Felger, R.S. and S. Rutman. 2015. Ajo Peak to Tinajas Altas: Flora of Southwestern Arizona Part 19. Eudicots: Polygalaceae to Simmondsiaceae. Phytoneuron 2016-47: 1–71. Published 23 June 2016. ISSN 2153 733X

AJO PEAK TO TINAJAS ALTAS: A FLORA OF SOUTHWESTERN ARIZONA
Part 19. EUDICOTS: POLYGALACEAE TO SIMMONDSIACEAE

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ABSTRACT

A floristic and natural history account is provided for 16 eudicot families as part of the vascular plant flora of the contiguous protected areas of Organ Pipe Cactus National Monument, Cabeza Prieta National Wildlife Refuge, and the Tinajas Altas Region in southwestern Arizona — the heart of the Sonoran Desert. The 16 families include 33 genera with 52 taxa. At least 19 species are represented by fossil specimens from packrat middens, four of which are no longer present. This is the nineteenth contribution for this flora, published in Phytoneuron and also posted open access on the website of the University of Arizona Herbarium: <http://cals.arizona.edu/herbarium>.

This contribution to our flora in southwestern Arizona includes sixteen eudicot families (Table 1). The flora area covers 5141 km^2 (1985 mi^2) of contiguous protected areas in the heart of the Sonoran Desert (Figure 1).

The first article in this series includes maps and brief descriptions of the physical, biological, ecological, floristic, and deep history of the flora area (Felger et al. 2013a). This flora includes the modern, present-day taxa as well as fossil records from packrat middens. Explanation of the format for the flora series is provided in part 3 (Felger et al. 2013b). These contributions are also posted open access on the website of the University of Arizona Herbarium (ARIZ). Family designations follow APG III and IV (Angiosperm Phylogeny Group 2009, 2016) and the Angiosperm Phylogeny Website (Stevens 2012). Non-native taxa established in the flora area are marked with an asterisk (*) and non-natives not established in the flora area are marked with double asterisks (**). Fossil specimens are indicated with a dagger symbol (†) and fossils of taxa 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). Descriptions and keys pertain to taxa and populations as they occur in the flora area.

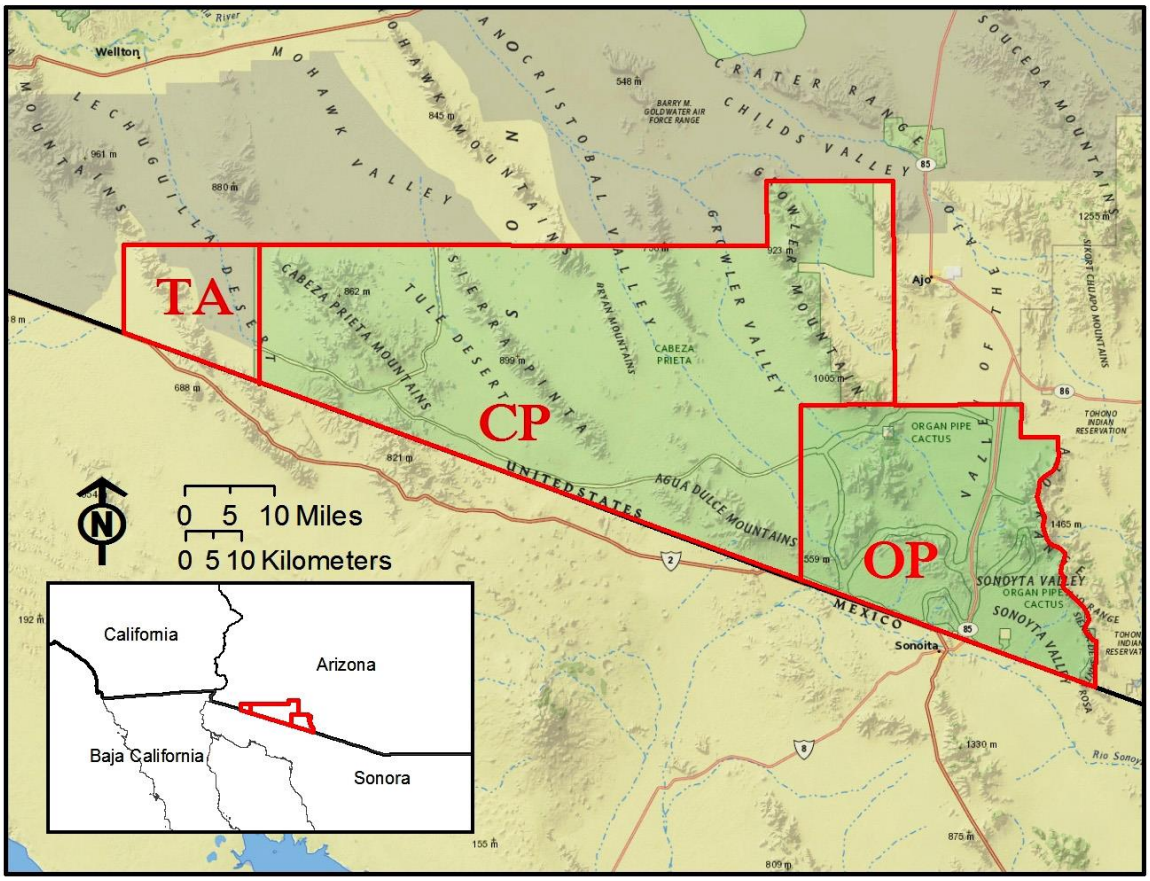

Figure 1. Flora area in southwestern Arizona. OP = Organ Pipe Cactus National Monument; CP = Cabeza Prieta National Wildlife Refuge; TA = Tinajas Altas Region. Green shading indicates approximate boundaries of federally designated wilderness.

Table 1. Local distributions and growth forms of Polygalaceae, Polygonaceae, Portulacaceae, Primulaceae, Ranunculaceae, Resedaceae, Rosaceae, Resedaceae, Rhamnaceae, Rosaceae, Rubiaceae, Rutaceae, Salicaceae, Santalaceae, Salicaceae, Simaroubaceae, Simmondsiaceae, Sapindaceae, and Simmondsiaceae. † = Modern species also represented by a fossil; †† = fossil taxa no longer present; ** = non-native species not established in the flora area. OP = Organ Pipe Cactus National Monument; CP = Cabeza Prieta National Wildlife Refuge; TA = Tinajas Altas Region. SU = Summer/warm-season ephemerals; WI = winter-spring/cool-season ephemerals; PR = perennials.

Taxon	**Region**			**Growth Form**			
	Organ Pipe	Cabeza Prieta	Tinajas Altas	Ephemerals			Perennial
				Summer	Winter	Non-seasonal	
POLYGALACEAE							
Hebecarpa macradenia	OP						PR
POLYGONACEAE							
†*Chorizanthe brevicornu*	OP	CP	TA		WI		
†*Chorizanthe corrugata*	OP	CP	TA		WI		
†*Chorizanthe rigida*	OP	CP	TA		WI		
†*Eriogonum abertianum*	OP					NS	
Eriogonum deflexum	OP	CP				NS	

†*Eriogonum fasciculatum* var. *polifolium*	OP	CP	TA				PR
†*Eriogonum fasciculatum* var. *unknown*			TA				PR
Eriogonum inflatum	OP	CP	TA				PR
Eriogonum maculatum	OP				WI		
Eriogonum thomasii	OP	CP	TA		WI		
Eriogonum thurberi	OP	CP	TA		WI		
Eriogonum trichopes	OP	CP	TA			NS	
†*Eriogonum wrightii* var. *nodosum*	OP	CP	TA				PR
†*Eriogonum wrightii* var. unknown			TA				PR
Nemacaulis denudata		CP	TA		WI		
**Polygonum argyrocoleon*	OP	CP				NS	
Pterostegia drymarioides	OP				WI		
Rumex hymenosepalus	OP						PR
PORTULACACEAE							
Portulaca halimoides	OP	CP	TA	SU			
**Portulaca oleracea*	OP	CP		SU			
Portulaca suffrutescens	OP			SU			
Portulaca umbraticola	OP			SU			
PRIMULACEAE							
***Anagallis arvensis*	OP				WI		
Androsace occidentalis	OP				WI		
RANUNCULACEAE							
†*Anemone tuberosa*	OP		†TA				PR
Clematis drummondii	OP	CP					PR
Delphinium scaposum	OP	CP					PR
†*Myosurus cupulatus*	OP				WI		
Myosurus minimus	OP				WI		
††*Myosurus nitidus*	OP				WI		
Thalictrum fendleri	OP						PR
RESEDACEAE							
Oligomeris linifolia	OP	CP	TA		WI		
RHAMNACEAE							
††*Ceanothus vestitus*	OP						PR
Condalia globosa	OP	CP					PR
†*Condalia globosa* &/or *C. warnockii*	OP		TA				PR
Frangula betulifolia	OP						PR
Rhamnus crocea	OP						PR
†*Ziziphus obtusifolia*	OP	CP	TA				PR
RIVINACEAE							
Rivina humilis							PR
ROSACEAE							
†*Vauquelinia californica*	OP						PR
RUBIACEAE							
Galium aparine	OP				WI		
Galium microphyllum	OP						PR
†*Galium stellatum*	OP	CP	TA				PR

RUTACEAE							
Ptelea trifoliata	OP						PR
†*Thamnosma montana*		CP	TA				PR
SALICACEAE							
Populus fremontii	OP	CP					PR
Salix gooddingii	OP						PR
SANTALACEAE							
†*Phoradendron californicum*	OP	CP	TA				PR
††*Phoradendron juniperinum*	OP						PR
††*Phoradendron serotinum*	OP						PR
SAPINDACEAE							
Dodonaea viscosa	OP						PR
Sapindus drummondii	OP						PR
SIMAROUBACEAE							
Castela emoryi	OP	CP					PR
SIMMONDSIACEAE							
†*Simmondsia chinensis*	OP						PR

POLYGALACEAE – Milkwort Family

Herbs, vines, shrubs, and trees; worldwide; 24 genera, 965 species.

Hebecarpa

The single member of this family in the flora area is in the genus *Hebecarpa*, segregated from the polyphyletic *Polygala* sensu lato, and includes 40–70 species mostly in Mexico, with 9 species ranging into southwestern USA and a few extending to South America (Abbott 2011).

Hebecarpa macradenia (A. Gray) J.R. Abbott

[*Polygala macradenia* A. Gray]

Gland-leaf milkwort. Figure 2.

Small, densely branched perennials, to about 15 cm tall, from a somewhat woody base. Herbage densely pubescent and gland dotted. Leaves 3–8 mm long, subsessile or short petioled, lanceolate to elliptic-ovate. Flowers bilateral and somewhat pea-like (sometimes confused with legumes). Sepals 5, separate, including an enlarged wing-like lateral pair, purple and petal-like, each ca. 2.5 mm long. Corollas of 3 small, fused white and yellow petals. Stamens 8. Fruits oblong to narrowly ovoid capsules, ca. 5 mm long, pubescent and gland dotted. Flowering with sufficient soil moisture during warmer months.

Rocky soils, often granitic or other calcium-rich substrates, in hills and mountains, and often on arroyo and canyon slopes. Widely scattered across much of Organ Pipe except the arid southwestern part.

Southwestern USA except California and northern Mexico from Baja California and northern Sonora to Tamaulipas and Zacatecas.

OP: Pitahaya Canyon, 3400 ft, *Nichol 23 Feb 1939*. Canyon N of Alamo Canyon, 31 Mar 1948, *Darrow 3857*. Puerto Blanco Drive, 13 mi by road NW of Visitor Center, 10 May 1979, *Bowers 1714*. Gunsight Hills, granite, 24 Mar 2013, *Rutman*, photos.

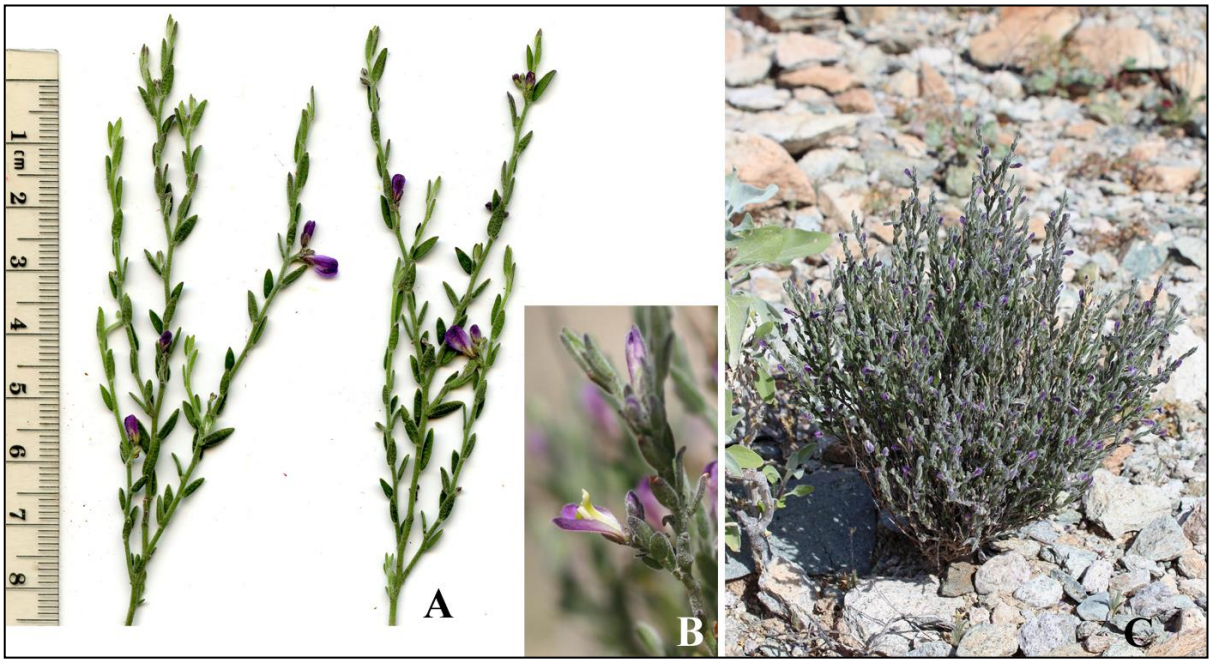

Figure 2. *Polygala macradenia*. (A) Gunsight Hills near E boundary of ORPI, 11 Mar 2015. Trail to Victoria Mine, Puerto Blanco Mts: (B) 1 Apr 2010; (C) 7 Feb 2014.

POLYGONACEAE – Buckwheat Family

Ephemerals/annuals or perennial herbs or small shrubs (those in the flora area; includes lianas and trees elsewhere). Stems often swollen at nodes with fused stipules enclosing (sheathing) the stem, or stipules reduced or absent. Leaves simple, alternate, or occasionally opposite or whorled, usually entire. Flowers mostly small and radial. Calyx in 1 or 2 series, often petal-like; petals none. Fruits 1-seeded achenes (those in the flora area).

Worldwide; 43 genera, 1110 species.

1. Stipules evident and sheathing the stems; subfamily **Polygonoideae**.

2. Leaves sessile or nearly so; flowers (calyx) 1.5–2.5 mm long…….. **Polygonum**
2. Petioles well developed on the larger, lower leaves; flowers (calyx) more than 5 mm long. …… **Rumex**

1. Stipules absent; subfamily **Eriogonoideae**.

3. Ephemerals/annuals or perennials; involucral bracts united below to form a tube.

4. Small ephemerals; involucres bearing spine-tipped teeth and a single flower (flowers minute and often cryptic)…….. **Chorizanthe**
4. Small ephemerals to woody perennials; involucres with blunt-tipped teeth or bracts and multiple flowered…… **Eriogonum**

3. Ephemerals; involucral bracts solitary or separate.

5. Plants with woolly hairs; leaves in a basal rosette, the blades several times longer than wide and pointed at the tip; Cabeza Prieta dunes……..... **Nemacaulis**
5. Plants sparsely hairy, not woolly; leaves cauline (on the stem), the blades as wide or wider than long and usually notched; Organ Pipe…… **Pterostegia**

Chorizanthe – Spine flower

Small, spring ephemerals (annuals and some perennials elsewhere). Leaves entire, in basal rosettes and soon deciduous or withering, usually by early March, some leaves also alternate along stems; stipules none. Involucres with 3 or 6 teeth, these often spinescent and recurved; usually dimorphic. (The few involucres in the lower axils are solitary, larger, and less modified than those in the upper axils.) Flowers 1 per involucre, minute, white or yellow, the perianth barely protruding or hidden in firm, spinescent bracts; stamens often 9, 6, or 3. Flowering mostly February to March, the plants mostly mature before or during April. By the time the plants are in full flower with onset of fruiting, the weather is warm and the plants are leafless or nearly so.

Western North America and Chile; 50 species. The North American species are annuals with a taproot and leaves in a basal rosette, whereas the South American species are mostly perennials.

1. Stems stout and spiny, not breaking apart at maturity, the dry plants ("skeletons") tough and persistent; involucral tube as wide as long…….. **Chorizanthe rigida**
1. Stems slender and not notably spiny, not persistent, the stems and inflorescences fragile and breaking apart at maturity; involucral tube longer than wide.

2. Leaves narrowly oblanceolate; involucre 6-toothed, with sharp recurved teeth 2–4 mm long, like tiny grappling hooks…… **Chorizanthe brevicornu**
2. Leaves broadly ovate to orbicular; involucre 3-parted, the teeth (segments) 2–7.5 mm long, not notably sharp or hooked……. **Chorizanthe corrugata**

Chorizanthe brevicornu Torrey subsp. **brevicornu**
Brittle spine-flower, short-horn spine-flower. Figure 3.

Plants (3) 5–25 cm tall, often wider than tall. Stems much-branched above (except when stunted); lower stems often reddish green; upper stems, inflorescence branches, and involucres mostly yellowish green. Internodes of fresh, young growth slightly swollen just below nodes. Dry mature stems brittle, breaking apart at nodes. Herbage with appressed white hairs. Basal rosette leaves (1) 1.8–8 cm × (1) 1.3–5 mm, narrowly oblanceolate without a distinct petiole, semi-succulent on young robust plants, very quickly withering; stem leaves reduced above. Involucres solitary at nodes, each subtended by recurved (hooked) bracts 2–3 mm long. Involucral tube straight or slightly curved, 3.5–4 mm long, cylindrical but 3-angled with 6 prominent ribs, each rib extending into a recurved, spinose tooth 1 mm long ("short-horned" as indicated by the specific name) like tiny grappling hooks. Perianth white, barely protruding from the involucre. Stamens 3. Achenes cylindrical, tightly enclosed by the involucre.

The dry, mature plants completely break apart and "disappear" during April or May. The propagules contain a stem segment with mostly 1–3 internodes and an involucre with its single seed. The rigid, sharp, and recurved teeth at both the base and tip of the involucre are like tiny grappling hooks attaching to skin, clothing, fur, or feathers. Apparently the seed germinates while enclosed in the involucre. There seems to be weak dimorphism in size and weight of disseminules: the lower stems, which are stouter and have longer internodes than the upper stems, produce stouter involucres in their axils than do those in the upper-stem axils.

Widespread and common across the flora area; washes and sandy flats to rocky slopes. Specimens more 10,000 years old are recorded for the Tinajas Altas Region.

Mojave, Sonoran, and Great Basin deserts in Arizona, Baja California, California, Nevada, southwestern New Mexico, northwestern Sonora, and Utah. Another subspecies occurs at elevations and latitudes above the desert from central California to Idaho and southeastern Oregon.

OP: Alamo Canyon, 14 Mar 1941, *Benson 10675*. Headquarters, *McDougall 10 Apr 1941*. Dripping Springs, 15 Apr 1952, *Parker 7912*. Aguajita, *Beale 8 Apr 1988* (ORPI).

CP: Canyon bottom, NE approach to Agua Dulce Pass, 13 Apr 1964, *Niles 344*. Charlie Bell Pass, 3 Apr 1992, *Whipple 3930*. Pinta Sands, 11 Apr 1993, *Felger 93-395*.

TA: Tinajas Altas, *Van Devender 5 Mar 1983*. Steep canyon slope N of Tinajas Altas, 19 Mar 1998, Felger, observation. Tinajas Altas, bajada, 19 Mar 1998, *Felger*, observation. †Butler Mts, fruit-bearing segments (with hooks), 10,360 ybp.

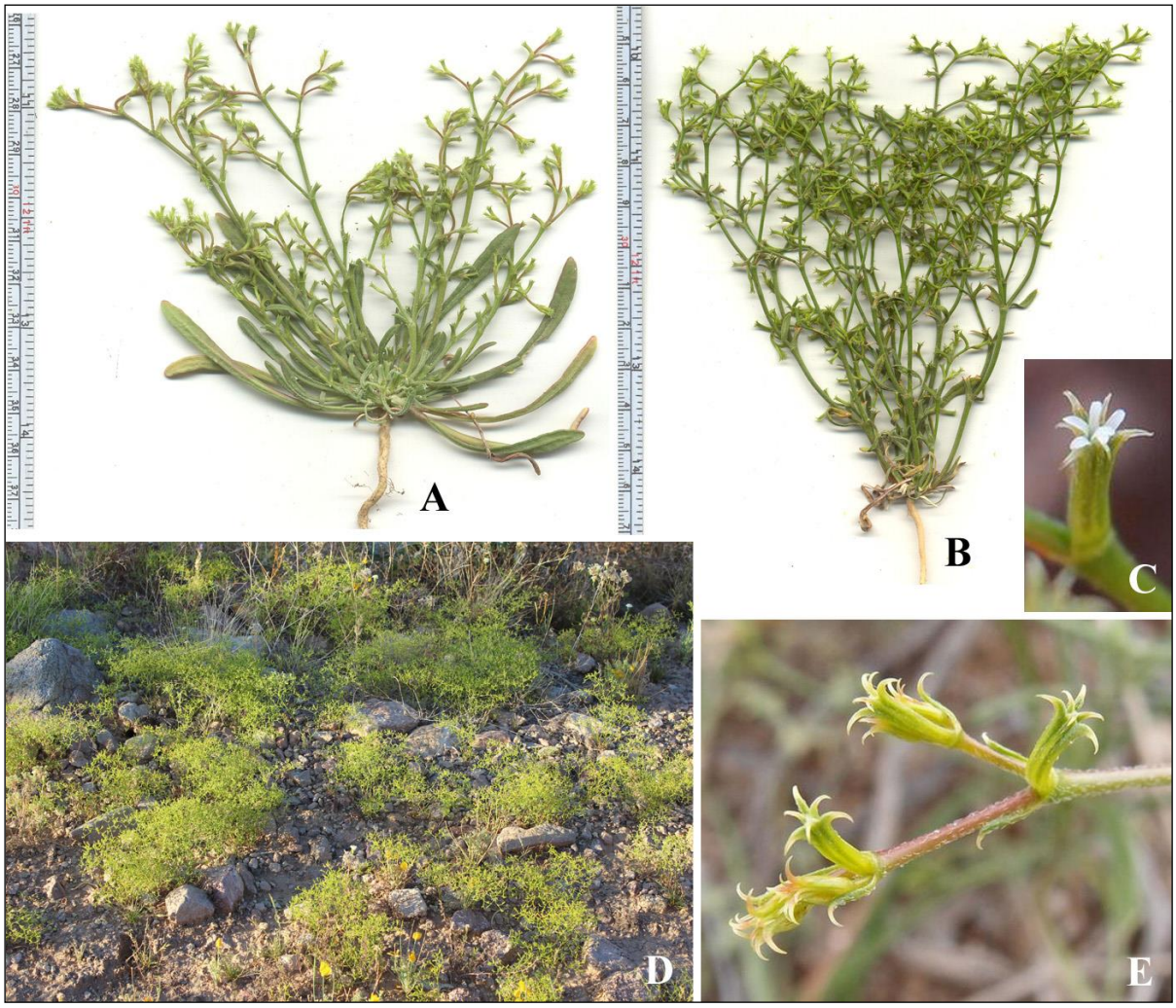

Figure 3. *Chorizanthe brevicornu* subsp. *brevicornu*. (A) El Huerfano, Sonora, 5 Mar 2014. (B) Below Gillespie Dam, Maricopa Co., 31 Mar 2013. (C & E) Flats E of Tinajas Altas, 2 Mar 2014, photos by Sue Carnahan. (D) Hat Mountain, Maricopa Co., 22 Mar 2014.

Chorizanthe corrugata (Torrey) Torrey & A. Gray
Wrinkled spine-flower. Figure 4.

Plants (1.5) 3–15 cm tall, compact, intricately branched above, as wide or wider than tall. Stems densely white hairy below, often glabrate above and with age. Leaves of basal rosette densely white woolly, conspicuously petioled, the blades (5) 8–30 mm long, broadly ovate to orbicular; stem leaves reduced above. Involucres densely crowded, yellow-green; hat-shaped, drying red-brown, firm and corrugated with transverse wrinkles. Involucral tube 2–3.7 mm long, cylindrical, with 3 lobes (teeth) 2–7.5 mm long, the tips recurved and moderately spinose; lobes of lower involucres markedly larger and broadly elliptic to ovate, the lobes of upper involucres smaller and narrower. Upon maturity the inflorescence quickly breaks apart into single-involucre pieces. Perianth white, barely protruding from the involucral tube. Stamens 6. Achenes 2.5 × 0.4 mm, cylindrical, smooth but not shiny, the tip 3-angled and minutely tuberculate, tightly enclosed in the hard involucral tube; seed disseminated with the involucre and apparently germinating while enclosed in it.

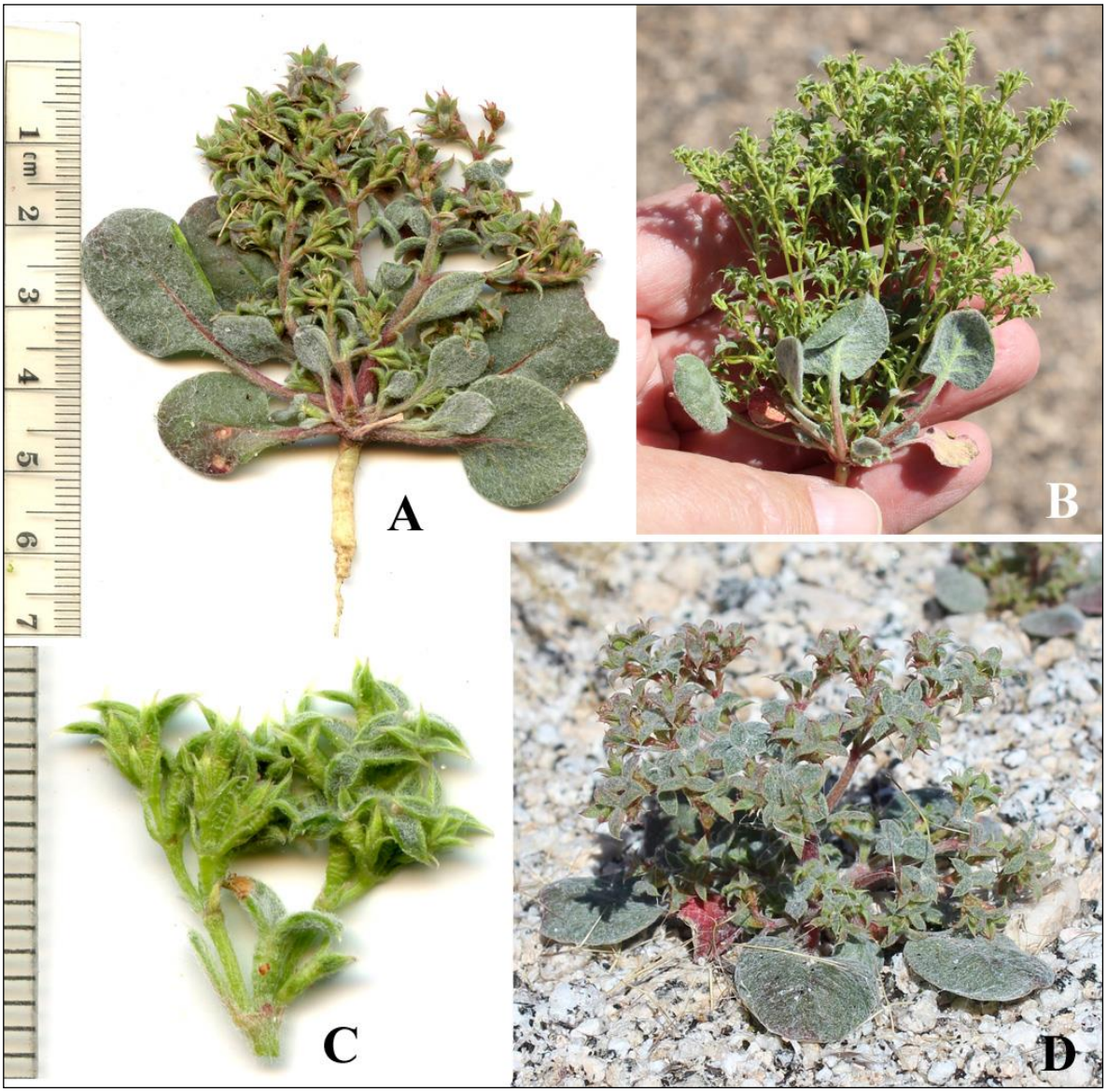

Figure 4. *Chorizanthe corrugata*. Sierra de Aguila, about 93 km W of Sonoyta on Mex Hwy 2, Sonora: (A & D) 7 Mar 2015; (C) 19 Mar 2015. (B) Vicinity of Los Vidrios, Mex Hwy 2, 17 Mar 2014.

Widely scattered in washes, sand flats, bajadas, and low rocky hills in the central portion Cabeza Prieta and a few records from Organ Pipe and one from Tinajas Altas. Generally aggregated in small, isolated populations. Many or perhaps most of the plants germinate in close proximity to their parent plant. A 2400-year-old specimen is recorded from the Puerto Blanco Mountains.

Western Arizona, southeastern California, southern Nevada, northeastern Baja California, and northwestern Sonora.

OP: 15 mi S of Bates Well, 1300 ft, sandy plains in open *Larrea-Franseria deltoidea*, 17 Mar 1945, *Gould 2982*. Flats 1.4 mi WSW of Bates Well, *Rutman 6 Apr 1998* (ORPI). †Puerto Blanco Mts, involucre, 2340 ybp.

CP: Tule Well, *Goodding 6 Mar 1940* (ASU). Davidson Canyon, 8 Apr 1979, *Lehto 23607* (ASU). Pinacate Lava Flow, 11 Apr 1978, *Lehto 22525* (ASU). Christmas Pass, 13 Apr 1992, *Harlan 267* (CAB). Pinta Sands, 11 Apr 1993, *Felger 93-394*.

TA: Tinajas Altas Pass, ca. 62.6 km (by air) SE of Yuma, 329 m, rocky granitic slope and derived grus, Mar 2014, *Van Devender*, photo (MABA/ARIZ).

Chorizanthe rigida (Torrey) Torrey & A. Gray
Devil's spine-flower. Figure 5.

Plants drying as a rigid, spiny skeleton resembling a miniature ocotillo and often persisting for a number of years. Plants (1) 2–10 cm tall with stout stems soon becoming rigid and obscured by crowded, rigid, straight spines. Some plants only 5 cm tall had taproots more than 25 cm deep. Larger leaves in a basal rosette as well as along the stem, the leaves soon withering; leaves petioled, the blades 6–32 mm long, ovate to orbicular, densely white woolly below, usually less so to sparsely white hairy above. Bracts spine-like, (4) 7–26 mm long. Involucres 3-angled and 3-toothed or segmented, the tube 2 mm long, about as wide as long and reticulated, the segments triangular to leaf-like, unequal, the longest one in the trio 4–20 mm long. Flowers minute, the perianth yellow-green and scarcely visible. Stamens 9. Achenes mostly 1.4–1.5 mm long, shiny red-brown, strongly 3-angled or -lobed and beaked. The size, length and width, weight, and even the shape of the involucral segments and size of the contained seed are highly variable, resulting in different dispersal characteristics (Martinez-Berdeja et al. 2014). The seed is tightly held in the involucre, even on dry dead plants more than one year old. Seedlings often germinate at the base of old dry plants that seem to serve as nurse plants.

Figure 5. *Chorizanthe rigida*. (A) Aguajita Wash near international boundary, 25 Feb 2015. (B & C) Near Black Tank, Crater Range, 29 Mar 2015; (B) skeleton of dead plant.

Common and widespread across the flora area; flats, rocky slopes, bajadas, and broad, gravelly washes. Its history in the Tinajas Altas Region extends to more than 8000 years.

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

OP: Alamo Canyon, *Nichol 26 Mar 1939*. Dripping Springs, 15 Apr 1952, *Parker 7923*. Growler Mts, foothills, 16 Apr 1952, *Parker 7972*. Aguajita, *Beale 8 Apr 1988* (ORPI).
CP: 2 mi W of Organ Pipe on road to Papago Well, 31 Jan 1992, *Felger 92-1*. Charlie Bell Pass, 3 Apr 1992, *Whipple 3936*. Pinta Sands, 11 Apr 1993, *Felger 93-396*. Cabeza Prieta Tanks, 15 Jun 1992, *Felger*, (observation).
TA: Camino del Diablo SE of Raven Butte, 20 Feb 2005, *Felger 05-33*. Tinajas Altas, bajada and lower slopes, 19 Mar 1998, *Felger* (observation). †Butler Mts, 3-parted floral bracts, 740 to 8160 ybp (3 samples).

Eriogonum – Wild buckwheat

Annual or perennial herbs or small shrubs. Leaves basal or along stems, whorled or alternate, the margins entire or sometimes wavy or scalloped; without stipules. Flowers in involucres with 4 or 5 teeth or lobes (those in the flora area). Sepals (tepals) petal-like, in 2 series of 3 segments each. Stamens 9; styles 3. Achenes mostly 3-winged or 3-angled.

A diverse North American genus, 250 species mainly in western North America, and one of the more diverse genera in the flora area in terms of number of species (10) and growth forms. Stems and "seeds" (achenes) of various species were eaten by the Cahuillas and others (Bean & Saubel 1972).

1. Annuals or small shrubs; stems leafy (although drought deciduous).

2. Annuals, not woody.

3. Involucres pubescent but not glandular, the flowers glabrous; involucres 2–3 mm long, the teeth 4–6 mm long……..…….. **Eriogonum abertianum**
3. Involucres and flowers glandular pubescent; involucres 1–1.5 (2) mm long, the teeth 0.4–0.8 mm long…….. **Eriogonum maculatum**

2. Shrubs or subshrubs, usually somewhat woody at base.

4. Involucres (flowers) in dense, head-like clusters on top of a well-developed peduncle; involucres 2.5 mm long……..……. **Eriogonum fasciculatum**
4. Involucres solitary and sessile at nodes (flowering branch may appear racemose); involucres 1–1.7 mm long……..… **Eriogonum wrightii**

1. Annuals or herbaceous perennials; stems not leafy or with much reduced leaves, the leaves largest and mostly at the base of the plant, often forming a basal rosette.

5. Annuals; bracts leafy, teeth of involucre longer than the tube……. **Eriogonum abertianum**
5. Annuals or herbaceous perennials; bracts not leafy, teeth of involucre shorter than or barely as long as the tube.

6. Leaves green, hairy but not woolly.

7. Perennials and flowering in first year; involucres 5-lobed; tepals (1.5) 2–2.7 (3.5) mm long. ……. **Eriogonum inflatum**
7. Ephemerals; involucres 4-lobed; tepals 1.2–1.8 mm long…….. **Eriogonum trichopes**

6. Leaves usually grayish green, and woolly/tomentose, at least below.

8. Flowering branches slender but not thread-like.

9. Involucres glabrous, 1.5–2.2 mm long…….... **Eriogonum deflexum**
9. Involucres and flowers glandular pubescent; involucres 1–1.5 (2) mm long.
……..... **Eriogonum maculatum**

8. Flowering branches very slender—thread-like (filiform).

10. Flowering branches and involucres glabrous; involucres 0.8–2.3 mm long; outer tepals longer than wide, broadest and swollen (inflated) at base…… **Eriogonum thomasii**

10. Flowering branches and involucres glandular pubescent; involucres 2–3.2 mm long; outer tepals as wide as or wider than long, broadest above (towards the tip), narrowed at base to a claw…….. **Eriogonum thurberi**

Eriogonum abertianum Torrey
Abert's wild buckwheat. Figure 6.

Figure 6. *Eriogonum abertianum*. Alamo Wash: (A) 2 Aug 2014; (B) 26 Aug 2014; (C) 30 Mar 2008. (D) Estes Wash, 2 Aug 2014. (E) Coffeepot Mountain, Sikort Chuapo Mts, Maricopa Co., 27 Feb 2005.

Annuals 10–50 cm tall, pubescent, the herbage greenish to grayish or reddish. Leaves villous to tomentose; basal leaves petioled, the blades oblong to obovate, 1–4 cm long; upper stem leaves mostly sessile, reduced, linear, lanceolate, or narrowly obovate. Inflorescences open, 5–50 cm tall; branches hirsute; the bracts somewhat leaf-like. Peduncles, mostly straight, slender, villous to tomentose. Involucres broadly campanulate, 2–3 mm long and wide, villous-canescent; teeth 5, lobe-like, usually reflexed, 4–6 mm long. Flower in rounded, head-like clusters; flowers 3–4.5 mm long; perianth white to pale yellow, becoming pinkish or reddish, and glabrous; tepals dimorphic, those of the outer whorl orbiculate-cordate, those of the inner whorl lanceolate to spatulate. Achenes brown to dark brown, lens-shaped, 0.6–1 mm long. Flowering late winter and spring and with summer rains.

Eastern part of Organ Pipe including the Ajo, Diablo, and Puerto Blanco mountains. *Eriogonum abertianum* has been part of the Ajo Mountain flora for at least 20,500 years.

Eastward in southern and central Arizona to western Texas, Chihuahua, Coahuila, San Luis Potosí, and northern Sonora.

OP: Alamo Canyon, *Tinkham 18 Apr 1942*. Bull Pasture Trail, *Fox 1 Apr 1985*. Canyon Diablo, 21 Mar 1935, *Kearney 10833*. Dripping [Springs] Wells, 18 Mar 1945, *Gould 3015*. Montezuma's Head, W slopes, 16 Jan 1976, *Phillips 76-10*. Trail to Mt Ajo, near crestline above The Cones, 4090 ft, 10 Apr 2005, *Felger* (observation). †Alamo Canyon, involucres, 1150 & 9570 ybp. †Montezuma's Head, involucres, 20,490 ybp.

Eriogonum deflexum Torrey var. **deflexum**
[*E. deflexum* var. *turbinatum* (Small) Reveal]
Skeleton weed. Figure 7.

Ephemerals or annuals, often 5–50+ cm tall, with a well-developed taproot. Leaves in a basal rosette, 1.5–5 cm long, soon deciduous, the petioles prominent and usually longer than the blades, the blades orbicular, often cordate, especially the larger leaves; lower leaf-blade surfaces densely grayish-white woolly, the upper surfaces sparsely to densely woolly and often darker green. Flowering stems much-branched, the inflorescences more or less flat-topped, the stems leafless and glaucous, the larger ones relatively thick but not swollen. Involucres, pedicels, and outer tepal lobes glabrous. Involucres 5-lobed, 1.5–2.2 mm long, the pedicels 0.5–10 mm long. Perianth white or pink, the outer segments 1.8–2.3 mm long, orbicular to broadly elliptic, cordate, and blunt at tip. Often flowering late spring and sometimes into early summer, and sometimes persisting and flowering through summer and again in fall.

Washes, plains, and slopes, especially in open, disturbed habitats, and sometimes on rocky slopes to peak elevations; widespread across Organ Pipe and the eastern two-thirds of Cabeza Prieta. This one of the few annuals to survive and flower during the hot, dry late spring and early summer.

This species occurs from eastern California to Utah, Arizona, New Mexico, Baja California, and northern Sonora. Var. *deflexum* occupies a large portion of the range of the species; also 2 other varieties.

OP: Alamo Canyon, *Nichol 26 Mar 1939*. Growler Mts, foothills, 16 Apr 1952, *Parker 7979*. Quitobaquito, 13 Sep 1986, *Felger 86-267*.
CP: Childs Mtn, near summit, 18 Aug 1992, *Felger 92-642*. Cabeza Prieta Peak, S side of summit, 2550 ft, 24 Mar 1995, *Yeatts 3666* (CAB). O'Neill Hill, 9 Apr 1996, *Harlan 464*. Large wash SW of Scarface Mtn, *Rutman 22 Mar 2003*. Cabeza Prieta Tanks, 15 Jun 1992, *Felger* (observation).

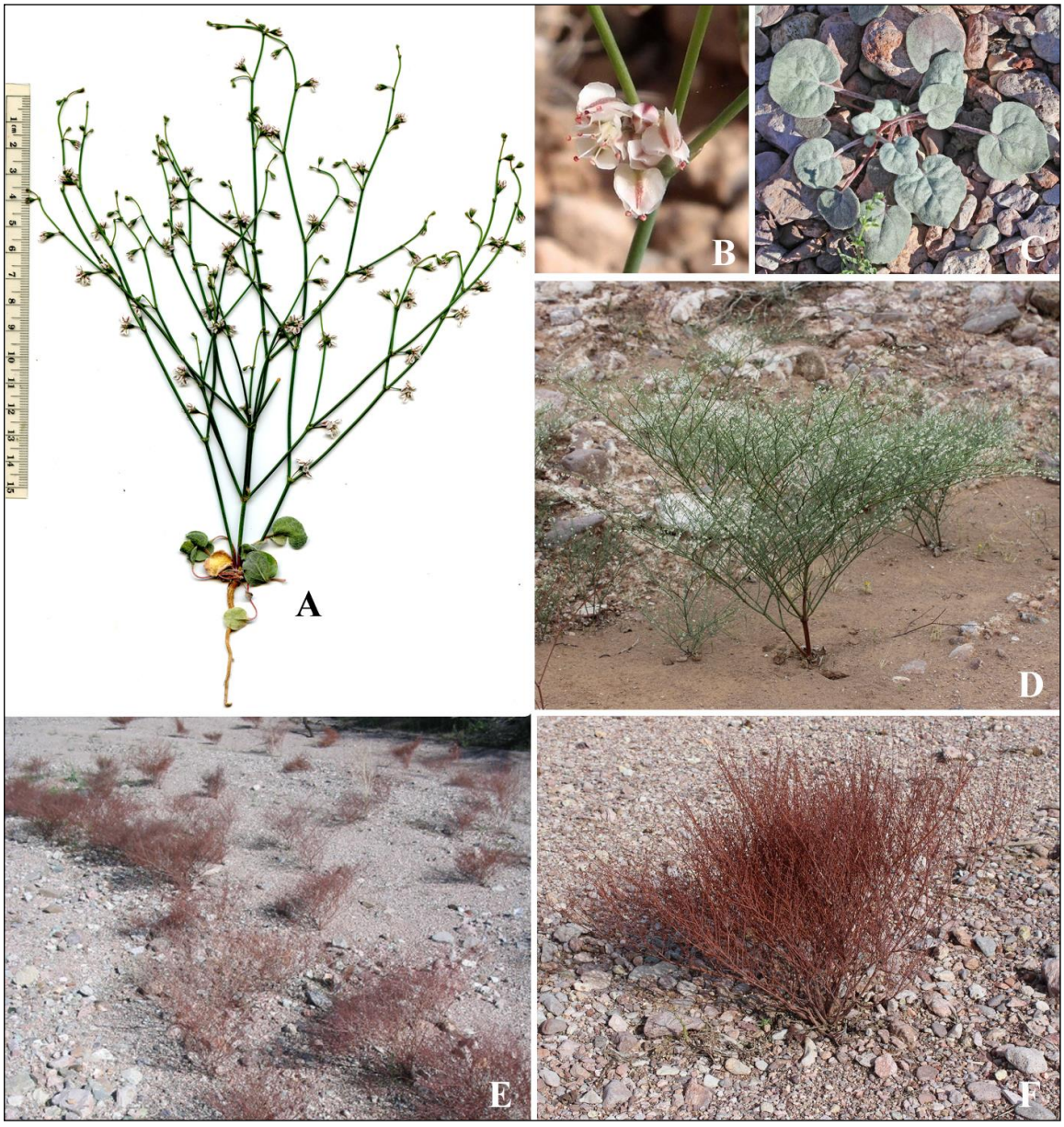

Figure 7. *Eriogonum deflexum* var. *deflexum*. (A) Acuña Valley, 15 Mar 2015. (B) Waterman Mountains, Ironwood Forest National Monument, 23 Feb 2013. Alamo Wash upstream from bridge: (C) 29 Jan 2014; (F) 28 Dec 2013. (D) Alamo Wash in Ajo Valley, 2 Aug 2014. (E) Kuakatch Wash near E boundary of Organ Pipe, 22 Jan 2005.

Eriogonum fasciculatum Bentham var. **polifolium** (Bentham) Torrey & A. Gray
Flat-top buckwheat. Figure 8.

Low spreading woody shrubs 0.5–0.8 (1) m tall, often compact and much-branched with leafy stems and shredding bark, the branches woody below. First-year stems, inflorescence branches, and peduncles conspicuously pubescent (canescent). Leaves fascicled, sessile or nearly so, 3–15 (18) mm long, linear to narrowly oblanceolate, white hairy on both surfaces—canescent above, densely woolly below; leaf margins and midrib on lower surface thick and prominent, the margins mostly revolute. Flowers crowded into compact, often clustered heads on long, leafless stems (scapes); involucres 5-toothed, 2.5 mm long, moderately to densely white hairy. Flowers white or pink, 3 (3.5)

mm long, the outer perianth segments densely white hairy mostly toward the base and along the broad midrib. Achenes 2–2.5 mm long. Flowering February to May and in fall.

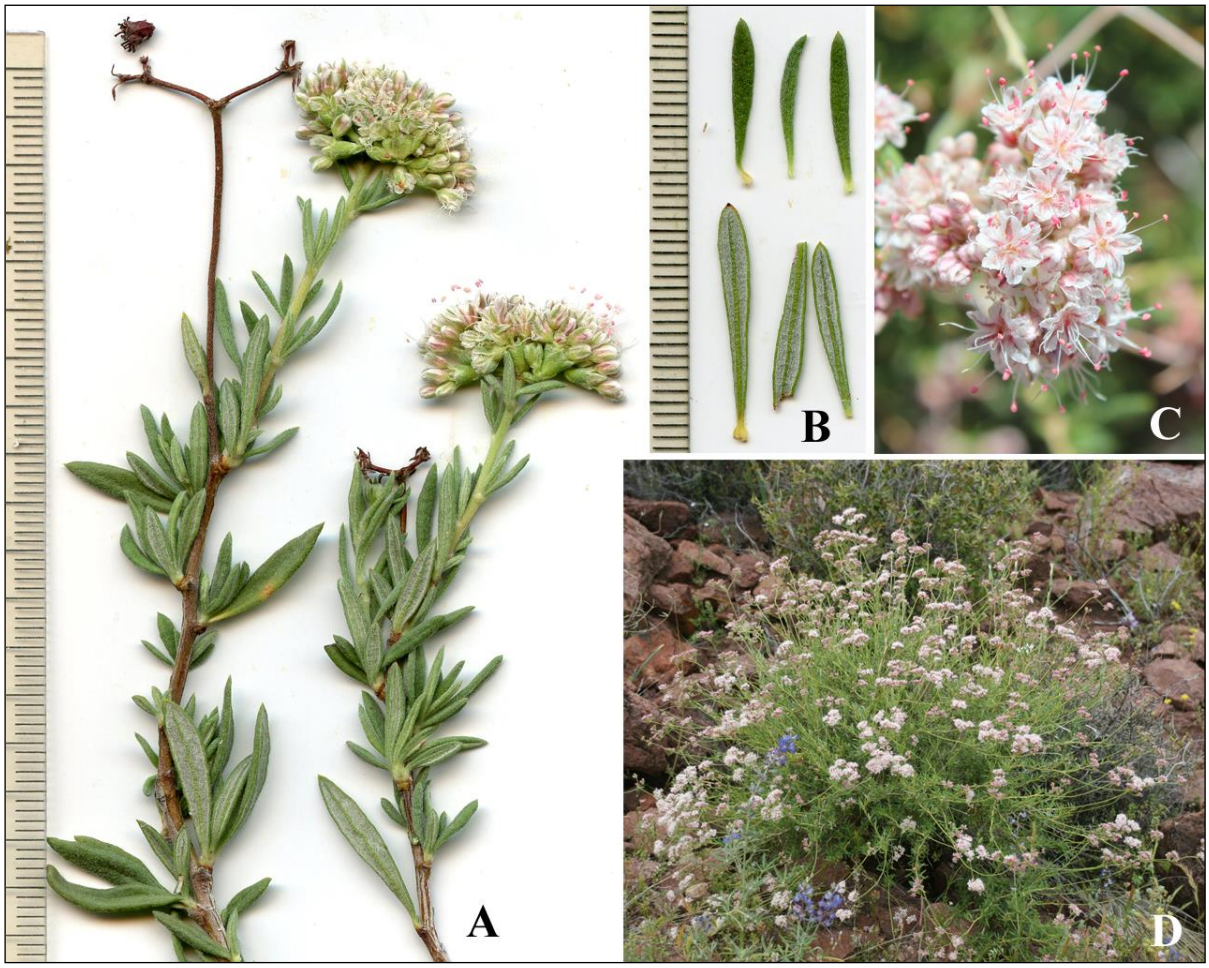

Figure 8. *Eriogonum fasciculatum*. (A & B) Bull Pasture Trail, 8 Sep 2014. (C) 27 Feb 2014, Alamo Canyon. (D) 4 Apr 2015, Alamo Canyon

Widespread across the flora area, mostly higher elevations in canyons and rocky slopes of hills and mountains, especially north-facing, also upper bajadas and washes, and absent from lowland areas. This species has been part of the regional flora for at least 21,900 years.

This species occurs in western and southern Arizona to east-central California and southwestern Utah, Baja California, and northern Sonora. Variety *polifolium* is primarily in the desert and is the most common shrubby *Eriogonum* in southern Arizona. Four other varieties, mostly in California.

OP: Pitahaya Canyon, *Nichol 23 Feb 1939*. Walls Well, *Nichol 28 Apr 1939*. Alamo Canyon, 17 Apr 1952, *Parker 8009*. Sierra de Santa Rosa, 1600 ft, 11 Feb 1978, *Bowers 1033* (ORPI). †Variety unknown: Alamo Canyon, leaves, 1150 ybp. †Montezuma's Head, leaves, 13,500 & 21,840 ybp. †Puerto Blanco Mts, on ridge, leaves, 9070 ybp.

CP: N side of Tule Mts, 2 Feb 1992, *Felger 92-52*. Tuseral Tank, 14 Jun 1992, *Felger* (observation).

TA: Tinajas Altas, 27 Mar 1932, *Shreve 5942*. Tinajas Altas Mts, NE of upper tanks, 26 Oct 2004, *Felger 04-74*. †Butler Mts, leaves, 8160 to 11,060 ybp (3 samples). †Variety unknown: Tinajas Altas, leaves, 5080 to 18,700 ybp (7 samples).

Eriogonum inflatum Torrey & Frémont
Desert trumpet, bladder stem. Figure 9.

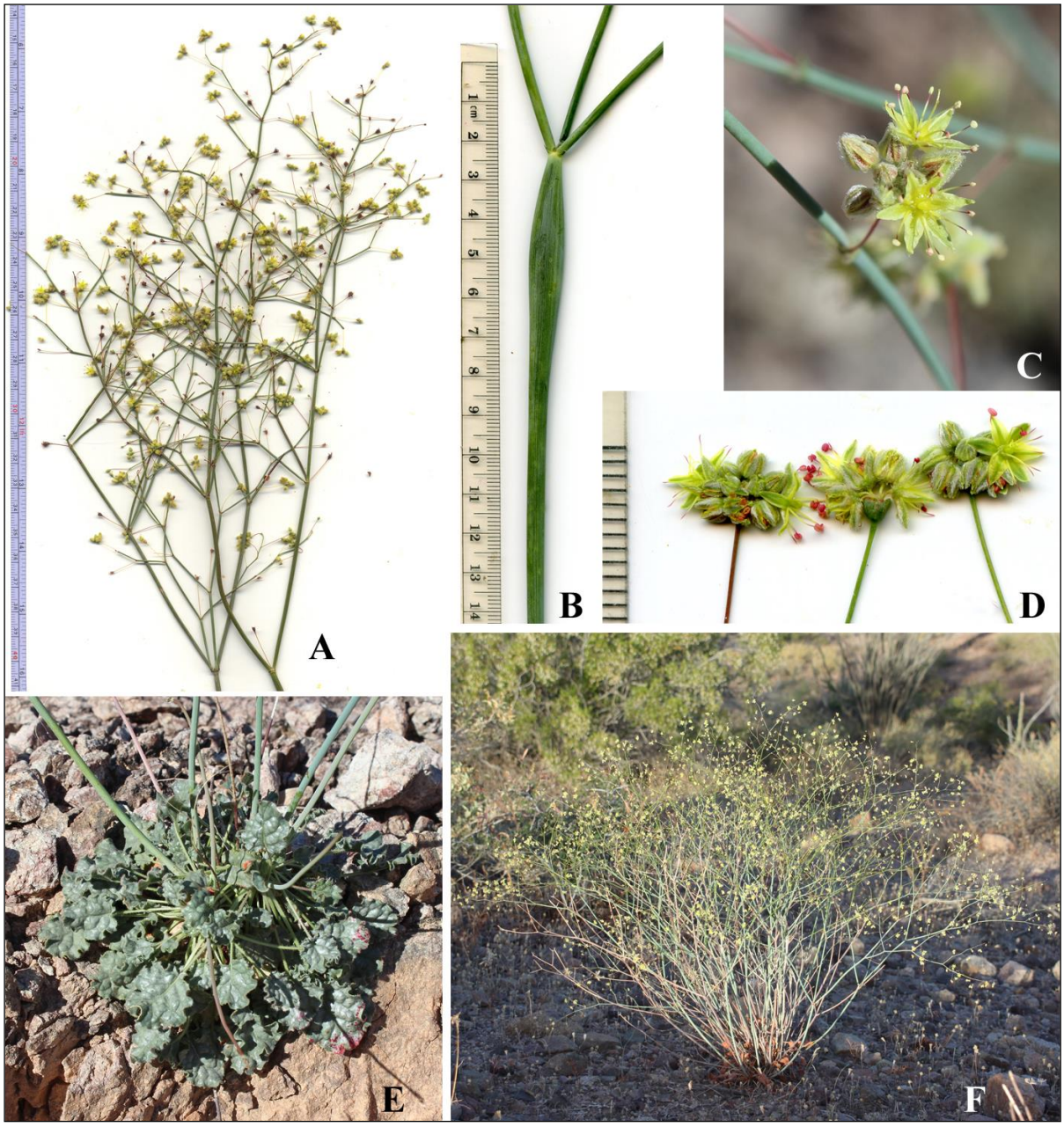

Figure 9. *Eriogonum inflatum*. (A) Darby Wells Road near Black Mountain, 17 Sep 2013. (B) Ajo Scenic Loop, Little Ajo Mts, 16 Mar 2015. (C) Lookout Mountain, Barry M. Goldwater Range, Maricopa Co., 12 Mar 2014. (D) Acuña Valley, 15 Mar 2015. (E) Roadcut on Hwy 85, N of Alamo Wash, 23 May 2010.

Herbaceous perennials with a hard, knotty base, also flowering in first season. Stems often many, leafless, glaucous to greenish; the first internode usually erect, often (7) 9–31 cm long, the upper part often inflated (swollen and hollow) with no apparent pattern. Second node (top of the first internode) commonly producing 2 or 3 (4–6) branches. Leaves basal or nearly so, green to reddish green, the dry leaves semi-persistent, the blades oblong to orbicular or kidney-shaped with wavy margins; petioles prominent. Involucres 5-toothed. Flowers yellow with red or green bases; tepals

mostly 2–2.7 mm long (as short as 1.5 at early anthesis to 3.5 mm as fruit develops), covered with whitish-translucent, fleshy, curved to curled hairs, the tepal margins glabrous and bright yellow. Flowering mostly in spring and again with the summer rains.

Common on rocky slopes, upper bajadas and sometimes along floodplains of larger washes, and generally absent from open desert flats; widespread across the flora area. *Eriogonum inflatum* has grown in the Tinajas Altas Region for more than 8200 years.

Deserts across much of Arizona, southern and east-central California to Colorado, Nevada, New Mexico, Utah, both Baja California states, and northwestern Sonora.

"The cause of the fistulose [inflated] stem and inflorescence branches in *Eriogonum inflatum* was imaginatively attributed by A.M. Stone and C.T. Mason (1979) to the larvae of gall insects. This fallacy continues to appear in the literature. Greenhouse studies have shown that stems of this and some other species of the genus inflate without the presence of any insects. Other researchers have shown that the inflation involves a build-up of CO_2 within the stems, which take over as the primary photosynthetic body as leaves wilt or eventually dry up and fall away from the plant (C.D. Osmond et al. 1987). Not all individuals of *E. inflatum* will have fistulose stems and branches, as this feature is partly a function of available moisture: the drier the conditions, the less pronounced the inflation. Stems produced in the summer tend to be inflated less frequently than those produced in the spring" (Reveal 2005: 386).

This *Eriogonum* is a food plant for the desert metalmark butterfly (*Apodemia mormo deserti*). The stems were harvested in spring before flowering and eaten fresh or cooked by the Cahuillas and others (Bean & Saubel 1972; Hodgson 2001).

OP: Bates Well, *Nichol 26 Apr 1939*. Ajo Valley, 20 Apr 1942, *Cooper 625*. Quitobaquito, 14 Sep 1988, *Felger 88-460*.

CP: Pinacate Lava, *Simmons 17 Oct 1962* (CAB). 4.7 mi E of Tule Well, 11 Apr 1993, *Felger 93-442*. Near Charlie Bell Pass, 9 Apr 1993, *Felger 93-339*. Agua Dulce Pass, Heart Tank, 13 & 14 Jun 1992, *Felger* (observations).

TA: Canyon below Raven Butte Tank, *Felger 10-226*. Cipriano Pass, N end of Tinajas Altas Mts, *Reeves 5441* (ASU). Above Tinajas Altas, 19 Mar 1998, *Felger* (observation). †Butler Mts, fruit with calyx, 8160 ybp.

Eriogonum maculatum A. Heller
Spotted wild-buckwheat

Cool-season annuals, perhaps persisting into summer, mostly 10–20 cm tall. Herbage and flowering stems usually tomentose. Basal rosettes leaves petioled, the blades lanceolate to obovate, 1–3 cm long, the stem leaves reduced. Flowering stems to 25 cm, tall; peduncles thread-like. Peduncles, involucres, and flowers glandular-pubescent. Involucres 1.5–3+ mm wide, with 5 teeth 0.4–0.8 mm long. Flowers 1–2.5 mm wide; perianth pale yellow, often becoming pink or reddish, the outer lobes (tepals) elliptic to rounded, the lower half inflated, the inner lobes lanceolate. Achenes 1–1.5 mm long, glabrous.

Documented from the flora area by a single specimen without specific locality.

California to eastern Washington, Idaho, Utah, southwestern New Mexico, Arizona, and Baja California. Mostly a species of the Great Basin, Mojave, and northern Sonoran Deserts.

OP: Organ Pipe National Monument, wash, 1798 ft, *Walden 18 Apr 1964* (ASU 11269, det. James L. Reveal 1968).

Eriogonum thomasii Torrey
Thomas's buckwheat. Figure 10.

Delicate winter-spring ephemerals, mostly (4) 8–15 cm tall (well-watered plants sometimes to 25+ cm). Leaves in a basal rosette, densely white woolly, the blades about as wide as long, ovate or circular to kidney-shaped, upper surfaces not as hairy and often greener than the lower surfaces, the petioles prominent. Flowering stems 1 or sometimes several to many, much-branched above, the branches very slender and glabrous. Involucres 5-lobed, glabrous, 0.8–1.2 mm long. Flowers 1.5–1.9 mm long, at first yellow, becoming pink below and white above, with age the outer tepals become swollen at the base, longer than wide, with short, stout, and minute glandular hairs below, otherwise glabrous.

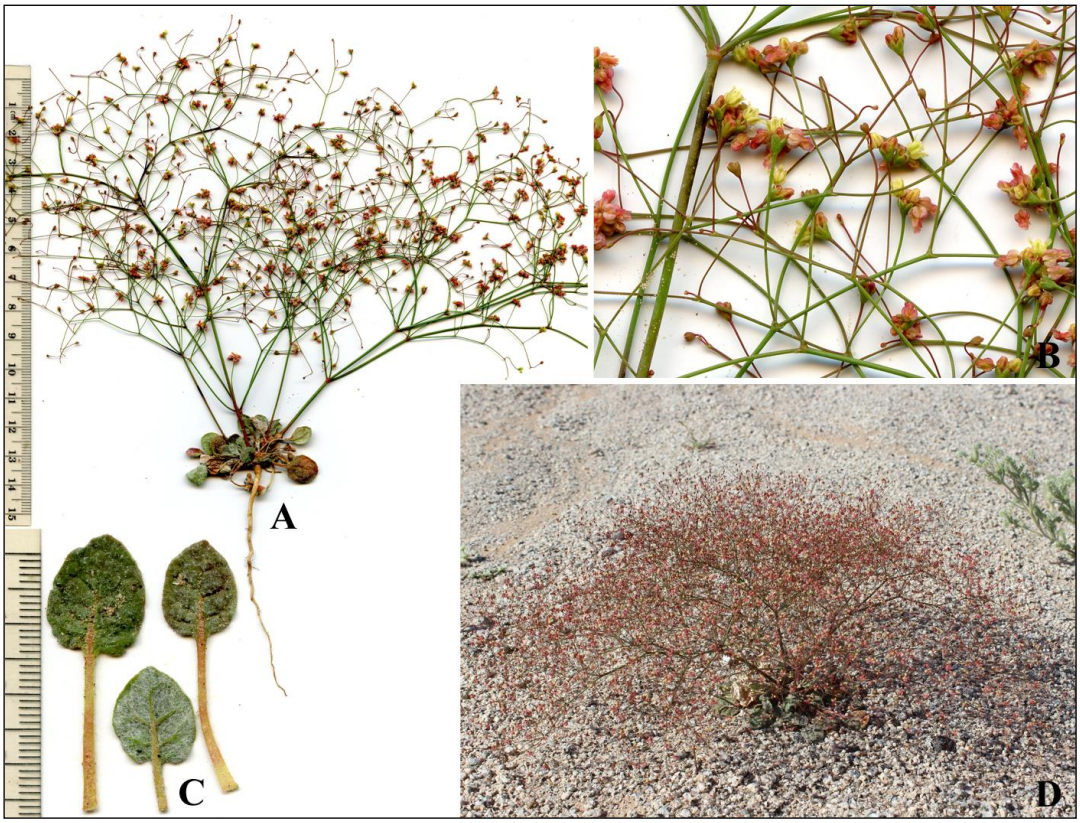

Figure 10. *Eriogonum thomasii*. (A & B) Acuna Valley, 12 Mar 2015. (C & D) Granite-derived soil (grus) at base of Sierra del Águila, 93 km W of Sonoyta on Mex Hwy 2, 7 Mar 2015.

Widespread in the flora area; desert pavements and open gravelly-sandy areas of rocky slopes, bajadas, mesas, washes, canyons, and sand flats and dunes.

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

OP: Puerto Blanco Mts, 2000 ft, *Nichol 25 Feb 1939*. Growler Mts, foothills, 16 Apr 1952, *Parker 7968*. Pozo Nuevo, 30 Mar 1978, *Bowers 1103*. Pitahaya Canyon, *Rutman 13 Mar 1998* (ORPI). Quitobaquito, 29 Mar 1988, *Felger 88-123*.

CP: Sandy soil, Pinacate Lava Fields, 30 Mar 1933, *Shreve 6213*. Papago Well, 22 Mar 1935, *Kearney 10871*. Little Tule Well, 9 Apr 1993, *Felger 93-333* (CAB). Pinta Sands, 11 Apr 1993, *Felger 93-393*.

TA: Tinajas Altas, 1900 ft, *Van Devender 5 Mar 1983*. Coyote Water, 21 Feb 2005, *Felger 05-153*.

Eriogonum thurberi Torrey
Thurber's buckwheat. Figure 11.

Small winter-spring ephemerals about the same size as and similar in general appearance to *E. thomasii*. Leaf blades ovate, broadly elliptic, or nearly orbicular, white woolly to moderately woolly and greenish, the margins nearly entire to crenate-lobed; petioles prominent. Peduncles and involucres densely glandular hairy, the hairs (stalks) whitish, the glands pinkish. Involucres 2–3.2 mm long, 5-lobed. Flowers 1.2–1.3 mm long, about as wide as long, the outer tepals white or pink, narrowed to a claw at the base.

Figure 11. *Eriogonum thurberi*. CD Trail, S of Engineer Canyon, Burro Mountains, Grant Co., New Mexico, 20 Apr 2010, photos by Russell Kleinman (gilaflora.com).

Generally on sandy-gravelly soils; near the Sonora border in Organ Pipe, Cabeza Prieta at least in the vicinity of Tule Well, and west of the Tinajas Altas Mountains and common in nearby northwestern Sonora.

Southern Arizona, southwestern New Mexico, southern California, Baja California, and northwestern Sonora.

OP: Senita Basin Road, 4.5 mi S of Senita Basin, 23 Mar 1969, *Lehto 15443-f* (ASU, det. James L. Reveal 1969).

CP: 1 km N of Tule Well, 11 Apr 1993, *Felger 93-438*.

TA: E edge of Davis Plain, west-branch of Camino del Diablo, *Felger 05-93*.

Eriogonum trichopes Torrey
Little desert-trumpet. Figure 12.

Winter-spring or spring-early summer ephemerals, occasionally persisting through summer and flowering again in fall. Plants usually broader than tall, with 1–several main stems, much-branched above into very slender branches, the plants extremely variable in size depending on soil moisture, (10) 30–50 (100) cm across. Larger plants may break off just below the surface after maturing and the upended plants may become tumbleweeds. Near the Mexican border "In early September 1992, I watched dust devils lift these tumbleweeds into the sky until they were no longer visible" (Felger 2000: 408). Stems yellow-green, glabrous and sometimes glaucous, the upper part of the first internode of larger branches sometimes inflated (especially among vigorously growing plants; see *E. inflatum*), the first internode usually erect or nearly so, (2) 5–10 cm long, the lateral branches whorled at most nodes, spreading nearly at right angles, the lower 1–several nodes often producing 3–17 branches, and even the upper nodes usually whorled. Leaves in a basal rosette, coarsely hairy, the blades broadly oblong to circular, (0.5) 1.5–5.5 cm long, the margins crenate to nearly entire; petioles (1) 4–13 cm long. Involucres 1 mm long, 4-lobed, glabrous, on elongated, slender spreading pedicels. Flowers yellow to greenish yellow, occasionally red-tinged. Tepals 1.2–1.8 mm long, the outer tepals covered with whitish-translucent, fleshy, curled hairs. Commonly flowering March–late April.

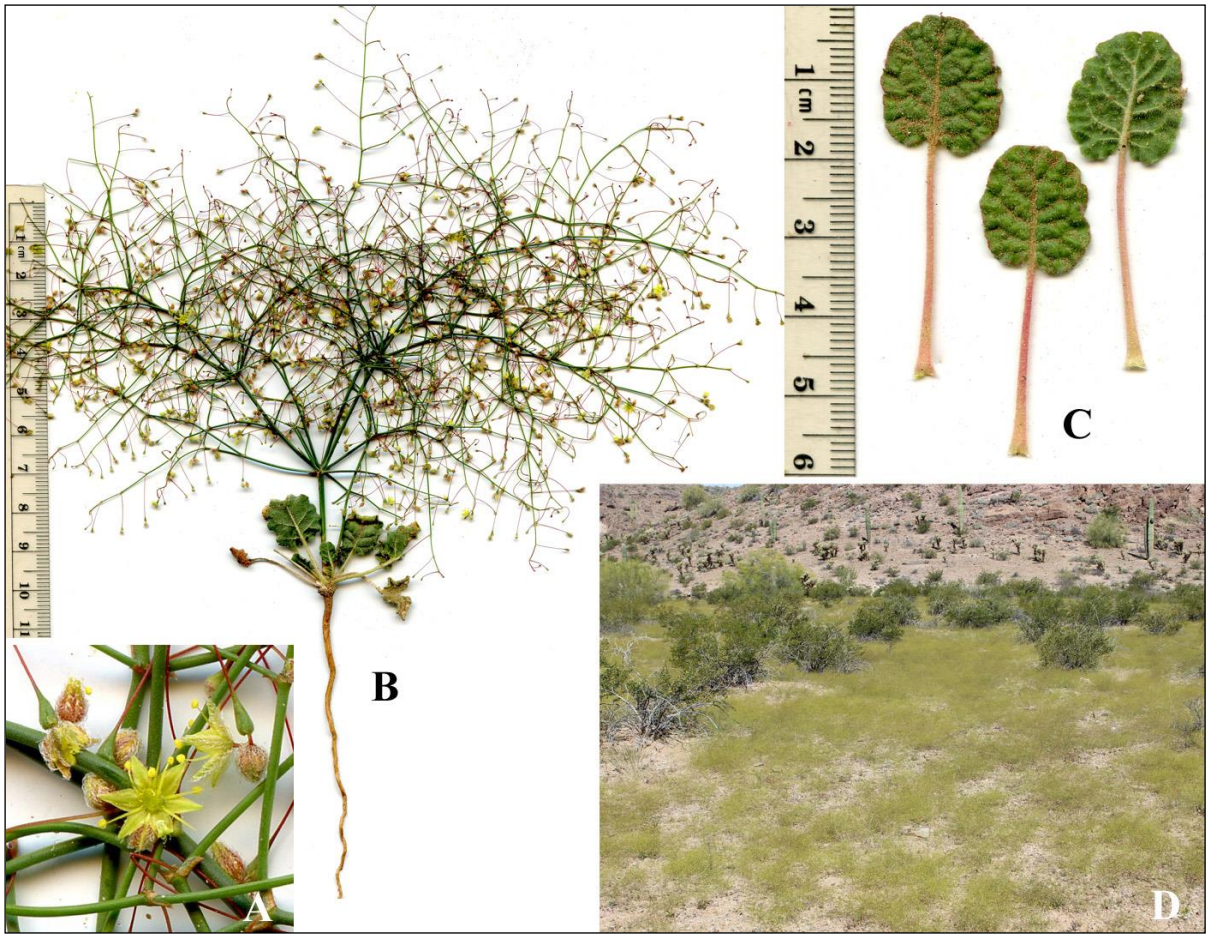

Figure 12. *Eriogonum trichopes*. (A & B) Ajo, 23 Mar 2015. (C) Midway Wash near Hwy 85, 8 Mar 2015. (D) Near Hat Mountain, Sauceda Mountains, Maricopa Co., 22 Mar 2014.

Widespread in Cabeza Prieta, especially the western part, Tinajas Altas, and Organ Pipe except the eastern margin; lower elevations including desert pavements, mesa tops, sandy plains, and alluvial flats, washes, and dunes.

Arizona to southeastern California, southern Nevada, southern New Mexico, southwestern Utah, Baja California, Chihuahua, and northwestern and central Sonora.

OP: 8 mi S of Growler Well, *Nichol 17 Apr 1939*. Growler Mts, foothills, 17 Apr 1952, *Parker 7988*. Puerto Blanco Drive at old road to Dripping Springs, 12 Apr 1978, *Bowers 1253*.

CP: Flats E of O'Neill Pass, *Monson 24 May 1957*. Las Playas, 15 Apr 1964, *Niles 346*. Pinacate Lava Flow, 11 Apr 1992, *Harlan 191*. Pinta Sands, 15 Sep 1992, *Felger 92-776*.

TA: Camino del Diablo, SE of Raven Butte, *Felger 05-28*.

Eriogonum wrightii Torrey ex Bentham var. **nodosum** (Small) Reveal
[*E. wrightii* var. *pringlei* (J.M. Coulter & Fisher) Reveal]
Bastard-sage. Figure 13.

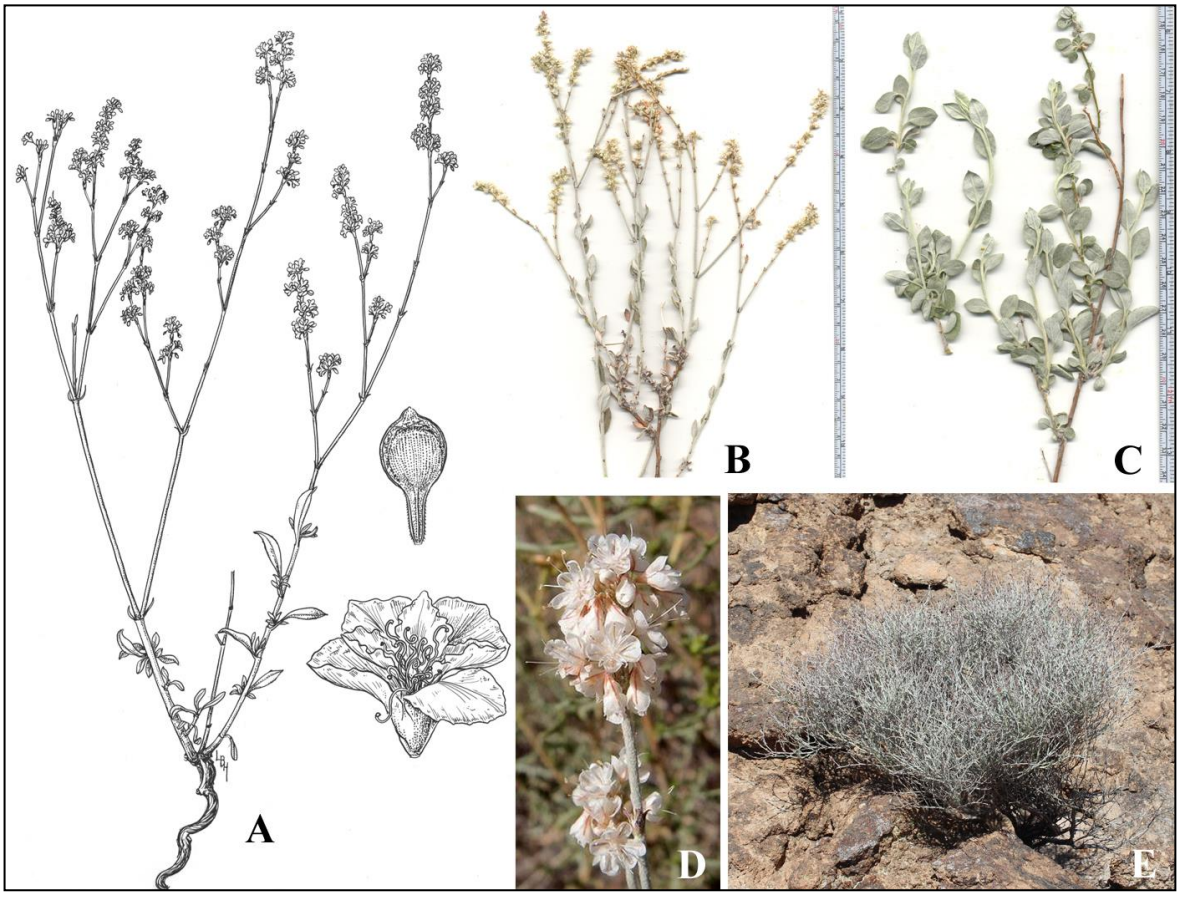

Figure 13. *Eriogonum wrightii*. (A) By Lucretia Breazeale Hamilton. (B) Alamo Canyon, 21 Sep 2008. (C) Estes Canyon, 31 Mar 2008. (D) Salero Ranch, 1 Oct 2013, photo by Sue Carnahan. (E) W of Hat Mountain ear Thanksgiving Day Tank, Sauceda Mts, 24 Mar 2016.

Messy-looking much-branched small shrubs 0.5–nearly 1 m tall, with slender whitish stems. Herbage generally densely white woolly. Leaves readily drought deciduous, the plants essentially leafless or with relatively few and reduced leaves in dry seasons; larger leaves on primary shoots 8–

25 mm long; leaf blades narrowly to broadly lanceolate or elliptic, the upper surfaces often more sparsely woolly than lower surfaces, gradually narrowed at the base into a sometimes prominent petiole, the smaller leaves sessile. Involucres solitary in axils (the floriferous stems appear racemose), more or less cylindrical, 1–2 mm long, 5-ribbed and 5-toothed, the perianth white or pink. Achenes short-beaked and ovoid, about as long as the involucre. Flowering response apparently non-seasonal with sufficient soil moisture, but perhaps not during summer.

Larger hills and mountains, especially north-facing slopes and canyons, throughout the flora area. This species has grown in the region for more than 37,000 years.

Var. *nodosum* occurs in the Sonoran Desert in southwestern and central Arizona, southeastern California, Baja California, and northwestern Sonora. It is the most arid-inhabiting of the approximately ten varieties in southwestern USA and northwestern Mexico.

OP: Pitahaya Canyon, 3400 ft, *Nichol 23 Feb 1939*. Bull Pasture Trail, 5 Nov 1977, *Bowers 931*. Sierra Santa Rosa, 11 Feb 1978, *Bowers 1033*. Arch Canyon, 2 Dec 1990, *Felger 90-562*. †Alamo Canyon, leaves, 8130 to 14,500 ybp (4 samples). †Variety unknown: Alamo Canyon, leaves, 8130 to 14,500 ybp (4 samples). †Puerto Blanco Mts, on ridge, twigs, leaves, 7560 to 14,1020 (8 samples).

CP: 3.2 mi E of Tule Well, 19 Feb 1979, *McLaughlin 1965*. Tule Tank, 23 Mar 1992, *Harlan 135*. Agua Dulce Tank, 13 Jun 1992, *Felger 92-568*. Sierra Pinta, summit, *Cain 15 Nov 2003*.

TA: Tinajas Altas, 5 Dec 1935, *Goodding 1449*. Frontera Canyon, 18 Mar 1998, *Felger* (observation). †Variety unknown: Tinajas Altas, leaves, 5860 to 15,680 (14 samples), & >37,000 ybp.

Nemacaulis

This genus has a single species.

Nemacaulis denudata Nuttall var. **gracilis** Goodman & L.D. Benson

Woolly heads, cotton heads. Figure 14.

Spring ephemerals with delicate ascending and spreading stems, often as wide or wider than tall, with a well-developed taproot. Stems slender, mostly (7) 12–25 cm long; lower internodes relatively long, lower stems moderately pubescent with white hairs, upper stems thread-like and glabrate or glabrous. Leaves, nodes, bracts, and involucres densely white woolly; hairs on involucres often becoming brown with age. Leaves mostly in a basal rosette, (1.5) 2.6–5 (6.5+) cm × 2.6–5.5 (10) mm, narrowly oblanceolate; green or reddish beneath the dense white hairs, when wet the hairs instantly absorb water to become appressed and transparent, the midrib prominent; margins mostly undulate to sometimes entire; stem leaves few and reduced or absent. Flowering stems usually much-branched and diffuse. Involucral bracts separate, each subtending a single flower; bracts often yellow-green when young, otherwise reddish with conspicuous yellow-membranous margins, the larger, outer bracts 1.9–3 mm long. Flowers buried in wool of glomerules, yellow, 0.7–1.3 mm long, on slender pedicels; perianth segments 6. Seeds 0.75–0.9 mm long, smooth and shiny, dark brown to blackish, plump, shaped like a fat teardrop, the tip 3-angled.

Dunes and sand flats in the western part of Cabeza Prieta, especially in the vicinity of the Pinta Sands, and in the Tinajas Altas Region.

Southwestern Arizona, southern California (mostly inland deserts), both Baja California states, and northwestern Sonora. Another variety occurs in coastal California and Baja California. *Nemacaulis*, with a single species, can be distinguished from *Eriogonum* in having 3 rather than 9 stamens and the involucral bracts separate rather than united into a tube.

CP: Dunes, 6 mi W of O'Neill's Grave, 13 Mar 1983, *Eiber 27*. Pinta Sands, 10 Apr 1993, *Felger 93-392*.

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

Figure 14. *Nemacaulis denudata* var. *gracilis*. (A) Dunes near Mayan Palace, SE of Puerto Peñasco, Sonora, 20 Feb 2015. (B & C) Dunes 37 km SE of Sonoyta, Sonora, 20 Feb 2014.

Polygonum

Annual and perennial herbs and shrubs. Worldwide; 65 species.

***Polygonum argyrocoleon** Steudel ex Kunze
Silver-sheath knotweed. Figure 15.

Non-seasonal annuals with a stout taproot. Stems slender, erect to spreading. Stems and leaves glaucous, highly variable in size and number. Leaves alternate, sessile or nearly so, narrowly elliptic to narrowly lanceolate, mostly less than 1 cm long, sometimes 2–6 cm long, and soon deciduous; upper leaves usually reduced to bracts, the plants leafless or nearly so in drought or dry habitats; margins entire. Stipules fused, forming membranous sheaths around the stem above the usually swollen nodes. Flowers in small axillary clusters on terminal spike-like stems. Calyx petal-like, pink or white, 2–3 mm long. Achenes 3-angled, 2 mm long.

Locally common at Jose Juan Tank and perhaps other dirt charcos; germinating in wet soil. Common agricultural weed in nearby Sonora. The seeds are probably disseminated by birds. Also found in a 2005 roadside re-seeding in Organ Pipe.

A widespread weed, native to the Near and Middle East.

OP: Hwy 85, from roadside seeding, N of park headquarters, 9 Apr 2005, *Felger 05-161*.
CP: Jose Juan Tank, common in dried mud, not seen elsewhere, 12 Jun 1992, *Felger 92-562*

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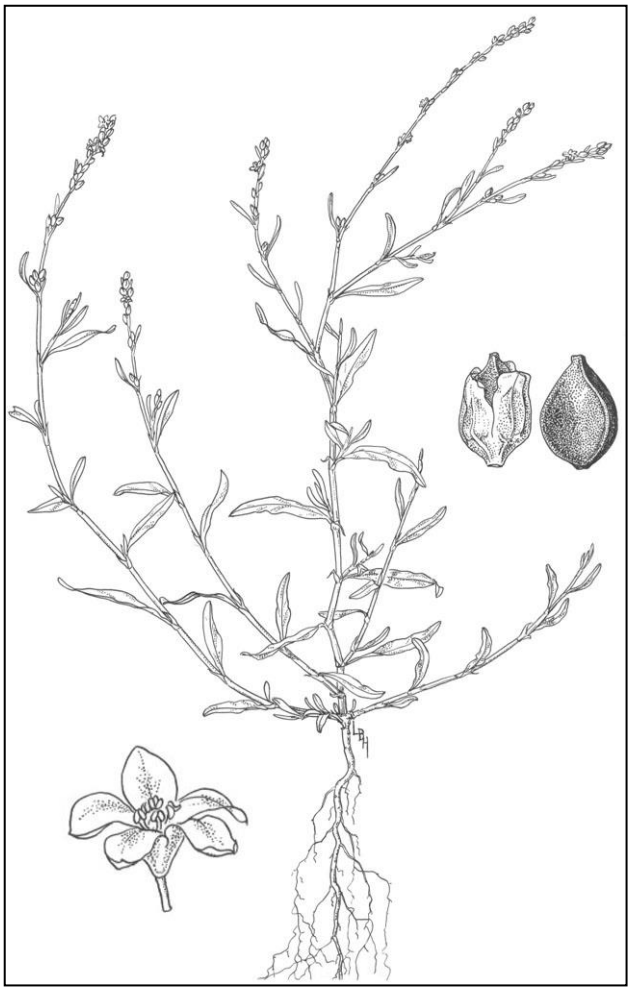

Figure 15. *Polygonum argyrocoleon*. By Lucretia Breazeale Hamilton

Pterostegia

This genus has a single species.

Pterostegia drymarioides Fischer & C.A. Meyer
Woodland thread-stem. Figure 16.

Delicate spring ephemerals with slender, fragile, and often trailing stems; sparsely pubescent. Leaves opposite; petioles to 1 cm long; leaf blades to 2 cm wide, broadly elliptic to fan-shaped, the margins entire or 2-lobed, the uppermost leaves reduced in size. Flowers 2 or 3 enclosed in a single bract; flowers reddish, the perianth 1 mm long, pale yellow or pink. Stamens 6. The fruiting involucral bract enlarging. Achenes 1–1.5 mm long.

Mountain canyons and major washes of Organ Pipe but apparently not in the Lower Colorado Valley areas of the southwestern part of the Monument. Mostly in moist habitats in canyons and on north-facing rocky slopes and cliffs, and locally in sandy soils, often in the shelter of shrubs.

Arizona, California, southern Nevada, southwestern Utah, Baja California, Baja California Sur, and expected in northern Sonora (documented within 1 km of Sonora in the Sierra Santa Rosa).

OP: Canyon Diablo, 21 Mar 1935, *Kearney 10815*. Alamo Canyon, 14 Apr 1941, *McDougall 94*. Armenta Road 1.4 mi W of Hwy 85, 11 Mar 2003, *Felger 03-249*. Sierra Santa Rosa, 12 Mar 2003, *Felger 03-316*. Wash 1.2 mi NW of Kino Peak, 1510 ft, 20 Mar 2005, *Rutman 2005-0320-12* (ORPI).

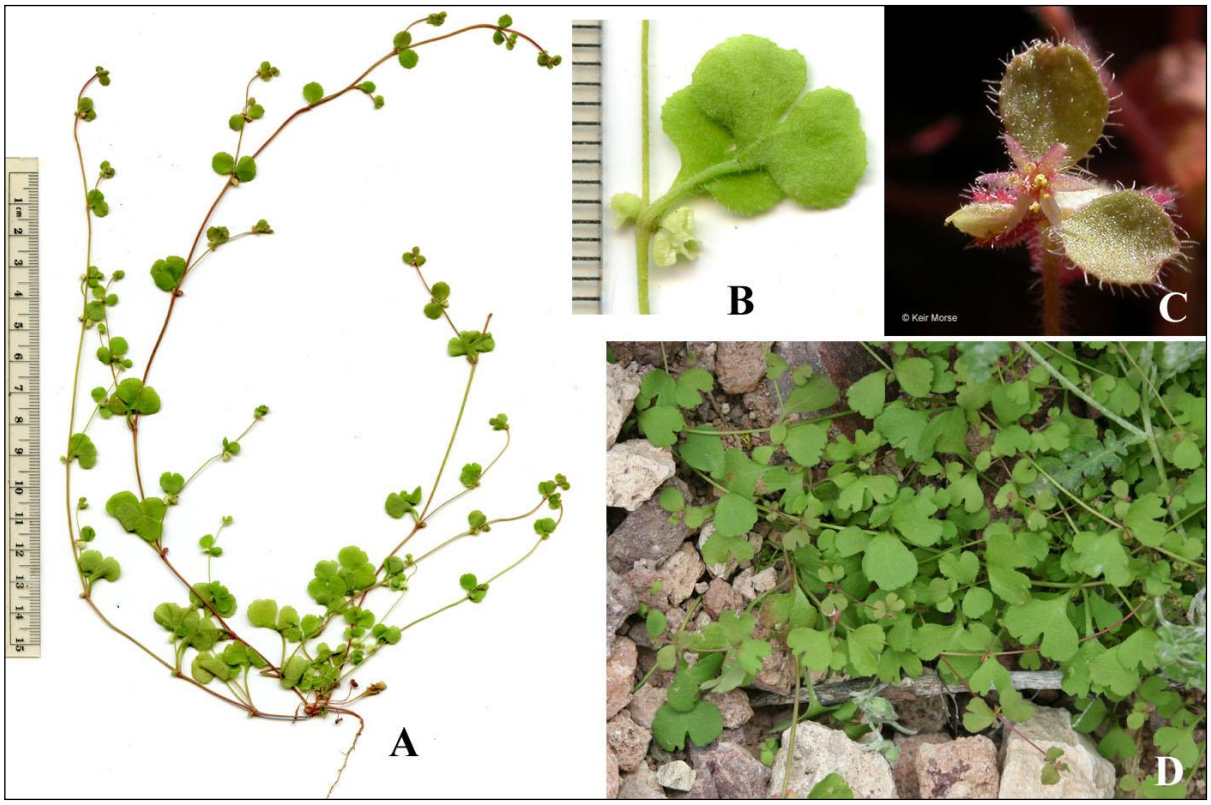

Figure 16. *Pterostegia drymarioides*. (A–B) Estes Canyon, 22 Mar 2015. (C) Joshua Tree National Park, San Bernardino Co., CA, 8 Apr 2005, photo by Keir Morse (SEINet). (D) Alamo Canyon, 18 Mar 2005.

Rumex – Dock; *cañaigre*

Annual and perennial herbs. Worldwide; 200 species.

Rumex hymenosepalus Torrey

Sand dock, wild rhubarb; *cañaigre*; wakondam. Figure 17.

Robust, herbaceous perennials from a cluster of thick, tuberous roots and short rhizomes. The plants die back during the summer and the new growth emerges during the cool season with flowering in late spring. Leaves alternate, mostly basal and petioled, the stem leaves reduced and often sessile above; larger leaves with blades to 25 m long, rather thick and sometimes slightly fleshy, lanceolate to oblong, the margins entire or wavy (crisped). Flowering stems often more than 30 cm tall. Inflorescences terminal and overtopping the leaves, narrowly paniculate and densely flowered. Perianth with an outer whorl of 3 smaller sepals and an inner whorl with 3 larger sepals (valves) 10–15 mm long, oblong to rounded-cordate, enlarging in the fruit (this species lacks a tubercle, a warty bump on the valves of various other *Rumex* species). Stamens 6; styles 3, the stigmas 3, red, broad, peltate, and conspicuously fringed.

Locally at the north side of Organ Pipe; scattered along the gravelly soil of Kuakatch Wash from near Walls Well to 5 km westward. Rutman's 1995 collection is probably the same area as MacDougal's 1907 observation.

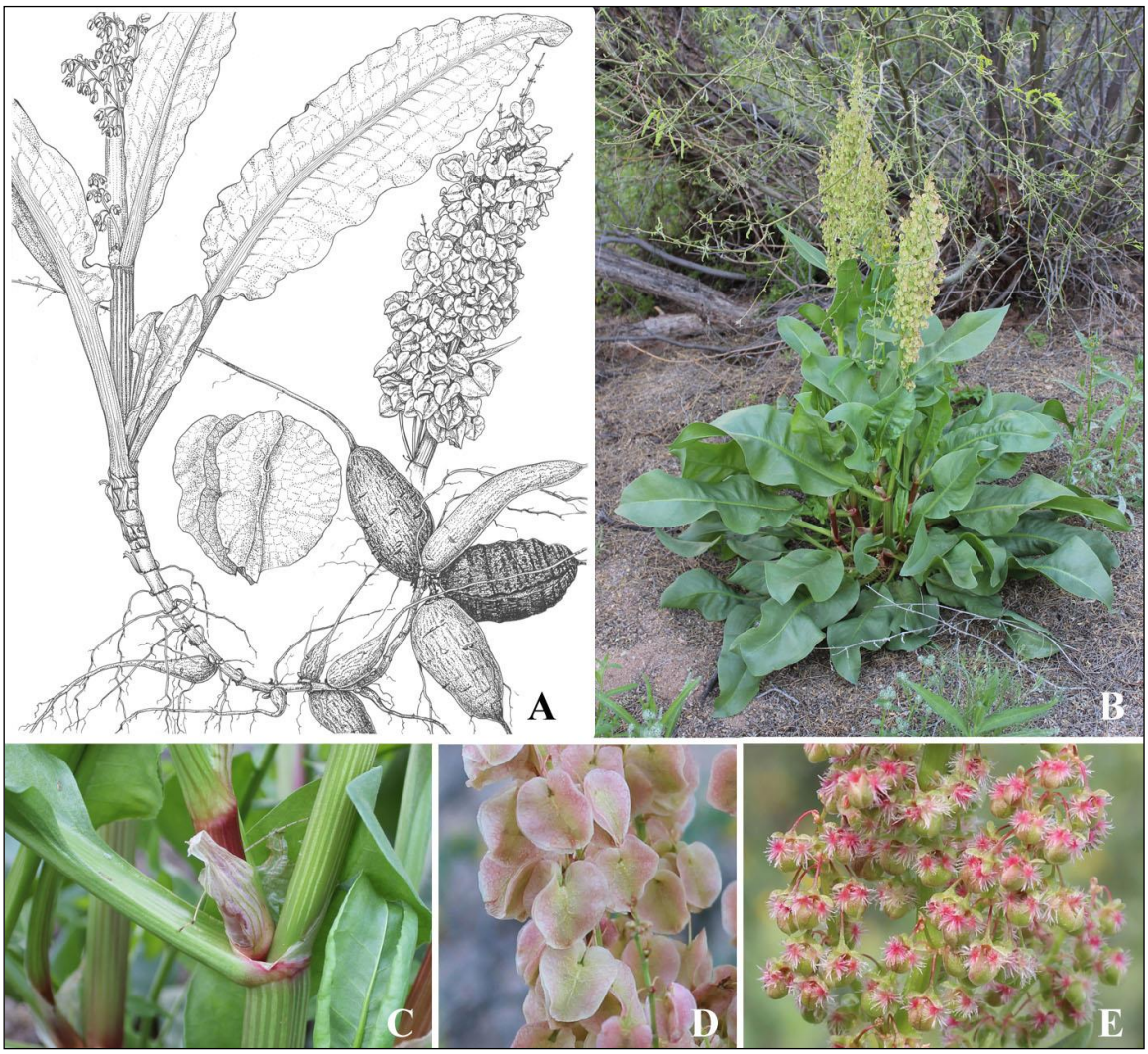

Figure 17. *Rumex hymenosepalus*. (A) By Lucretia Breazeale Hamilton. (B–E) Kuakatch Wash near E boundary of Organ Pipe, 11 Mar 2015; 17E shows flowers with fringed, red stigmas.

Southwestern USA to Wyoming, and Baja California, northern Sonora, and Chihuahua.

The leaves and "stalks" of native and non-native species of dock were sometimes important food plants. They were cooked and eaten as greens, but because of citric, malic, and oxalic acids they were cooked in a change of water. The "seeds" (achenes) were also eaten (Hodgson 2001). Dock was an important food and medicinal plant among the Tohono O'odham (Castetter & Bell 1942).

The tuberous roots were an important sources of medicine in the region, and the plants were sometimes transplanted to home gardens (Rea 1997). The Tohono O'odham made yellow dyes for cotton fabrics from *R. crispus* and *R. hymenosepalus* roots (Castetter & Bell 1942). Most of the earlier ethnobotanical reports are not documented with specimens and species identifications might be questioned.

OP: Walls Well, Nov 1907, *MacDougal* (observation; Rose & Standley 1912). Sonoyta road 1 mi S of N entrance, 10 Apr 1941, *McDougall 82*. Kuakatch Wash near E boundary, *Rutman 15 Apr 1995* (ORPI).

PORTULACACEAE – Purslane Family

The APG systems trims the purslane family to a single genus. Genera formerly placed in this family include *Calandrinia*, *Cistanthe*, *Claytonia*, and *Phemeranthus* in Montiaceae and *Talinum* in Talinaceae.

Portulaca – Purslane

Summer ephemerals (those in the flora area; annual and perennial herbs elsewhere), succulents, especially the leaves. Stems leafy, the leaves alternate or subopposite; stipules none. Sepals 2, fused to lower part of ovary (the sepals interpreted as sepal-like bracts). Flowers brightly colored, opening in sunlight, the petals often lasting only a few hours and then deliquescent (dissolving or melting away; the petals interpreted as derived from sepals or staminodes). Fruit a capsule, circumscissile (opening more or less around the middle, the top coming off like a lid). Seeds many, variously sculptured or ornamented, usually with a white strophiole (a seed outgrowth that regulates water movement in and out of the seed). Worldwide; at least 100 species.

1. Leaf axils and flower clusters densely white-hairy; leaves terete (may appear flat when dry).

   2. Roots not tuberous; flowers 3–7 mm wide, the sepals red-pink and somewhat persistent, the petals yellow but often hidden or seldom seen……..... **Portulaca halimoides**
   2. Roots tuberous; flowers to 25 mm wide, the petals coppery orange…..... **Portulaca suffrutescens**

1. Plants glabrous or essentially so (sometimes with a few inconspicuous hairs); leaves thick but flattened

   3. Capsule rim not collar-winged, the capsule opening about at the middle, the lid conical. …….... **Portulaca oleracea**
   3. Capsule rim surrounded by a collar-like wing 1–2 mm wide, the capsule opening above the middle, the lid shallow and saucer-like…….. **Portulaca umbraticola**

Portulaca halimoides Linnaeus
[*P. parvula* A. Gray]
Silk-cotton purslane. Figure 18.

Plants often diminutive with slender stems 2–12 cm long, but sometimes fairly robust when well-watered. Stems scarcely succulent when mature, often bright pinkish red. Leaves green, nearly terete but slightly flattened when fresh, 7–23 mm long. Long, silky white hairs in leaf axils and surrounding flowers. Sepals red-pink and relatively persistent; petals, anthers, and stigma golden yellow but only evident while the flowers are open—generally from a few hours after sunrise until late morning or midday. Petals 4 mm long, about as long to slightly longer than the sepals. Capsules 1.3–1.6 mm wide, the lid separating slightly below the middle. Seeds 0.5–0.6 mm maximum width, reddish brown to iridescent (metallic) blackish blue, cochleate (snail-shaped), and studded with star-shaped tubercles, their radii (arms) short; strophiole white.

Often seasonally common or even abundant on lower bajadas, washes and floodplains such as the southwestern part of Organ Pipe, Daniels Wash, and Coyote Wash.

Arid and tropical America from southwestern North America and Florida to Brazil and Peru.

Figure 18. *Portulaca halimoides*. (A) Sedona, Yavapai Co., 29 Aug 2005, photo by Max Licher (SEINet). (B) N of Summerford Mountain in black grama grassland, Jornada Long Term Ecological Reserve, Dona Aña Co., NM, 15 Aug 2008, photo by Patrick Alexander. (C) Mojave National Preserve, San Bernardino Co., CA, 23 Sep 2011. (D) Mojave National Preserve, San Bernardino Co., CA, 24 Sep 2011; photos by Keir Morse.

OP: 0.5 km W of Lukeville, 10 Nov 1987, *Felger 87-281*. Aguajita Wash, 14 Sep 1988, *Felger 88-433*. Hocker Well, 3 Dec 1990, *Felger 90-576*.
CP: Pinta Sands, *Edwards 8 Oct 1977* (ASU). Daniels Arroyo, 26 Sep 1992, *Harlan 305*.
TA: Coyote Water, 25 Oct 2004, *Felger 04-61*.

***Portulaca oleracea** Linnaeus
Purslane; *verdolaga*; ku'ukpalk. Figure 19.

Plants erect to spreading or prostrate with age and size; glabrous except a few inconspicuous axillary hairs. Stems usually much-branched, relatively thick and succulent except in stunted plants. Herbage green or reddish late in the season. Leaves mostly 1–1.5 cm long, alternate or subopposite, flattened, spatulate to obovate, truncate to moderately notched. Sepals green, winged near the tip, the wings persistent on the capsule lid. (The wings narrower during drought and late in the season.) Petals, stamens, and stigma yellow, the petals 5–5.5 mm long, broadly oblong to obovate, deeply notched at apex. Capsules separating at about the middle, the capsule lid conical with at least 1 seed usually remaining with the lid, the others falling quickly. Seeds 0.6–0.8 mm wide, numerous, dull reddish brown to blackish, granulate, with low star-shaped (stellate) tubercles, their rays touching or interlocking, and a thin white strophiole.

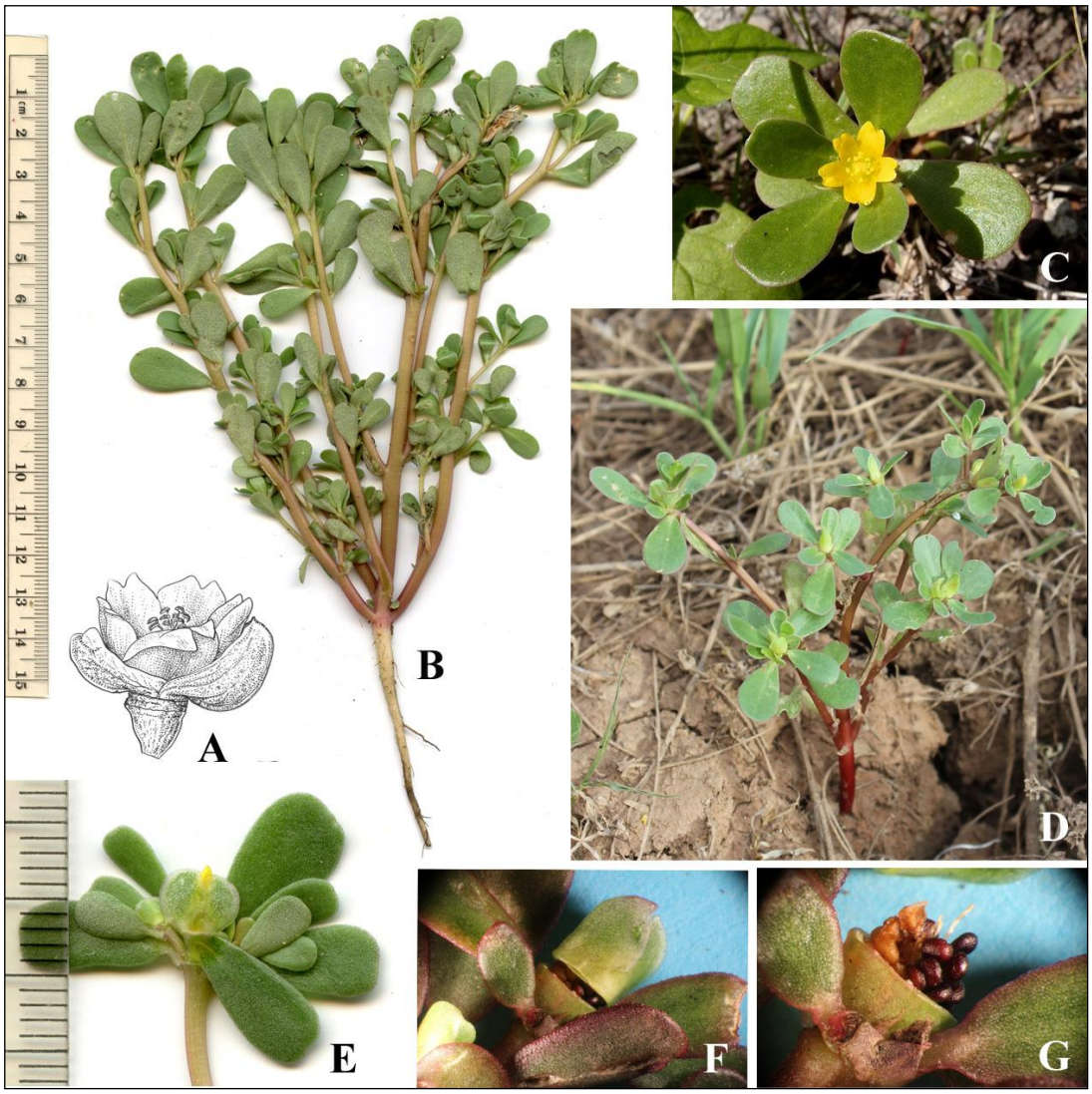

Figure 19. *Portulaca oleracea*. (A) By Lucreatia Breazeale Hamilton. (B & D) Hwy 86 roadside, mile 62, 1 Aug 2014. (C) Salero Ranch, Santa Cruz Co., 27 Jul 2013, photo by Sue Carnahan. (E) Dunes 37 km SW of Sonoyta on Hwy 8, 14 Sep 2014. (F & G) El Cerrito, Contra Costa Co., CA, 10 Aug 2011, photos by Zoya Akulova (CalPhotos).

Seasonally common in washes and floodplains in scattered localities in Organ Pipe and playas in Cabeza Prieta.

Worldwide in tropical to warm-temperate climates, mostly weedy; often difficult to determine which populations might be native. *Portulaca oleracea* may have been in the New World in pre-contact times.

This popular potherb has "the highest content of omega-3 fatty acids and antioxidants of any green leafy vegetable examined to date, suggesting that common purslane should be considered for its nutritional value and not for its weediness" (Matthews 2003: 499). "You would gather it and wash it and then boil it until it was tender, the same way as the other grass plants. You could refry it with butter and onions and it would be very good" (Betty Melvin in Zepeda 1985: 62).

OP: Aguajita, 14 Sep 1988, *Felger 88-432*. 0.5 mi E of Lukeville, 11 Nov 1987, *Felger 87-318*. Bull Pasture, *Wirt 29 Jul 1990*. Dripping Springs, *Wirt 25 Jul 1990*. 0.5 mi W of Gachado Junction, *Wirt 25 Jul 1990*.

CP: Las Playas, 28 Nov 2001, *Felger 01-554*.

Portulaca suffrutescens Engelmann
Figure 20.

Ephemerals (those in the flora area, perennials elsewhere) with small, tuberous roots. Mature stems scarcely succulent. Leaves linear-terete, often to 10 mm long. Conspicuous white hairs in leaf axils and among the flowers and fruits. Flowers relatively large, to 2.5 cm wide, the petals coppery orange. Capsules 2.5 mm or more wide, subglobose. Seeds 0.5–0.65 mm wide, usually with raised, stellate tubercles.

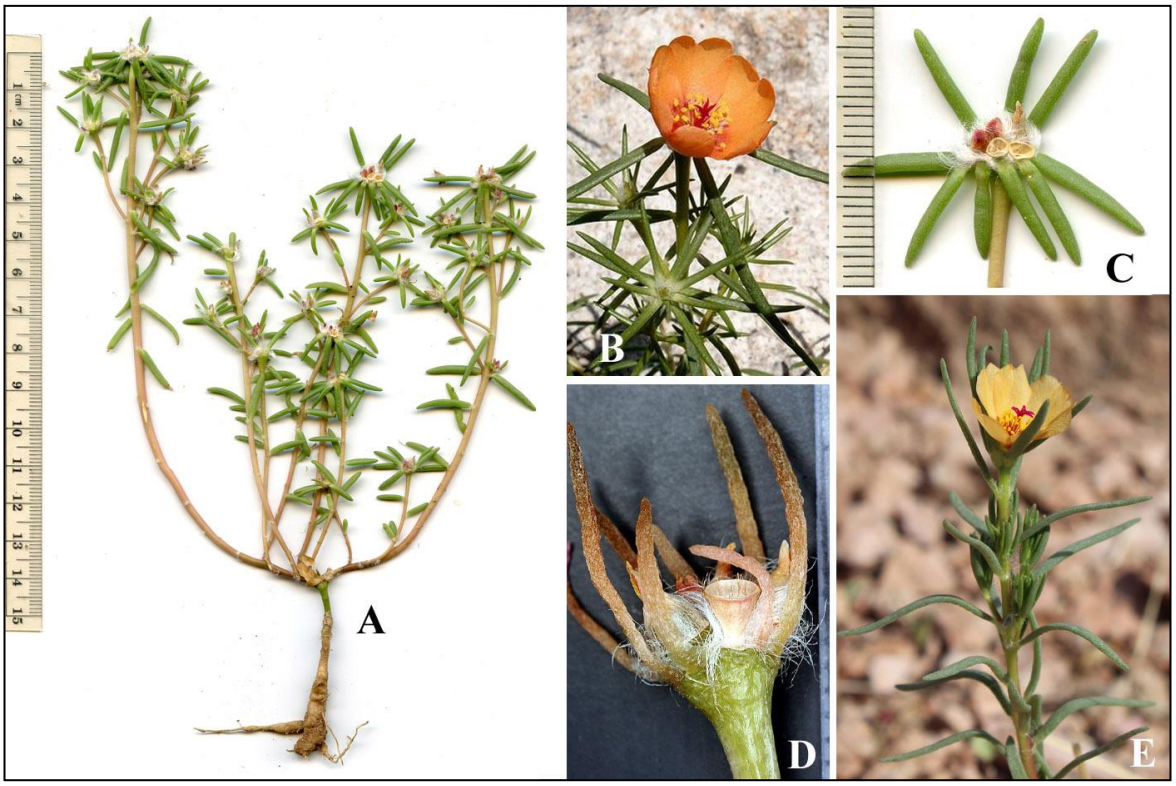

Figure 20. *Portulaca suffrutescens*. (A & C) Thin soil over bedrock, Bull Pasture Trail, 19 Sep 2014. (B) Salero Ranch, Santa Cruz Co., 27 Jul 2013, photo by Sue Carnahan. (D) Capsule with lid already gone (center) and a capsule still with its lid (left), Bill Evans Lake, Burro Mountains, NM, Grant Co., 31 Oct 2009, photo by Russell Kleinman (gilaflora.com). (E) Below the arch, Arch Canyon, 2 Aug 2013.

Common in the Ajo Mountains on shallow soil over rock, sometimes in mats of *Selaginella arizonica*. This species is an annual in the Sonoran Desert even though the roots are tuberous; elsewhere it is often perennial.

Eastward in southern and central Arizona to western Texas and southward to central Mexico.

OP: Bull Pasture, 9 Aug 1979, *Bowers 1799* (ORPI). Bull Pasture Basin, 24 Sep 2006, *Rutman 2006-0924-5*. Arch Canyon, trail to the arch, 2 Aug 2013, *Rutman 20130802-1*.

Portulaca umbraticola Kunth
[*P. coronata* Small. *P. lanceolata* Engelmann. *P. umbraticola* subsp. *lanceolata* (Engelmann) J.F. Matthews & Ketron]
Winged purslane. Figure 21.

Plants similar to those of *P. oleracea*. Glabrous except a few hairs at nodes and among the flowers and fruits. Leaves flat, obovate or lanceolate, 10–20+ mm long, the tip truncate to rounded. Flowers 10 mm wide, the petals yellow. Capsules 3–5 mm wide with a conspicuous collar-like wing 1–2 mm wide surrounding the capsule rim, capsules opening above the middle to shed a flattish, shallow saucer-like lid. Seeds 0.5–1 mm wide, dull gray, the tubercles stellate with prominent peg-like projections.

Ajo Mountains, sometimes in rock crevices.

Widespread in the Americas. Matthews & Ketron (1991) recognized 3 weakly differentiated subspecies; populations in southwestern Arizona would be subsp. *lanceolata*, which occurs in southern USA and Mexico.

OP: Bull Pasture: 11 Sep 1988, *Wilson 193*; *Wirt 23 Aug 1990* (ORPI).

Figure 21. *Portulaca umbracticola*. Thin soil over bedrock, below the arch, Arch Canyon: (A) 12 Sep 2014; (B & D) 16 Sep 2006. (C) Salero Ranch, 7 Aug 2013, photo by Sue Carnahan.

PRIMULACEAE – Primrose Family

Worldwide; annuals, herbaceous perennials, shrubs, and trees; 58 genera, 2590 species.

***Anagallis**

Annual and perennial herbs. Eurasia; 20 species.

****Anagallis arvensis** Linnaeus subsp. **arvensis**
[*Lysimachia arvensis* (Linnaeus) U. Manns & Anderberg]
Scarlet pimpernel. Figure 22.

Delicate winter-spring annuals. Stems, slender and leafy, often trailing. Leaves opposite or whorled, often 5–15+ mm long, glabrous, sessile, ovate and entire. Flowers radial, 5-merous, on long pedicels; solitary in leaf axils. Calyx about as long as the corolla. Corollas 5-lobed, 5 mm long, pale orange, with stalked glands. Fruits of circumscissile capsules.

Figure 22. *Anagallis arvensis* subsp. *arvensis*. (A) Pinnacles National Monument, San Benito Co., CA, 23 Apr 2004, photo by Keir Morse. (B) Ruby, Santa Cruz Co., 16 Apr 2014, photo by Sue Carnahan. (C) Deer Creek Center, Selma, Josephine Co., OR, 31 May 2007, photo by Keir Morse.

Occasional garden weed at the Organ Pipe headquarters and doubtfully establishing in natural habitats in the region. The plants are toxic to people and livestock.

Worldwide garden weed, native to Europe.

OP: Flowerbed at Resource Center, *Beale 2 Apr 1988* (ORPI). Residence area, 30 Mar 1988, *Felger 88-138*.

Androsace

Annual and perennial herbs. Northern Hemisphere, mostly temperate and arctic; 100 species.

Androsace occidentalis Pursh
[*A. occidentalis* var. *arizonicus* (A. Gray) H. St. John]
Western rock-jasmine. Figure 23.

Small winter-spring ephemerals; plants often reddish, 3–10+ cm tall. Leaves in a small basal rosette; 5–15 mm long, sessile, lanceolate-elliptic, entire to finely toothed; stipules none. Stems

upright, firm, supporting an inflorescences of small, scapose umbels subtended by involucral bracts 2–5 mm long. Flowers radial, 5-merous. Calyx 2.8–5 mm long, hairy, deeply 5-lobed, the calyx tube scarious, the lobes about half as long to equaling the tube. Corollas shorter than the calyx, 5-lobed, white and sometimes with a pink tinge. Fruits of capsules, rounded and 5-valved, 3–5 mm long, with many seeds.

Diablo Mountain canyons and more widespread in Ajo Mountain canyons and on slopes to the crestline where it can be seasonally abundant.

Elsewhere in Arizona mostly above the desert. Canada to northern Mexico.

OP: Canyon Diablo, 21 Mar 1935, *Kearney 10851*. Alamo Canyon, 14 Mar 1941, *Benson 10684.* Arch Canyon, 11 Mar 1983, *Daniel 2612* (ASU). Trail from The Cones to Mount Ajo, 4025 ft, 10 Apr 2005, *Felger 05-269*.

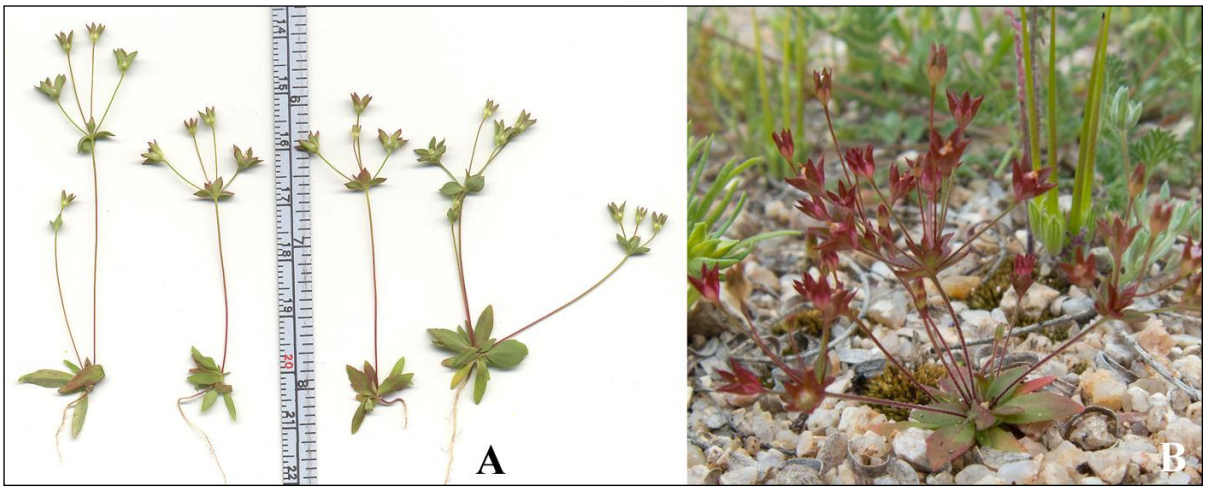

Figure 23. *Androsace occidentalis*. (A) Estes Canyon, 2 Mar 2008. (B) Dove Valley Trail, McDowell Mountain Preserve, Maricopa Co., 12 Mar 2015, photo by Steve Jones (SEINet).

RANUNCULACEAE – Ranunculus Family

Ephemerals, annuals, perennial herbs, and vines (those in the flora area; elsewhere also some shrubs). Leaves alternate, opposite, or in basal rosettes. Flowers highly variable, radial or bilateral, the floral parts separate. Stamens many. Pistils 1–many.

Worldwide, mostly temperate; 62 genera, 2525 species.

1. Perennial vines…….. **Clematis**
1. Annual or perennial herbs, not vining.

2. Diminutive ephemerals; leaves linear and entire……..…… **Myosurus**
2. Root perennials; leaf blades about as wide as long, lobed to deeply dissected or compound.

3. Leaves 2-4 times pinnately compound…….. **Thalictrum**
3. Leaves lobed to deeply dissected.

4. Stems usually less than 20 cm tall; flowers whitish to pink, radial, one to several on each stalk; sepals 5, petals none…….. **Anemone**
4. Stems usually more than 20 cm tall; flowers dark blue, bilateral, several to many on each stalk; sepals 5, petals 4…… **Delphinium**

Anemone

Herbaceous perennials, worldwide; 150 species.

Anemone tuberosa Rydberg
Desert wind-flower. Figure 24.

Herbaceous perennials from thick, tuberous roots, growing during the cooler months of the year. Stems usually less than 20 cm tall. Leaves in a basal rosette, glabrous or essential so, petioles 5–7 cm long, the blades 3 cm long, divided into 3 segments, each one irregularly divided into deeply cleft, toothed segments. Flowers radial, one to several on each stalk, the receptacle elongating in fruit, the sepals 8–10 in number, 1–1.5 cm long, linear-oblong, whitish to pale rose-pink and quickly deciduous; flowering March and April. Stamens 50 or more. Fruits of achenes 3 mm long, aggregated in a cone-like short, thick column.

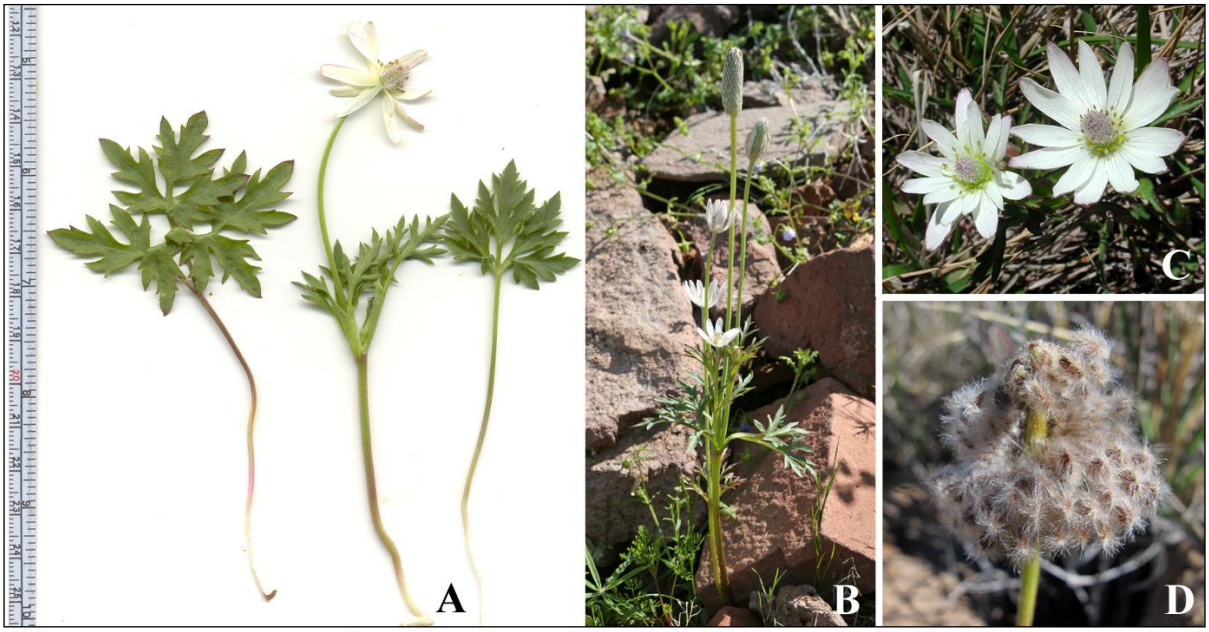

Figure 24. *Anemone tuberosa*. Estes Canyon: (A) 31 Mar 2008; (B) 27 Feb 2005. (C) Ghost Town Trail, Salero Ranch, Santa Cruz Co., 11 Feb 2014, photo by Sue Carnahan. (D) Canyon slopes along Upper Verde River N of Clarkdale, Yavapai Co., 13 Apr 2013, photo by Frankie Coburn (SEINet).

Canyons and often on north-facing slopes in the Ajo Mountains, especially at higher elevations. It has grown in the Ajo Mountains for at least 20,500 years and more than 9900 years ago it was in the Tinajas Altas Mountains.

Eastward and northward in southern and central Arizona to Texas, Utah, eastern California, Baja California, and northern Sonora to Nuevo León.

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

OP: Alamo Canyon, *McDougall 16 Apr 1941*. Grass Canyon, 1 mi from end of road, 26 Feb 1978, *Bowers 1086* (ORPI). Trail to crestline, above The Cones , 4025 ft, 10 Apr 2005, *Felger 05-266*. †Alamo Canyon, seeds, 14,500 ybp. †Montezuma's Head, seed, 20,490 ybp.

TA: †Tinajas Altas, seeds, 9900 ybp.

Clematis

Perennial vines, worldwide; 300 species.

Clematis drummondii Torrey & A. Gray

Texas virgin-bower; *barbas de chivato*. Figure 25.

Robust, perennial vines, often with woody bases, winter-dormant, climbing to the tops of shrubs and trees, with tendril-like petioles and leaf rachises. Leaves opposite, long-petioled, odd-pinnate, mostly with 5 leaflets; leaflets 1.5–5 cm long, deltate to ovate, 3-cleft or parted, the margins variously toothed. Inflorescences with several or more flowers in simple or compound cymes. Flowers radial, unisexual, mostly with male and female flowers on separate plants (polygamodioecious). Sepals 4, white to pale yellowish, about 1 cm long; petals none. Male flowers with 40 or more stamens; female flowers with more than 30 pistils. Fruits of small achenes each with a persistent feathery white beak (the persistent elongated style) 4–9 cm long. Flowering mostly summer and early fall, the fruits in conspicuous rounded clusters, feathery and white.

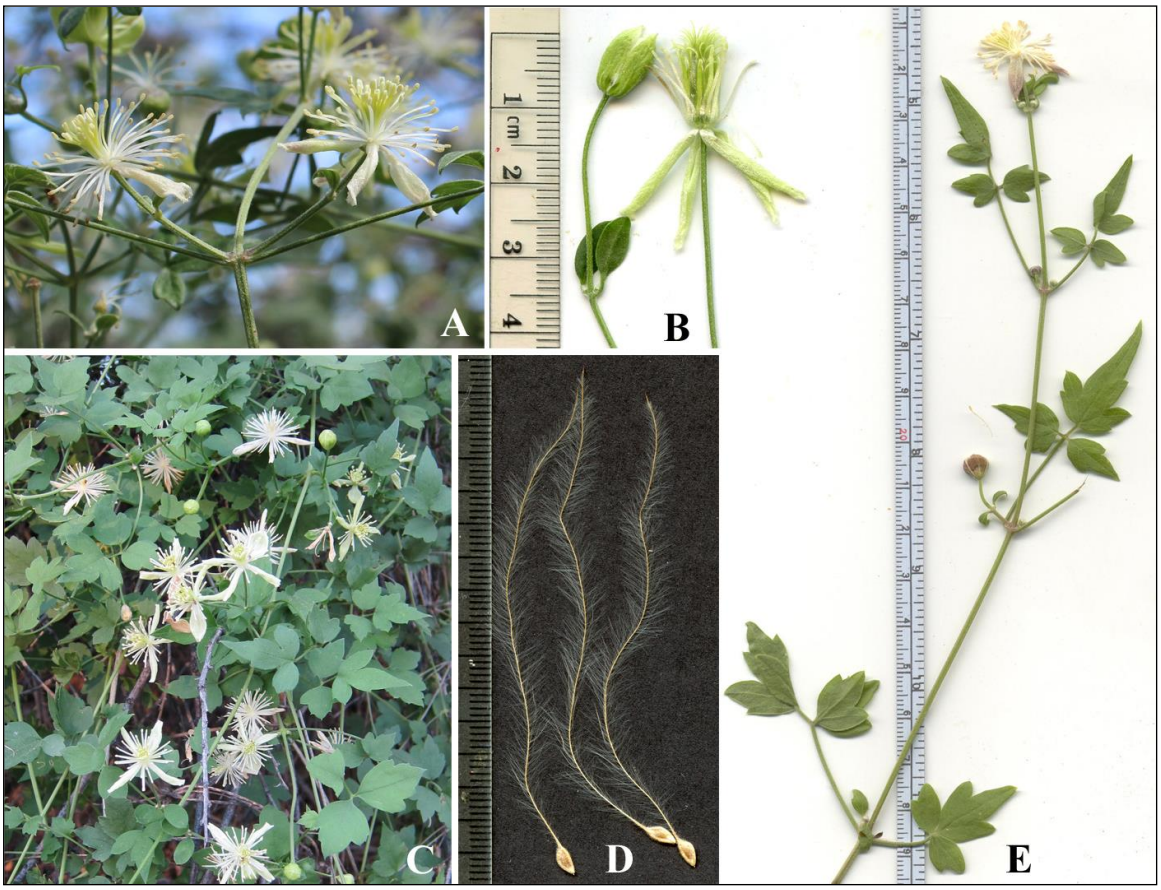

Figure 25. *Clematis drummondii*. (A) Staminate flowers, Kuakatch Wash near E boundary of Organ Pipe, 10 Sep 2013. (B) Pistillate flower, E branch of Daniels Arroyo, 5 Sep 2014. (C) Cuerda de Leña, 17 Sep 2013. (D) E Crater Range, Maricopa Co., 5 Nov 2014. (E) Staminate flower, Bates Well Road, S of Black Mountain, 17 Aug 2008.

Often festooning mesquites and blue palo verde trees along major washes, canyons, and at the edges of some charcos. Widely scattered in Organ Pipe except the southwestern portion and in the eastern part of Cabeza Prieta and northwest to Monreal Well.

Arizona to west Texas, Baja California Sur, and Sonora to Tamaulipas, Nuevo León and Puebla.

OP: Alamo Canyon, *Nichol 14 Mar 1939*. Bates Well, 25 Nov 1939, *Harbison 25672*. Cuerda de Leña Wash at N boundary, 13 Sep 1978, *Bowers 1534*. 1 mi E of Lukeville, 11 Nov 1987, *Felger 87-326*. Canyon NW of Kino Peak, 2000 ft, *Tibbitts 20 Mar 2005* (ORPI).

CP: Bluebird Mine (Simmons 1966). Daniels Arroyo at Charlie Bell Rd, 18 Aug 1992, *Felger 92-670* (ASU). Jose Juan Represo, 14 Sep 1992, *Felger 92-722*. Road to Lower Well, 25 Feb 1993, *Felger 93-71*. Monreal Well, 14 Jun 1992, *Felger* (observation).

Delphinium – Larkspur

Perennial herbs, worldwide; 300 species.

Delphinium scaposum Greene

Bare-stem larkspur; *espulita cimarrona*. Figure 26.

Herbaceous perennials, from thickened, fibrous-fleshy roots, with 1 to several erect stems 35–60 (85) cm tall, growing during the cooler months of the year, summer dormant. Herbage glabrous or soft pubescent. Leaves mostly in a basal rosette, stem leaves alternate when present; petioles 2–13.5 cm long; blades 2.5–6 cm wide and about as long, with 3–5 deeply cleft and palmately parted broad lobes. Flowering stems with racemes mostly 5–12+-flowered. Flowers pedicelled, showy, bilateral, 2.5–3 cm wide. Sepals 5, deep blue, the upper one forming a prominent spur somewhat longer than the petals. Petals 4, the upper pair forming a nectar-producing spur enclosed by the calyx spur; petals deep blue and white. Filaments dark blue, with thin whitish wings below. Pistils mostly 3, the fruits of many-seeded capsules 12–15 mm long. Flowering March and April.

Widespread in Organ Pipe, especially in the larger mountains, not in the drier, southwestern part on the Monument. Also in the eastern part of Cabeza Prieta. Arroyo margins, hills, and mountains, often on north-facing slopes.

Widespread in Arizona except the southwestern corner, southeastern California, Colorado, Nevada, New Mexico, Utah, and northern Sonora.

Specimens from the flora area were annotated by Michael J. Warnock as *Delphinium parishii* A. Gray subsp. *parishii*, described in 1887. Plants from southwestern Arizona, however, do not seem distinct from *D. scaposum*, described in 1871, and the key characters provided by Warnock (1997) do not serve to distinguish them.

OP: Alamo Canyon, *Nichol 4 May 1939*. Above Dripping Springs, 16 Apr 1952, *Parker 7960*. Near Hwy 85 and road to Alamo Canyon, 30 Mar 1988, *Baker 7603* (ASU). Rocky slope NW of Kino Peak, 1782 ft, 20 Mar 2005, *Rutman 2005-0320-43* (ORPI). Trail from The Cones to Mount Ajo, 4090 ft, 10 Apr 2005, *Felger* (observation).

CP: 0.4 mi on Charlie Bell Road W of E boundary of the Refuge, 9 Apr 1993, *Felger 93-309*. S of Charlie Bell Pass, 9 Apr 1993, *Felger 93-336*. Childs Mtn, 2240 ft, 25 Feb 1993, *Felger 93-30*.

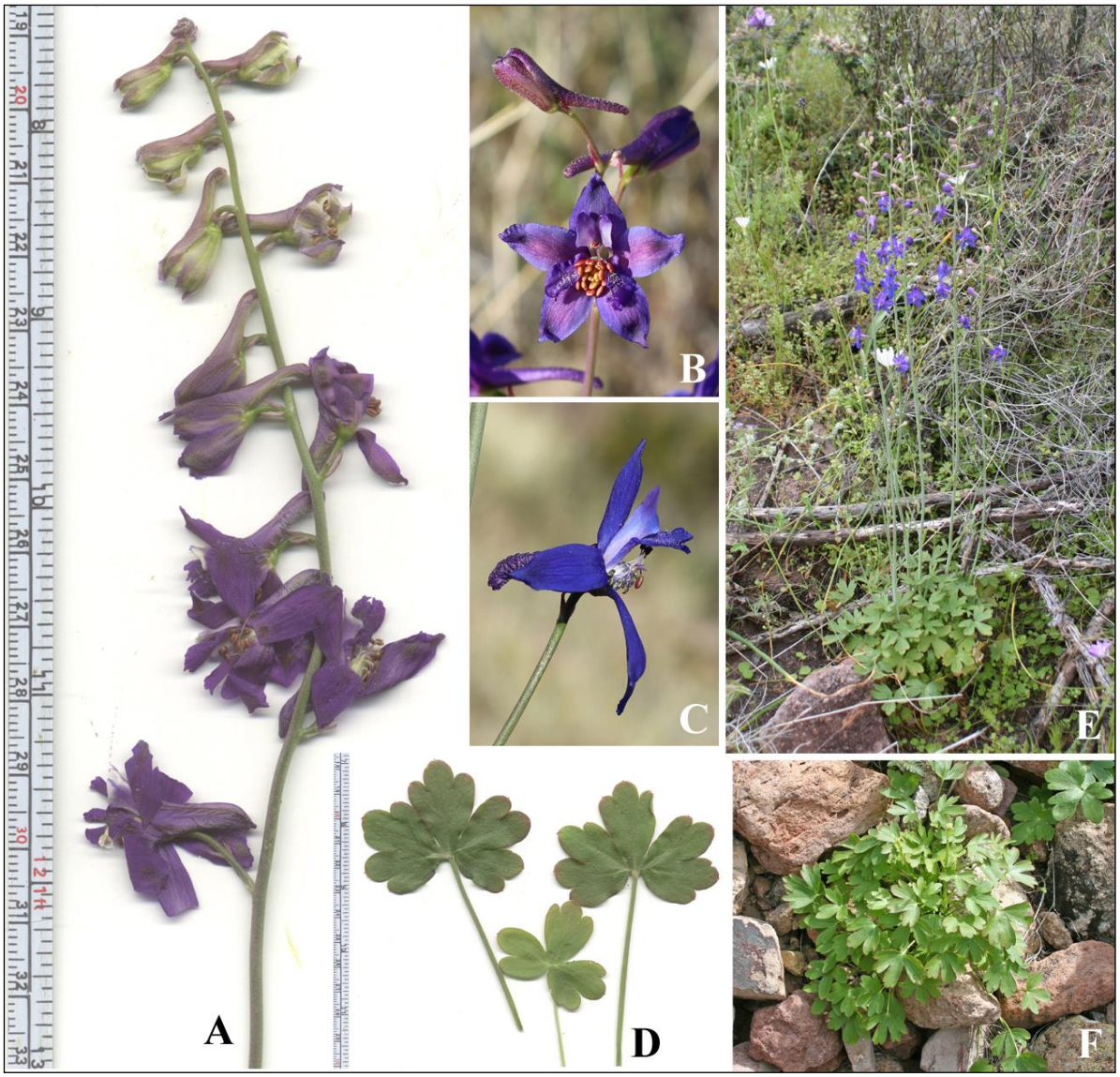

Figure 26. *Delphinium scaposum*. Bull Pasture Trail: (A & D) 7 Mar 2014; (E) 18 Mar 2005; (F) 23 Feb 2009. (B & C) Hat Mountain, Sauceda Mts, 22 Mar 2014.

Myosurus – Mousetail

Dwarf, delicate, short-lived cool-season ephemerals, about 2–10 cm tall. Leaves erect, linear, entire, in a basal rosette. Flowers single on slender scapes, radial, inconspicuous, mostly green, the fruiting receptacle elongated (cylindrical) and spike-like (like a mouse tail), the pistils numerous. (The single flower somewhat resembles the many-flowered spikes of *Plantago.*) Sepals petal-like, usually 5, with a small spur; petals 5 or fewer, and inconspicuous. Stamens 5 to many. Fruits of achenes. On wet or moist soils. Temperate regions worldwide; 15 species.

1. Outer face of achene about as wide as long, appearing swollen, beak of achene 0.6–1+ mm long. …….. **Myosurus cupulatus**
1. Outer face of achene obviously longer than wide, not noticeably swollen, the beak to 0.4 mm long. ……. **Myosurus minimus**

Myosurus cupulatus S. Watson
Mousetail. Figure 27.

Locally in temporarily wet or moist microhabitats in the Ajo Mountains, such as margins of drying, small puddles and arroyo-bottom pools, or at the base of cliffs. It has been part of the Ajo Mountain flora for more than 21,800 years.

Eastern California to Colorado, Texas, Utah, Baja California, and northern Sonora.

OP: Bull Pasture Trail, 2800 ft, 21 Jun 1979, *Bowers 1758* (ORPI; plants dry and dead). Alamo Canyon, *Wirt 13 Mar 1991* (ORPI). S Fork of Alamo Canyon, *Wirt 5 Mar 1998*. Bull Pasture, 10 Apr 2005, *Felger 05-199*. Arch Canyon, *Holm 10 Apr 2012* (specimen discarded). †Montezuma's Head, fruits, 17,830 to 21,840 ybp (3 samples). †Montezuma's Head: receptacle fragment with 2 achenes, 17,830 ybp; achenes, receptacle fragment with achene, 21,840 ybp.

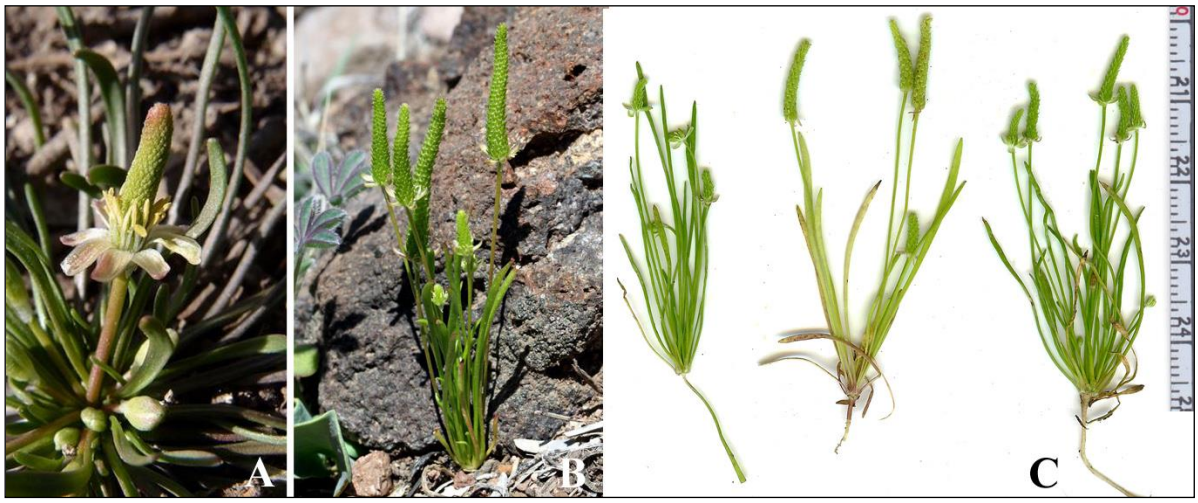

Figure 27. *Myosurus cupulatus*. (A) Catfish Tank, NE Grosvenor Hills, Salero Ranch, Santa Cruz Co., 17 Feb 2014, photo by Sue Carnahan (SEINet). (B) Sycamore Canyon near Cliff, Grant Co., New Mexico, 2 Apr 2010, photo by Russell Kleinman (gilaflora.com). (C) Bull Pasture, 18 Mar 2005.

Myosurus minimus Linnaeus
Dwarf mousetail. Figure 28.

Emergent from shallow water. Leaves 3–8+ cm × 0.4–0.9+ mm. Scapes erect, 3–6.3+ cm long. Spike-like receptacle 15+ × 2.6+ mm. Sepals 1.5–1.6 mm long, the spur 0.5 mm long. Stamens 5. Achenes with a minute, scarcely apparent beak.

Recorded from Quitobaquito when the oasis was owned and managed by the Orozco family. It grew with other small and likewise locally extirpated herbaceous plants requiring open wetland habitat (Felger et al. 1992). No other collections of this species are known from the Monument or nearby regions.

Vernal pools and other wetland habitats; Alaska and Canada, across the USA to Baja California, Eurasia, and Africa.

OP: Quitobaquito, marshy area bordering alkaline pool, with *Poa annua*,18 Mar 1945, *Gould 2986*.

Figure 28. *Myosurus minimus*. (A) Aeromodelers Field, Yolo Co., CA, about 2008, photo by Barry Rice (CalPhotos). (B) Hobro, Nordjylland, Denmark, date unknown, photo by J.C. Schou (BioPix).

††**Myosurus nitidus** Eastwood
[*M. egglestonii* Wooton & Standley]

This species occurred with *M. cupulatus* more than 21,800 years ago in the Ajo Mountains. The nearest present-day populations are in central Arizona. Also in Colorado and New Mexico, often growing under sagebrush (*Artemisia tridentata* complex).

OP: †Montezuma's Head, receptacle with one dozen achenes, 21,840 ybp.

Thalictrum – Meadow-rue

Nearly worldwide, mostly temperate; 120–200 species.

Thalictrum fendleri Engelmann ex Gray
Fendler's meadow-rue. Figures 29A and B.

Tall slender perennial herbs; glabrous. Stems often purplish. Leaves 2–4 times pinnately divided, the segments lobed or crenate. Male and female flowers on separate plants (dioecious). Stamens numerous, pendulent, with prominent anthers. Female flowers with enlarged brush-like stigmas. Sepals greenish; petals none. Fruits of achenes in clusters about 1 cm long.

Known in the flora area from a single population in a protected microenvironment in the upper reaches of Arch Canyon, along with several other isolated populations of non-desert plants. This is the closest approach to the Sonoran Desert for this primarily temperate plant. The nearest population is in the Baboquivari Mountains. This species is widespread in Western North America.

OP: Arch Canyon, W of Mount Ajo, canyon bottom shaded by steep canyon walls and trees; *Quercus turbinella*, *Sapindus drummondii*, *Frangula betulifolia*, *Morus microphylla*, *Ptelea trifoliata*; *Ribes quercetorum, Rhus aromatic*, *Phacelia ramosissima,* and *Urtica gracilenta*, *Holm & Ryan 29 Mar 2015*.

Figure 29A. *Thalictrum fendleri*. (A) Male flowers, W fork of Oak Creek, N of Sedona, Coconino Co., 25 Aug 2005, photo by Max Licher (SEINet). (B) Reef Campground, Huachuca Mountains, Cochise Co., 8 Aug 2005, photo by Patrick Alexander (SEINet). (C) Garden Canyon, Huachuca Mts, Cochise Co., 19 Aug 2010, photo by Jillian Cowles (SEINet).

Figure 29B. *Thalictrum fendleri*. Little Cherry Creek Road, Pinos Altos Mountains, Grant Co., NM, photos by Russell Kleinman (gilaflora.com): (A) Male flower, 30 Jun 2009; (B) Female flowers, 30 Jun 2009; (C) female flower, 2 Jul 2009.

RESEDACEAE – Mignonette Family

Northern and eastern Hemispheres; 6 genera, 85 species.

Oligomeris

Western North America and Old World; 3 species.

Oligomeris linifolia (Vahl) J.F. Macbride

Desert cambess. Figure 30.

Ephemerals recorded in the region from October through May; glabrous, (5) 10–40 cm tall. Stems leafy, few-branched or much-branched when well watered, with a well-developed taproot. Leaves alternate or fascicled in densely clustered axillary short shoots; leaves narrowly linear, 1.5–3.5 (4.3) cm × 6–12 mm; stipules bristle-like. Inflorescences of slender, densely flowered spikes. Flowers sessile, moderately bilateral, inconspicuous, green and white. Bracts and sepals fleshy, green with white margins, 1–2 mm long; sepals 4; petals 2, white, 1 mm long. Stamens 3. Fruits of capsules 2.5 (3) mm wide, globose; ovary and capsules gaping open at the top, of 4 swollen carpels each terminating in a broad tooth surmounted by a stigma, the teeth unequal in size. Seeds 0.5–0.6 × 0.45 mm, numerous, shiny black, smooth, and obovoid.

Widespread, mostly at lower elevations; lower slopes, desert plains, pavements, gravelly soils of washes and arroyo beds, sand flats, dunes, and often abundant in playas and at charcos.

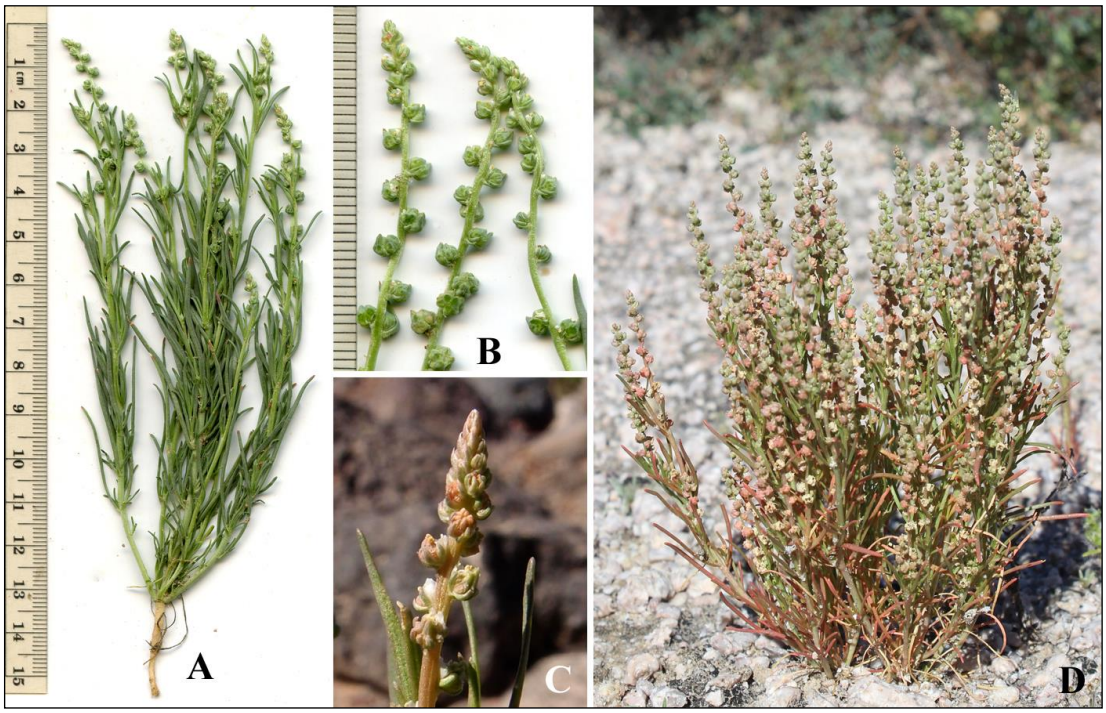

Figure 30. *Oligomeris linifolia*. (A & B) Aguajita Wash near international boundary, 8 Feb 2015. (C) Papago Tanks, Pinacate Biosphere Reserve, Sonora, 24 Feb 2014, photo by Sue Carnahan. (D) Quitobaquito Hills, 25 Feb 2015.

Mostly deserts, also Mediterranean climates; northwestern Mexico and southwestern USA, Africa and the Middle East to India. Although sometimes claimed not to be native in the New World, it is in fact native to the Southwest. The seeds were eaten by the Seris (Felger & Moser 1985) as well as by people living along the shores of ancient Lake Cahuilla (in a reduced phase now the Salton Sea), as shown by Wilke's (1978) analysis of coprolites from prehistoric lakeshore campsites. The Seris parched and ground the seeds, and consumed the flour mixed with water. *Oligomeris linifolia*

also may have been a common food resource on the Baja California Peninsula (Hodgson 2001). Although the seeds are minute, they are often available in substantial quantity. Molecular research by Martín-Bravo et al. (2009) shows that it is native in North America, although representing a remarkable disjunction in the family.

OP: Puerto Blanco Mts, 2000 ft, *Nichol 25 Feb 1939*. Quitobaquito, *Nichol 28 Apr 1939*. Flats N of Bates Mts, 23 Mar 2003, *Rutman 2003-398* (ORPI).

CP: Las Playas, 15 Apr 1941, *Benson 10776*. Pinta Sands, 29 Mar 1970, *Duncan 4*. Papago Well, *Furlow 14 Mar 1979*. Near Tule Well, 21 Mar 1992, *Yeatts 3249* (CAB).

TA: Butler Mts, *Van Devender 27 Mar 1983*. Coyote Water, 25 Oct 2004, *Felger 04-53*. Tinajas Altas Pass, 18 Mar 1992, *Felger* (observation).

RHAMNACEAE – Buckthorn Family

Hardwood shrubs and occasionally small trees (those in the flora area; elsewhere commonly trees and some perennial herbs). Leaves usually alternate, simple, pinnately veined or 3–several main veins from the base; stipules small or modified into spines. Flowers in axillary clusters, radial, and small; bisexual or unisexual, green, yellow, or white, or sometimes pink, usually with a short hypanthium resembling a calyx. Sepals 4 or 5, united at the base, the lobes usually triangular and quickly deciduous. Petals 4, 5, or none. Fruits of fleshy drupes. Worldwide; 50 genera, 950 species.

1. Fruits dry capsules, 3-seeded…….. **Colubrina**
1. Fruits fleshy drupes, 1–3-seeded.

2. Leaves more than 5 cm long and minutely toothed or leaves 2–3 cm long and holly-like with spine-tipped teeth; fruits 2- or 3-seeded; Ajo Mountains.

3. Leaves about twice as long as wide, the margins finely toothed, the teeth not spine-tipped; flowers bisexual, 5-merous; drupes at first red, blackish or purplish when ripe, usually 3-seeded. …… **Frangula**
3. Leaves about as wide as long, the margins with spine-tipped teeth; flowers unisexual, 4-merous; drupes bright red, usually 2-seeded……. **Rhamnus**

2. Leaves less than 2.5 cm long, the margins entire or teeth few and not spine-tipped; fruits 1-seeded; widespread including the Ajo Mountains.

4. Leaves spatulate, widest well above middle; fruits 3–4.5 mm long, the surfaces not glaucous. …… **Condalia**
4. Leaves ovate to narrowly elliptic, widest from well below to middle of leaf; fruits 8–10 mm long, the surfaces glaucous……. **Ziziphus**

Ceanothus

North America; 55 species of shrubs.

††Ceanothus vestitus Greene
[*C. greggii* var. *vestitus* (Greene) McMinn]
Mojave ceanothus

Rigidly-branched shrubs. The leaf is distinctive — thick and with a cellular pattern of venation.

Ceanothus vestitus is documented for the Ajo Mountains from 9600 to more than 29,000 years ago. This is a typical chaparral plant of sub-Mogollon Arizona above the desert, 3000–7000

feet. The nearest present-day populations of *C. vestitus* are in southern Arizona in the Santa Rita and Superstition mountains.

California to Nevada, Utah, southwest Texas, Baja California, and perhaps northern Sonora (see Currie & Ayers 2006). The fossils, especially the older ones, may instead be the closely related *C. pauciflorus* de Candolle [*C. greggii* A. Gray], which occurs in north-central Mexico (Currie & Ayers 2006).

OP: †Alamo Canyon, leaves, 9570 to 29,110 ybp (3 samples).

Colubrina californica I.M. Johnston
[*C. texensis* (Torrey & A. Gray) A. Gray var. *californica* (I.M. Johnston) L.D. Benson]
Large drought-deciduous shrubs with small whitish flowers.

Benson and Darrow (1945) reported it for the Ajo Mountains but no specimen has been located. The nearest known populations are nearby in hills south of Sonoyta (Felger 2000) and in the Sauceda Mountains (e.g., 2 km S of Thanksgiving Day Tank, *Felger 02-141*).

Arizona and southeastern California, both Baja California states and western Sonora.

Condalia
Hardwood shrubs, Americas; 18 species.

Condalia globosa I.M. Johnston var. **pubescens** I.M. Johnston
Desert snakewood; *crucillo*; kawk kuavulĭ. Figure 31.
Shrubs or small trees often 2–4 m tall, with very hard wood. Densely branched, sometimes with short, thick trunks and lower limbs; twigs mostly thorn-tipped. Partly evergreen to gradually deciduous in drought; larger leaves petioled, quickly drought deciduous, the smaller leaves subsessile. Leaves spatulate, 3.3–22 × 1.5–4 mm, crowded on very short spur-branches (short shoots), the margins entire. Lower leaf surfaces with conspicuous raised veins, the upper surfaces with the midrib concave; lower surface of young leaves often yellowish with minute, glistening golden glands. Flowers in small clusters at short shoots. Pedicels slender, 2.7–6 mm long. Flowers yellowish green, 3 mm wide, the disk at anthesis awash with sticky glistening nectar. Calyx tube broad and very short, with a flat disk and 5 lobes; petals none. Fruits globose, dark brown or blackish, 3–4.5 mm long plus a persistent style 0.5 mm long; disk at base of fruit 2 mm wide. Flowering en mass during warmer months, especially following summer rains; fragrant and attracting hoards of insects.

Banks and streamways of large arroyos and canyons; widespread in Organ Pipe and the northeastern part of Cabeza Prieta. Larvae of the saturniid moth *Agapema anona* feed on condalia and spongy masses of their cocoons are often seen among the thorny branches.

Condalia globosa ranges from southeastern California and southwestern Arizona to northwestern Sinaloa and through the Baja California Peninsula. Apparently only var. *pubescens* occurs in the northernmost part of the range and only var. *globosa* occurs in the southernmost part (e.g., south of Guaymas, Sonora).

Condalia fossils resembling *C. globosa* were in the Tinajas Altas Mountains 9000 to 11,000 years ago, and this species or perhaps the related *C. warnockii* M.C. Johnston was in the Puerto Blanco Mountains 9700 years ago. The nearest present-day *C. warnockii* shrubs are in the Sauceda Mountains in the Goldwater Gunnery Range.

Figure 31. *Condalia globosa* var. *pubescens*. (A) Estes Canyon, 14 Aug 2013. (B) Ironwood Hills & Silverbell Road, Tucson, 12 Jun 2010, photo by Ries Lindley. (C) Ajo Scenic Loop, Little Ajo Mts, 31 Jul 2014. (D) Chico Suni Wash near Chico Suni Village, 30 Oct 2014. (E) Kuakatch Wash near E boundary of Organ Pipe, 3 Mar 2014.

Tree-sized condalias were once more common (e.g., *Peebles 14329*; Felger et al. 2001). Many of the larger condalias, especially in nearby Sonora in the Sonoyta region and near Ajo, have regrown from axe-cut large stumps. The plants are slow growing. The wood is attractive when worked, and was locally called rosewood and used to make items such as paperweights and pistol grips (Simmons 1966). The thin, fleshy part of the small fruits was eaten fresh, probably serving as a minor resource (Castetter & Bell 1942; Hodgson 2001). In 2003 Jim Malusa found the tallest

recorded specimen—it was in the Little Ajo Mountains and measured 5.5 m tall with a crown 7.6 m across, and the trunk 112 cm in circumference (American Forests 2013).

OP: Bates Well, *Nichol 26 Apr 1939*. 20 mi SE of Ajo, "common in the vicinity of Sonoita, Sonora, and there attains a height of about 20 feet," 6 May 1939, *Peebles 14329*. Pitahaya Canyon, *Nichol 23 Feb 1939*. Quitobaquito, 5 Mar 1940, *Peebles 14557*. Dripping Springs, 18 Mar 1945, *Darrow 2447*. Headquarters, 5 May 1949, *Supernaugh 438*. Aguajita Spring, 23 Oct 1987, *Felger 87-274*. †*C. globosa* or *C. warnockii*: Puerto Blanco Mts, on ridge, seeds, 9720 ybp.

CP: 2 mi N of Corner Well (Simmons 1966). Packrat Hill, 25 Feb 1993, *Felger 93-60*. Charlie Bell Rd, 1 km W of E boundary of Refuge, 5 Mar 1994, *Felger 94-21*. Daniel's Arroyo in Charlie Bell area, tree, 1310 ft, 22 Nov 1998, *Harlan 529*.

TA: †*C.* cf. *globosa*: Tinajas Altas, seeds, 8970 & 10,950 ybp.

Frangula

Shrubs and small trees, North America and Eurasia; 50 species. A genus segregated from *Rhamnus*.

Frangula betulifolia (Greene) Grubov
[*Rhamnus betulifolia* Greene]
Birchleaf buckthorn; *salicieso*. Figure 32.

Shrubs or small trees to 8 m tall; bark smooth. Leaves winter deciduous, alternate, 6–10 cm long; petioles short; leaf blades oblong to elliptic, relatively thin, dark green, and pubescent on both surfaces when young, margins more or less serrated. Inflorescences of small axillary cymes much shorter than the leaves; flowering with new leaves in spring. Flowers 5-merous, pedicellate; sepals 1–2 mm long, yellow, and triangular; petals 1 mm long, pale yellow, becoming brownish with age. Drupes purplish-black when ripe, spherical, 0.5–1 cm wide, glabrous, and with (2) 3 (4) seeds.

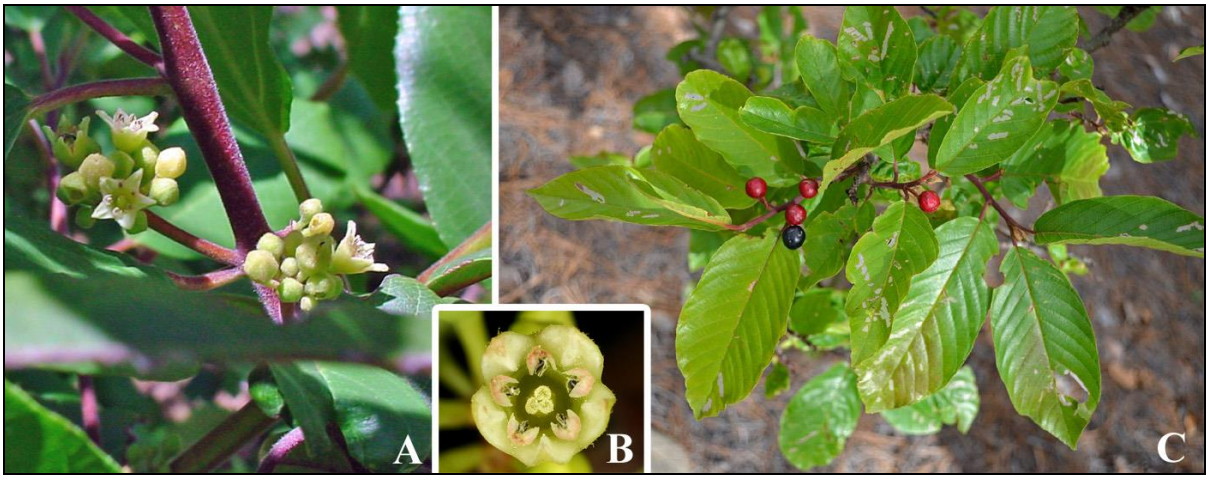

Figure 32. *Frangula betulifolia*. (A) C Bar Ranch Road, Burro Mountains, Grant Co., NM, photo by Russell Kleinman (gilaflora.com). (B) Little Cherry Creek Road, Piños Altos Mountains, Grant Co., NM, photo by Russell Kleinman (gilaflora.com). (C) Sierra el Tigre, Sonora, 10 Aug 2015, photo © by Sky Jacobs (SEINet).

Small, isolated populations grow in the Ajo Mountains at higher elevations in protected, shaded canyons and their north-facing slopes, especially at cliff bases. This decidedly non-desert plant ranges no closer to the Sonoran Desert.

Eastward in mountains in southern Arizona, New Mexico, west Texas, and Sonora to Durango, Tamaulipas, and Nuevo León (Nesom & Sawyer 2009).

OP: Pitahaya Canyon, 3400 ft, *Nichol 23 Feb 1939.* N-facing slopes of the arch in Arch Canyon, 900 m, desertscrub with *Vauquelinia* and *Dodonaea*, 2 Dec 1990, *Felger 90-542*.

Rhamnus

Shrubs and trees, nearly worldwide; 110 species.

Rhamnus crocea Nuttall, 1838

[*R. ilicifolia* Kellogg, 1863. *R. crocea* var. *ilicifolia* (Kellogg) Greene, 1891. *R. crocea* subsp. *ilicifolia* (Kellogg) C.B. Wolf, 1938]

Hollyleaf buckthorn, hollyleaf redberry. Figure 33.

Woody shrubs to small trees, with rigid branches. Leaves 2–3 cm long, alternate, essentially evergreen, petioled and holly-like, the leaf blades obovate to ovate or orbicular, glabrous with spinescent, toothed, or entire margins. Flowers on 1–few-flowered axillary cymes much shorter than the leaves. Flowers pedicelled, unisexual, 4-merous, small and yellow-green; sepals 4, greenish-yellow, and triangular; petals none; flowering March and April. Stamens 4. Fruits of fleshy, globose red drupes to about 5 mm wide with 2 seeds.

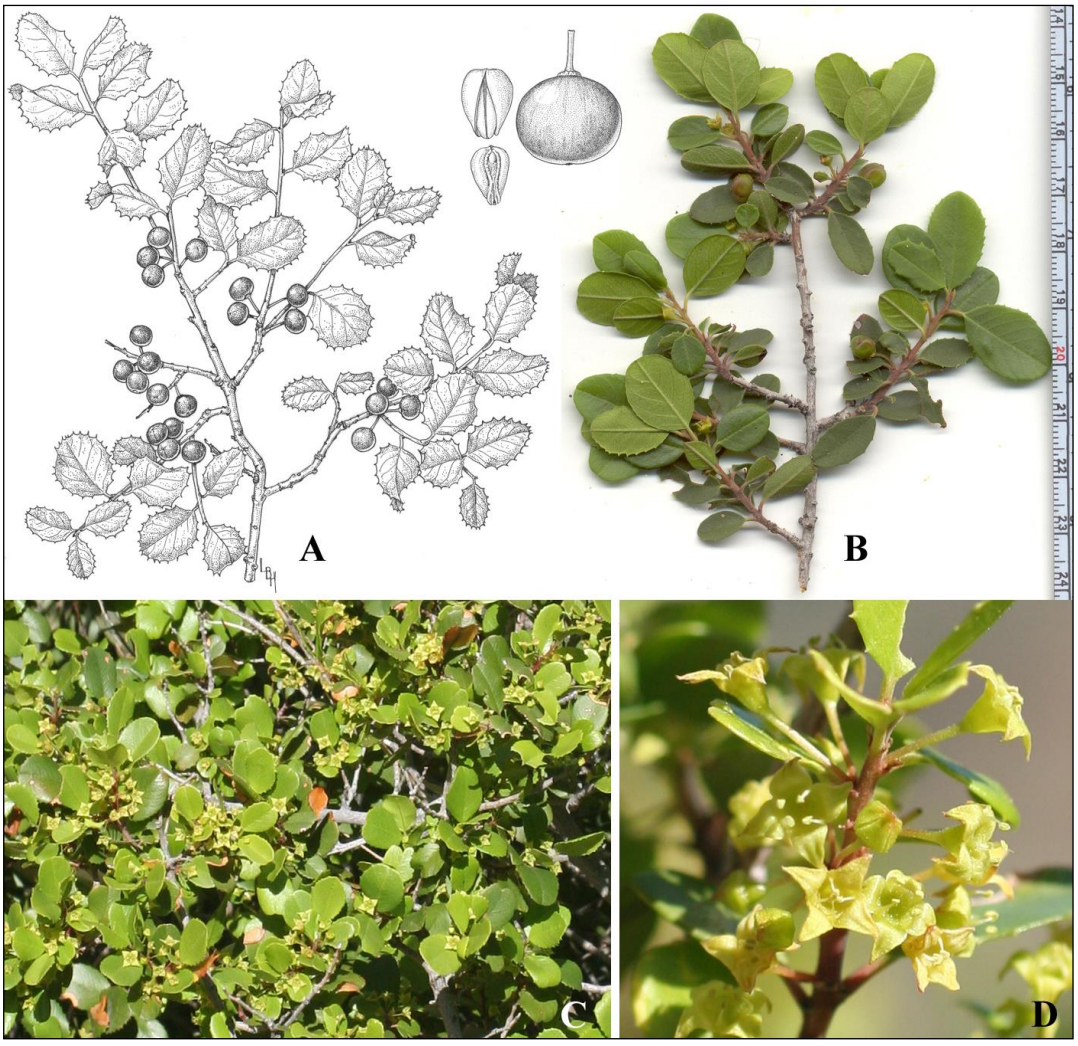

Figure 33. *Rhamnus crocea*. (A) By Lucretia Breazeale Hamilton. (B) Middle fork of Alamo Canyon, 24 Mar 2008. (C & D) Bull Pasture, 5 Apr 2010.

Ajo Mountains canyon bottoms and north-facing slopes at middle and high elevations (above 2800 ft), often growing with *Juniperus*, *Quercus*, and *Vauquelinia*.

Generally in chaparral and oak woodland; western and southern Arizona, and southeastern Oregon to Baja California, and Nevada.

Neal (2006) mapped both *Rhamnus crocea* and *R. ilicifolia* in Organ Pipe. In the identification key *R. crocea* is separated by having smaller leaves and entire or toothed margins, and *R. ilicifolia* is distinguished by larger leaves with spinescent margins. Both leaf forms can be found on the same plant among the Ajo Mountain population. The older of the two names is chosen here. In California, where the two are sympatric over a relatively broad region, *R. crocea* is distinguished from *R. ilicifolia* in its essentially non-thorny branches and smaller leaves with less spinose margins. The variation may be environmentally related rather than genetic.

OP: Pitahaya Canyon, *Nichol 23 Feb 1939.* Alamo Canyon, 2500 ft, 17 Mar 1952, *Parker 8001*. Boulder Canyon, 2800 ft, 3 May 1978, *Bowers 1292*. Bull Pasture Trail, 3000 ft, 5 Apr 1978, *Bowers 1210*. Arch Canyon, 2 Dec 1990, *Felger 90-546*.

Ziziphus

Trees, shrubs, and vines. Nearly worldwide, mostly tropics and subtropics; 100 species. Some Old World species, both tropical and temperate, are important fruit trees.

Ziziphus obtusifolia (Hooker ex Torrey & A. Gray) A. Gray var. **canescens** (A. Gray) M.C. Johnston
[*Condalia lycioides* (A. Gray) Weberbauer var. *canescens* (A. Gray) Trelease]
Lotebush, white crucillo, graythorn; *abrojo*. Figure 34.

Spinescent, messy-looking sprawling shrubs to 2+ m tall, with rigid branches forming dense, thorny tangles. Stems gray-green, the twigs thorn-tipped and commonly spreading at right angles. Young branches, leaves, inflorescences, pedicels, and exposed portions of buds densely pubescent with short spreading white hairs; twigs and branches glabrate with age. Leaves sparse and quickly drought deciduous, the shrubs often nearly leafless; leaves alternate on long shoots and in several-leaved fascicles on short shoots, the blades triangular-ovate to narrowly elliptic, mostly 8–22 mm long, the midrib prominent, the lateral veins pinnate, the margins entire or with a few small teeth, especially on long-shoot leaves. Leaf edges are often chewed by insects and at first glance might not appear entire. Flowers in axillary sub-umbellate clusters usually less than 1 cm long. Basal disk of flowers and fruits semi-persistent. Flowers 2.5–3 mm wide. Sepal lobes broadly triangular, surrounding a flat disk. Petals white, clawed, sticking out laterally from not quite open flowers, later loosely enfolding the stamens and quickly falling after the anthers mature (petals often gone by the time the stigma expands). Fruits of fleshy drupes, 8–10 mm long, blackish blue to purple-brown, the pericarp thin, fleshy, and edible and slightly sweet. Flowering at least May–September, the flowers visited by honeybees, native bees, large orange-winged spider wasps (*Pepsis* or *Hemipepsis*), and other insects.

Mostly along washes and canyons. Widespread in Organ Pipe, Cabeza Prieta especially in the eastern part, and also at Tinajas Altas. It has been in the Tinajas Altas Mountains for at least 8700 years.

Variety *canescens* mostly in the Sonoran Desert: southeastern California, southern Nevada, and western and southern Arizona to southern Sonora, and both Baja California states. Var. *obtusifolia* is mostly in the Chihuahuan Desert Region.

The fleshy parts of the fruits were eaten fresh or cooked (Rea 1997) and the Seris obtained sizable quantities of the fruit from packrat nests (Felger & Moser 1985). Among the O'odham the fleshy fruits were boiled to a syrup like that of cactus fruits and the juice was sometimes fermented (Castetter & Underhill 1935).

OP: Bates Well, *Nichol 26 Apr 1939*. Alamo Canyon, 27 Mar 1976, *Scaggs 2072*. Aguajita, 19 Jun 1989, *Felger 89-233*. N of Quitobaquito Pond, hypersaline soils with underground water from Quitobaquito Springs, bosque around pond, 15 Jun 2013, *Rutman 20130615-4*.

CP: E side of Pinacate lava flow (Simmons 1966). Tule Well, 14 Apr 1992, *Harlan & Steinmann 283* (CAB). Daniels Arroyo at Charlie Bell Rd, Heart Tank, Tule Well, 12–16 Jun 1992, *Felger* (observations). Las Playas, playa mesquite thicket, 210 m, 24 Nov 1994, *Harlan 445*.

TA: Tinajas Altas, broad wash immediately E of the tinajas, 20 Nov 2008, *Felger 08-170*. †Tinajas Altas, twigs, 1230 to 8700 ybp (3 samples).

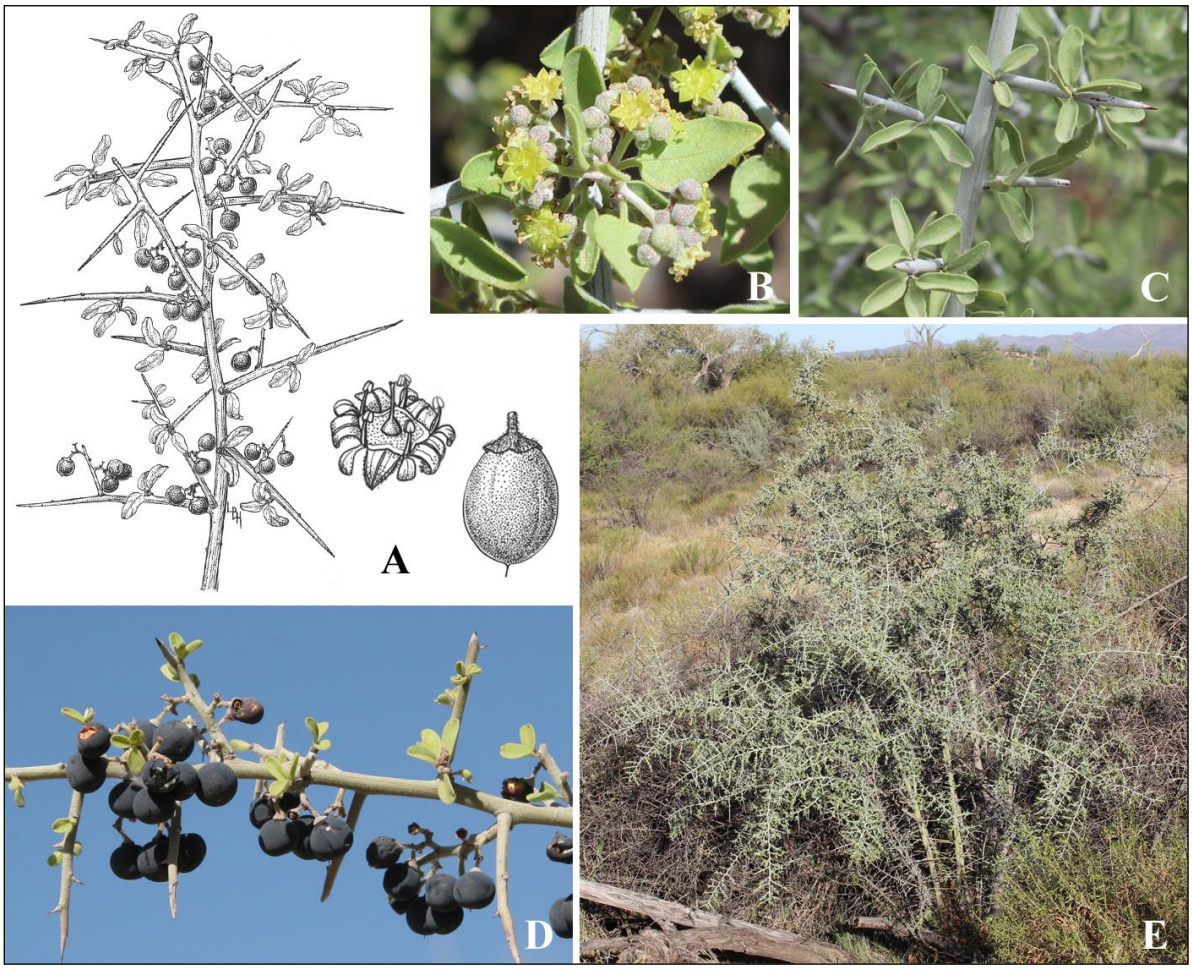

Figure 34. *Ziziphus obtusifolia* var. *canescens*. (A) By Lucretia Breazeale Hamilton. (B) Aguajita Wash near Aguajita Spring, 18 Mar 2015. Quitobaquito: (C) 17 Jul 2013; (D) 14 May 2006; (E) 23 Sep 2014.

(RIVINACEAE) **PETIVERIACEAE**

Herbs to trees or lianas; warm regions of the New World, Australia, New Hebrides and New Caledonia; 9 genera, 13 species. *Rivina*, formerly included in Phytolaccaceae or Rivinaceae, is more recently placed in the Petiveriaceae (Stevens 2012).

Rivina

This genus has a single species.

Rivina humilis Linnaeus

Rouge plant, pigeon berry; *chile de coyote*. Figure 34.

Bushy perennials, scarcely woody at the base, often reaching 1+ m tall, and often growing through other shrubs; growing and flowering with warm to hot weather, the plants frost-sensitive. Stems slender and brittle. Herbage reddish green. Leaves alternate, often 4–12 cm long, simple and entire, ovate, thin, and quickly wilting. Inflorescences of terminal racemes often 4–8 cm long. Flowers white or pink, 4–5 mm wide; sepals 4; petals none; stamens 4. Fruits 3–4 mm in diameter, fleshy, red-purple, and yielding a red dye.

Canyons in the Ajo and Diablo mountains, especially at higher elevations.

Southern and central Arizona to Florida, Baja California Sur and Sonora to South America, the Caribbean, and Africa (introduced?); also widely introduced elsewhere and often cultivated as an ornamental plant. There are numerous references of this species thriving in remarkably deep shade as well as full sun. Although some authors report that the fruits are edible (e.g., Pennington 1963, Standley 1920–1926), others report the fruit to be toxic to humans (e.g., Austin 2004, 2010; Nellis 1997).

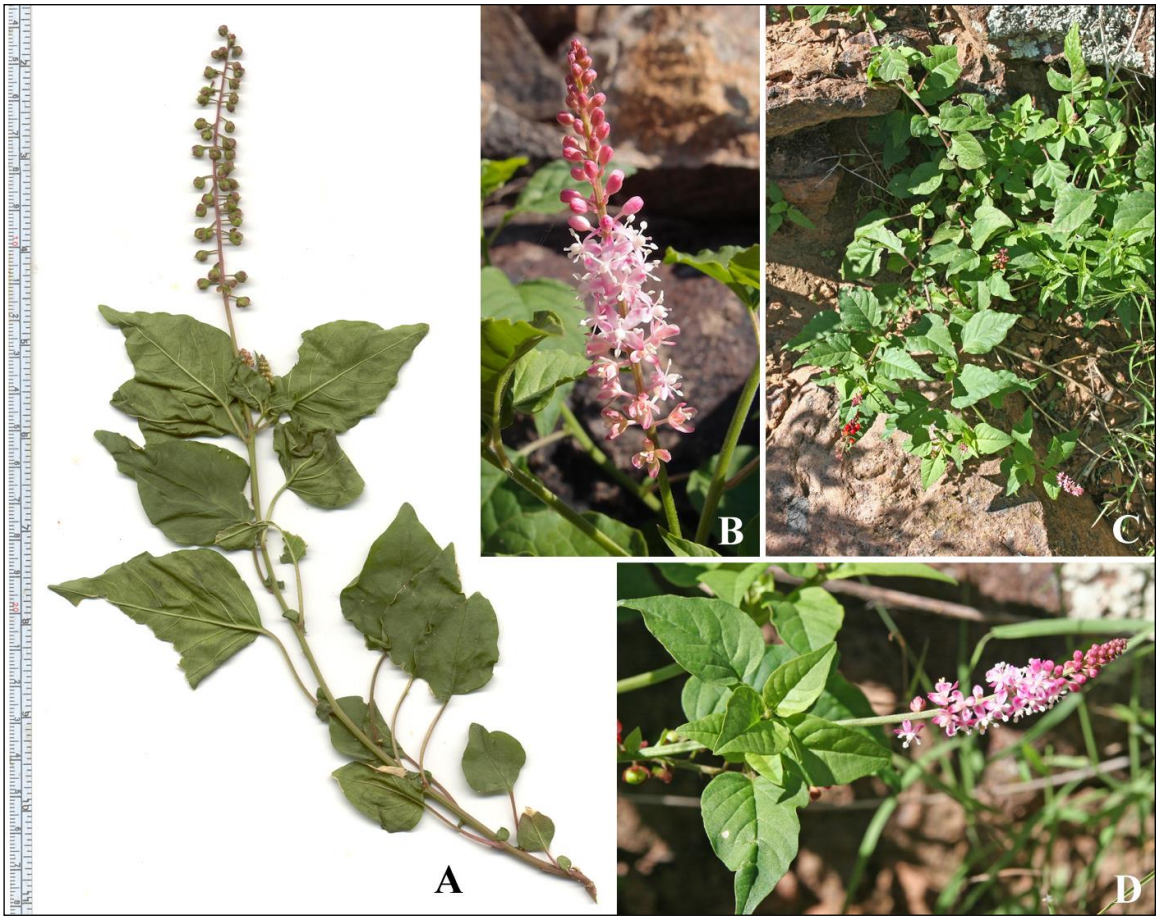

Figure 35. *Rivina humilis*. (A, C & D) Arch Canyon, 16 Sep 2006. (B) SE slope of Poorwill Hill, Salero Ranch, Santa Cruz Co., 29 Jul 2013, photo by Sue Carnahan (SEINet).

OP: Alamo Canyon, 13 Sep 1941, *Goodding 294-41*. Canyon Diablo, 15 Apr 1951, *Supernaugh 430* (ORPI). Below arch in Arch Canyon, 900 m, 2 Dec 1990, *Felger 90-509.*

ROSACEAE – Rose Family

Herbs to trees, worldwide; 110 genera, 3000 species.

Vauquelinia

Shrubs and trees. Southwestern USA and northern Mexico; 2 species.

Vauquelinia californica (Torrey) Sargent subsp. **sonorensis** W.J. Hess & Henrickson
Sonoran rosewood. Figure 36.

Hardwood shrubs and trees. Multiple-stem large shrubs often 3–4 m tall at higher elevations on open slopes and trees in riparian canyons. A tree in Alamo Canyon measured 14.3 m in height with an average crown spread of 12.2 m, and a trunk 2 m in circumference at 1.4 m above ground level (American Forests 2013), as the largest individual in the genus. Herbage with short crinkled to matted hairs. Leaves evergreen and alternate; petioles 3–8 mm long; leaf blades firm (sclerophyllous), linear to linear-lanceolate or narrowly oblong, (3) 5–12 cm × 5–11 mm, markedly bicolored, white-woolly below and dull green and generally glabrate above, the margins thickened, sub-entire to mostly finely toothed.

Inflorescences of terminal, flat-topped compound corymbs often 4 cm wide. Pedicels, floral cups, calyx lobes, and fruits with small, woolly hairs. Flowers 1 cm wide; sepals and petals each 5, the petals white. Fruits of capsules, 4.5–6.5 mm long, firm and woody at maturity, with 5 carpels united below and separate above, each with 2 seeds; seeds with a terminal wing. Flowering May–August.

Canyons and upper elevations in the Ajo Mountains and locally at upper elevations in the Diablo and Puerto Blanco mountains. In Alamo Canyon growing with *Quercus* and *Sapindus*, and at higher elevations often with *Dodonaea viscosa* and *Frangula betulifolia*.

This species has been part of the flora of the Ajo Mountains for at least 13,500 years; these fossils closely resemble subsp. *sonorensis*. For example, specimens 8600 years old have dense pubescence of white, curly-tangled and crinkled hairs on the lower surfaces along the midrib and blade, which is diagnostic for this subspecies. Most of the fossil specimens consist of midribs with a bit of blade tissue, as if the rest was eaten by the packrat collectors.

This subspecies also occurs in the Saucedo and Sand Tank Mountains, the Sierra Cubabi south of the Ajo Mountains in Sonora, and mountains in Baja California. Populations in neighboring regions such as the Baboquivari Mountains have plants with some leaves that may approach subsp. *sonorensis* in shape and color. This species, with four subspecies, ranges from central Arizona and northern Sonora to Baja California Sur, and New Mexico to Durango and Coahuila (Felger et al. 2001; Hess & Henrickson 1987).

OP: Pitahaya Canyon, *Nichol 23 Feb 1939*. Summit of Bull Pasture Trail, 3500 ft, *Cummins 11 Oct 1976*. Arch Canyon, 850 m, 2 Jun 1978, *Hess & Wilhelm 4259* (holotype of subsp. *sonorensis*, MOR; isotype NY). Alamo Canyon, 2500 ft, 13 Jun 1978, *Bowers 1341*. N-facing slopes below the arch of Arch Canyon, 900 m, 2 Dec 1990, *Felger 90-543*. Puerto Blanco Mts, occasional on steep rocky slopes, upper elevations NW of Pinkley Peak, *Rutman 24 Mar 2001* (ORPI). Along bases of cliffs in upper watershed of Diablo Canyon, Diablo Mts, 3000 ft, *Tibbitts 6 Mar 2003*. †Alamo Canyon, leaf fragments, fruits, 8130 to 9570 ybp (3 samples). †Montezuma's Head, leaves, 13,500 ybp.

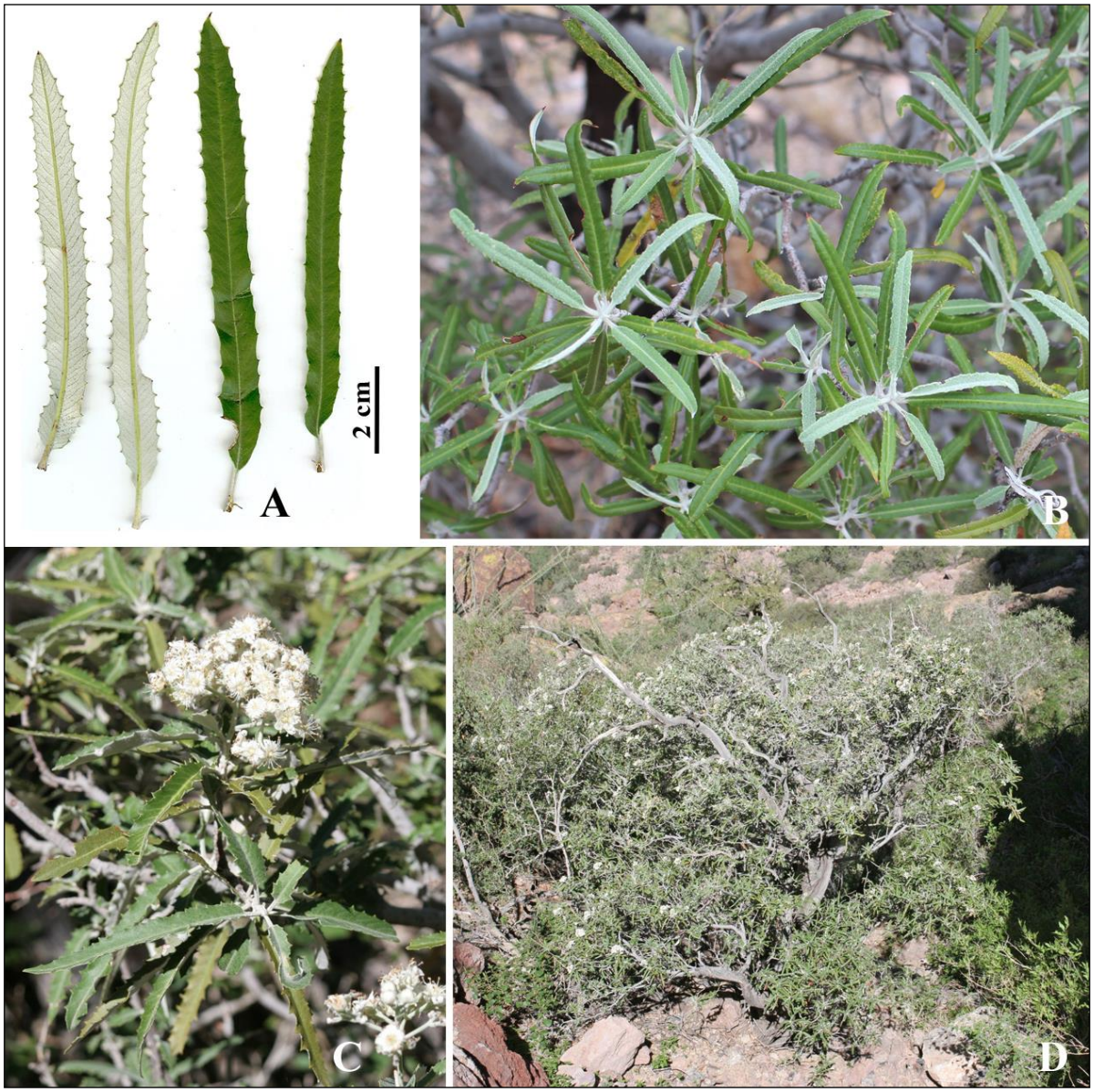

Figure 36. *Vauquelinia californica* subsp. *sonorensis*. (A) Alamo Canyon, 13 Mar 2005. (B) Estes Canyon, 14 Aug 2013. (C & D) Boulder Canyon, 24 Sep 2007.

RUBIACEAE – Madder Family

Annuals, perennial herbs, vines, shrubs, and trees. Worldwide; 500 genera, 6000 species.

Galium – Bedstraw

Annual or perennial herbs, or shrubs. Stems slender, square at least when young. Leaves opposite and decussate, whorled, with 4 (2 leaves and 2 leaf-like stipular appendages) or more leaves per node. Flowers small, radial, 4-merous, bisexual or unisexual. Calyx minute or absent; corollas rotate, deeply 4-parted. Ovary inferior. Fruits 2-lobed, 2-seeded, dry or fleshy, indehiscent, sometimes bristly or hairy. Worldwide; 650 species.

1. Small shrubs, larger stems woody and firm; leaf tips sharp-pointed; hairs on ovaries and fruits dense, straight, and longer that the fruits; widespread…… **Galium stellatum**
1. Annual or perennial herbs with delicate, weak stems; leaves not sharp-tipped; ovaries and fruits with few tubercles or very short hairs, or the hairs longer and hooked; Ajo Mountains.

2. Ephemerals; leaf midrib green, the margins not white-edged; ovaries and fruits covered with white, spine-like hooked hairs, these often about as long as fruit width…… **Galium aparine**
2. Perennials; leaves with white margins and midrib; ovaries and fruits with few blunt tubercles or very short, thick hairs (not hooked) much shorter than the fruits…….. **Galium microphyllum**

Galium aparine Linnaeus
Stickywilly, goose-grass bedstraw. Figure 37.

Cool-season ephemerals with delicate, often trailing or scrambling stems; herbage notably scabrous, clinging to clothing by small hooked (retrorse) hairs. Stems to more than 50 cm long. Leaves 6–8 per node, 15–30 mm long, with a mucronate tip, the lower (earlier) leaves spatulate and petioled, the upper (later) leaves linear-oblanceolate and sessile. Flowers small, few on leafy lateral branchlets, bisexual; corollas rotate, 1.6–1.8 mm wide, the lobes acute or obtuse, white or yellowish. Fruits with hooked hairs usually shorter the fruit body.

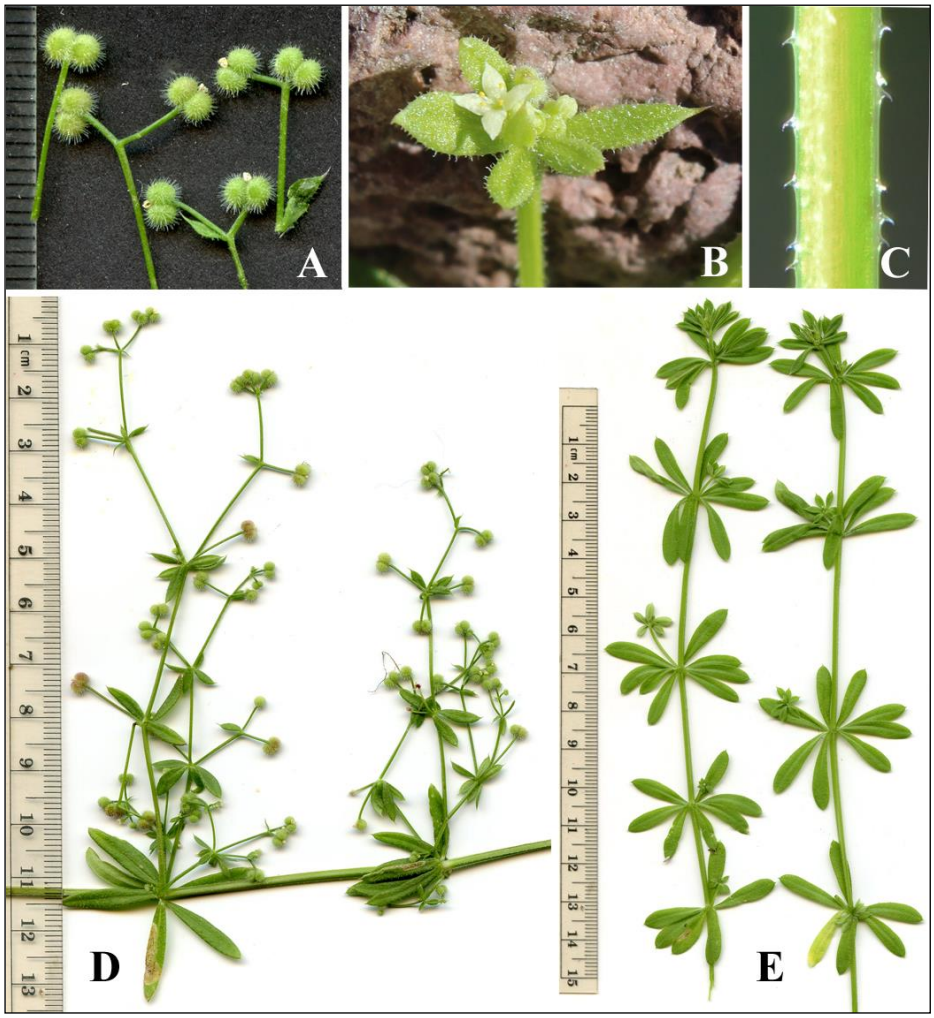

Figure 37. *Galium aparine*. Alamo Canyon: (A & D) 4 Apr 2014; (B & C) 26 Feb 2014; (E) 4 Feb 2015.

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

Widespread in Arizona mostly above the desert; across the USA, Baja California, and the Sierra Madre Occidental in Chihuahua and Sonora.

OP: Canyon Diablo, 21 Mar 1935, *Kearney & Peebles 10845*. Alamo Canyon: *Tinkham 18 Apr 1942*; 29 Mar 2003, *Felger 03-401*. Canyon NW of Kino Peak, 2000 ft, 20 Mar 2005, *Rutman 2005-0320-34* (ORPI).

Galium microphyllum A. Gray
Bract-leaf bedstraw. Figure 38.

Perennial herbs, tufted and somewhat woody at the base; stems to 40 cm long; glabrous or sparsely pubescent, the hairs not hooked. Leaves 4 per node, less than 1 cm long, linear or sometimes ovate, sharp-pointed; margins thick and light-colored. Flowers solitary at nodes or on several-flowered branchlets; bisexual, sessile and in 4-leaved involucres, corollas rotate, 2–2.5 mm wide, the lobes ovate, spreading, and greenish or white; flowering at least in July and August. Fruits granulated or tuberculate, not hairy.

Figure 38. *Galium microphyllum*. Upper Fresno Canyon, Salero Ranch, Santa Cruz Co., 22 Apr 2015, photos by Sue Carnahan (SEINet).

Ajo Mountains, canyon bottoms and "rocky slopes and in shade of boulders" (Bowers 1980: 43).

Arizona to Texas, mostly at elevations above the desert, and Sonora mostly the eastern part, Chihuahua, and Baja California Sur.

OP: Arch Canyon, *anonymous 14 Jan 1965* (ORPI). Alamo Canyon, S fork *Van Devender 31 Aug 1978* (ORPI); 29 Mar 2003, *Felger 03-415*.

Galium stellatum Kellogg
[G. *stellatum* var. *eremicum* Hilend & J.T. Howell]
Starry bedstraw. Figure 39.

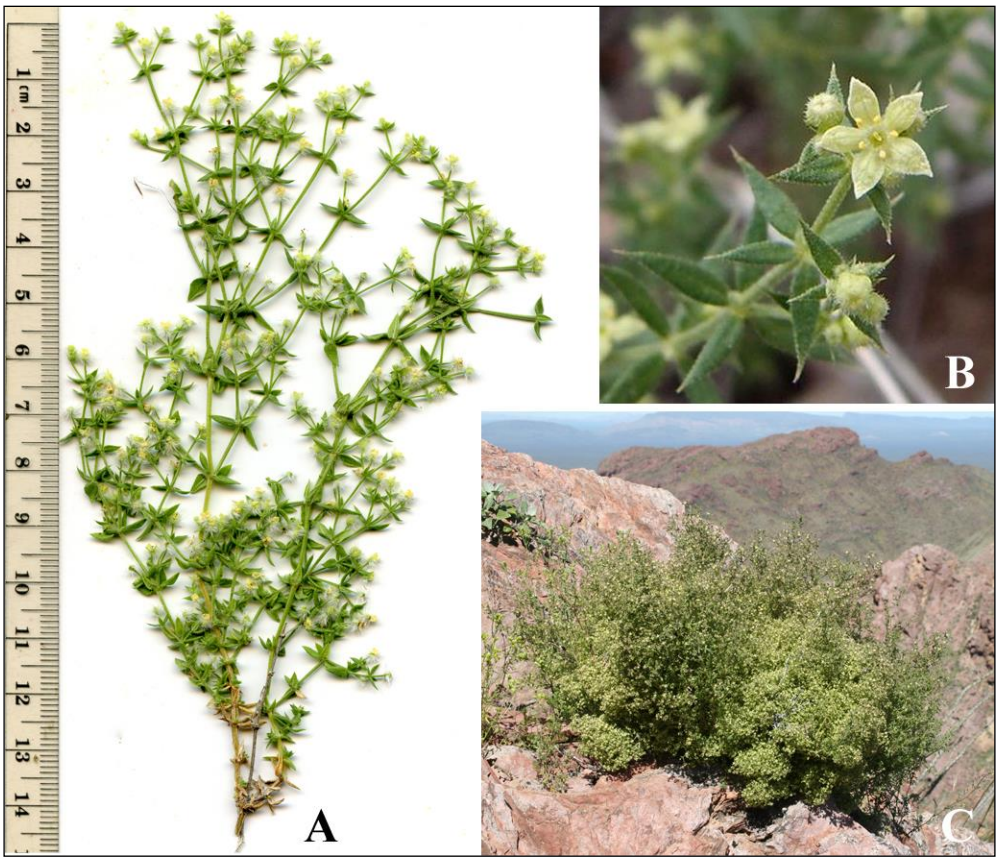

Figure 39. *Galium stellatum*. (A) Alamo Canyon, 4 Apr 2015. (B) Male flower, Wild Burro Canyon, Tortolita Mts, Pima Co., 24 Mar 2013, photo by Sue Carnahan. (C) Trail to Mount Ajo, 26 Mar 2005.

Dense to open, untidy and irregular-shaped small shrubs or subshrubs, reaching 50–80 cm tall. Stems slender, brittle, and square in cross-section with white-margined corners. Leaves and young stems scabrous with short white hairs. Vegetative or long-shoots woody with long internodes and brittle perennial stems forming the framework of the plant, with peeling, stringy bark and relatively large leaves, the old dry leaves whitish and often persisting. Fertile or short-shoots bunched at nodes of the long shoots, with very short internodes, dying back or deciduous during drought, and with slender and relatively flexible stems and small leaves. Leaves sessile, ovate to lanceolate, narrowed to a subspinose tip, short- and long-shoot leaves mostly 2–8 (10+) × 0.8–3 mm; lower leaf surfaces with a prominent white midrib and moderately inrolled margins. Male and female flowers

on separate plants. Flowers in small leafy panicles among the short shoots. Corollas 2.5–3 mm wide, whitish to pale yellow with purplish net-like veins. Ovaries and fruits densely covered with spreading, straight silky white hairs, the hairs longer than the fruit. Fruits dry, 3–5 mm wide including the hairs. Flowering in spring.

Widespread across the region in granitic and volcanic ranges; usually north- and east-facing slopes among rocks and along canyons, and in the more arid mountains especially toward higher elevations. *Galium stellatum* has been a part of the local flora for at least 18,700 years.

Mostly in desert mountains; western and southern Arizona, southwestern Utah, southern Nevada, southeastern California to northern Baja California Sur, and northern Sonora. *Galium stellatum* is the shrubbiest of all the New World galiums.

OP: Pitahaya Canyon, 3400 ft, *Nichol 23 Feb 1939*. Alamo Canyon, 12 Apr 1978, *Bowers 1251*. Canyon NW of Kino Peak, 2000 ft, 20 Mar 2005, *Rutman 2005-0320-33* (ORPI). †Alamo Canyon, twigs, leaves, seeds, 9570 ybp. †Montezuma Head, leaf, fruit (with long straight hairs papillate at their bases), 21,840 ybp.

CP: Tule Tank, 26 Mar 1932, *Shreve 5937*. E side Sierra Pinta, 28 Mar 1957, *Monson 8*. Agua Dulce Spring canyon, 13 Apr 1964, *Niles 340*. Cabeza Prieta Mts, *Van Devender 9 Mar 1980*. Christmas Pass, 13 Apr 1992, *Harlan & Steinmann 275* (CAB). Sierra Arida, 1595 ft, W slope below summit, 18 Mar 1992, *Yeatts 3254* (CAB).

TA: Tinajas Altas, 29 Mar 1930, *Harrison & Kearney 6574*. 1 mi N of Tinajas Altas, 17 Apr 1948, *Kurtz 1153*. †Tinajas Altas, stems, leaves, fruits, 4010 to 18,700 ybp (13 samples).

RUTACEAE – Rue or Citrus Family

Unarmed shrubs or small trees (those in the flora area; also perennial herbs elsewhere), gland-dotted and aromatic (with essential oils). Leaves alternate, simple or compound; without stipules. Flowers in short panicles or racemes, unisexual or bisexual, radial, and with a disk, the sepals and petals each 4 or 5. Worldwide; 158 genera, 1900 species.

1. Leafy shrubs, the leaves with 3 broad leaflets; Ajo Mountains……. **Ptelea**
1. Leafless or sparsely leafy shrubs, the leaves simple, linear or scale-like; arid slopes in Cabeza Prieta and Tinajas Altas…….. **Thamnosma**

Ptelea

Shrubs or sometimes small trees. USA and Mexico; 3 species.

Ptelea trifoliata Linnaeus
Hop tree. Figure 40.

Slender shrubs or small trees to 4 (8) m tall, the younger stems shiny reddish brown with prominent lenticels. Leaves aromatic with a citrus- or skunk-like fragrance when crushed; winter deciduous, alternate, shiny and glabrous or glabrate; petioled, the leaflets three, thin, and gland-dotted, the terminal one largest, 3.5–10 × 1.5–5 cm, lanceolate to obovate, the lateral leaflets unequal, the margins minutely toothed or entire. Flowers in small terminal panicles, bisexual and unisexual, with citrus-like fragrance, fly pollinated, greenish white, 4- or 5-merous, 11–15 mm wide, the sepals 1–2 mm long, the petals 4–5 mm long. Flowering March and April. Fruits of thin, papery, disc-shaped, wind-dispersed samaras 1–2.3 cm wide, with a conspicuously veined broad encircling wing. Fruits ripening around July.

Ajo Mountains, canyons and rocky slopes, above and at the upper edge of the desert; this is the closest that hoptree comes to the desert.

Arizona, mostly above the deserts. Canada to southern Mexico with five subspecies and 12 varieties of doubtful merit; southern Arizona populations are subsp. *angustifolia* (Bentham) V.L. Bailey.

OP: Alamo Canyon: *Harbison 13 Dec 1939* (SD); 3800 ft, *Tinkham 20 Apr 1942*. Arch Canyon, 1 Apr 1976, *Skaggs 212* (ARIZ, ASC). Above Pitahaya Canyon, 1180 m, base of N-facing cliffs, foliage with odor of skunk, trees to 8 m tall, 25 Mar 1990, *Baker 7782* (ASU, ORPI). Arch Canyon, 915 m, tree to 4 m tall, old bark light gray, smooth with lenticels, young shoots red-brown, 12 May 1988, *Baker 7610* (ASU). Estes Canyon, *Pate 19 Nov 1994* (ORPI). Trail from The Cones to Mount Ajo, 4025 ft, slender tree-like 2.5+m tall, leaves stinky, shiny green, flowers cream colored, 10 Apr 2005, *Felger 05-264*.

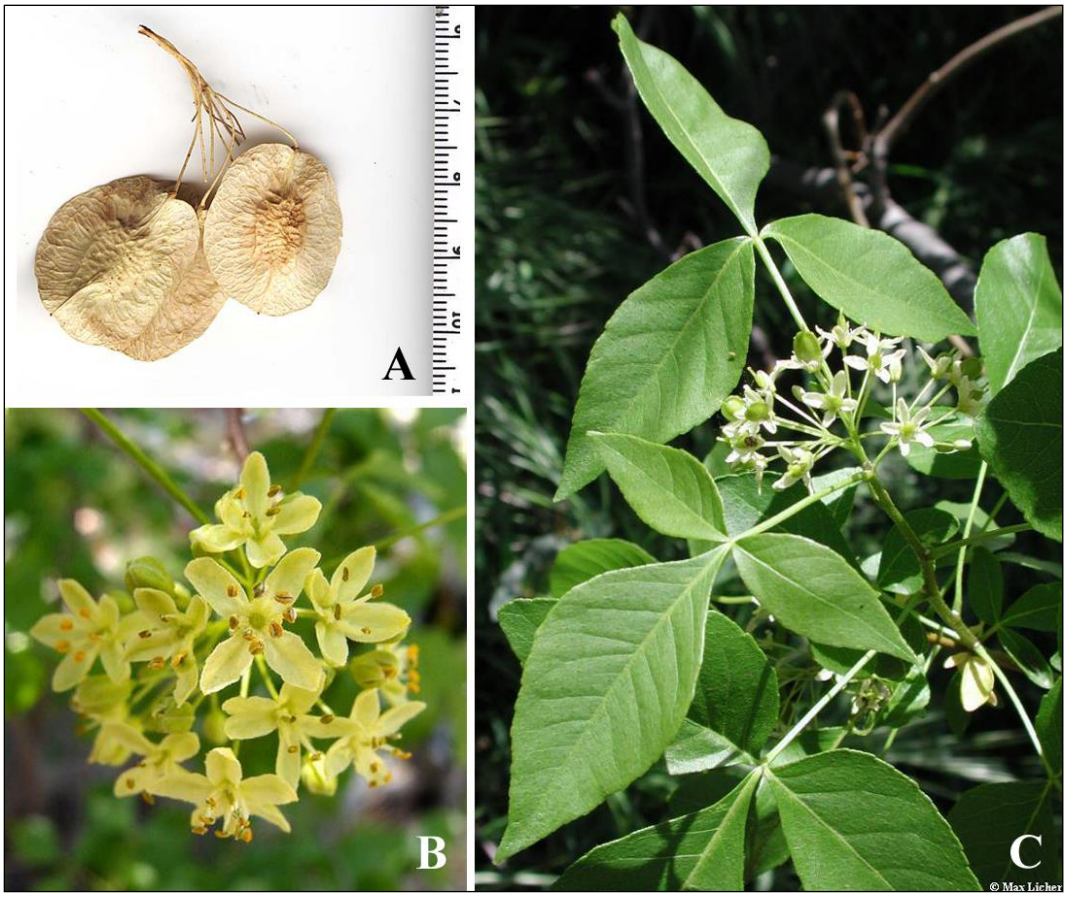

Figure 40. *Ptelea trifoliata*. (A) Trail to Woods Canyon, near Chiricahua National Monument, Cochise Co., 3 Jun 1975, *Reeves R-2980* (ASU). (B) Florida Canyon, Santa Rita Mountains, Pima Co., 5 Apr 2015, photo by Sue Carnahan. (C) West Fork of Oak Creek Canyon, Coconino Co., 25 Apr. 2001, photo by Max Licher (SEINet).

Thamnosma

Subshrubs and shrubs. Southwestern USA, northern Mexico, and southern Arabia to southern Africa; 12 species.

Thamnosma montana Torrey & Frémont

Turpentine broom. Figure 41.

Small aromatic shrubs, often almost leafless. Stems strangely yellowish green. Herbage and flowers stinky, or new growth often lemon-like when crushed; densely dotted with donut-shaped

glands 0.3–0.4 mm wide. Leaves alternate, sparse and quickly shed, linear or narrowly spatulate, 6–23 × 0.8–1.2 mm, reduced above to scales. Inflorescences of few-flowered raceme-like branches near stem tips, or flowers solitary in axils. Flowers bisexual, about 1 cm long, glistening dark indigo-blue (sepals, petals, and stamens), contrasting spectacularly with the stems. Sepals 4, short and thick. Petals 4 and thick. Flowers protogynous—the style and stigma protrudes from the unopened flower, then the corolla opens and the filaments elongate and the anthers open and shed pollen. Flowers stinking at midday, visited by large syrphid flies and honeybees (the bees vigorously stick their head into the corolla, forcing apart the petals to get inside). Flowering January to April, and fruiting in the same season. Fruits tough and leathery, of 2 inflated, gland-dotted, rounded chambers, each 5–7 mm wide; seeds 1–3 per chamber.

Hot, exposed rocky slopes and ridges, usually localized, in many ranges in the western part of Cabeza Prieta and in the Tinajas Altas Mountains, extending to the top of at least the Tule Mountains. *Thamnosma montana* has been in the Tinajas Altas Mountains for more than 37,000 years.

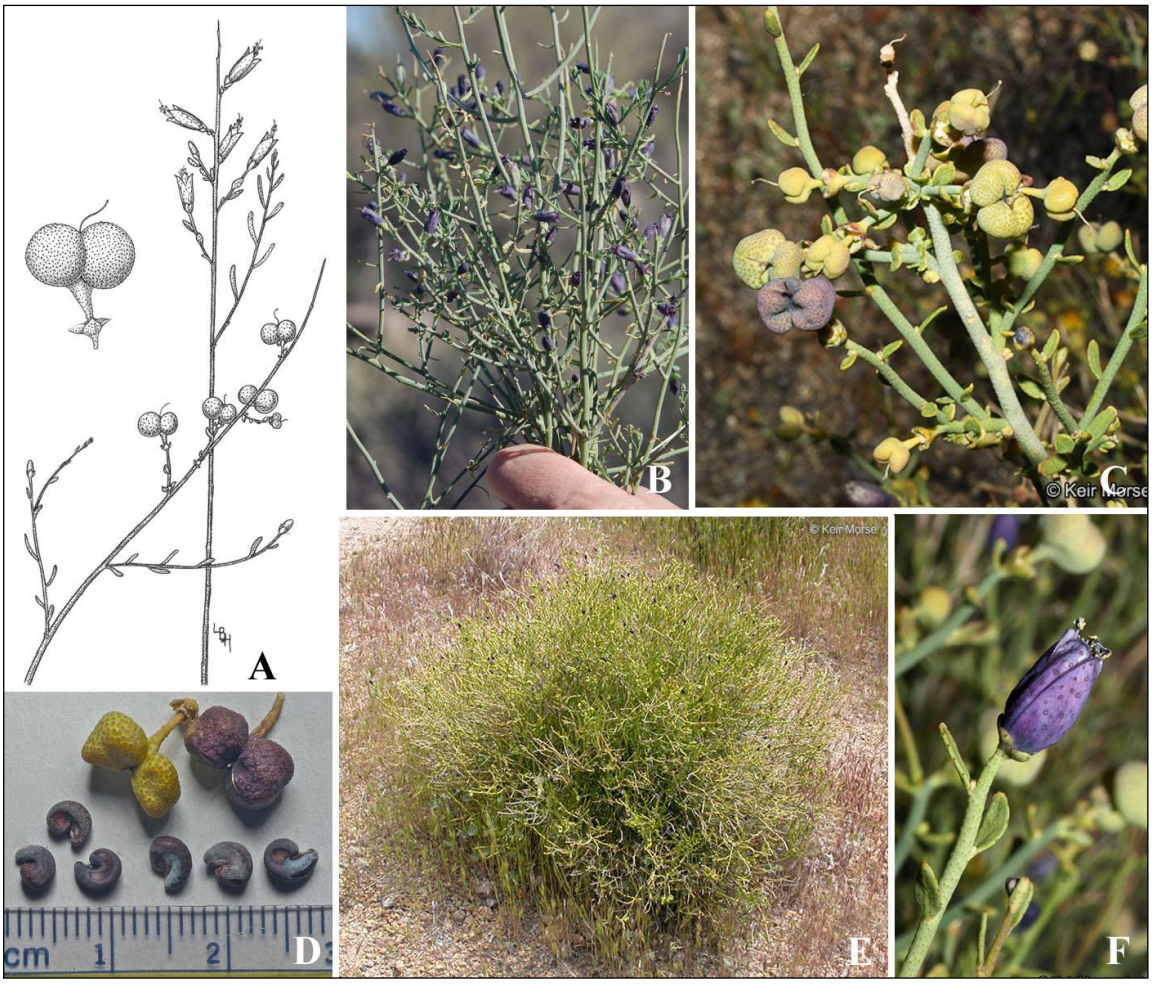

Figure 41. *Thamnosma montana*. (A) By Lucreatia Breazeale Hamilton. (B) First Water, Superstition Mts, Maricopa Co., 10 Feb 2012, photo by Karen Wellner (SEINet). (C & F) Anza Borrego State Park, San Diego Co., CA, 27 Mar 2011, photo by Keir Morse (CalPhotos). (D) The Mohave Cross, Veterans of Foreign Wars Memorial, Cima Rd, Mohave National Preserve, San Bernardino Co., CA, 5 Jun 2013, photo by Jean Pawek (CalPhotos). (E) Hole in the Wall, Mojave National Preserve, San Bernardino Co., 13 Apr 2005, photo by Keir Morse (CalPhotos).

Dry regions in Arizona, southeastern California, southern Nevada, southwestern Utah, Baja California, and extreme northwestern Sonora.

CP: Tule Tank, 25 Nov 1934, *Goodding 211*. E side of Sierra Pinta, *Monson 29 Mar 1957* (CAB). 3 mi W of Tule Well on Camino del Diablo, 18 Apr 1976, *Engard 914* (DES). A-1 Basin, Cabeza Prieta Mt, 11 Mar 1984, *Hodgson 2751* (DES). Tule Mts: NW side, 2 Feb 1992, *Felger 92-62*; top of mountain, 17 Feb 2002, *Rutman & Tibbitts* (observation). Eagle Tank, Heart Tank, 13 & 14 Jun 1992, *Felger*, observations.

TA: Tinajas Altas Mts, 5 Mar 1927, *Harrison & Belden 3612*. SE base of Tinajas Altas Mts, 18 Mar 1998, *Felger 98-103*. †Tinajas Altas, twigs, fruits, 5080 to 15,050 (4 samples) & >37,000 ybp.

SALICACEAE – Willow Family

The two genera in the flora area: Trees and shrubs with soft wood. Leaves winter deciduous, alternate, petioled, and with stipules (often soon deciduous). Male and female flowers on different plants. Flowers in catkins and presumably wind-pollinated, although visited by bees. Calyx vestigial; petals none. Fruit a small capsule. Seeds minute, each with a tuft of long, silky hairs adapted for wind dispersal.

Traditionally this family included only 2 genera, *Populus* and *Salix*. In the APG III system, there are 55 genera with 1010 species including the former Flacourtiaceae.

1. Leaf blades more or less deltoid, about as long as wide; catkins drooping…… **Populus**
1. Leaf blades linear to lanceolate, more than twice as long as wide; catkins erect…… **Salix**

Populus – Cottonwood; *álamo*

Trees and shrubs, northern Hemisphere; 40 species.

***Populus fremontii** S. Watson subsp. **fremontii**
[*P. deltoides* Bartram ex Marshall var. *fremontii* (S. Watson) Cronquist]
Frémont cottonwood; *álamo*; 'auppa. Figure 42.

Softwood trees to 13+ m tall with a broad crown, the leaves winter deciduous. Flowers greenish yellow, in February; fruits ripe late March and early April.

Mearns (1892–1893) wrote, "It is exclusively planted along acequias here [Sonoyta and Quitobaquito], and said to be the cottonwood of the Gila River near Gila Bend." Bryan (1925: 427) reported that, "the pond [at Quitobaquito], which with its fringing cottonwoods makes a refreshing green spot in desert." During the 1990s five cottonwood trees grew at the margin of the pond at Quitobaquito, occasionally producing root sprouts. These trees, all female, were probably planted from cuttings, the nearest source being the nearby Río Sonoyta where the trees were common. In 2016, of the five trees, all but three were dead.

Cottonwoods were often planted at ranches and homesteads — if there was sufficient water to sustain them. According to a letter in the Organ Pipe archives, there were one or more cottonwood trees in Alamo Canyon, but we have found no specimens and no photos. Andrew "Nic" Nichol collected specimens at "Tres Alamos Canyon" in the Ajo Mountains, the name he used for his Alamo Canyon collections of 24 February 1939. "Tres Alamos" refers to the three main branches of the canyon, rather than three cottonwoods. The Gray family, who ranched in the area from 1919 to 1976, called the houses, well, and corrals "The Alamo".

Arizona, California, and Utah to Baja California and northern Sonora. Another subspecies occurs in New Mexico and Texas to the Valley of Mexico.

OP: Quitobaquito: Large tree, 5 Mar 1940, *Peebles 14563*; *Benson 5 Mar 1940*; Edge of pond, 25 Mar 1944, *Clark 11509* (ORPI). Small grove of large trees (one root sprout), these trees all pistillate and probably a single clone, 10 Nov1987, *Felger 87-303*; 19 Jun 1989, *Felger 89-252*.

CP: Simmons (1966) reported a cottonwood tree at Lower Well (the tree was planted and has perished).

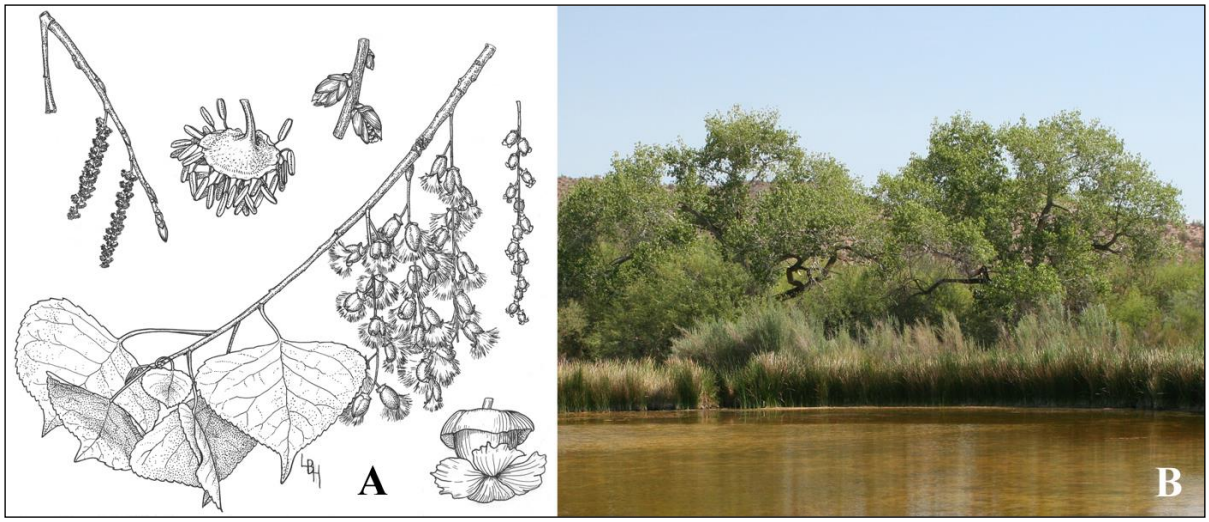

Figure 42. *Populus fremontii* subsp. *fremontii*. (A) By Lucretia Breazeale Hamilton. (B) N side of Quitobaquito Pond, 27 Jun 2006.

Salix – Willow; *sauz*

Trees and shrubs (dwarfed at high elevations and in the arctic), worldwide; 450 species.

Salix gooddingii C.R. Ball
[*S. nigra* Marshall var. *vallicola* Dudley]
Goodding willow; *sauz*; ce'ul. Figure 43.

Large shrubs to thick-trunked trees to 8+ m tall, with soft wood. Young herbage hairy, soon glabrate. Leaves winter deciduous, uniformly green on both surfaces, short petioled, narrowly lanceolate, 5.5–11 cm × 8–17 mm. Male flowers with 4–9 stamens. Peak flowering in February and March.

Trees at the Quitobaquito pond and shrubs in canyon bottoms in Alamo Canyon and Bull Pasture in the Ajo Mountains.

Southwestern USA and northwestern Mexico including both Baja California states, Sonora, and Sinaloa.

Cocopah "bows were made from willow, and being less elastic and more liable to break when dry, old ones were seldom seen. Those used for hunting deer were from six to eight feet in length" (Chittenden 1901: 203–204). Small hunting bows for birds and smaller game were also made from willow (MacDougal 1906). For the Hia-Ced O'odham, Lumholtz (1912: 331–332) reports, "To make bows, these Indians travelled as far as the Colorado River to get willow as material."

OP: Quitobaquito: Near edge of pond, small tree, 5 Mar 1940, *Peebles 14562*; Edge of pond, 25 Mar 1944, *Clark 11508* (ORPI, UNM). Spring Canyon [in Bull Pasture], *Bean 19 Feb 1950* (ORPI). N fork of Alamo Canyon, *Fouts 11 Jul 1949* (ORPI). N fork of Alamo Canyon, *Rutman 24 May 1998* (ORPI).

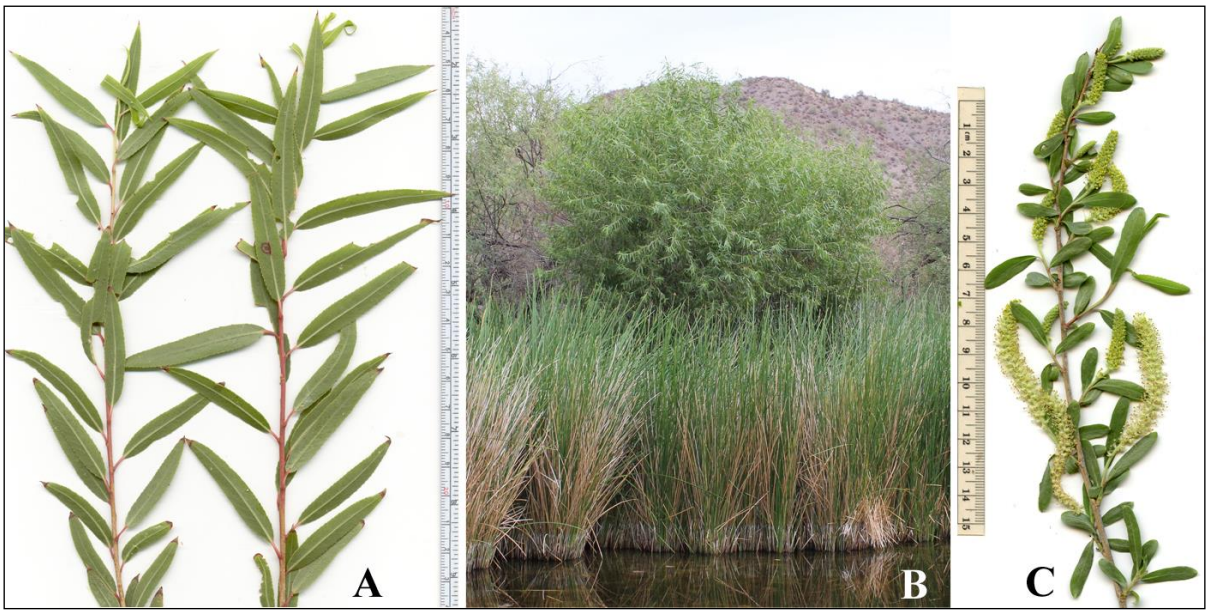

Figure 43. *Salix gooddingii*. Quitobaquito: (A) 11 Sep 2008; (B) 18 Jul 2013; (C) branch with staminate catkins, 25 Feb 2015.

SANTALACEAE – Sandalwood Family (includes Viscaceae)

In collaboration with Kelsey Marie Yule, Ecology and Evolutionary Biology, University of Arizona.

Perennial herbs to trees; includes many hemiparasites. Worldwide, 44 genera, 990 species.

Phoradendron – Mistletoe

Epiphytic parasites, on dicot and conifer trees and shrubs (those in the flora area). Stems photosynthetic, jointed. Male and female flowers on different plants. Flowers small, embedded in a jointed spike, and insect-pollinated. Fruit a globose, sessile berry with mucilaginous pulp. Seeds sticky at one end, germinating on branches of the host trees or shrubs where birds have roosted. Three species are recorded from the flora, two of them only from Ice Age packrat middens. Americas; 235 species.

Phoradendron californicum Nuttall

Desert mistletoe; *toji*; ha:kvad. Figure 44.

Branches arching to drooping, often forming many-branched masses festooning desert trees and shrubs. Stems terete. Leaves scale-like, 1–2.5 mm long. Flowers small, green or yellow; male flowers highly fragrant and attracting great numbers of honeybees and other insects (e.g., Halictidae, Syrphidae, Tephritidae). Flowering and fruiting at various seasons, with massive flowering often December to February, the fruits ripening in late winter to early spring. Berries globose, 4.5–5.5 mm wide, the pulp viscid and translucent whitish, 1-seeded; eaten in quantity by phainopeplas. Seeds 4 mm long.

Parasitic on woody legumes, *Coursetia glandulosa*, *Olneya tesota*, *Parkinsonia* spp., *Prosopis* spp., *Senegalia greggii*, *Vachellia constricta*, and other plants such as *Condalia*, and common where the hosts occur; occasionally on *Larrea* and rarely on *Asclepias albicans*. Widespread across the flora area for more than 8200 years.

Southeastern California to southwestern Utah, Arizona, and southwestern New Mexico and southward to the Cape Region of Baja California Sur, Sonora, northwestern Sinaloa, and southwestern Chihuahua.

Monson (1943) reported that in Organ Pipe the rancher [Henry Gray] "has already lost four cows from starvation. . . He has even chopped a considerable amount of mistletoe from palo verdes and mesquite in an effort to give his cattle more feed." Mexican ranchers, however, say that if mistletoe is fed to cattle they will abort their fetuses. *Phoradendron* is reported as toxic to cattle and other animals but reports are few (e.g., Burrows & Tyrl 2013). Tim Tibbitts was monitoring Sonoran pronghorn in the Valley of the Ajo on 13 May 2013 and watched them eat *Phoradendron californicum* for hours as well as *Olneya* and *Parkinsonia microphylla* flowers.

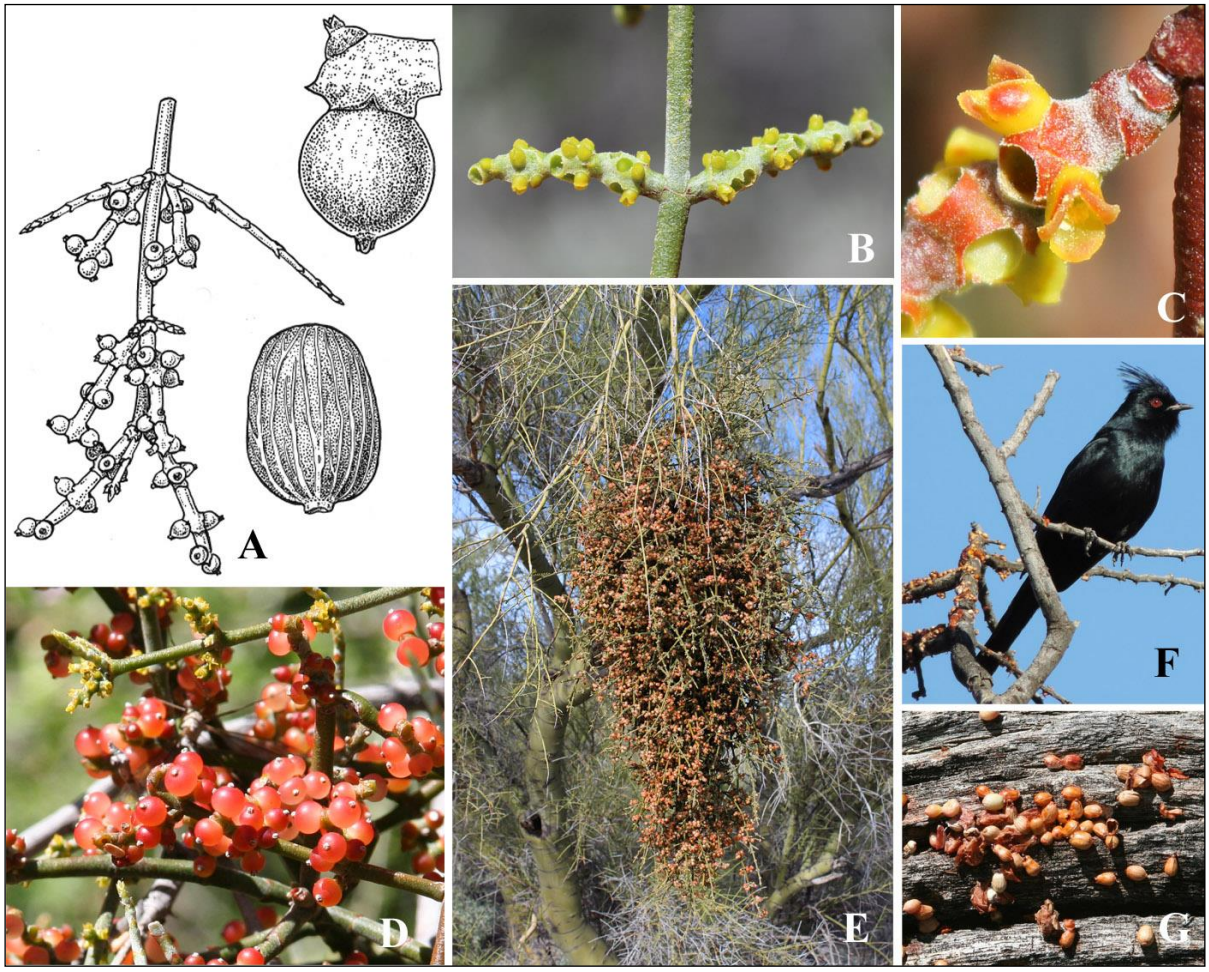

Figure 44. *Phoradendron californicum*. (A) By Lucretia Breazeale Hamilton. (B) Aguajita Wash near international boundary, 15 Mar 2015. (C) Alamo Canyon, 26 Feb 2014. (D) Near Montezuma Head, 24 Mar 2008. (E) Victoria Mine, 7 Feb 2014. (F) Phainopepla with expelled mistletoe seeds, middle fork of Alamo Canyon, 24 Mar 2014. (G) Estes Canyon, 2 Mar 2008.

The fleshy fruits were eaten fresh or more often cooked; it is often plentiful and easily harvested (Castetter & Bell 1951; Castetter & Underhill 1935; Rea 1997). The Seris selectively harvested the fruits from mistletoe growing on desert legume trees (Felger & Moser 1985). However, there are many reports that mistletoe berries are toxic (e.g., Kingsbury 1964).

Phoradendron californicum maintains a high transpiration rate to gain water, mineral nutrition, and carbon from the host xylem tissue (Schulze & Ehrleringer 1984). Infestations are only correlated with host mortality under severe drought conditions (Spurrier & Smith 2007). Genetically differentiated races are known to infect *Prosopis* and *Senegalia.* Fruiting phenology of *Phoradendron californicum* does not differ by host species, but flowering phenology is delayed for parasites of *Prosopis* relative to those of other host species (Yule et al. 2016).

Phoradendron californicum is engaged in a specialized mutualistic interaction with the phainopepla (*Phainopepla nitens*). While many birds (e.g., western bluebirds, mockingbirds) consume the berries, the phainopepla is the primary disperser of *Phoradendron californicum*, effectively dispersing an order of magnitude more seeds per plant than the next most common disperser (Cowles 1936; Larson 1996). Phainopeplas have a small gizzard relative to their digestive tract, adapted to remove the exocarps of mistletoe berries for their dispersal in packets of 8–16 intact mistletoe seeds (Walsberg 1975). Phainopeplas defend breeding territories rich in mistletoe berries throughout the period of *Phoradendron californicum* fruiting, leading to a highly aggregated mistletoe distribution (Aukema 2004).

OP: Quitobaquito, 30 Jan 1894, *Mearns 2742* (US). Pitahaya Canyon, *Nichol 23 Feb 1939*. Alamo Canyon, 14 Mar 1941, *Benson 10673*. Vicinity of Senita Basin, *P. californicum* on *Vachellia constricta* and occasionally on *Coursetia glandulosa*, *Yule 7 May 2016*, observation. †Alamo Canyon, twigs, seeds, 1150 & 8130 ybp. †Puerto Blanco Mts, twigs with scale leaves, 1910 to 7970 ybp (5 samples).

CP: Papago Well, 31 Jan 1992, *Felger 92-9*. Tule Well, 14 Apr 1992, *Harlan 285* (CAB).

TA: Coyote Water, on *Prosopis glandulosa*, 25 Oct 2004, *Felger 04-59. Felger*, observations: Camino del Diablo near Coyote Wash, on *Asclepias albicans*, 29 Dec 2001; Tinajas Altas, on *Olneya*, 19 Mar 1998. †Butler Mts, fruits, 740 to 8160 ybp (3 samples)

††Phoradendron juniperinum Engelmann Juniper mistletoe

This mistletoe is a juniper parasite with leaves reduced to scales. It is documented for the Ajo Mountains between 9600 and 22,000 years ago. It apparently grew on two or more different juniper species: *Juniperus californicus* and *J.* aff. *arizonica/coahuilensis* were the only junipers present in Alamo Canyon 9600 years ago, and *J.* cf. *osteosperma* and *J. scopulorum* were the only ones at Montezuma's Head 20,500 to 29,900 years ago. The nearest present-day populations of this mistletoe are in the Santa Rita and Santa Catalina mountains near Tucson.

Western USA and northern Mexico.

OP: †Alamo Canyon, twigs, fruits, 9570 ybp. Montezuma's Head, twigs, fruits, 20,490 & 21,840 ybp.

††Phoradendron serotinum (Rafinesque) M.C. Johnston

This broad-leaved mistletoe was in the Ajo Mountains 13,500 to 32,000 years ago. These fossils are from small-leaved forms. Oaks are the most likely host plant, and *Quercus turbinella* is the only oak known from the Ajo Mountains. There are, however, other potential hosts.

This mistletoe species is wide ranging in western USA and northern Mexico. Two subspecies may have been in the Ajo Mountains: subsp. *macrophyllum* (Engelmann) Kuijt, which grows on a wide range of hosts other than oaks, including canyon hackberry (*Celtis reticulata*), Arizona ash (*Fraxinus velutina*), soapberry (*Sapindus drummondii*), and cottonwoods (e.g., *Populus fremontii*). The nearest known populations are in the Baboquivari Mountains. It also grows on cottonwood (*Populus fremontii*) in the lower Colorado River, such as at Yuma. Subspecies *tomentosum* (de Candolle) Kuijt is a common parasite of oaks and today occurs in the Baboquivari Mountains.

OP: †Alamo Canyon, twigs, leaves, 14,500 & 32,000 ybp. Montezuma's Head, twigs, leaves, 13,500 & 21,840 ybp.

SAPINDACEAE – Soapberry Family

Trees, shrubs, or vines, or rarely herbaceous. Leaves almost always alternate, usually compound, seldom entire; stipules usually none. Flowers often unisexual. Fruits dry or fleshy. Worldwide, greatest diversity in Asia and America, tropical and subtropical, few in deserts; 140 genera, 1325 species.

1. Leaves simple; evergreen or sometimes drought deciduous…….. **Dodonaea**
1. Leaves pinnately compound; winter deciduous…… **Sapindus**

Dodonaea

Shrubs or small trees. Leaves simple (or pinnate elsewhere). Fruits of capsules. Mostly Australian, several from Madagascar, Java, and Hawaii; 1 in the Americas; 50 species.

Dodonaea viscosa Jacquin var. **angustifolia** (Linnaeus f.) Bentham
Hop bush; *saucillo*, *tarachico*. Figure 45.

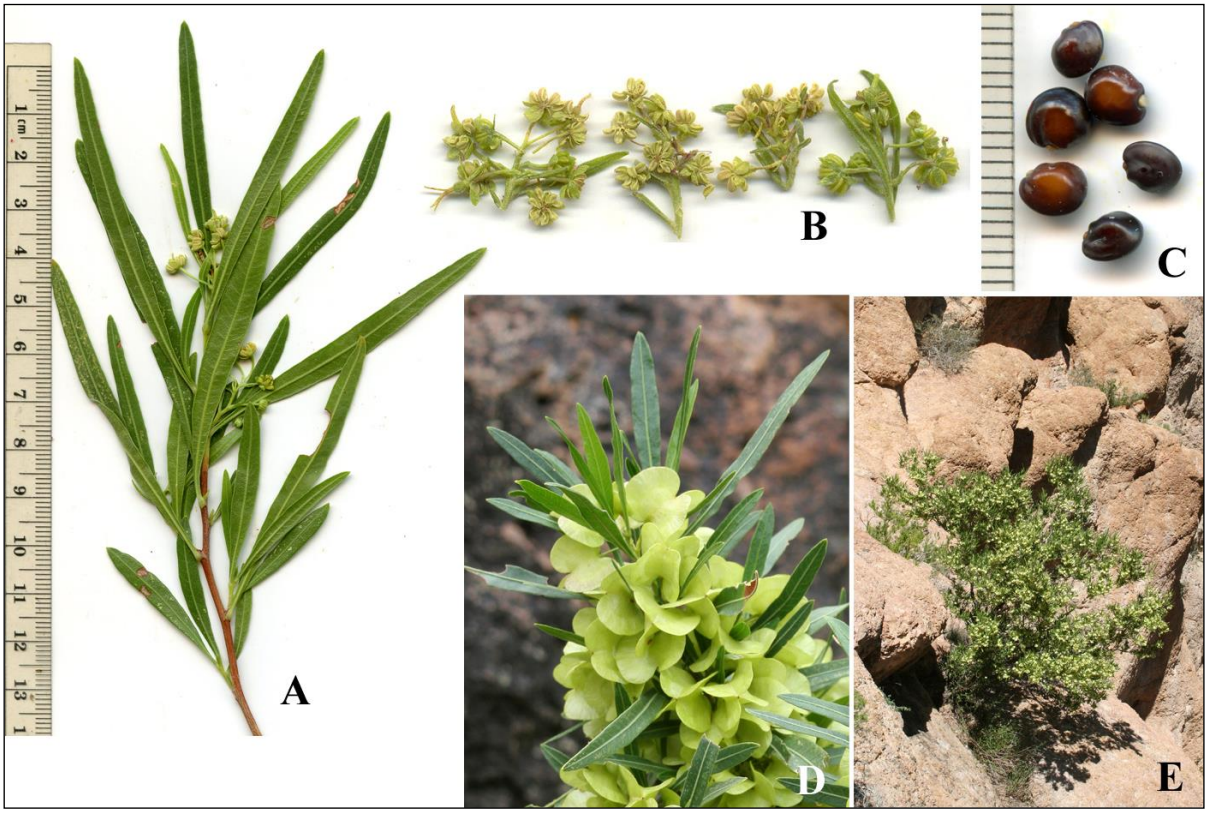

Figure 45. *Dodonaea viscosa* var. *angustifolia*. Alamo Canyon: (A) 3 Sep 2014; (B) Staminate flowers, 10 Sep 2008; (C) 4 Apr 2015; (D & E) 18 Mar 2005.

Leafy shrubs often 1–1.5 (2+) m tall with shredding-peeling bark, the branches mostly erect-ascending. Herbage, especially when young, ovaries, and developing fruits, densely resinous-glutinous. Leaves evergreen or very tardily drought deciduous, 3–9 cm × 3–9 mm, linear to linear-oblanceolate, narrowed at base and essentially sessile, the midrib prominent, the margins entire;

stipules none. Male and female flowers on different plants and occasionally with some bisexual flowers. Flowers in small clusters among the leaves, pedicelled, and yellow-green; sepals 2 mm long, often 4 in number; petals none. Male flowers with mostly 8–10 stamens. Fruits of 3-winged, papery capsules 1–2 cm wide. Seeds 3–3.5 mm wide, dull blackish.

Mostly on rocky slopes, especially at higher elevations in the Ajo Mountains, and also in the Puerto Blanco Mountains.

In the Sonoran Desert Region often in the ecotone between desert and oak woodland. This species in southeastern California to west Texas and Mexico, as well as worldwide in tropics and subtropics. There is much variation in leaf size. The narrow-leaved plants from Arizona and northwestern Mexico have been called var. *angustifolia*, which is sometimes considered a distinct species. However, the broader-leaved var. *viscosa* sometimes occurs within the same region.

OP: Pitahaya Canyon, 3400 ft, *Nichol 23 Feb 1939*. Alamo Canyon, 13 Dec 1939, *Harbison 26240*. Dripping Springs, 16 Apr 1952, *Parker 7962*. Arch Canyon, 28 Mar 1965, *Lockwood 159*.

Sapindus

Trees and shrubs, New World, Asia, and Oceania; 13 species.

Sapindus drummondii Hooker & Arnott
[*S. saponaria* Linnaeus var. *drummondii* (Hooker & Arnott) L.D. Benson]
Soapberry; *jaboncillo, amolillo*. Figure 46.

Mostly slender-stemmed, spindly shrubs, but sometimes trees, 2–5 m tall; often propagating by root sprouts. Herbage with soft, white to golden colored curved hairs. Leaves winter deciduous, often 15–30 cm long, pinnately compound with 10–19 leaflets; leaflets lanceolate, tapering to a slender point, moderately asymmetric with entire margins, the larger leaflets 4–8.5 × 1–2 cm; leafstalks, especially the larger ones, narrowly winged. Male and female flowers on separate plants and also with some bisexual flowers, in dense, terminal panicles. Flowers cream-white, 4–5 mm wide, often densely pubescent especially at the petal bases. Sepals and petals each 5, the petals more or less elliptic to broadly obovate, 2.5–2.8 × 1–2 mm. Male flowers with 8–10 stamens. Fruits mostly 1-lobed by abortion of the other 2 lobes; each lobe 12–15 mm wide, amber colored, drupe-like, globose, and 1-seeded.

Organ Pipe in Alamo and Estes canyons, and abundant at Cherioni Wash near the well. Canyon bottoms and along some larger xeroriparian washes.

Border region of southwestern USA and northern Mexico.

Common names found in the literature include *amolillo*, cherioni, cherrion, Chinaberry, Drummond soapberry, Indian soap plant, *jaboncillo*, Mexican soapberry, soapberry, and western soapberry. Bryan (1925: 182) reported, "The site of Cherioni Well was chosen because of the presence of a large cherioni tree. In this instance the tree indicated water at shallow depth, but not in sufficient quantity to be valuable." Cherioni trees remain abundant in the area. Cherioni is also a term for a soil type or series—a very shallow soil over a hardpan.

As indicated by the common names, the fruits were widely used for soap (Uphof 1968), although such use is not documented for the flora area (Felger 2007). The Tohono O'odham made arrow foreshafts from the straight stems, although creosotebush (*Larrea*) was preferred (Castetter & Underhill 1935).

OP: Alamo Canyon, 2600 ft, 13 Jun 1978, *Bowers 1340*. Cherioni Well, *Jackson 26 May 1966* (ORPI).

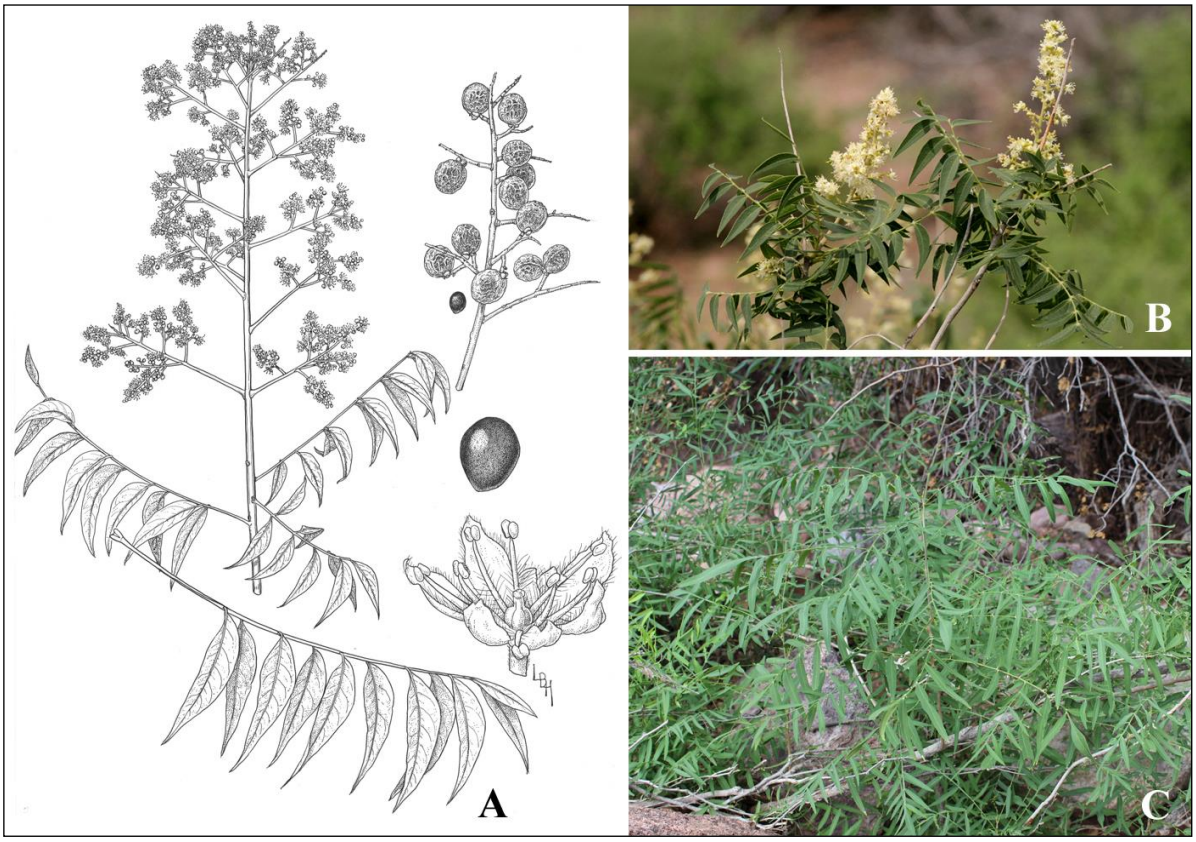

Figure 46. *Sapindus drummondii*. (A) By Lucretia Breazeale Hamilton. (B) Staminate plant, La Cueva, Organ Mountains, Doña Ana Co., NM, 7 Sep 2006, photo by Patrick Alexander (SEINet). (C) Alamo Canyon, 7 Sep 2013.

SCROPHULARIACEAE, see OROBANCHACEAE, PHRYMACEAE, and PLANTAGINACEAE (Felger & Rutman 2016, part 17).

SIMAROUBACEAE – Quassia Family

Trees and shrubs. Leaves alternate, simple or odd-pinnate, without stipules, or essentially leafless. Warmer regions of the world, few in deserts; 20 genera, 120 species.

Castela

Mostly leafy, drought-deciduous shrubs. Semiarid subtropical to arid regions of the Americas; 15 species.

Castela emoryi (A. Gray) Moran & Felger
[*Holacantha emory*i A. Gray]
Crucifixion thorn; *corona de cristo*. Figure 47.

Shrubs and small trees, essentially leafless, mostly 2–4+ m tall with well-developed trunks, the wood very hard and twisted, the twigs rigid, thick, thorn-tipped, and moderately to densely pubescent with short white hairs, glabrous with age. Seedlings and young plants with slender,

flexible and moderately leafy stems, the nodes with short, sharp spines and alternate and quickly drought-deciduous leaves to 1 cm long. Mature plants essentially leafless, the new growth with few, quickly deciduous scale leaves. Flowers crowded in dense, many-branched panicles 1.5–15 cm long, the flowering branches pubescent and pinkish. Flowers 8–9 mm wide, radial, the petals often 7, cupped, mostly cream-yellow to greenish or rose-pink; stigmas chartreuse, the ovaries green, becoming red as the petals fall; flowers often tended by black ants. Flowering April to early summer. Fruits in dense, short clusters, persisting for several years or more in the outer branches, with woody carpels in a star-shaped pattern.

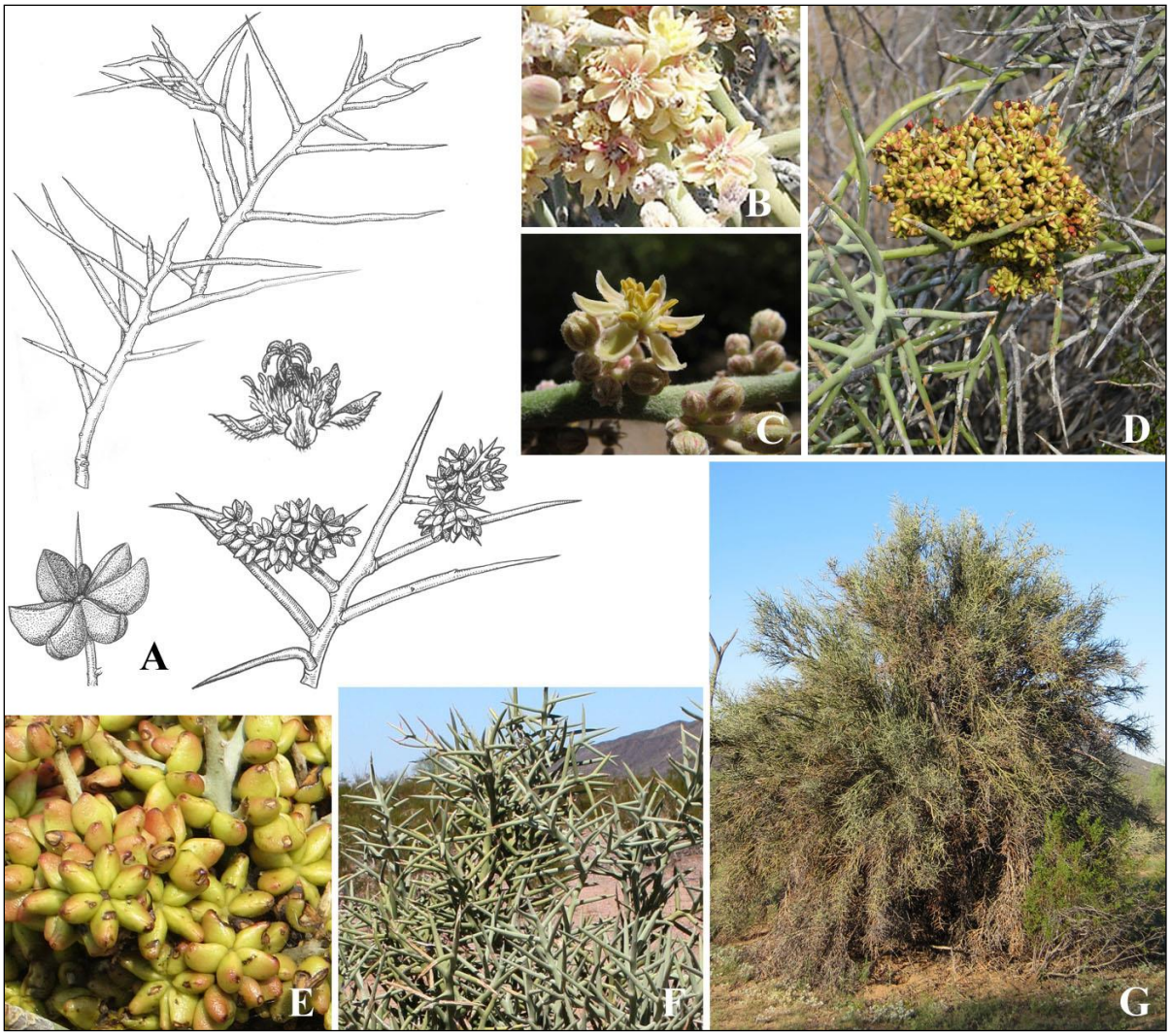

Figure 47. *Castela emoryi*. (A) By Lucretia Breazeale Hamilton. Just W of 17th Ave and Pecos Road S of South Mountain Park, Phoenix, Maricopa Co., photos by Leslie R. Landrum (SEINet): (B) 2 Jul 2004; (C) 13 Apr 2010. Cuerda de Leña, N boundary of Organ Pipe: (D & E) 22 Aug 2012; (G) 17 Sep 2013. (F) Growler Valley, 8 Oct 2006.

Widely scattered in mostly small, localized populations or sometimes extensive in Cabeza Prieta; creosotebush flats and often on nearly barren sandy soils of valley plains.

Southwestern Arizona, southeastern California, northern Baja California, and scarce in northwestern Sonora. Jim Malusa found the world record *Castela emoryi*, 25 feet tall with a crown

23 feet wide, in the Cuerda de Leña wash near the northern border of Organ Pipe (Arizona Registry of Big Trees 2005).

OP: Bates Well, *Harbison 20 Nov 1939* (SD). 1.5 mi E of junction at Bates Well, in a narrow canyon, 18 Mar 1945, *Gould 3012*. Cuerda de Leña Wash near N boundary of Monument, 24 Jul 1978, *Bowers 1382* (ORPI). Armenta Ranch, *Rutman 16 Aug 2001* (ORPI).

CP: Adobe Windmill, a colony of about 2 dozen plants,12 Jun 1992, *Felger 92-545*. E Pinta Sands, 16 Jun 1992, *Felger 92-629*. Observations: Southward and to 5 km E of Redtail Tank, 12 Jun 1992, *Felger*; Chico Suni Temporal, 25 Feb 1993, *Felger*.

SIMMONDSIACEAE – Jojoba Family

This family has a single species.

Simmondsia chinensis (Link) C.K. Schneider
Jojoba; hohovai. Figure 48.

Woody shrubs, evergreen or very tardily partially to rarely fully deciduous during extended drought. Leaves opposite, 2–5 cm long, often held upright, somewhat leathery and dull green to grayish, elliptic, lanceolate or oblanceolate, entire, sessile or short-petioled; stipules none. Male and female flowers on separate plants; flowering in January. Male flowers many in short-stalked clusters, the sepals 4–6, yellow-green, 2–5 mm long, petals none, stamens 8–12+. Female flowers single in leaf axils, green, the sepals 5, 8–12 mm long in flower, enlarging to 20 mm long in fruit; ovary with three ovules, but usually only one seed develops; seeds 1.5–2 cm long.

Northern and eastern part of Organ Pipe including the Ajo, Diablo, and Puerto Blanco mountains, and Copper Canyon just east of the Cabeza Prieta boundary (Simmons 1966); especially common at higher elevations in the Ajo Mountains. Jojoba is relished by bighorn sheep and deer (Simmons 1966). It was in the Ajo Mountains 1200 years ago.

Southern Arizona, southwestern New Mexico, southern California, both states of Baja California, and northwestern Sonora to the Guaymas region.

The seeds are the largest of any plant in the flora area and one of the largest of any Sonoran Desert plant. The thick, fleshy cotyledons contain simmondsin, a cyanogenic glucoside, and a high percentage of the unique liquid wax, which is the basis of the jojoba industry. The seeds have been used for food (Castetter & Underhill 1935; Meigs 1939) but are nutritionally marginal or not digestible. The Seris regarded them as an emergency food (Felger & Moser 1985). The Cahuillas made a coffee substitute from the ground seeds (Bean & Saubel 1972). Sonoran Desert people valued the seed oil (actually a liquid wax) for shampoo and hair care (Felger and Moser 1985). There is a long history of medicinal use of the seeds to treat many ailments, including colds, eye problems, and sores, and for women at childbirth (del Barco 1980; Castetter & Underhill 1935; Felger and Moser 1985). Kino reported that jojoba was esteemed for its medicinal properties, and in the late seventeenth century it was in demand in Mexico City and even in Spain (Burrus 1954, 1971).
OP: Alamo Canyon, *Nichol 4 May 1939* (ORPI). Dripping Springs, 16 Apr 1952, *Parker 7954*. Estes Canyon, *Warren 9 May 1975*. Arch Canyon, 11 Mar 1983, *Daniel 2584* (ASU). Diablo Canyon, Diablo Mts, 3000 ft, *Tibbitts 6 Mar 2003*. Trail from The Cones to Mount Ajo, 4090 ft, 10 Apr 2005, *Felger* (observation). †Alamo Canyon, leaf fragments, fruits, 1150 ybp.

Figure 48. *Simmondsia chinensis*. (A) By Lucretia Breazeale Hamilton. (B) Alamo Canyon, 30 Jan 2014. Estes Canyon: (C) Pistillate flowers, 30 Jan 2014; (D) Staminate flowers, 3 Apr 2010; (E) Staminate plant, 2 Mar 2008. (F & G) Ajo, 8 Jul 2015.

ACKNOWLEDGEMENTS

In addition to the gratitudes provided in part 1 in this flora series, we thank George McNeil Ferguson, Walter Frank Fertig, Richard (Rick) Alan Johnson, Andrew M. Salywon, Andrew C. Sanders, James (Jim) Thomas Verrier, Thomas R. Van Devender, and George Yatskievych for information and review. We thank Susan Davis Carnahan for expert copy editing, information, and

photos. For use of photos we thank Patrick Alexander, Peter Holm, Steve Jones, Hank Jorgenson, Les Landrum, Max Licher, Ries Lindley, Steve Matson, Gary A. Monroe, James D. Morefield, Keir Morse, Jean Pawek, Barry Rice, J.C. Schou, and Karen Wellner. Kelsey Yule (in Santalaceae) thanks Judie Bronstein and Noah Whiteman for facilitating her research. We also thank Matthew B. Johnson for illustrations. RSF thanks the Wallace Research Foundation for financial support.

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