

KALLSTROEMIA HAGERI (ZYGOPHYLLACEAE),
A NEW CALTROP FROM BAJA CALIFORNIA, MEXICO

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ABSTRACT

A new species in the genus *Kallstroemia* (Zygophyllaceae), **K. hageri** Rebman, endemic to the Baja California peninsula is described here for the first time. It is similar to *K. peninsularis* D.M. Porter in having retrorse pubescence on its stems and pedicels, but differs in its smaller flowers, shorter fruit beak, shorter pedicels, and fewer leaflet pairs per leaf. This new species occurs mostly in the midpeninsular region and ranges from the Sierra de La Libertad in the southern part of the state of Baja California south to the vicinity of Cerro Mechudo in the southern Sierra de La Giganta of Baja California Sur. A botanical illustration and a key to the species in the genus *Kallstroemia* from the Baja California peninsula are also presented.

RESUMEN

Aquí se describe una nueva especie del género *Kallstroemia* (Zygophyllaceae), **K. hageri** Rebman, endémica de la península de Baja California. Es similar a *K. peninsularis* D.M. Porter por tener pubescencia retrorsa en sus tallos y pedicelos, pero difiere en sus flores más pequeñas, pico de fruto más corto, pedicelos más cortos y menos pares de folíolos por hoja. Esta nueva especie se encuentra principalmente en la región mediapeninsular y se extiende desde la Sierra de La Libertad en la parte sur del estado de Baja California hasta las inmediaciones de Cerro Mechudo en el sur de la Sierra de La Giganta de Baja California Sur. También se presenta una ilustración botánica y una clave de las especies del género *Kallstroemia* de la península de Baja California.

INTRODUCTION

The peninsula of Baja California is composed of two Mexican states (Baja California and Baja California Sur) that are politically divided at the 28th parallel. The peninsula and its adjacent islands, located in both the Gulf of California (Sea of Cortés) and the Pacific Ocean, support a wealth of plant species diversity. Wiggins (1980) estimated that 2,958 total taxa including 686 endemic taxa occur in Baja California, an endemism rate of 23.2%, but recent plant discoveries and a more complete overview of the literature and herbarium specimens suggest that the flora consists of more than 3,890 plant taxa with a rate of endemism closer to 26% (Rebman et al. 2016).

The Zygophyllaceae are a somewhat conspicuous plant family in some parts of the Baja California peninsula because the Creosote Bush (*Larrea tridentata* (DC.) Coville) dominates the vegetation in many drier desert plant communities, and the endemic Baja California Caltrop (*Kallstroemia peninsularis* D.M. Porter, a summer annual with showy orange-yellow flowers) is common in the Cape region of Baja California Sur. Other members of the family are less prevalent, but can be found through much of the peninsula (e.g., *Fagonia*, *Viscainoa*). According to Porter (1963), although the Zygophyllaceae are a relatively small plant family worldwide, the Baja California region may have more diversity in this family than any other place of comparable size. In that publication, he reported that the Zygophyllaceae are represented in Baja California by 6 genera, 15 species, and 19 total taxa. Since the time of that publication, however, many taxonomic changes (Beier 2005; Laport et al. 2012; Porter 1969) have changed our concept of that diversity significantly. As part of a voucher-based checklist for all of the plants in the Baja California region by Rebman et al. (2016), the Zygophyllaceae now include 7 genera, 17 species, and 19 total taxa of which 2 species are non-native, and 8 of the 17 native taxa are endemic or near-endemic (with only one or few populations outside of the Baja California region). In respect to the genus *Kallstroemia*, only three species, *K. californica* (S. Watson) Vail, *K. parviflora* Norton, and *K. peninsularis*

were previously known to occur on the peninsula of Baja California. Porter's (1963) inclusion of *K. grandiflora* A. Gray in the Cape region of Baja California Sur was a misinterpretation of the taxon now recognized as *K. peninsularis*, which he named and described at a later date (Porter 1969). With the description of this new species (*K. hageri* Rebman), 2 of the 4 species (50%) in the genus *Kallstroemia* found in the Baja California region are endemic to the peninsula.

Note, the taxonomic description below closely follows the descriptive style presented by D.M. Porter (1969) in his monographic treatment of the genus *Kallstroemia*.

TAXONOMIC TREATMENT

***Kallstroemia hageri* Rebman, sp. nov. (Figs. 1 & 2).** TYPE: MEXICO. BAJA CALIFORNIA: Mpio. Ensenada, Sierra de La Libertad, south of Bahía de Los Angeles, Arroyo La Bocana on the eastern side of the Sierra, along the arroyo between Rancho La Bocana and Rancho San Pedro, 28.4833°N, 113.4400°W, 340 m elev., 2 Oct 2012, *Rebman 25097* (HOLOTYPE: SD 223624!; ISOTYPE: BCMEX).

Similar in the genus only to *Kallstroemia peninsularis* by having retrorse pubescence on its stems and pedicels, but differs from that species in having smaller flowers, shorter fruit beak, shorter pedicels, and fewer leaflet pairs per leaf.

Life Form annual herb. Stems prostrate to decumbent, to 80 cm long, hirsute with longer, white to light yellow, slightly reflexed to retrorse trichomes that are bulb-based and hirtellous with shorter, white, retrorse trichomes, that may be straight or curved. Stipules 5–7 mm long, less than 1 mm wide, linear to lanceolate. Leaves even-pinnately compound, elliptical in shape, to 4.5 cm long. Leaflets 2–4 pairs (most commonly 3 pairs), elliptic to oblong, appressed-hirsute, 8–18 mm long, 3–9 mm wide, middle leaflet pairs largest. Pedicels longer than subtending leaves, significantly thickened distally, 16–30 mm long in fruit. Flowers pentamerous, approximately 9–12 mm wide (on live material). Sepals (in fruit) subulate, hispid with long (>1.5 mm), obvious, spreading trichomes and hirtellous with much shorter, inconspicuous trichomes, each sepal 4–5.5 mm long, approx. 0.5 mm wide, slightly longer than mature mericarps but shorter than fruit beak, margins involute making them appear linear, persistent. Petals 5, yellow to orange, broadly obovate, apex rounded to slightly notched, 4–5 mm long and 1–3 mm wide (on dried specimens), fugacious. Stamens 5, with ovoid anthers less than 0.5 mm long, anthers and pollen yellow. Ovary ovoid, strigose. Style cylindrical near apex, conical at base, strigillose to base of stigma. Stigma clavate, 10–ridged, papillose, extending down upper one-third of style. Fruit base ovoid, strigose, to 3 mm long, fruit beak conical to 3.5 mm long (slightly longer than the mature mericarps) and strigillose to stigma base. Mericarps 2–3 mm high, 1.5–2 mm wide, abaxially with rounded tubercles, sides slightly pitted, adaxial edge slightly angled.

Distribution and Habitat.—*Kallstroemia hageri* is endemic to the Baja California peninsula ranging from the lower eastern side of the Sierra de La Libertad in the southern part of the state of Baja California south through the Sierra Guadalupe and Sierra la Giganta to the vicinity of Cerro Mechudo in the southern Sierra de La Giganta of Baja California Sur (Fig. 2). This new species can be found in desert habitats in Central Desert, Gulf Coast, and La Giganta Ranges ecoregions of the peninsula (Garcillán et al. 2012) associated with arroyo and succulent desert scrub dominated by *Olneya tesota* A. Gray, *Parkinsonia microphylla* Torr., *Bursera microphylla* A. Gray, *Jatropha cinerea* (Ortega) Müll. Arg., *Jatropha cuneata* Wiggins & R.C. Rollins, *Pachycereus pringlei* (S. Watson) Britton & Rose, *Fouquieria diguetii* (Tiegh.) I.M. Johnst., *Lysiloma candidum* Brandegee, *Colubrina viridis* M.E. Jones, *Condea emoryi* (Torr.) Harley & J.F.B. Pastore, *Ambrosia monogyra* (Torr. & A. Gray) Strother & B.G. Baldwin, and *Bebbia juncea* (Benth.) Greene. Additional associates include *Datura discolor* Bernh., *Bursera fagaroides* (Kunth) Engler, *Adelia brandegeei* V.W. Steinm., and *Aeschynomene nivea* Brandegee. *Kallstroemia hageri* occurs mostly on flat sandy substrates scattered with larger volcanic rocks, especially in canyon/arroyo bottoms and adjacent benches; elevation 25–500 m.

Taxonomic Discussion.—*Kallstroemia hageri*, found in the mid-portions of the Baja California peninsula in the states of Baja California and Baja California Sur, is an apparently rare new species of caltrop. Its rarity might only be a result of collection bias as it is morphologically very similar to the widespread and highly variable *K. californica* (S. Watson) Vail, which is often not collected since it can be very common and abundant in favorable years in some areas of the peninsula. Unlike almost all other species in the genus *Kallstroemia*

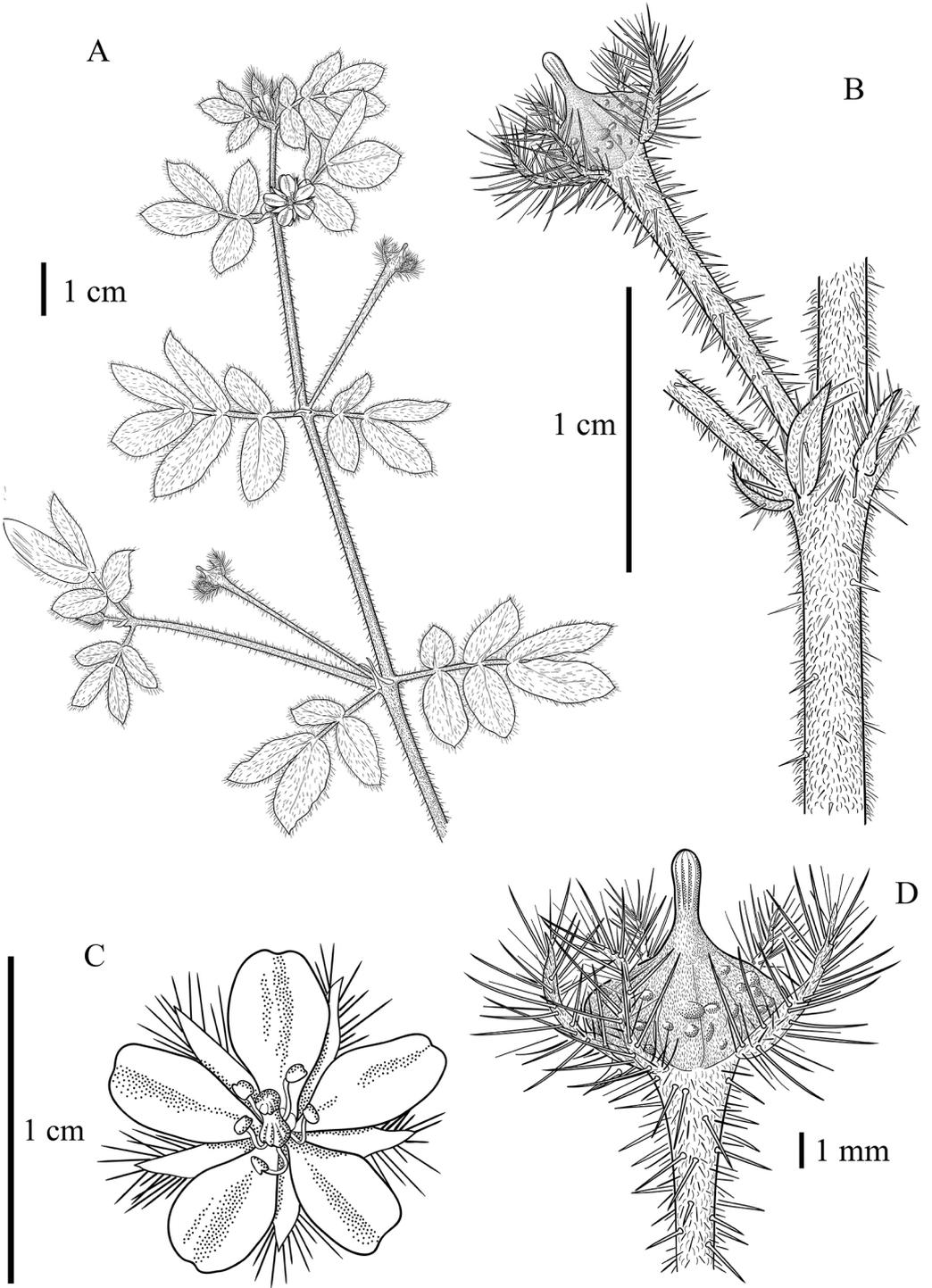


FIG. 1. *Kallstroemia hageri* Rebman. A. Stem portion with leaves, fruits, and flower visible. B. Fruit on end of pedicel showing retrorse pubescence and stipules at stem node. C. Flower. D. Fruit with persistent sepals. Illustrations are based on the type specimen (Rebman 25097).

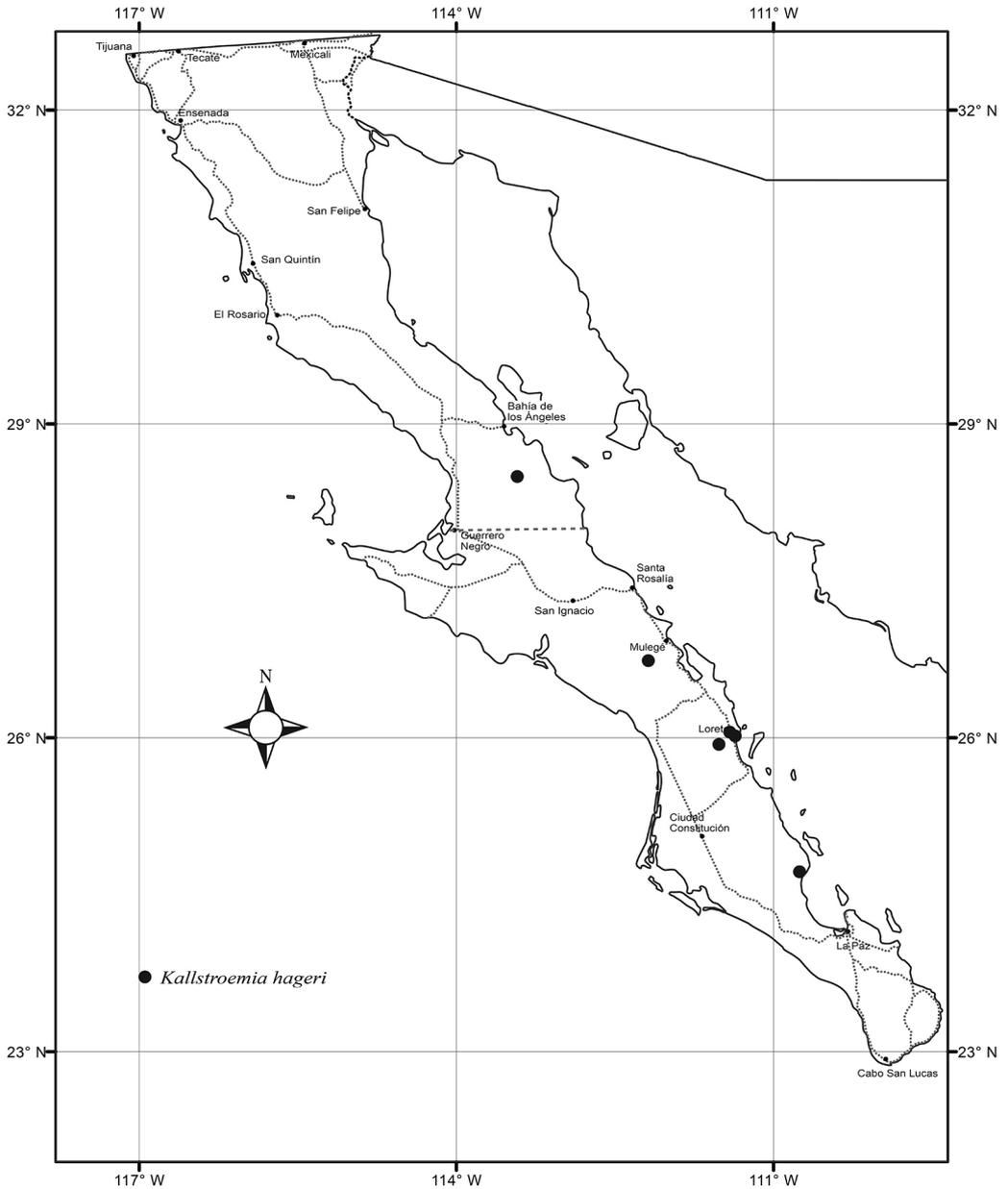


FIG. 2. Distribution of *Kallstroemia hageri* (closed circles) on the Baja California peninsula.

(except *K. peninsularis*), this new taxon has retrorse pubescence on both stems and pedicels. When Porter (1969) described the southern peninsular endemic *K. peninsularis*, he stated that the species was unique in its genus by having retrorse pubescence, but now another Baja California endemic *Kallstroemia* species has been found with that same pubescence type. Although *K. hageri* shares the same pubescence type as *K. peninsularis*, these two species are very different in many other characters. *Kallstroemia peninsularis* has showy flowers with much larger petals (> 15 mm long vs. < 10 mm in *K. hageri*), longer fruit beak (7–10 mm long vs. < 3.5 mm

in *K. hageri*), longer pedicels at fruit maturity (to 64 mm long vs. 30 mm in *K. hageri*), and generally more leaflet pairs per leaf (4–5 pairs vs. 2–4 pairs, but mostly 3 pairs in *K. hageri*). Furthermore, the distribution of *K. hageri* is more northerly on the Baja California peninsula while *K. peninsularis* occurs mostly in the Cape region with a few scattered populations extending to the extreme southern Sierra de La Giganta and the adjacent Magdalena Plains as far north as the vicinity of Ciudad Insurgentes.

In some areas, *Kallstroemia* species are known to grow sympatrically and that holds true for *K. hageri* as well. This new species has been collected together on mixed herbarium sheets with material of *K. californica* from Baja California Sur from the same locality in the vicinity of Cerro Mechudo on *M. Dominguez Leon* 2866 (SD) and in the Sierra de La Giganta near Loreto on *A. Carter* 4595 (SD). The material on these mixed sheets looks similar from a distance, but is easy to distinguish under a dissecting microscope since *K. hageri* has retrorse pubescence and persistent sepals with rather large spreading trichomes, while *K. californica* has antrorse pubescence and typically deciduous sepals with shorter and appressed trichomes. It should be noted that specimen *M. Dominguez Leon* 2866 (SD), collected in the vicinity of Cerro Mechudo in the southern Sierra de La Giganta, appears to comprise three species of *Kallstroemia* (*K. californica*, *K. hageri*, and *K. peninsularis*) implying sympatry. At present, that location in the Sierra de La Giganta region is the southernmost distribution of *K. hageri* and almost the northernmost limit of *K. peninsularis*. The specimens of both *K. hageri* and *K. peninsularis* at this locality of sympatry appear to hold their respective distinguishing characters with no intermediacy in morphology observed.

Kallstroemia parviflora Norton is also known to occur on the Baja California peninsula but appears to be quite rare. Porter (1963) listed this species, citing voucher specimens from the Cape region of Baja California Sur, and stated that they appear to be large-flowered variants of *K. parviflora* that approach the petal size of *K. grandiflora*. Subsequently, he cited almost all of these same specimens (along with the specimens that he cited as *K. grandiflora* in 1963) as paratypes in his original description of *K. peninsularis* (Porter 1969). It should be noted that *K. parviflora* does occur on the peninsula but is restricted, so far as is known, to the vicinity of San Matias pass between Ensenada and San Felipe in the northern state of Baja California.

Kallstroemia californica is a widespread and variable species that occurs from the southwestern USA, east to Texas and south to Central America. Porter (1963) recognized two varieties of this species, var. *californica* and var. *brachystylis* (Vail) Kearney & Peebles. He defined the varieties by var. *californica* having more leaflets (3–6 pairs), shorter leaflets (to 7 mm long), smaller petals (3–5 mm long), shorter fruit beaks (1–2 mm long), and sharply tuberculate mericarps, and var. *brachystylis* having fewer leaflets (2–4 pairs), longer leaflets (6–21 mm), slightly larger petals (4–6 mm long), longer fruit beaks (2–3 mm long), and more rounded tuberculate mericarps. He stated, however, that these morphological characters seem intergrade in much of their ranges obscuring these varieties and most subsequent treatments do not recognize these infraspecies at all. Porter (1963) also stated that var. *brachystylis* is the infraspecies most common in the Baja California region. After reviewing all of the herbarium specimens of the genus *Kallstroemia* deposited in the SD Herbarium, I agree that these two infraspecies do not appear to have taxonomic value and specimens matching each morphological variety can be found in most of the peninsula. It should be noted that a few specimens from the region between San Ignacio and the central Sierra de La Giganta region of Baja California Sur, such as *A. Carter* 5633 (SD), appear to be most closely related to *K. californica*, but have much larger flowers (petals greater than 10 mm long), 3 pairs of leaflets with the terminal pairs being the largest, and a fruit beak longer than 3 mm. I have tentatively identified some such specimens as *K. aff. maxima* (L.) Hook. & Arn. because they key out to that taxon in Porter (1969), but the fruit morphology does not match that species. It is possible that these specimens represent yet another undescribed taxon from the Baja California region, but more taxonomic research and specimen collections are needed.

Phenology.—Flowers and fruits present September to October following summer rains.

Etymology.—This new species is being named in honor of Dr. Michael (Mick) Hager, a friend and the director of the San Diego Natural History Museum for 25 years. Dr. Hager was integral in re-focusing the Museum's mission back to the southern California and Baja California regions and it was his vision that

created the Biodiversity Research Center of the Californias. His leadership and tireless efforts at the Museum are greatly appreciated and have contributed immensely to improving our natural history knowledge of the region. Suggested English common name is Hager's Caltrop.

Conservation.—*Kallstroemia hageri*, found in the mid-portions of the Baja California peninsula in the states of Baja California and Baja California Sur, is apparently a rare species of caltrop. At present, it is only known from six different specimens spanning an approximately 500 km long distribution. However, its rarity might be a result of collection bias as it is morphologically very similar to the widespread and highly variable *K. californica*, which is often not collected since it can be very common and abundant in favorable years in some areas of the peninsula. Plus, the areas where this new species occurs are part of the peninsula that are not overly well documented with herbarium vouchers.

Additional specimens studied. **MEXICO. Baja California Sur: Mpio. Comondu:** Sierra de La Giganta: Cañon de los Potrerillos ca. 5.0 km NW of Loreto, 26.01667°N, 111.36667°W, 25 m elev., 9 Sep 1963, A. Carter 4595 (SD!); Rancho Aguajito, Arroyo Gua, NW of Loreto, 26.05°N, 111.42°W, 210 m elev., 26 Sep 1967, A. Carter 5258 (SD!); cerca del Rancho San Matias, 11 km al noroeste de poblado San Javier, 25.94301°N, 111.53338°W, 9 Oct 2012, R. Dominguez Cadena 3959 (SD!). **Mpio. La Paz:** Sierra Mechudo; Campamento La Angostura, 24.73333°N, 110.75°W, 90 m elev., 5 Oct 2000, M. Dominguez Leon 2866 (HCIB, SD!). **Mpio. Mulege:** Sierra Guadalupe; W of Mulege; SE of the ex-Mision Guadalupe; in canyon area W of Rancho San Patricio, 26.76472°N, 112.19611°W, 500 m elev., 15 Oct 1999, Rebman 6089 (BCMEX, HCIB, SD!).

KEY TO THE SPECIES OF *KALLSTROEMIA* ON THE PENINSULA OF BAJA CALIFORNIA

1. Leaves obovate, terminal leaflets of mature leaves largest; sepals usually deciduous _____ (in part) **K. californica** (S. Watson) Vail
1. Leaves elliptical, middle leaflets of mature leaves largest; sepals deciduous or persistent.
 2. Stem and pedicel pubescence retrorse.
 3. Petals > 15 mm long; fruit beak 7–10 mm long _____ **K. peninsularis** D.M. Porter
 3. Petals < 10 mm long; fruit beak < 3.5 mm long _____ **K. hageri** Rebman
 2. Stem and pedicel pubescence antrorse.
 4. Fruit beak < fruit body; pedicel < to = subtending leaf; petals typically < 5 mm long; sepals usually deciduous _____ (in part) **K. californica**
 4. Fruit beak > fruit body; pedicel > subtending leaf; petals typically > 6 mm long; sepals persistent _____ **K. parviflora** Norton

ACKNOWLEDGMENTS

This work was supported in part by funds from the sales of the Baja California Plant Field Guide 3rd edition (Rebman & Roberts 2012), the Jiji Foundation, and Alan Harper. My deepest gratitude is extended to José Delgadillo, curator of the BCMEX Herbarium at the Universidad Autónoma de Baja California in Ensenada, to José Luis León de la Luz, curator of the HCIB Herbarium at the Centro de Investigaciones Biológicas del Noroeste, and to SD Herbarium staff and volunteers at the San Diego Natural History Museum for their support and collaborative efforts that facilitate my floristic research. Very special thanks to Callie Mack for creating the beautiful botanical illustrations and distribution map. I am always indebted to the many people who have joined and helped me with field work on the flora of Baja California. Special thanks to the appropriate Mexican authorities for granting permits needed to conduct field research and collection of plant specimens in the region. I am indebted to Eli Wehnke for facilitating all of our joint field research in the Sierra de La Libertad and to Víctor Sánchez Sotomayor of CONANP for allowing the field investigation in this part of the Valle de Los Cirios Reserve.

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