules 2.5–3.5 cm long. ……. **Argemone ochroleuca**

Argemone gracilenta Greene

Prickly poppy, cowboy's fried eggs; *cardo*. Figure 34.

Robust herbaceous perennials often to 1+ m tall, also flowering in first season. Herbage, sepals, and fruits glaucous and densely prickly-spiny. Sap lemon-yellow, drying black. Leaves 8–20 (40) cm long, pinnately lobed, thistle-like. Flowers large, with white petals 3–5 cm long, and about 150+ yellow stamens. Often flowering during hot weather in late spring or early summer after most wildflowers have dried up, and continuing sporadically through the summer. Capsules 3–4.5 cm long.

Figure 34. *Argemone gracilenta*. (A–C) Why, 3 Apr 2005. (D) West of Three Points (Robles Junction), Hwy 86 at mile 145, 16 Apr 2015.

Widely scattered across the flora area at lower elevations and often seasonally abundant in low-lying, poorly drained silty-clayish soils of floodplains and playas, sandy washes, and often in disturbed habitats.

Arizona, western Sonora, and both Baja California states.

OP: Walls Well, *Nichol 28 Apr 1939*. West gate [Bates Well Road at N boundary of Monument], 1500 ft, 23 Apr 1942, *Cooper 611*. Loamy flat W of Cuerda de Leña wash, just S of N boundary, 23 Mar 2003, *Rutman 2003-390* (ORPI).

CP: Las Playas, 31 Jan 1992, *Felger 92-11*. Between O'Neill Hills & Pinacate Lava, 17 Mar 1992, *Yeatts 3208* (CAB). Daniels Arroyo at Charlie Bell Road, 9 Apr 1993, *Felger 93-365*.

****Argemone ochroleuca** Sweet subsp. **ochroleuca**
Mexican prickly poppy; *cardo*. Figure 35.

Herbage, sepals, and fruits glaucous and conspicuously prickly-spiny. Sap bright yellow. Leaves 8–15+ cm long, pinnately lobed, thistle-like. Petals pale yellow, 2.5 cm long. Stamens 40–75, pale yellow. Capsules 2.5–3.5 cm long.

Widely scattered, rarely encountered, and probably not established in the flora area; washes and disturbed habitats such as roadsides. In the mid-1990s it was locally common in Gunsight Wash but died out during two consecutive dry winters of the late 1990s. Probably not native in the flora area.

Figure 35. *Argemone ochroleuca* subsp. *ochroleuca*. (A) Near Alamos, Sonora, 9 Apr 2015; (B) Alamos, 30 Apr 2014; photos by Sue Carnahan. (C) Agua Dulce Wetland, Ironwood Forest National Monument, 16 Apr 2015, photo by Elizabeth Makings.

This species is weedy and adventive worldwide, the original distribution difficult to determine. The plants and flowers are smaller than those of the white-flowered prickly poppy.

OP: Growler Wash, 1 mi downstream from Bates Well, petals light yellow, *Johnson 25 Apr 1992* (ASU, det. G.B. Ownby 1992).

Eschscholzia – Gold poppy

Winter-spring ephemerals in the Sonoran Desert. Glabrous, the sap colorless. Leaves 3-times dissected into linear segments. Flowers yellow to orange, open during the day, closing in cloudy weather. Sepals 2, united into a cap pushed off by the opening flower. Petals usually 4. Capsules slender, ribbed, 2-valved, dehiscent from base. Seeds rounded and elaborately sculptured. Western North America; 12 species.

1. Flowers mostly 1 per stalk (scape), the plants otherwise nearly stemless; floral receptacle with a ring-like winged rim; petals 15–40 mm long (may be smaller when drought-stunted); stamens 20 or more; capsules 4.7–8 cm long…… **Eschscholzia californica** subsp. **mexicana**
1. Stems of larger plants branched, leafy, and with several or more flowers; receptacle not winged; petals 3.2–8 mm long; stamens mostly fewer than 12; capsules 2.3–5 (6) cm long.
…….. **Eschscholzia minutiflora**

Eschscholzia californica Chamisso subsp. **mexicana** (Greene) C. Clark
Mexican gold-poppy; *amapolita del campo*; ho:hi 'e'es. Figure 36.

Herbage and capsules bluish glaucous. Leaves mostly basal, 6–11 cm long. Flowering stalks usually 7–20 cm long and mostly leafless, 1-flowered, or with several 1-flowered branches or pedicels. Floral receptacles forming a cup with a spreading winged rim. Flowers showy, the petals, stamens, style, and stigma bright yellow-orange, the petals 15–40 mm long (as small as 7 mm when drought-stunted at end of season), the stamens 20–24. Capsules 4.7–8 cm long. Seeds 1.1–1.3 mm wide, similar to those of *E. minutiflora*.

Widespread in Arizona Upland areas of Organ Pipe including washes, roadsides, bajadas, canyons, and rocky slopes, and along the San Cristobal Wash in Cabeza Prieta.

Southeastern California to western Texas, southern Nevada, southwestern Utah, northern Sonora, both Baja California states, and northwestern Chihuahua.

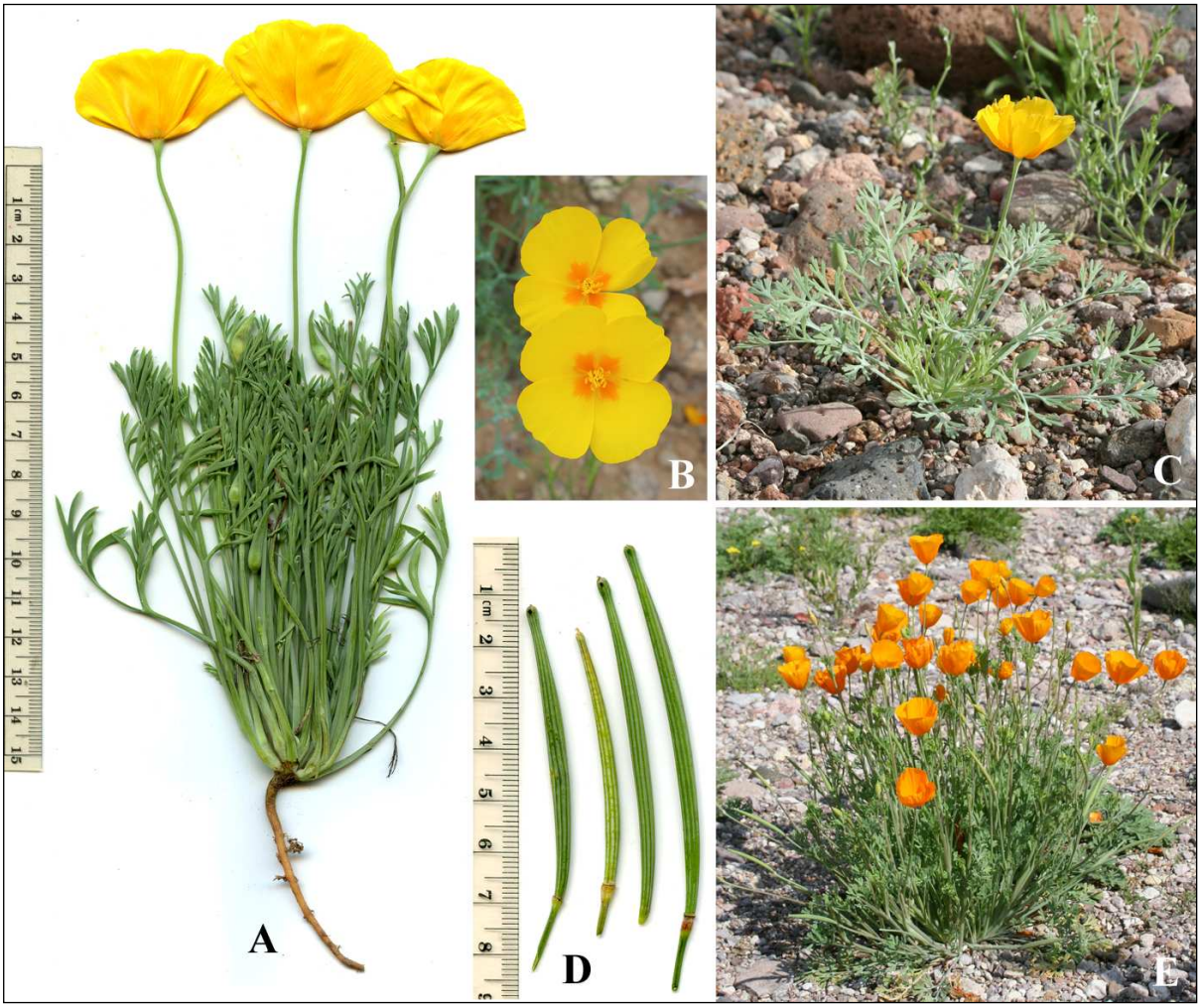

Figure 36. *Eschscholzia californica* subsp. *mexicana*. (A) Wash crossing Hwy 85 near N boundary of Organ Pipe, 14 Feb 2015. (B & D) N slope of the Puerto Blanco Mts, 12 Mar 2015. (C) Ten Mile Wash at Pipeline Road, NE of Ajo, 4 Mar 2009. (E) Coffeepot Mountain, Sikort Chuapo Mts, 27 Feb 2005.

Disjunct and separated by the intervening severe desert from the more western subsp. *californica*, which ranges from Washington to northwestern Baja California. This species probably extended its range in the Sonoran Desert region during glacial times and has been isolated by increasing aridity. The California or Mexican gold poppy is sometimes cultivated and often included in wildflower seed packages.

OP: Quitobaquito, *Nichol 10 Mar 1939* (the only record from the Quitobaquito area). Alamo Canyon, *Nichol 14 Mar 1939*. Arch Canyon, 3500 ft, 28 Mar 1965, *Niles 556*. 0.6 mi E of Lukeville, 20 Feb 1988, *Felger 88-07*.

CP: San Cristobal Wash, 13 Mar 2014, *Rutman*, photo.

Eschscholzia minutiflora S. Watson
Little gold-poppy. Figure 37.

Herbage bluish glaucous, highly variable, the larger plants with multiple-flowered leafy-branched stems 15–45 cm long (much smaller on young or stunted plants). Leaves 3–11 cm long, reduced upward. Petals 3.2–8 mm long, yellow-orange. Stamens often 8–10. Capsules mostly 2.3–5 (6) cm long. Seeds globose, 1–1.2 mm wide, dark brown with a reticulate pattern of grayish white sac-like hairs swelling when wet.

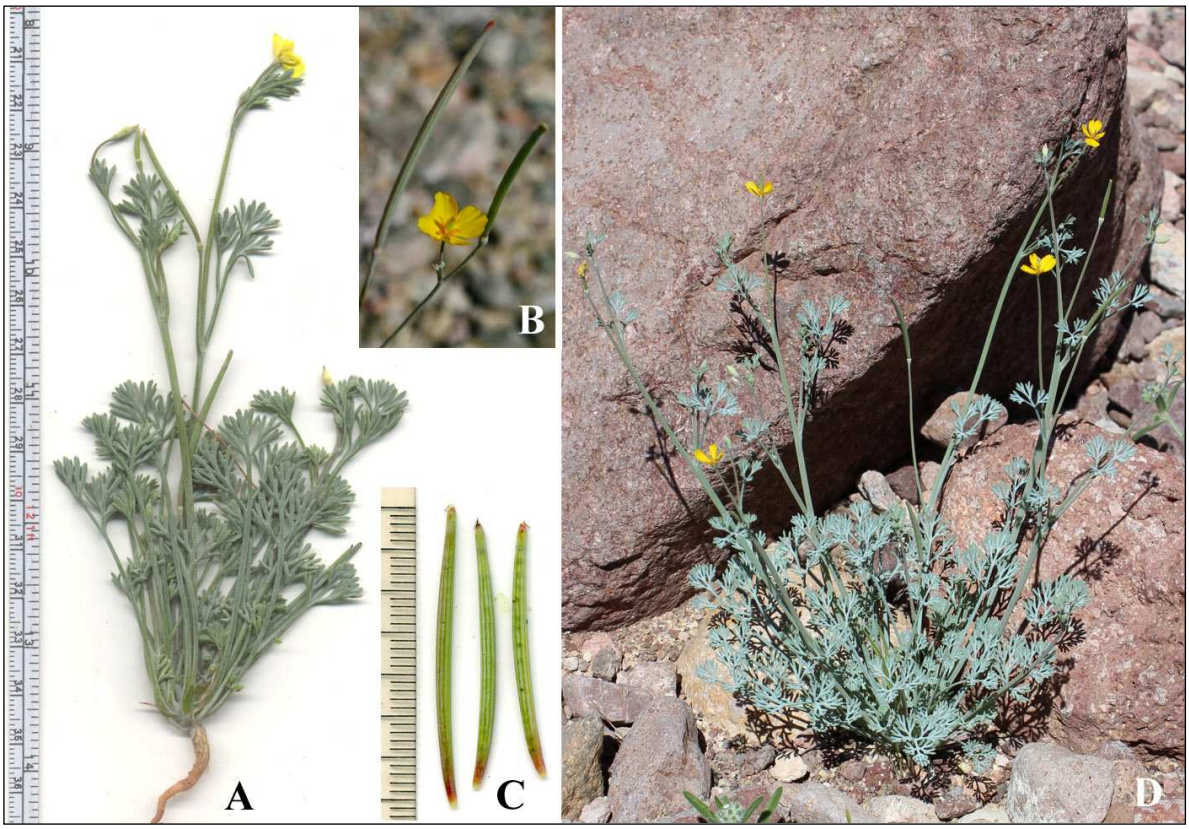

Figure 37. *Eschscholzia minutiflora*. (A) Near Bluebird Mine, 9 Mar 2014. (B) Eagle Tail Mountains Wilderness, Maricopa Co., 2 Apr 2008, photo by Elizabeth Makings. (C) Aguajita Wash near South Puerto Blanco Drive, 25 Feb 2015. (D) Estes Canyon near trailhead, 27 Feb 2014.

Widespread across the flora area in many habitats including washes, bajadas, plains, and rocky slopes. It is common from Tinajas Altas to the southwestern part of Organ Pipe and the Senita

Hills area, but also in Estes Canyon in the Ajo Mountains. Elsewhere in Organ Pipe is uncommon and localized. It seems to thrive best on granite-derived soils.

Southeastern California to Baja California Sur, southern Nevada, southwestern Utah, western Arizona, and northwestern Sonora.

OP: Victoria Pass near Burnham's Mine, *McDougall 8 Apr 1941*. Estes Canyon, 27 Mar 1966, *Niles 722*. Aguajita Wash, 6 Apr 1988, *Felger 88-290*. Large wash SW of Scarface Mt, 22 Mar 2003, *Rutman 2003-381*.

CP: Heart Tank, *Simmons 6 Mar 1964* (CAB). 1 km N of Tule Well, 11 Apr 1993, *Felger 93-440*.

TA: Vicinity of Tinajas Altas, *Van Devender 5 Mar 1983*. Tinajas Altas, canyon-wash just E of the tinajas, 28 Mar 2010, *Felger 10-188*. Surveyors Canyon, canyon bottom, 29 Mar 2010, *Felger 10-206*.

PHRYMACEAE – Monkey Flower Family (includes Scrophulariaceae, in part)

Annuals to herbaceous or woody perennials. Nearly worldwide; 13 genera, 188 species.

Erythranthe – Monkey-flower

Ephemerals (those in the flora area; also perennials elsewhere). Leaves opposite; stipules none. Flowers bilateral, in pairs from axils of opposite leaves or in bracteate racemes. Calyx often inflated, the sepals united into a strongly 5-angled or pleated tube, and 5-lobed. Corollas deciduous, slightly to strongly 2-lipped. Stamens 4, fertile. Fruits of capsules with numerous small seeds.

Americas and Asia; 111 species. *Erythranthe* is a genus segregated from *Mimulus* (Barker et al. 2012; Nesom 2012).

1. Flowers bright yellow, 1–2 cm long; calyx more than 8 mm long, becoming enlarged and inflated in fruit…… **Erythranthe cordata**
1. Flowers pink or yellow, less than 1 cm long; calyx 4–6 mm long, enlarging to less than 9 mm in fruit and not inflated……..…….. **Erythranthe rubella**

Erythranthe cordata (Greene) G.L. Nesom

[*Mimulus cordatus* Greene. *M. guttatus* Fischer ex de Candolle, in part, misapplied]

Monkey flower. Figure 38.

Spring ephemerals (in the flora area), highly variable in size depending on water, several–30+ cm tall. Leaves often petioled below and sessile above, to ca. 15 cm long (usually much smaller), ovate to rounded, the margins toothed. Inflorescence racemose. Flowers pedicellate; calyx swollen in fruit; corollas often 1–1.5 cm long, bright yellow with red spots in the throat and lip. Capsules often 5–10+ mm long.

Waterholes, temporary pools, and puddles in canyons in the Ajo and Puerto Blanco mountains.

Generally in wetland habitats. Southwestern USA in Arizona, California, Colorado, Nevada, New Mexico, Texas, and Utah, and northwestern Mexico in Chihuahua, Coahuila, and Sonora.

"Plants of *Erythranthe cordata* vary greatly in size but are consistently distinguished from *E. guttata* sensu stricto in their small corollas, autogamous breeding, and lack of rhizome" (Nesom 2015: 1). *Erythranthe guttata* ranges from Alaska and Canada to northern Mexico (Nesom 2012, 2015), but does not extend into the core area of the Sonoran Desert.

Fresh leaves can be eaten like lettuce (Chestnut 1902; Yanovsky 1936). The young, tender leaves may have a mushroom-like flavor, especially when growing in the shade, but taste bitter when older or in harsher conditions.

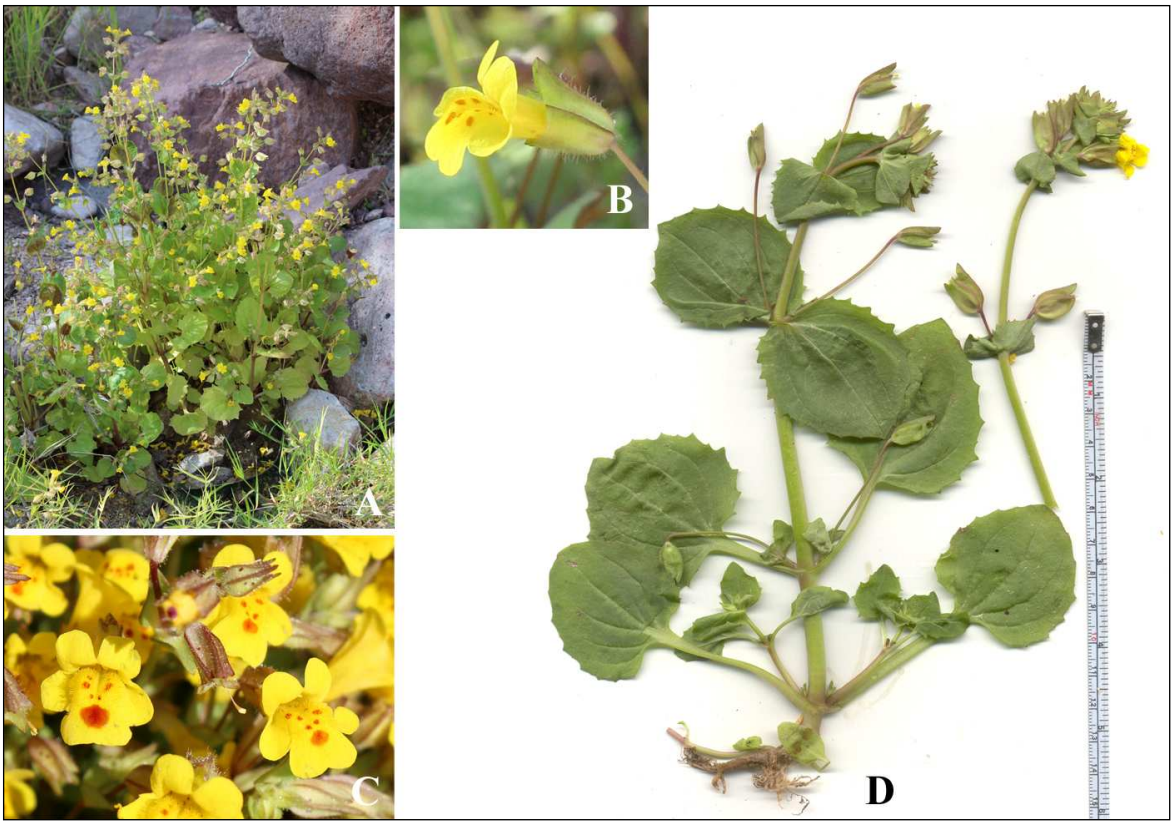

Figure 38. *Erythranthe cordata*. Alamo Canyon: (A) 4 Apr 2014; (B & D) 24 Mar 2008; (C) 26 Feb 2014.

OP: Alamo Canyon, *Nichol 14 Mar 1939*. Dripping Springs, 15 Apr 1952, *Cottam 12817*. Near Bull Pasture Spring, 3300 ft, 5 Apr 1978, *Bowers 1206*. Bull Pasture, 10 Apr 2005, *Felger 05-202*.

Erythranthe rubella (A. Gray) N.S. Fraga
[*Mimulus rubellus* A. Gray]
Little monkey-flower. Figure 39.

Diminutive winter-spring ephemerals, 1.5–8 cm tall. Herbage often reddish, sparsely short-haired. Leaves 5–10 mm long, the lower ones often broadly obovate, short petioled, the other leaves sessile and variable, including oblanceolate to obovate, elliptic, broadly ovate, or oval in shape; margins entire to broadly and bluntly shallow-toothed. Calyx cylindrical, slightly enlarging in fruits, 4–6 mm long, the lobes short and sparsely ciliate. Corollas protruding 4.5–6 mm from the calyx, corolla lobes notched, some populations with pink corollas, but mostly bright yellow with a maroon-red nectar guide, or the throat white with pink and the palate (the projecting part of the lower lip that closes the throat) yellow.

Locally in the Ajo Mountains and Gunsight Hills; washes and often moist microhabitats on rock slopes, and likely to be more widespread.

Southern California to Wyoming and New Mexico, both Baja California states, and northwestern Sonora.

OP: Alamo Canyon, damp sand, 19 Mar 1933, *Shreve 6202*. Alamo Canyon tributary just below crest of Ajo Mts, *Rutman 5 Mar 1998* (ORPI). Gunsight Hills, NE corner of Monument, *Rutman 4 Apr 1998* (ORPI).

Figure 39. *Erythranthe rubella*. Salero Ranch, Santa Cruz Co., 21 Mar 2014, photos by Sue Carnahan.

PHYTOLACCACEAE, *Rivina*, moved to **RIVINACEAE** (see Stevens 2012) in a forthcoming part of this flora series.

PLANTAGINACEAE – Plantain Family

Herbs and shrubs. Leaves opposite or alternate, sometimes in basal rosettes, simple, entire to dissected, without stipules. Flowers radial (*Plantago*) or bilateral. Calyx 4- or 5-lobed (the lobes often nearly separate and referred to here as sepals); corollas 4- or 5-lobed; stamens 2 or 4, and sometimes with a staminode. Fruit a capsule with numerous small seeds, or 2-seeded in *Plantago*.

Worldwide; 90 genera, 1900 species. Except for *Plantago*, those in the flora area were formerly included in Scrophulariaceae.

1. Shrubs; flowers bright yellow…….. **Keckiella**
1. Ephemerals or herbaceous perennials, not shrubs; flowers various colors.

2. Leaves basal, the vegetative stems not developed or very short; corollas radially symmetrical or nearly so, papery, whitish to brown, and persistent; capsules with 2 seeds. …… **Plantago**
2. Stems well developed; corollas bilaterally symmetrical, colorful, not papery, and often not persistent; capsules many seeded.

3. Plants vining or twining.

4. Stems often reaching 1+ m long; leaf blades triangular to triangular hastate-lobed, about as wide as long; corollas lavender-blue, 1.5–2 cm long……..... **Maurandella**
4. Stems less than 1 m long; leaf blades linear to ovate, longer than wide; corollas 1–1.5 cm long, purple or yellow.

5. Corollas yellow, 1.5 mm long; capsules globose……..… **Neogaerrhinum**
5. Corollas purple, 0.6–1 cm long, capsules ovoid …. ……..... **Sairocarpus**

3. Plants not vining.

6. Plants usually more than 40 cm tall; larger leaves more than 4 cm long; flowers at least 2 cm long, rose-pink or rose-purple……...…….. **Penstemon**
6. Plants often less than 30 cm tall; flowers not more than 1.5 cm long and not rose-colored.

7. Plants glabrous; corollas blue, with a prominent, slender spur……..... **Nuttallanthus**
7. Plants sparsely to densely pubescent, at least when young; corollas various colors, without a spur.

8. Leaves entire or toothed; calyx lobes 4; stamens 2 or 4; seeds not corky.

9. Leaves coarsely toothed; calyx 6–8 mm long; corollas dark blue, longer than the calyx; stamens 4; capsules ovoid…… **Stemodia**
9. Leaves entire to shallowly toothed; calyx 2–4 mm long; corollas white, shorter than the calyx; stamens 2; capsules flattened…….. **Veronica**

8. Leaves entire; calyx lobes 5; stamens 4; seeds corky.

10. Herbage viscid-sticky; pedicels shorter than the flowers or fruit..…... **Pseudorontium**
10. Herbage viscid-sticky or not; pedicels longer than the flowers or fruits.
……..… **Sairocarpus**

Antirrhinum – Snapdragon

Antirrhinum sensu lato has been segregated into several genera (e.g., Vargas et al. 2004). See *Neogaerrhinum, Pseudorontium,* and *Sairocarpus*.

Keckiella – Bush penstemon

Arizona, Baja California, California, Nevada, and Sonora; 7 species. A genus segregated from *Penstemon*.

Keckiella antirrhinoides (Bentham) Straw subsp. **microphylla** (A. Gray) Straw
[*Penstemon microphyllus* A. Gray. *P. antirrhinoides* Bentham subsp. *microphyllus* (A. Gray) D.D. Keck. *Keckia antirrhinoides* (Bentham) Straw subsp. *microphylla* (A. Gray) Straw]
Desert bush-penstemon. Figure 41.

Woody shrubs to 1.5 m tall, much branched, the stems slender and brittle, often branching at right angles. Bark light tan. Leaves opposite, petioles short or leaves sessile, mostly 1.5–3 cm long, more or less ovate, thick, canescent with sparse to moderately dense pubescence of short hairs; leaf margins entire; facultatively and gradually drought deciduous. Flowers showy; calyx lobes 5, acute; corollas bright yellow, 1.5–2+ cm long; stamens 4 plus a bearded staminode. Dry, dead capsules persistent; seeds many. Flowering at least April and May and in October.

Figure 41. *Keckiella antirrhinoides* subsp. *microphylla*. Near Indian Cove Campground, Joshua Tree National Park, San Bernardino Co., California, 30 Apr 2012.

Rocky slopes and canyons at higher elevations in the Ajo Mountains, often below north-facing cliffs, and one record from the Growler Mountains in Cabeza Prieta.

Western and central Arizona, southeastern California, Nevada, both states of Baja California, and mountain tops in northwestern Sonora. This is the only member of *Keckiella* that occurs inland and east of the western part of California and Baja California. Replaced by subsp. *antirrhinoides* in southwestern California and northwestern Baja.

OP: Arch Canyon, *Fouts* 2 May 1948 (ORPI). Boulder Canyon, 3000 ft, 3 May 1978, *Bowers 1281*. Alamo Wash, 31 Mar 1989, *Wilson 209*.

CP: Growler Mts, vicinity of Growler Peak, just N of Charlie Bell Pass, 302775 E, 3587989 N, *Peter Holm 4 April 2014.*

Maurandella

Southwestern USA and Mexico; 2 species. A genus segregated from *Maurandya*.

Maurandella antirrhiniflora (Humboldt & Bonpland ex Willdenow) Rothmaler
[*Maurandya antirrhiniflora* Humboldt & Bonpland ex Willdenow. *Asarina antirrhiniflora* (Humboldt & Bonpland ex Willdenow) Pennell]
Blue snapdragon-vine, blue twining snapdragon. Figure 42.

Ephemerals or annuals, or perhaps perennials (perennials elsewhere). Vines climbing into shrubs and trees such as mesquite; sometimes forming a curtain of slender, intertwining stems; essentially glabrous. Petioles and pedicels often curved and loosely twining. Leaves alternate, larger

leaves often 2–3 (4.5) cm long, the blades triangular and hastate-lobed. Flowers snapdragon-like, solitary from leaf axils, often 1.5–2 cm long (to 3 cm elsewhere). Sepals 5, linear-acute, persistent in fruit. Corollas lavender-blue, 2-lipped; the base of the lower lip swollen, white with lavender-blue speckles forming nectar guide-lines and with white hairs. Stamens 4, the filaments hairy at base. Capsules globose, dehiscent irregularly from near the tip; seeds numerous. Variously growing and flowering spring, summer, and fall.

Figure 42. *Maurandella antirrhiniflora*. (A) Kuakatch Wash near E boundary of Organ Pipe, 25 Aug 2008. (B) Josephine Canyon, Santa Rita Mts, Santa Cruz Co., 11 May 2013; (C) Salero Ranch, Santa Cruz Co., 12 May 2014; photos by Sue Carnahan. (D) Kuakatch Wash near E boundary of Organ Pipe, 7 Oct 2014. (E) Alamo Wash near Hwy 85, 22 Mar 2015.

Washes and canyons, widely scattered but seldom common; eastern part of Cabeza Prieta and Organ Pipe mostly in the northern and eastern part, and not in the drier, southwestern portion of the Monument.

Southern California to Texas, and northern Sonora to Coahuila and Puebla.

OP: Growler Wash, 13 Apr 1941, *McDougall 92.* 2 mi SE of Walls Well, 30 Aug 1945, *Gould 3221*. Bull Pasture Trail, 5 Nov 1977, *Bowers 933*. Wash just E of Visitor Center, *Van Devender 30 Aug 1978* (ORPI). Confluence of Alamo and Cherioni washes, *Warren 10 Nov 1983*.

CP: Daniels Arroyo, 1 mi N of Lower Well, 12 Jun 1992, *Felger 92-544.* Charlie Bell Road at Daniels Arroyo, 10 Apr 1993, *Felger 93-351*.

Neogaerrhinum

Southwestern USA, Baja California, and Sonora; 2 species. A genus segregated from *Antirrhinum.*

Neogaerrhinum filipes (A. Gray) Rothmaler
[*Antirrhinum filipes* A. Gray. *Asarina filipes* (A. Gray) Pennell]
Yellow twining-snapdragon. Figure 43.

Winter-spring ephemerals. Seedlings and young plants or lower stems sparsely to densely villous with white hairs, the stems and leaves otherwise glabrate. Stems slender with long internodes, climbing on shrubs by means of elongated, prehensile pedicels. Leaves opposite at base, alternate above, the blades broadly lanceolate to ovate at the lower nodes, narrower upward (linear-lanceolate to linear); larger leaves (1.5) 3–5 cm long, the petioles conspicuous. Pedicels very slender, often 4–6+ cm long, twining like a tendril when contacting other stems, even those of the same plant, or twigs, cactus spines, etc. Flowers snapdragon-like, bilateral with glandular hairs and sparse non-glandular white hairs. Corollas 1.5 cm long, 2-lipped, bright yellow. Capsules 5 mm long, globose, dehiscing irregularly. Seeds numerous, whitish, becoming dark brown with age, 1.1–1.5 mm long, with several thickened, parallel ridge-like wings on one side, the body irregularly tuberculate on the other side.

Figure 43. *Neogaerrhinum filipes*. (A & B) Senita Basin, 18 Mar 2005. (C) Joshua Tree National Park, San Bernardino Co., California, 10 Apr 2009, photo by Keir Morse (CalPhotos).

Infrequent along washes, canyons, and rocky slopes; widely scattered in Organ Pipe and one record in the eastern part of Cabeza Prieta.

Northwestern Sonora, western Arizona, southeastern California, southern Nevada, and southwestern Utah.

OP: Alamo Canyon, 14 Mar 1941, *Benson 19669* (RSA). Senita Pass, 13 Apr 1941, *McDougall 84.* Quitobaquito, 29 Mar 1988, *Felger 88-124*. Hills N of Puerto Blanco Mts, *Rutman 7 Apr 1998* (ORPI). Growler Mts, W of Growler Pass, 7 Mar 2003, *Rutman 2003-251* (ORPI).
CP: Chico Suni Wash, 2 Feb 2003, *Rutman 2003-27*.

Nuttallanthus
Annual and biennial herbs. North and South America; 4 species.

Nuttallanthus texanus (Scheele) D.A. Sutton
[*Linaria texana* Scheele. *L. canadensis* (Linnaeus) Dumont de Courset var. *texana* (Scheele) Pennell] Texas toadflax, blue toadflax. Figure 44.

Winter-spring ephemerals; what appears to be a basal rosette of pinnate leaves is a rosette of short, non-flowering, leafy stems that usually wither by flowering time (elsewhere these stems may develop into flowering stems). Lower leaves opposite, 4–20 mm long; upper stem leaves alternate, sessile, linear and glandular-punctate, the plants often leafless or nearly so by flowering time. Flowering stems often 15–25+ cm tall, one or occasionally several, erect and slender. Inflorescences racemose, compact and elongating in fruit, with a bract beneath each flower. Flowers blue and attractive, bilaterally symmetrical; corollas 8 mm long plus a conspicuous nectar-filled spur that attracts insects, the corolla lip serving as a landing pad. Stamens 4. Capsules rounded, 3 mm wide, opening by terminal slits. Seeds many.

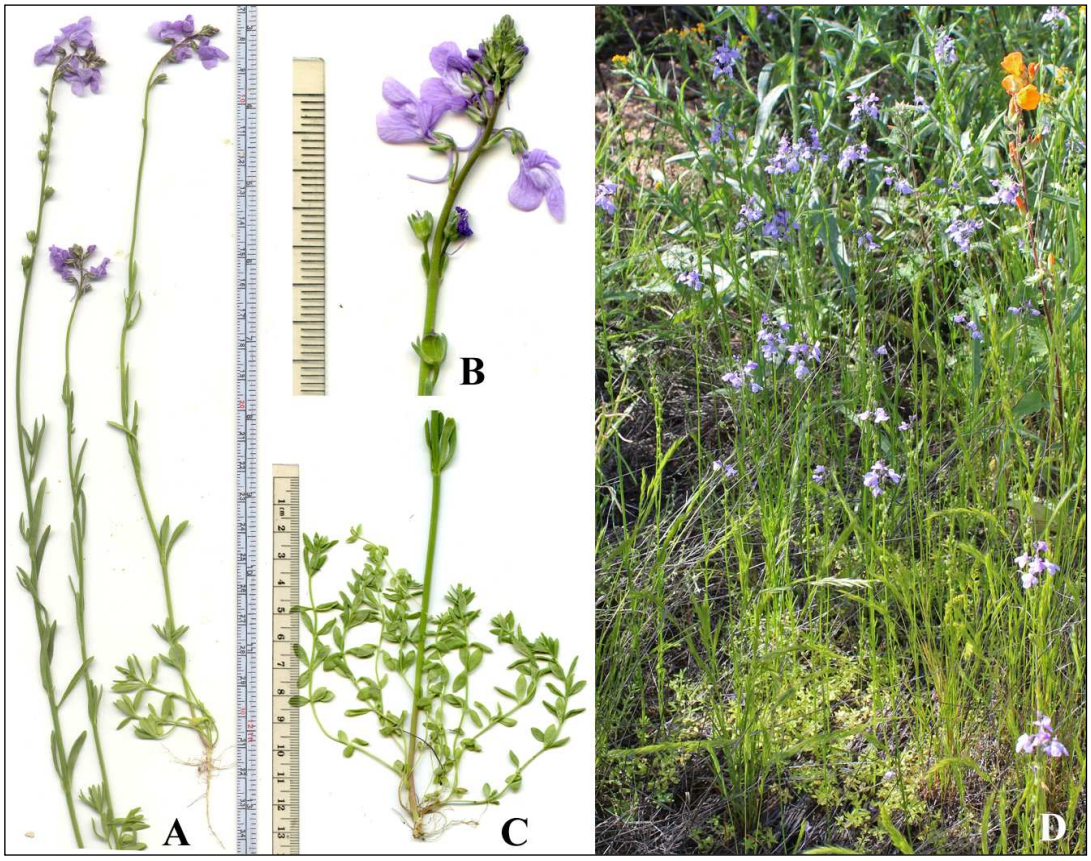

Figure 44. *Nuttallanthus texanus*. (A) Estes Canyon, 2 Mar 2008. (B–D) Sandy wash near Hwy 85, N end of Organ Pipe, 25 Feb 2014.

Organ Pipe in the Ajo and Diablo mountains and sand flats in the northern part of the Monument; washes, canyon bottoms, and rocky slopes and ledges.

Canada to central Mexico and temperate South America.

OP: Arch Canyon, *Dakan 13 Jan 1973* (ORPI). NW of Montezuma's Head, 2000 ft, *Van Devender 10 Mar 1978*. Bull Pasture, 28 Feb 1989, *Baker 7708* (ORPI). Wild Horse Canyon, 2400 ft, *Rutman 9 Mar 2001* (ORPI). Armenta Road 1.4 mi W of Ariz Hwy 85, 11 Mar 2003, *Felger 03-248*.

Penstemon – Beard tongue

Herbaceous perennials, probably short-lived (those in the flora area), occasionally facultative ephemerals. Leaves opposite, at first sometimes in a basal rosette, the upper leaves rarely alternate; leaf margins toothed or entire; lower leaves often petioled, the upper ones sessile. Inflorescences of oppositely branched panicles or racemes, the flowers subtended by usually conspicuous bracts. Sepals 5, nearly separate. Corollas showy, moderately to strongly 2-lipped. Fertile stamens 4, the fifth a sterile staminode, usually bearded (the "beard tongue"); nectaries of glandular hairs on the filaments. Capsules firm. Seeds numerous, irregularly angled. One or more *Penstemon* species were present in the region 11,000 years ago.

North America; 250 species—this is the largest genus of flowering plants endemic to North America.

1. Leaf margins entire, the upper leaves separate at their base…….. **Penstemon parryi**
1. Leaf margins toothed, the upper leaves joined at their base……... **Penstemon pseudospectabilis**

Penstemon parryi (A. Gray) A. Gray
Desert penstemon; *jaritos, varita de San José*; hevel 'e'es. Figure 45.

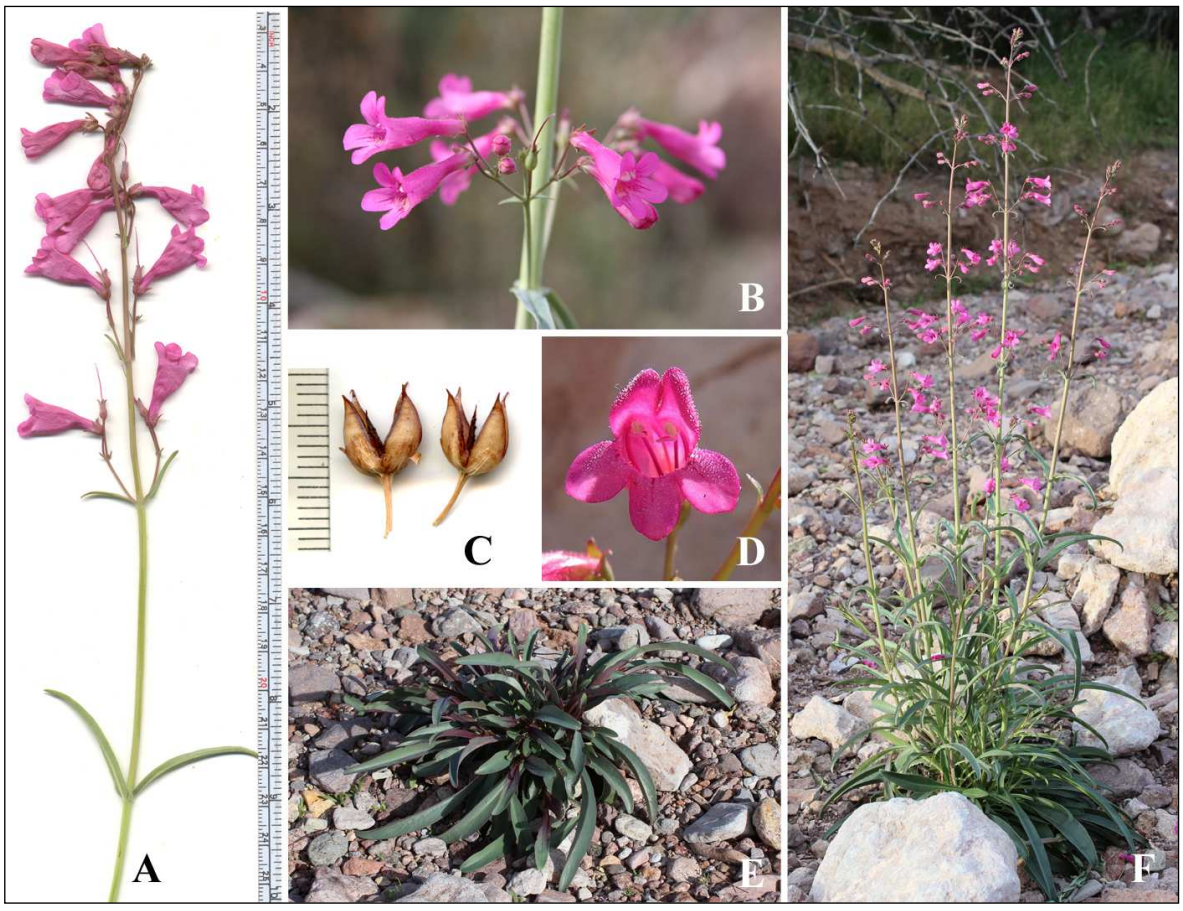

Figure 45. *Penstemon parryi*. (A) Kuakatch Wash near E boundary of Organ Pipe, 21 Mar 2008. (B) Pomeroy Wash at Pipeline Road, Sikort Chuapo Mts, 4 Mar 2009. (C) Diablo Mts near Ajo Mountain Drive, 17 May 2015. (D) Santa Catalina Mountains, 29 Mar 2014. (E) Alamo Wash, 28 Dec 2013. (F) Estes Canyon, 30 Jan 2014.

Perennials, or functioning as winter-spring ephemerals in the drier areas, taller stems 45–60+ cm. Herbage glaucous and glabrous. Early leaves in a basal rosette. Leaves entire, mostly lanceolate to elliptic, the lower leaves petioled, the larger leaves 5–12+ cm long, the upper leaves sessile and narrowed. Flowers on erect, slender, raceme-like panicles. Corollas 2 cm long, bright rose-pink. Staminode bearded with yellow hiars. Capsules 7–9 mm long. Seeds 1.1–1.8 mm long, dark red-brown, minutely tuberculate (appearing beaded), irregularly angled due to the developing seeds pressing on one another.

Widespread in Organ Pipe including higher elevations and rare on Childs Mountain. Expected in the northern and eastern margins of Cabeza Prieta and rare in the Tinajas Altas Mountains.

Southern Arizona and northwestern and eastern Sonora.

OP: Cipriano Well, *Nichol 27 Apr 1939*. Quitobaquito, 30 Nov 1939, *Harbison 26195*. Alamo Canyon, 3600 ft, *Tinkham 19 Apr 1942*. 1.5 mi E of Bates Well, 18 Mar 1945, *Gould 3006*. The Cones, on trail to Mount Ajo, 3565 ft, 10 Apr 2005, *Felger 05-240*.

CP: Childs Mt, cliff ridge near tower (summit), one plant seen, Mar 2004, *Curtis McCasland* (observation).

TA: Tinajas Altas, wash just below the lower tank, rare, 10 Jan 2002, *Felger* (observation).

Penstemon pseudospectabilis M.E. Jones subsp. **pseudospectabilis**
Mojave beard-tongue. Figure 46.

Herbaceous perennials often 0.5–1+ m tall, also flowering in the first year. Stems and leaves glaucous and glabrous. Larger leaves 7–16.5+ × 3.3–5 cm, broadly ovate, to triangular ovate above, the margins coarsely toothed; lower leaves petioled and separate, the middle ones sessile, and the upper leaves connate (leaves of the opposite pair joined at their bases). Pedicels, calyces, and corollas sparsely to moderately glandular hairy. Corollas bright rose-purple, 2.5–3 cm long. Staminode glabrous or sparsely bearded with glandular hairs. Capsules 10–14 mm long. Flowering during cooler months, from mid-October but mostly February–April.

Mountains in the eastern part of Organ Pipe, and locally and mostly in canyons and at higher elevations in the western part of the flora area.

This species occurs in Arizona, southeastern California, southern Nevada, southwestern New Mexico, and northern Sonora. The western populations are subsp. *pseudospectabilis*.

OP: Arch Canyon, 3500 ft, 28 Mar 1965, *Lockwood 161*. Grass Canyon, 2600 ft, 26 Feb 1978, *Bowers 1091*.

CP: Major ravine N of Eagle Tank (Simmons 1966). Large wash below Heart Tank, locally rare, 27 Feb 1993, *Felger 93-160*. Cabeza Prieta Peak, 2550 ft, N-facing side of summit, 14 Mar 1995, *Yeatts 3648* (CAB).

TA: Tinajas Altas, frequent in wash above tanks, 487 m, 8 Mar 1984, *Hodgson 2723* (DES). Frontera Canyon, 18 Mar 1998, *Felger* (observation). Canyon above Tinajas Altas, canyon bottom and lower N-facing slopes among rocks, 26 Oct 2004, *Felger 04-77*.

†**Penstemon** sp.

TA: †Tinajas Altas, fruits, 10,950 & 11,040 ybp.

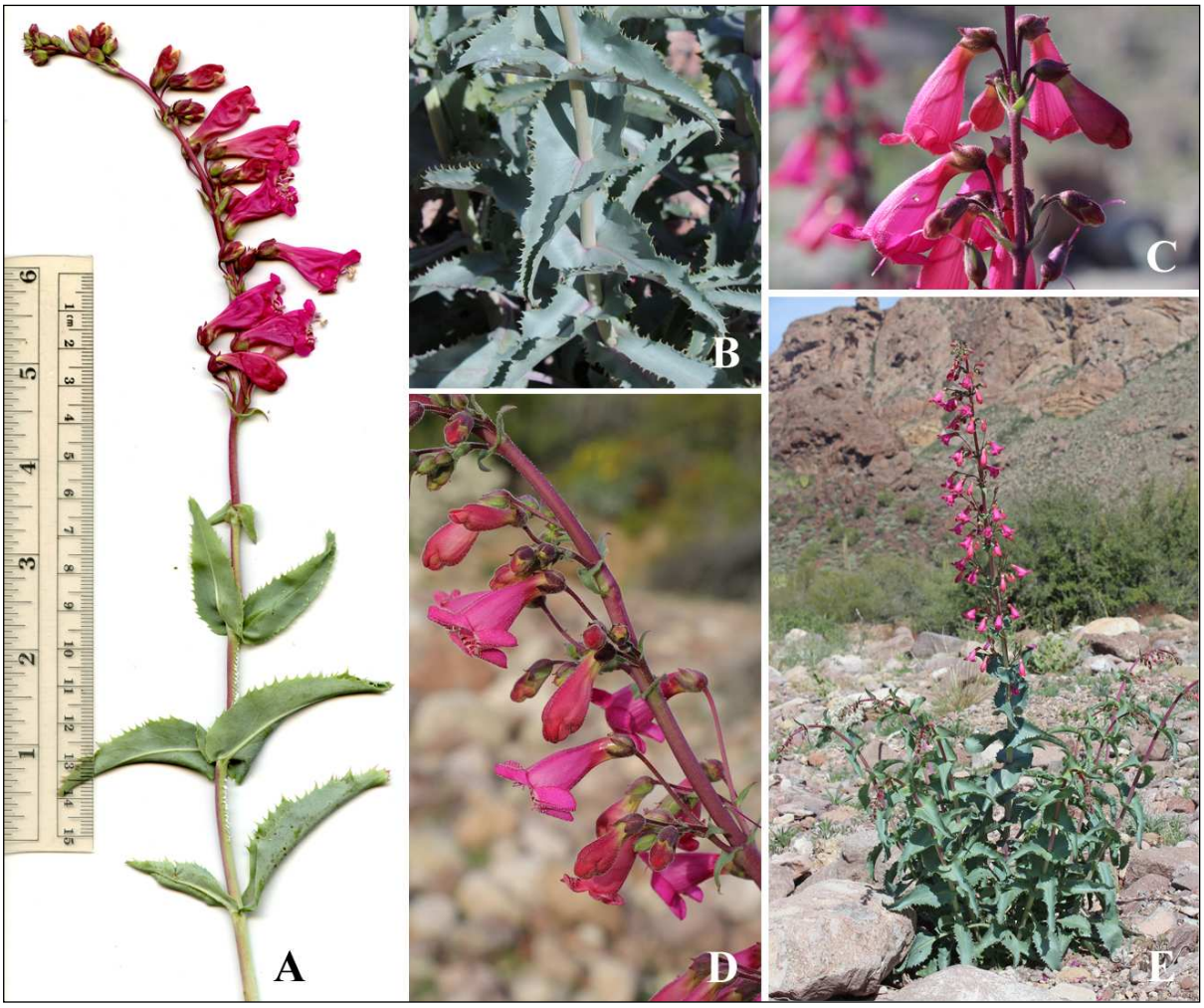

Figure 46. *Penstemon pseudospectabilis* subsp. *pseudospectabilis*. Estes Canyon: (A) 17 May 2015; (B & C) 27 Feb 2014; (D & E) 13 Jan 2014.

Plantago – Plantain

Those in the flora area: Small, winter-spring ephemerals. Vegetative stems very short, commonly appearing stemless. Leaves in close spirals resembling a basal rosette, slender and parallel veined. Flowering stems slender and leafless. Flowers in spikes, usually wind-pollinated, radially symmetrical or nearly so, and 4-merous. Sepals green or papery, the corollas papery, straw-colored, and persistent. Capsule opening around the middle (circumscissile), 2-seeded. When water contacts the seed coat it quickly forms a jacket of slime (mucilage) that on drying tenaciously glues the seed to any available substrate.

Annual and perennial herbs. Worldwide; 250 species.

1. Bracts broadly ovate to obovate, with broad papery-membranous margins, none longer than the sepals; seeds shiny…….. **Plantago ovata**
1. Bracts linear to narrowly oblong, all green (or sometimes with minute membranous wings at base), the bracts of the lower flowers usually much longer than the sepals; seeds dull...**Plantago patagonica**

Plantago ovata Forsskål var. **fastigiata** (E. Morris) S.C. Meyers & Liston
[*P. insularis* Eastwood. *P. fastigiata* E. Morris. *P. insularis* var. *fastigiata* (E. Morris) Jepson, not *P. insularis* Nyman ex Briquet]
Woolly plantain, Indian wheat; *pastora*; mumsa. Figure 47.

Winter-spring ephemerals, highly variable in size depending on soil moisture, usually with a well-developed slender taproot. Herbage, flowering stems, and inflorescences moderately to densely pubescent with loosely woolly and silky silvery-white hairs. Cotyledons narrow-linear, dark brown when dry and often persistent. Plants generally appearing stemless, but sometimes forming a short, leafy stem occasionally reaching 7.5 cm tall. Leaves (4) 5–17 cm × 1–10 mm, erect to ascending or spreading, linear to linear-lanceolate, gradually narrowed below to a winged petiole; margins entire.

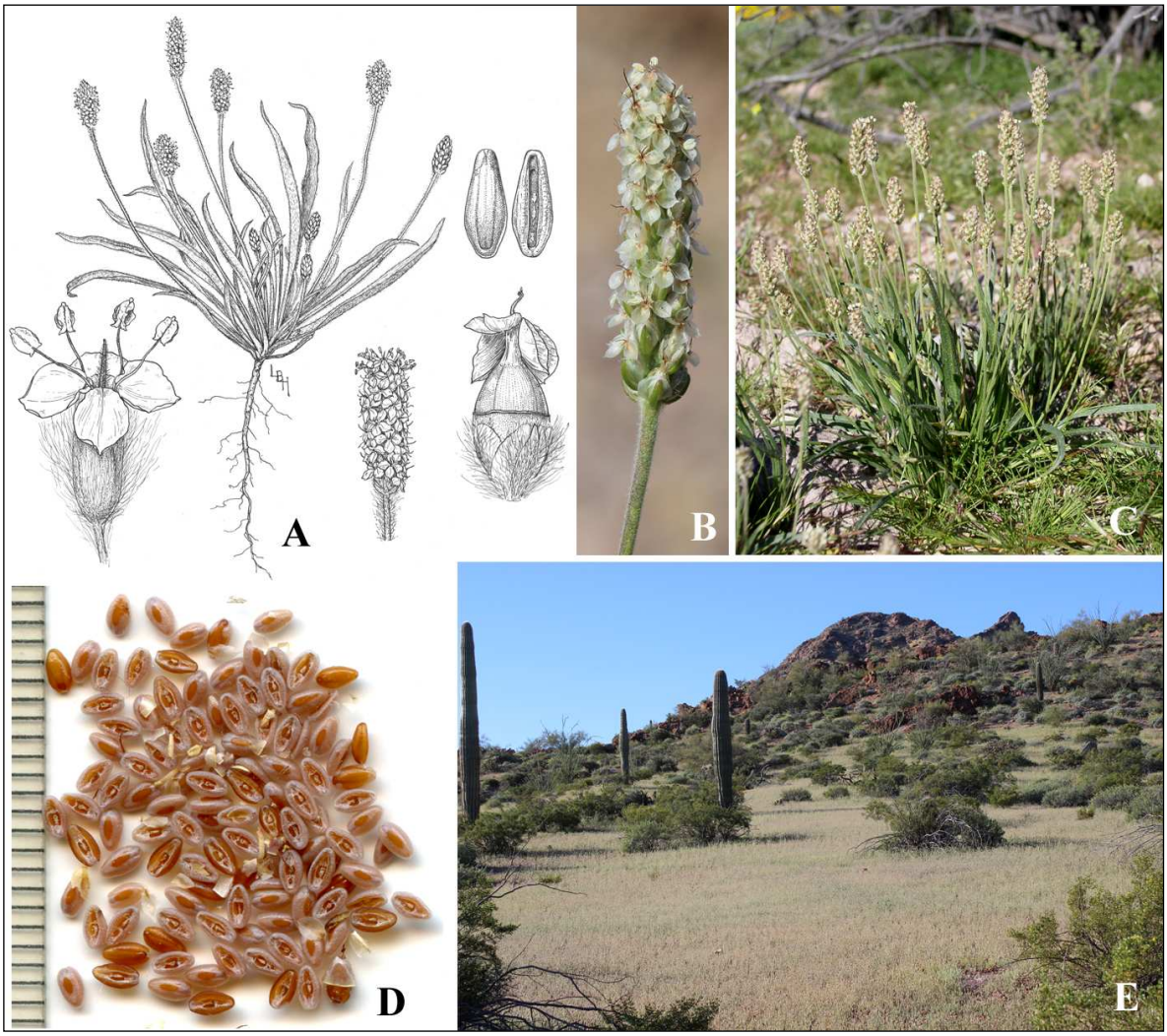

Figure 47. *Plantago ovata* var. *fastigiata*. (A) By Lucretia Breazeale Hamilton. (B) Estes Canyon, 27 Feb 2014. (C) W of Quitobaquito, along U.S./Mex border, 5 Feb 2005. (D) 11 mi E of Why, Hwy 86 at mile 62, 5 Apr 2015. (E) Red Tanks parking area, North Puerto Blanco Drive, 15 Mar 2015.

There is considerable variation in plant size, leaf width, and pubescence (Felger 2000). Plants from the most arid southwestern corner of the flora area and the Gran Desierto dunes in Sonora often have especially narrow leaves, often only 1–1.5 mm wide. Drought-stressed plants can be as

small as 6.4–12 mm tall, with persistent cotyledons to 12 mm long, only two leaves 7 mm long, and a peduncle bearing a single flower and fruit.

Flowering stems (peduncle or scape plus spike) usually several or more per plant, erect to ascending, (3) 4–20 (30) cm tall, leafless, mostly many-flowered. Flowers and bracts straw-colored and papery. Floral bracts 2.5–3 mm long, broadly ovate to slightly obovate, with a thickened green midstripe and broad, papery-membranous white margins; the bracts and sepals similar. Flowers protogynous (the stigma protrudes from the unopened corolla before the stamens expand). Corollas membranous-papery and brown, the lobes broad and spreading. Fresh, young flowers, however, have transparent white or pale pink corolla lobes, and the style and stigma are reddish lavender. Stamens quivering in the slightest breeze; filaments lavender, the anthers cream-white. Seeds (1.8) 2.1–2.5 (2.7) mm long, 2 per capsule, ellipsoid, shiny yellowish- or reddish-brown, the outer face convex, the inner face flat and excavated.

Abundant and widespread, especially well developed on sandy soils including dunes, and desert plains and valleys, hills, and at least most mountains to their summits. This species has been in the region for at least 20,500 years, although the infraspecific status of the fossils has not been determined. Bassett and Baum (1969) claimed the North American population resulted from Old World introduction by California settlers in the late 18th and early 19th centuries, and a number of authors continued to parrot this claim.

Variety *fastigiata* is the inland North American variety in southwestern USA and northern Mexico, and one of the most common and widespread winter-spring ephemerals of the Sonoran Desert. Other varieties occur in western North America and the Old World (Meyers & Liston 2008). *Plantago ovata* is the only known species within the Plantaginaceae having the basic chromosome number 4; other species have 5 or 6. Of the species belonging to *Plantago* section *Albicans*, *P. ovata* is the only one also found outside the Old World (Rahn 1979).

The seeds probably were eaten by all Sonoran Desert people (Hodgson 2001). The seeds were boiled, parched and ground into flour, or often merely soaked in water and consumed as a beverage or eaten as a gelatin-like mass (Felger 2007; Felger & Moser 1985). In favorable years it is abundant in spring and could be a significant food source. The seeds were also widely used medicinally. Commercial psyllium seed derives from cultivated varieties or forms of Old World *P. ovata* and *P. psyllium*.

OP: Tres Alamos Canyon, *Nichol 24 Feb 1939*. Alamo Canyon, 3000 ft, 14 Mar 1941, *Benson 10683*. Dripping Springs, 15 Apr 1952, *Parker 7908*. 6 mi E of Hwy 85 on Camino Dos Republicas, 11 Feb 1978, *Bowers 1039*. Aguajita Wash, 19 Jun 1989, *Felger 89-261* (ORPI). Armenta Road 1.4 mi W of Ariz Hwy 85, 11 Mar 2003, *Felger 03-256*. W side of Sierra Santa Rosa, along border, 12 Mar 2003, *Felger 03-373* (ASU). †Alamo Canyon, seeds, 1150 ybp. †Montezuma's Head, seeds, 20,490 ybp.

CP: Pinta Sands, 1 Feb 1992, *Felger 92-25*. Near Tule Well, 19 Mar 1992, *Yeatts 3228* (CAB). Charlie Bell Pass, 3 Apr 1992, *Whipple 3923*. Charlie Bell Road near east Refuge boundary, 9 Apr 1993, *Felger 93-320*.

TA: Above the tinajas, 19 Mar 1998, *Felger* (observation). Coyote Water, 21 Feb 2005, *Felger 05-123*. †Butler Mts, seeds, 740 to 11,250 ybp (6 samples).

Plantago patagonica Jacquin
[*P. purshii* Roemer & Schultes. *P. purshii* var. *oblongata* (E. Morris) Shinners]
Pastora. Figure 48.

Winter-spring ephemerals somewhat resembling *P. ovata*. Herbage with tawny brown hairs. Leaves linear to linear-lanceolate, often 2–8 (12) cm long. Flowering stems leafless, erect to ascending, often (6) 9–20 (27) cm tall. Bracts green or sometimes with minute membranous wings

near the base, linear to nearly oblong, the bracts subtending the lower flowers often more than twice as long as the sepals, becoming shorter on upper flowers; mid-spike bracts 3.5–5 (6) mm long. Flowers cleistogamous (self-pollinating in the bud, the anthers not exserted beyond the corolla mouth). Corollas moderately bilateral. Seeds 3 mm long, 2 per capsule, dull dark brown.

Widespread, valleys to rocky slopes across Organ Pipe except the southwestern part; Ajo Mountains westward to the eastern part of Cabeza Prieta.

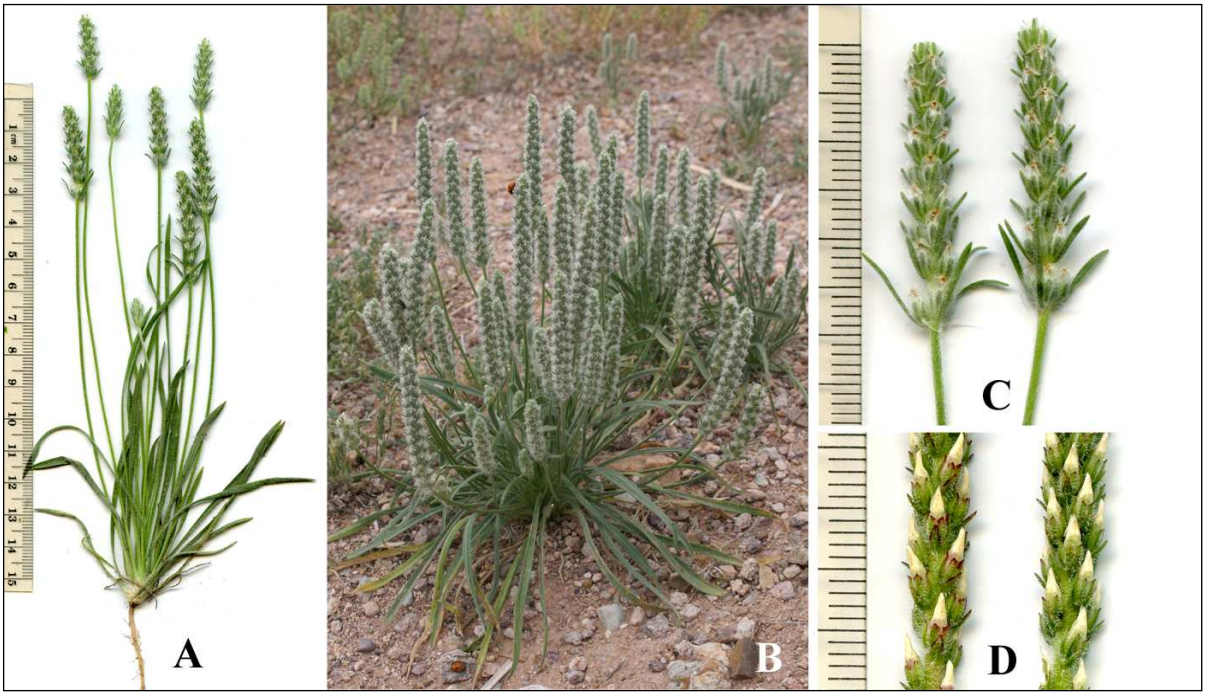

Figure 48. *Plantago patagonica.* (A & C) Wash crossing Hwy 85, N boundary of Organ Pipe, 25 Feb 2015. (B) Javelina Mountain, Sauceda Mts, 3 Apr 2005. (D) 11 mi E of Why, Hwy 86 at mile 62, 5 Apr 2015.

Western North America from Canada to northern Mexico and introduced farther east, and disjunct in Argentina and Chile.

The seeds were used in similar ways as those of *P. ovata* (Hodgson 2001), but *P. patagonica* is not as widespread or common in the Sonoran Desert.

OP: Alamo Canyon, 14 Mar 1941, *Benson 10683.* Near Arch Canyon, 28 Mar 1965, *Niles 558.* San Cristobal Wash near W boundary, 20 Mar 2003, *Rutman 2003-370.* Floodplain near N end of Pozo Nuevo Hills, 11 Apr 2003, *Rutman 2003-454*. Trail from The Cones to Mount Ajo, 4090 ft, 10 Apr 2005, *Felger* (observation).

CP: Jose Juan Represo, 12 Jun 1992, *Felger 92-560*. San Cristobal Wash at Camino del Diablo, 10 Apr 1993, *Felger 93-377.*

Pseudorontium

One species; a genus segregated from *Antirrhinum.*

Pseudorontium cyathiferum (Bentham) Rothmaler
[*Antirrhinum cyathiferum* Bentham]
Desert snapdragon, dog's mouth. Figure 49.

Figure 49. *Pseudorontium cyathiferum*. (A, C–F) Sandy wash, S side of Sierra Blanca, Pinacate Biosphere Reserve, Sonora, 18 Feb 2015. (B) N of Mulegé, Baja California Sur, 25 Oct 2006, photo by Patrick Alexander (SEINet).

Non-seasonal ephemerals, 3–25 cm tall, viscid (sticky) glandular hairy and foul smelling; often with more than one major stem and branched mostly from the lower half of the plant. Leaves opposite at lower 1 or 2 nodes, alternate and usually gradually smaller upwards; prominently petioled; leaf blades ovate to broadly lanceolate, often with apical glands (dark purplish areas); larger leaves 1.5–4 (5.5) × 0.8–1.6 cm. Pedicels shorter than the flowers or fruit, turning downward, inverting the fruit. Corollas 1 cm long, purple-blue with darker veins, the lip with 2 yellow spots and hairy at the entrance to the throat. Capsules globose. Seeds many, 1.9–2.5 mm long, whitish, becoming dark brown with age, with a wide cup-shaped wing surmounted by a linear body 1.5–1.7 mm long and tuberculate on irregular ridges.

Washes, bajadas, canyons, and slopes; widespread across the region but seldom common.

Sonoran Desert in southwestern Arizona, southeastern California, both Baja California states, and Sonora.

OP: Quitobaquito, 27 Nov 1939, *Harbison 26182* (SD). Senita Basin, 2 Mar 1989, *Baker 7715* (ASU, ORPI). Alamo Canyon, 15 Mar 2003, *Rutman 2003-325* (ORPI). NE slope of Pinkley Peak, *Rutman 31 Oct 2003* (ORPI).

CP: 26 mi W of Papago Well, Tule Mts, 1000 ft, 15 Apr 1940, *Benson 10792*. Near Tule Well: 20 Mar 1992, *Yeatts 3236* (CAB); 23 Mar 2002, *Harlan 512*. Cabeza Prieta Tanks, 15 Jun 1992, *Felger* (observation).

TA: Frontera Canyon, 18 Mar 1998, *Felger* (observation). Tinajas Altas Pass, 2 Mar 2014, *Sue Carnahan*, photo.

Sairocarpus – Snapdragon

Winter-spring ephemerals. Branchlets often twining. Leaves alternate, except lowermost leaves opposite. Flowers small and snapdragon-like. Capsules ovoid with many seeds.

At least a dozen species in southwestern USA and northwestern Mexico. A genus segregated from *Antirrhinum* (Barringer 2013, and in press).

1. Plants glandular-pubescent; leaves mostly ovate; pedicels mostly not longer than the flowers …..…….....…… **Sairocarpus nuttallianus**
1. Plants glabrous or essentially so (except sparsely pubescent at base); leaves mostly linear or nearly so; pedicels mostly longer than the flowers …..... **Sairocarpus watsonii**

Sairocarpus nuttallianus (Bentham) D.A. Sutton
[*Antirrhinum nuttallianum* Bentham subsp. *subsessile* (A. Gray) D.M. Thompson. *A. nuttallianum* var. *subsessile* (A. Gray) Jepson. *A. pusillum* Brandegee]
Lesser snapdragon, violet snapdragon. Figure 50.

Plants glandular-pubescent; usually with a single main axis and only short branches from above the approximate mid-height of the plant. The glandular-sticky stems often stick together in wind or when collected. Larger plants usually with some prehensile, or twining, branchlets. Leaves 0.5–3+ cm long, petioled, the blades ovate. Some plants may have exclusively chasmogamous flowers, the corollas about 1 cm long, violet-purple, the lower lip (palate) with two (sometimes confluent) whitish patches with purple venation, the tube with purple veins; other plants may have chasmogamous and cleistogamous flowers.

Ajo Mountains in canyons and rocky slopes to higher elevations and sometimes extending westward along major washes to the desert floor in the vicinity of Hwy 85.

Southern and central Arizona, expected in northern Sonora, and disjunct in Pacific southern California to Baja California Sur.

OP: Arch Canyon, 5 Apr 1978, *Bowers 1174* (ORPI). Junction Ajo Mt Drive with Boulder Canyon, 18 Apr 1983, *Thompson 264*. Alamo Canyon bridge on Hwy 85, *Rutman 4 Apr 2001* (ORPI). Alamo Canyon, 29 Mar 2003, *Felger 03-413*. Trail from The Cones to Mount Ajo, 4025 ft, 10 Apr 2005, *Felger 05-272*.

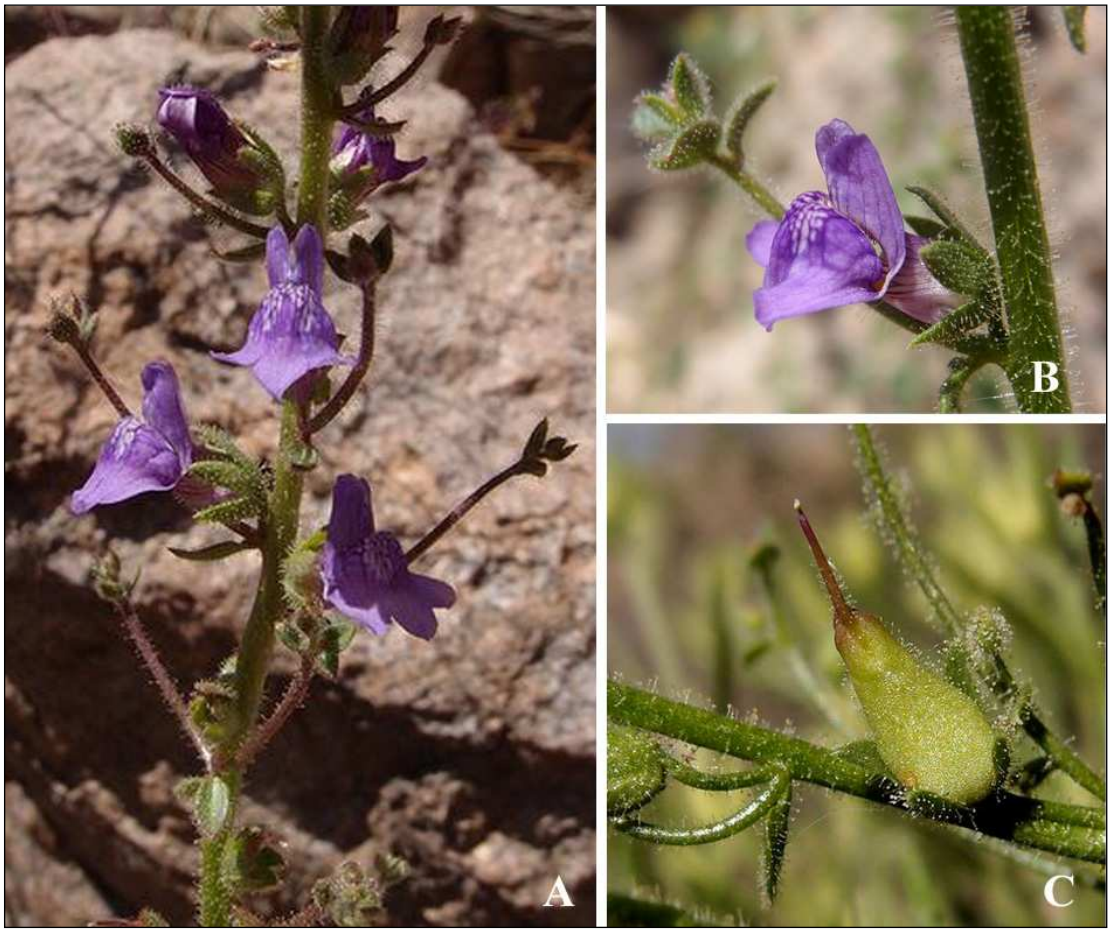

Figure 50. *Sairocarpus nuttallianus*. Salero Ranch, Santa Cruz Co., photos by Sue Carnahan: (A) 31 Mar 2012; (B) 1 Apr 2013; (C) 16 Apr 2015.

Sairocarpus watsonii (Vasey & Rose) D.A. Sutton
[*Antirrhinum watsonii* Vasey & Rose. *A. kingii* S. Watson var. *watsonii* (Vasey & Rose) Munz]
Watson's snapdragon. Figure 51.

Plants with delicate stems, the larger plants often with slender, twining branchlets; often sparsely pubescent at the base with glandular hairs, and glabrous or essentially so above. Leaves linear or nearly so, mostly 1–4+ cm long. Pedicels longer than the flowers. Corollas 6–7 mm long, bluish purple to dark purple with the lower lip (palate) white striped with purple, or the first flowers often cleistogamous with highly reduced, whitish corollas.

In the USA known only from Organ Pipe, in the Ajo Mountains and westward to the vicinity of the Monument headquarters. Otherwise mainly along the Sonora coast from the vicinity of Guaymas to Puerto Lobos and the Sierra Viejo near Caborca, islands in the Gulf of California, and much of the Baja California Peninsula.

OP: Between Diaz Mt and Sweetwater Wash, *Schmitt 24 Feb 1973* (ORPI). 2 mi W of Sweetwater Pass [northern Sonoyta Valley], 31º59'25"N, 112º41' 55"W, 640 m, E-facing hillside, near or under shrubs, weak annual with prehensile lateral shoots, flowers blue-lavender with white center, 1 Mar 1989, *Baker 7707* (ASU, ORPI; cited by D.J. Pinkava et al, 1992, J. AZ-Nev. Acad. Sci. 24/25: 17). Estes Canyon, *Rutman 15 Mar 1998* (ORPI). 0.5 mi E of main campground [near visitor center], rocky slopes of S-facing hill, *Rutman 31 Mar 1998* (ORPI).

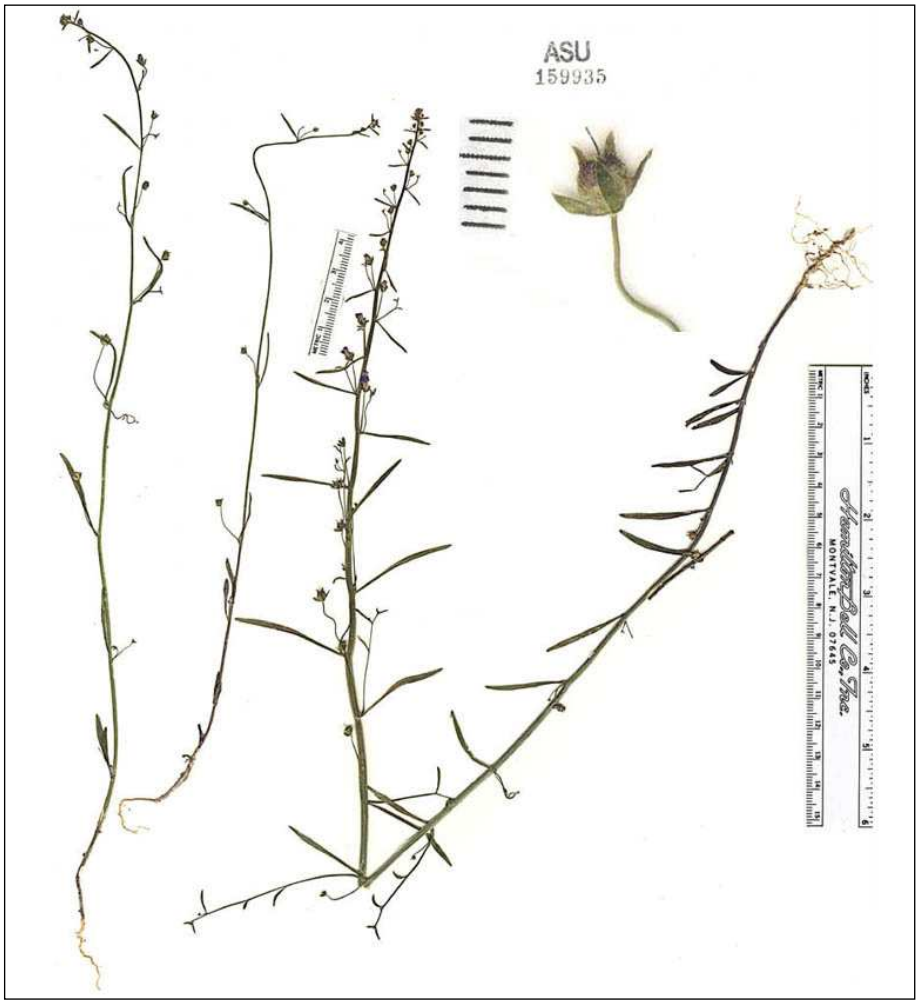

Figure 51. *Sairocarpus watsonii*. E-facing hillside, northern Sonoyta Valley, with *Ambrosia deltoidea*, *Carnegiea gigantea*, *Calliandra*, *Coursetia*, and *Simmondsia*, 1 Mar 1989, *Baker 7707* (ASU 159935).

Stemodia

Mostly perennial herbs and some shrubs; worldwide; 50 species.

Stemodia durantifolia (Linnaeus) Swartz
Purple stemodia. Figure 52.

Herbaceous perennials, also flowering in the first season, stems usually erect, to 30–40 tall; glandular pubescent. Leaves opposite, larger leaves often 8–15 mm long, the first leaves in a basal rosette, upper stem leaves reduced; leaf margins serrated. Pedicels 1–6 mm long; sepals 6–8 mm long; corollas 8–10 mm long, dark blue. Capsules ovoid; seeds many.

In the flora area known only from several records at water's edge in the bottom of Alamo Canyon.

Southwestern USA and tropical America.

OP: Alamo Canyon: Wash, *Dakan 2 Feb 1972* (ORPI); Wash bed of S fork of Alamo Canyon, next to a pool, 7 Sep 2013, *Rutman 20130907-5*.

Figure 52. *Stemodia durantifolia*. Alamo Canyon near Alamo Well: (A) 9 Sep 2013; (B) 11 Mar 2014. (C) King Canyon, Tucson Mts, 21 Feb 2009, photo by Patrick Alexander (SEINet). (D) Sabino Canyon, Santa Catalina Mts, Aug 2011, photo by Anthony Mendoza (SEINet).

Veronica

Northern Hemisphere, especially Eurasia; 250 species.

Veronica peregrina Linnaeus subsp. **xalapensis** (Kunth) Pennell
Purslane speedwell, necklace-weed. Figure 53.

Delicate winter-spring ephemerals, (6) 10–30 cm tall. Leaves and lower stems glabrate, the upper stems with slender stalked glands. Leaves opposite, 6–24 mm long, usually deciduous by fruiting time, oblong to elliptic or oblanceolate, the margins entire to shallowly toothed. Racemes elongated, mostly terminal, reaching 15–25 cm on larger plants, the floral bracts alternate and gradually reduced upwards. Pedicels short. Flowers minute and inconspicuous. Sepals 4, fruiting sepals 2.5–4 mm long. Corollas and stamens white, the corollas smaller than the calyx. Stamens 2. Capsules obcordate, 3–4 mm wide, distinctly flattened, wider than long. Seeds yellow-orange, many, (0.6) 0.7 (0.8) mm long, smooth, flattened on one side, ridged on the other side.

Locally on wet soil at charcos, tinajas, and canyon-bottom waterholes and puddles, sometimes abundant at the large playas in Cabeza Prieta, and formerly bordering the pond at Quitobaquito.

This subspecies ranges from Alaska and Canada to Central America and South America. Another subspecies occurs in temperate North America and Eurasia.

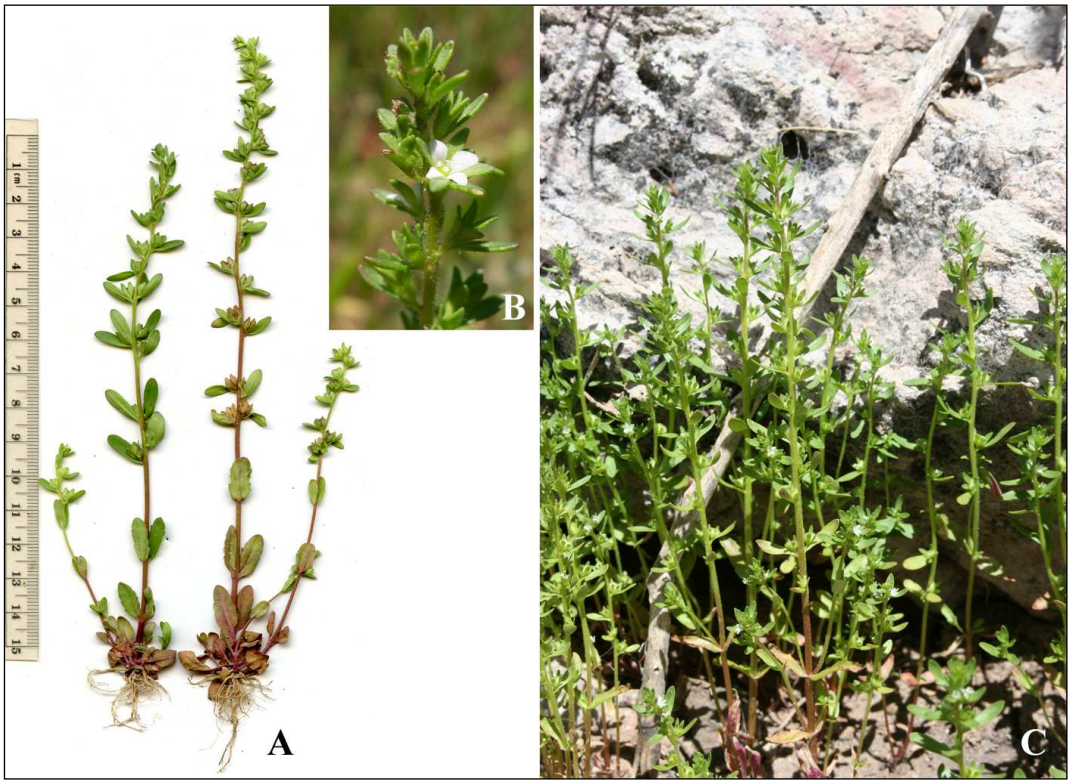

Figure 53. *Veronica peregrina*. (A) Pinacate Junction, Pinacate Biosphere Reserve, Sonora, 7 Mar 2015. (B) Hartwell Canyon, NW of Sedona, Yavapai Co., 4 May 2005, photo by Max Licher (SEINet). (C) Middle fork of Alamo Canyon, 26 Mar 2005.

OP: Quitobaquito: With *Poa annua* and *Myosurus* in marshy area bordering alkaline pool, 18 Mar 1945, *Gould 2987*; Wet soil on edge of lake, 17 Apr 1952, *Parker 7995*. Alamo Canyon, *Dakan 6 May 1973* (ORPI). Bull Pasture, 5 Apr 1978, *Bowers 1207* (ORPI).

CP: Las Playas, *Phelps 19 Mar 1978* (ASU). Jose Juan Represo, 12 Jun 1992, *Felger 92-563*. Cabeza Prieta Tanks, 15 Jun 1992, *Felger* (observation).

PLUMBAGINACEAE – Leadwort Family

Perennial herbs and shrubs; 27 genera, 836 species.

Plumbago

Herbs and shrubs; worldwide, 20 species.

Plumbago zeylanica Linnaeus
[*P. scandens* Linnaeus]
Doctorbush; *estrenina*. Figure 54.

Sprawling subshrub perennials, with upright to scandent stems. Leaves thin, mesophytic, and tardily drought-deciduous, often 6–10+ cm long, petioled, the blades lanceolate to elliptic or ovate. Flowers 5-merous, often 1+ cm wide. Corollas, filaments, style and stigma satiny white, the anthers violet-purple before opening longitudinally to shed the white pollen, the anthers then turn dark blue. The calyx bears stalked glands that stick to almost anything, and similar glands on the flowering stalk and bracts begin exuding at about the time of anthesis, perhaps protecting the flowers and fruits from predation; the calyx encloses the fruit. Fruits of 1-seeded capsules, 8 mm long, circumscissile near the base, readily detaching and adhering. Flowering at various seasons with warm weather and sufficient soil moisture.

Uncommon, in mesic areas of canyons in the Ajo Mountains.

Eastward in southern Arizona to Texas, Florida, and to South America and widespread in the Old World.

OP: N fork of Alamo Canyon, 2750 ft, 7 Oct 1951, *Parker 7744*. Arch Canyon, 3 May 1979, *Bowers 1299*.

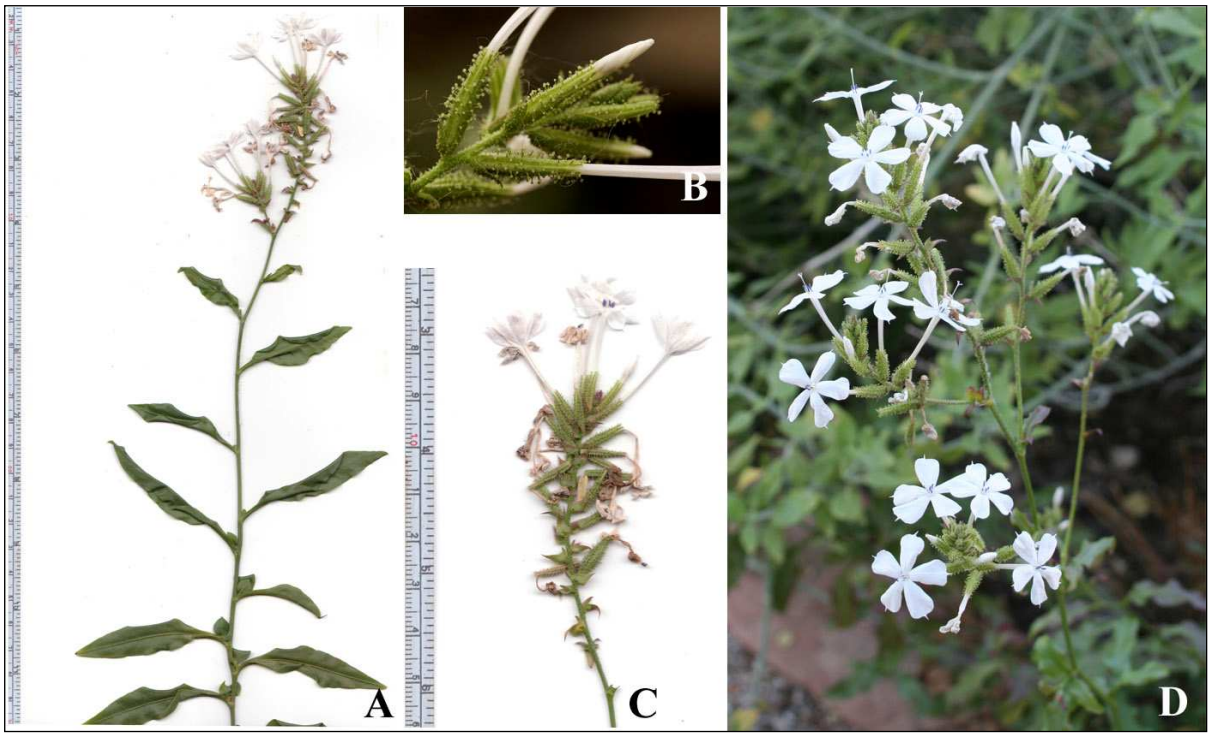

Figure 54. *Plumbago zeylanica*. Cultivated plant in Ajo garden: (A & C) 28 Sep 2008; (D) 26 Sep 2006. (B) Barranca de Batopilas, Sierra Madre Occidental, Chihuahua, Mexico, 22 Mar 2007, photo by Patrick Alexander.

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