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Sierra de La Libertad: a major transition between two desert regions in Baja California, Mexico

Elisabet V. Wehncke[1,4], Jon Rebman[1], Xavier López-Medellín[1,2], and Exequiel Ezcurra[3]

[1]Biodiversity Research Center of the Californias. San Diego Natural History Museum, San Diego, CA 92101, USA.
[2]Center for US-Mexican Studies, University of California, San Diego, USA.
[3]Department of Botany and Plant Sciences, University of California Riverside, CA 92521, USA.
[4]Corresponding author: lizwehncke@gmail.com

Abstract: The Sierra de La Libertad, a group of prominent mesas and canyons in the Central Desert region of Baja California, is one of the most isolated and overlooked areas in the peninsula. For centuries no other explorations have entered this area with a scientific interest, and efforts to delimit its biogeographic boundaries are done mostly by extrapolating data from global information systems and from records in adjacent areas. This sierra constitutes one of the most problematic transition areas among specialists who try to delimit the ecoregions of the peninsula. We conducted two biological expeditions to the Sierra de La Libertad in order to document and describe the plant communities associated with the blue fan palm oases in this remote area. A total of 351 plant species were registered of which, 60 constitute new records for the northern state (Baja California) and two are new species to science. Additionally, in this transition area we found 45 regional and seven local endemics. Scientific expeditions to remote places are still significant endeavors for better understanding biogeography, ecology, taxonomy, and ultimately conservation of biodiversity, and these ventures are of particular importance in little known desert ecotone areas such as the Sierra de La Libertad.
Keywords: biodiversity, blue fan palm, Central Desert, desert oases, Vizcaíno Desert.

Resumen: La Sierra de La Libertad, un grupo de prominentes mesas y cañones en la región del Desierto Central de Baja California, es una de las áreas más aisladas y desconocidas en la península. Por siglos ninguna exploración ha entrado en este área con un interés científico y los esfuerzos por delimitar sus límites biogeográficos son realizados en su mayoría extrapolando datos de los sistemas de información geográfica global y de registros en áreas adyacentes. Esta Sierra constituye una de las áreas de transición más problemáticas entre los especialistas que intentan delimitar las ecoregiones de la península. Realizamos dos expediciones biológicas a la Sierra de La Libertad con el objetivo de documentar y describir las comunidades de plantas asociadas a los oasis de palma azul en esta área remota. Un total de 351 especies de plantas fueron registradas, de las cuales 60 constituyen nuevos registros para el estado norte (Baja California) y dos resultaron nuevas especies para la ciencia. Además en este área de transición encontramos 45 endemismos regionales y siete locales. Las expediciones científicas a sitios remotos siguen aún siendo esfuerzos significativos para un mejor entendimiento de la biogeografía, ecología, taxonomía, y finalmente la conservación de la biodiversidad, y estos emprendimientos son de particular importancia en áreas poco conocidas de ecotonos de desierto como la Sierra de La Libertad.
Palabras clave: biodiversidad, Desierto Central, desierto El Vizcaíno, oasis, palma azul.

More than three hundred years have passed since the Jesuit missionaries arrived on the Baja California peninsula and started the first biological and cartographic explorations (Kino *et al*., 1954; Kino, 1969; 1710; Rudkin, 1952). Since then, different studies have been performed by a large number of explorers and researchers, who provided the biological, geographical, and environmental information that gradually allowed the identification of particular biogeographic patterns in the peninsula. Subsequently, this information was delimited through detailed maps, and for more than a hundred years diverse biogeographic regionalizations for the peninsula have been proposed and developed (see, Garcillán *et al*., 2010; González-Abraham *et al.*, 2010). Even though there seems to be a general agreement about the recognized regions, it is still difficult to determine and even more problematic to map the specific boundaries between the different communities or ecoregions without "on the ground" field work (Garcillán *et al*., 2010). After an exhaustive review of the published literature, González-Abraham *et al*. (2010) identified seven ecoregions showing disagreement between the specialists and proposed a new map of ecological regions and/or large vegetation types for the peninsula of Baja California.

With the combined effects of summer tropical rains, occasional hurricanes from the south, and cold weather and winter rain influences from the north, the mesas and canyons of the Sierra de La Libertad run deep into the Central Desert region and constitute one of the most interesting transition zones and one of the most controversial areas for vegetation experts. Probably due to its rough terrain and inaccessibility, the Sierra de La Libertad remains a very remote, intriguing, and overlooked region. Although many studies recognize (1) the climatic and geologic character of a central peninsular north-south transition (González-Abraham *et al*., 2010); (2) the existence of tropical and non-tropical components in the peninsular biota between 27 - 28° N latitude (Brandegee, 1892; Eisen, 1900; Nelson, 1921); (3) the difference between two ecoregions: the Central Desert in the north and the Vizcaíno Desert in the south based on climate and vegetation evidence (Aschmann, 1959); and (4) the presence of an ancient seaway associated with this transition zone (Gentry, 1978; Upton and Murphy, 1997; Aguirre-L. *et al*., 1999; Riddle *et al*., 2000; Zink, 2002), others do not distinguish it as an explicit transition zone (Wiggins, 1980; Peinado *et al*., 1993; Zipping and Vanderwier, 1994; Arriaga *et al*., 1997).

In 1751, the Jesuit missionary and geographer Fernando Consag registered for the first time the vegetation of the region and described the lifestyle and customs of its indigenous inhabitants. Later in 1889, T. S. Brandegee explored the Sierra de La Libertad with a particular botanical interest. Since then, this area seems to have become rather forgotten as a research target. In 2009, we performed two biological expeditions to the southern part of the Sierra de La Libertad and in particular along its major basin: El Paraíso canyon. Our particular objectives were to observe, survey, and document the local flora, as well as to describe the main plant communities of the remote desert oases, dominated by blue fan palms (*Brahea armata*). The presence of the palm oases supports the colonization and persistence of many other plant and animal species and provides an important structure to these ecosystems by trapping sediments and promoting multiple plant-animal interactions with the present-day fauna (Wehncke *et al*., 2009, 2010; Minnich *et al.* 2011).

Based on Risser's (1995) concept of ecotones, which refers to areas of steep gradients between more homogeneous vegetation associations, we should expect a high number of species extending their distributions to both sides of these margins as well as distinctive communities that take advantage of a variety of ecological niches in the transition zone. Commonly at broad spatial scales such as in biomes, biodiversity increases within the ecotonal zone because the ranges of many species correspond with the edges of adjacent biomes. Consequently, many species from two or more regions may be found in these transitional areas. Thus, near the periphery of their ranges the habitat of species is likely to be fragmented with many communities coexisting, therefore leading to a higher biological diversity (e.g., Whitcomb *et al*., 1981; Grover and Musick, 1990; Hansen and Urban, 1992; Gosz, 1993). It is in these blurry limits or ecotones where most of the energy flux exchange and the maximum interaction between different ecosystems and processes occurs (Risser, 1995, Franco-Vizcaíno *et al*., 2007; Wehncke *et al*., 2009, 2010). In this paper, we discuss the relevance of acknowledging this transition zone as an area of intense and varied climatic, geomorphologic, biological, and cultural mixing that plays a critical role not only for the distribution and exchange of numerous species, but also for the existence of endemic species.

Materials and methods

Study area. Two main regions are distinguished in the middle of the Baja California peninsula: the Central Desert towards the north, and the Vizcaíno Desert to the south (Aschmann, 1959). Based on the morphologic and anatomical differences of the genus *Agave* and its relationship with geological changes in the peninsula, Gentry (1978) mentioned the presence of an ancient sea intrusion that divided this area. This was previously suspected by the Jesuit missionary Miguel del Barco in 1780, when he interpreted the existence of marine shells in the middle of the peninsula and far from the coast as the result of the elevation of a part of the surface that had been submerged (González-Abraham *et al*., 2010). Once molecular studies were available investigations on the genealogical relationships among mtDNA lineages made great advances to elucidate the historical biogeography of Baja California (Lindell *et al*., 2006). With an extension of nearly 2,500 km^2, the Sierra de La Libertad (SLL from now onwards) is almost entirely located above 28º N (27º 49' - 28º 50' N; 113º 22' - 112º 43' W). Phytogeographically, it is located within Shreve's Vizcaíno Region, also known as the Central Desert of Baja California. El Paraíso Canyon (28º 30' N; 113º 4' W), the largest basin of SLL, is located in the southern part of the sierra and flows into the Pacific Ocean (Figure 1). This canyon is fed by many diverse tributaries that run from the highest elevations of the sierra. At their margins we can find true oases dominated by the blue fan palm (*Brahea armata*), which provide particular microclimatic conditions and habitats for many species. The area corresponds to the Central Desert Ecoregion according to González-Abraham *et al*. (2010).

The paleobotanical evidence shows that during the Cretaceous, a paratropical flora with Nearctic and Neotropical features, including Coryphoid palms (Arecaceae, Coryphoideae) was widely distributed in the northern hemisphere to approximately 65º N (Wehncke *et al*., 2009, 2010). Towards the end of the Miocene (12 million years ago), as climate became dryer and warmer, this vegetation became restricted to higher elevations or canyons that still maintained mesic conditions, creating isolated refuges in the middle of the sierra. By reducing and expanding their margins these populations followed the pace imposed by the cold and humid fluctuations of the Pleistocene (1.8 million-10,000 years ago). At present, these ecosystems constitute critical aquifer catchments and biotic communities that contrast with the surrounding, more arid, environments, and provide diverse ecological services that are fundamental for the region (Wehncke *et al*., 2012).

El Paraíso Canyon. After the first mission was settled in Loreto in 1697, subsequent explorations performed by Fernando Consag and Wenceslao Linck, among others, left significant information that constitute the first reports of the flora, fauna, ethnography, and biogeography of the northern desert region (del Barco, 1780). Since the beginning *Kañayiakamán*, as El Paraíso was called by the natives, enticed the interest of Consag who named it '*El Paraíso de los Californios*' because of the extraordinary descriptions by the natives of plentiful water and abundant resources in the area (Lazcano-Sahagún, 2000). In 1751, Consag entered the canyon passing through a very rugged landscape dominated by large palm groves covering hills and hanging from cliffs (del Barco, 1780; Lazcano-Sahagún, 2000). This constitutes the first reports that mentions blue fan palms (*Brahea armata*), together with a tree they called *milapa*, which is the boojum or cirio (*Fouquieria columnaris*), the presence of an ivy which they called '*yedra maligna*' (*Toxicodendron* sp.), that produces strong allergic reactions when touched, and as an extension of the Vizcaíno Desert into this area, he mentioned the presence of yucca (*Yucca valida*; del Barco, 1780; Lazcano-Sahagún, 2000, 2001). Even though Consag never started a mission in this place, a ranch called *El Paraíso* was founded to provide a resting site for caravans moving between the missions. Traces of ancient roads, ranches, refuges, and even rock walled corrals can still be found abandoned along these canyons. Much later, in 1889, T. S. Brandegee led a botanical expedition to this area, but unfortunately the information regarding the specific localities of specimen collections was scarce, sometimes misleading, or even lost (Moran, 1952). Some time later, Nelson (1921) and Ewan (1942) reconstructed and compiled the available information that could be extracted from Brandegee's specimen labels and letters deposited at the University of California Berkeley Herbarium (UC).

Based on this partial and incomplete information we explored these mountain ranges by air in 2006. From the air, we identified the main El Paraíso Canyon, its tributaries, and many remote blue fan palm oases, but we could not see any roads to reach them. In April and October of 2009, we

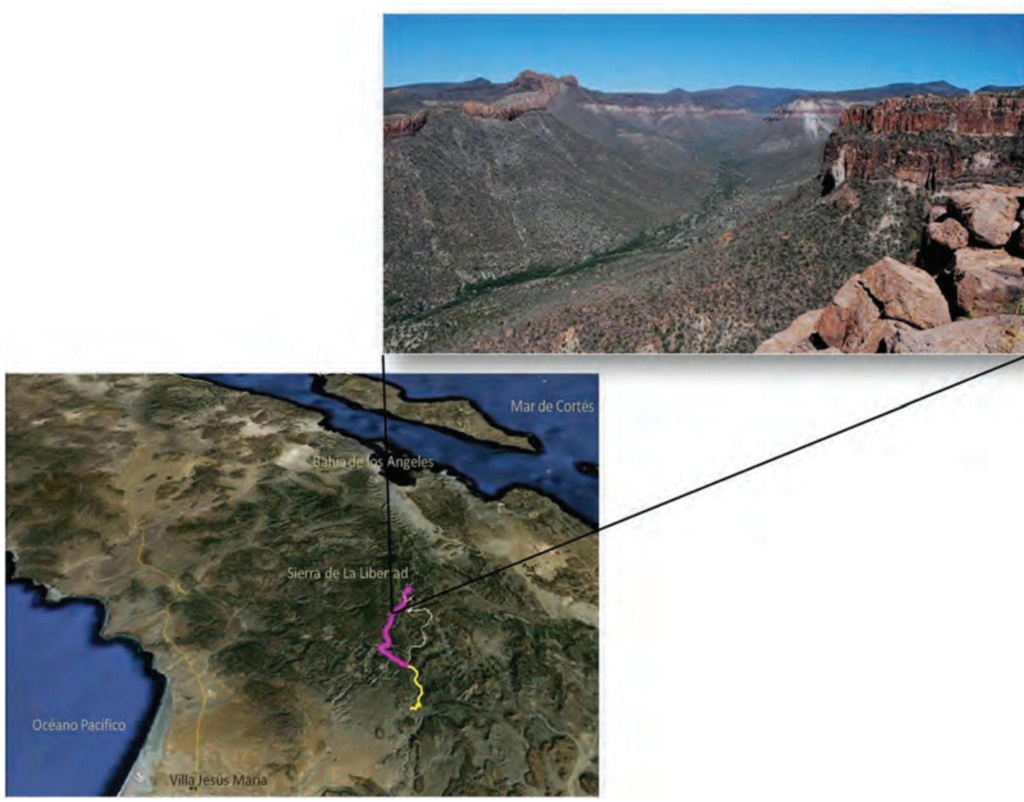

Figure 1. Google-Earth map showing the location of Sierra de La Libertad, Baja California, the routes followed during the expeditions, and a northeast view of El Paraíso canyon from the cliff border.

entered the area by mule with the main objective of surveying and documenting the local ecosystems and their vegetation (Figure 1). Voucher specimens of the flora collected in both expeditions are deposited in the herbaria of the San Diego Natural History (SD) and the Universidad Autónoma de Baja California (BCMEX), in Ensenada, Mexico.

Results

Vegetation description and major plant collections. Our expeditions to SLL contributed with a total record of 351 plant species (Appendix), of which 60 represent records of species that were not previously known to be in the northern Baja California region (state of Baja California). A total of 288 species were collected and other 63 were observed in the field. At a coarse scale, 71 species (20% of the total number of species registered during the two expeditions) are distributed mostly in the southern state (Baja California Sur), 80 (23%) species in the northern state (Baja California), and 148 (42%) species are common to both sides of SLL. On the other hand, 193 of the 351 species registered also inhabit the southern Sierra de San Francisco (SSF; Rebman unpublished flora) and 131 species are also found in the northern Sierra de La Asamblea (SA; Bullock *et al*., 2008). Altogether, these three sierras share 82 plant species (23%). Nonetheless, 109 species (31%) are present neither in the Sierra de San Francisco nor in the Sierra de La Asamblea; while 39% constitute common species found in both sides of SLL, 21% is formed by species expanding from the south, 30% by species expanding from the north, and 9% is composed by local and regional endemics that were not found in the adjacent sierras.

At a smaller scale of patches or communities, numerous northern species widen their distribution to the south and vice versa. In the first category (NS; Appendix 1, Figure 2), we grouped those species that are mostly distributed to the north. A few species in this group are also found further south, including those endemic to Baja California (BC) that are rarely distributed in Baja California Sur (BCS), but it also includes those species ranging as far south as the Sierra de San Francisco, Volcán Tres Vírgenes, and Sierra de Guadalupe. Thus, we found 39 (11%) northern species that use the SLL transition and extend their distributions to the south, and 21 (6%) southern species that have few populations distributed further north, ranging as far as Sierra de La Asamblea, and eastern Sierra de San Pedro Mártir (SN; Appendix, Figure 2). Furthermore, we identified 41 (12%) plant species commonly distributed in the north for which SLL represents the southernmost limit (SL), and 50 (14%) southern species for which SLL represents the northernmost limit of their distribution (NL; Appendix, Figure 2). Particularly, the southern part of SLL constitutes an area of local endemics and we considered seven main species (2%) into this category: *Eysenhardtia peninsularis* (Fabaceae), a new species of *Stephanomeria* (Asteraceae), a new species of cholla cactus, *Cylindropuntia* sp. nov. (Cactaceae); *Holographis virgata* ssp. *virgata* (Acanthaceae), *Rhus kearneyi* ssp. *borjaensis* (Anacardiaceae), *Agave avellanidens* (Agavaceae), and *Hedeoma tenuiflora* (Lamiaceae). Additionally, the following collected species were also considered an interesting locally endemic group: *Astragalus orcuttianum*, *A. prorifer*, *Brahea armata*, *Condalia brandegeei*, *Cryptantha fastigiata*, *Chorizanthe rosulenta*, *Dudleya gatesii*, *Eriogonum orcuttianum*, *E. pilosum*, *Penstemon eximius*, *Salvia peninsularis*, *Tragia moranii*, *Vallesia laciniata*, and *Xanthisma spinulosum* var. *gooddingii* (Appendix). At a coarser scale of analysis, SLL constitutes an area of regional endemism: 45 species (13%) were identified into this group (RE; Appendix, Figure 2). These species inhabit mainly this ecotonal area, but a few populations can be found towards the north and south of SLL.

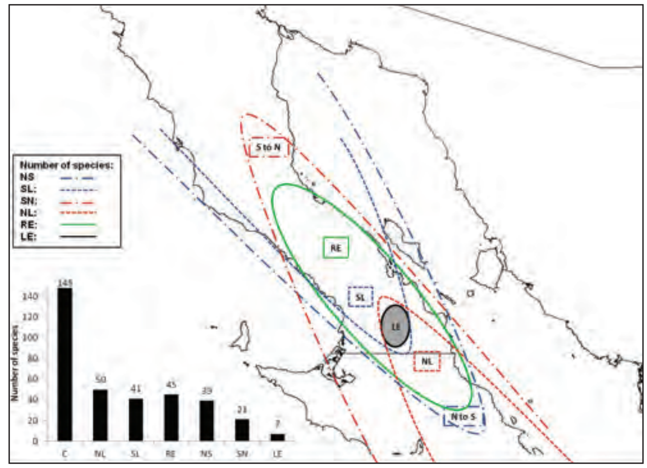

Figure 2. Map distribution and number of plant species registered in both expeditions to Sierra de La Libertad, that correspond to each category. Species were separated in categories according their extention ranges; NS: species mostly distributed to the north, but with populations in and crossing the ecotone area to the south, as far south as Sierra de Guadalupe and Volcan Tres Vírgenes; SN: species mostly distributed to the south, but with populations inhabit and crossing the ecotone area to the north, as far as Sierra de San Pedro Mártir; SL: species distributed in the north for which Sierra de La Libertad is the southernmost limit; NL: species distributed in the south for which the ecotone area is the northernmost limit; LE: local endemics; species that inhabit just in this ecotone area; RE: regional endemics; species that inhabit mainly this ecotone area and have few populations towards the north and the south of Sierra de La Libertad; and species that are common for both sides of SLL (C).

A major finding of these expeditions was the discovery and collection of two plant species new to science. As already mentioned, *Cylindropuntia* sp. nov. (Cactaceae) is a big succulent shrub that is widely distributed in El Paraíso Canyon at nearly 750 m in elevation (Figure 3A, B), and it seems to

Figure 3. Shrub of 2.5 m height of the new *Cylindropuntia* (Cactaceae) species (A, B); a sample of the new *Stephanomeria* species (C), found in El Paraíso canyon adjacent areas, Sierra de La Libertad.

be a morphological type between *C. cholla* and *C. alcahes*. The other new taxon is *Stephanomeria* sp. nov. (Asteraceae), which was found on a single population along a tributary of El Paraíso Canyon at 870 m. Even though seeds are needed to properly describe the new species, Dr. Les Gottlieb, a taxonomic expert in the genus *Stephanomeria*, corroborated that it is a new species. This new *Stephanomeria* is a very rare perennial herb, up to 1 meter tall, with blue green leaves, lavender petals and purple stigmata (Figure 3C).

Three other extremely rare species constituted significant botanical discoveries in the SLL. *Sageretia wrightii* (Rhamnaceae) and *Eriogonum abertianum* (Polygonaceae) were each only known in the peninsula from one single historical specimen. *Sageretia wrightii* was known only from a specimen collected by A. Carter in 1963 in the Sierra de La Giganta, BCS, and during our expeditions we found two different populations in SLL. Similarly, *E. abertianum* was only known from a specimen collected by T. S. Brandegee in 1889 in the vicinity of San Regis, which is near El Paraíso Canyon. In 2009 we found and collected specimens of this species in two different sites: one at 970 m on volcanic substrate, and the other at 1,200 m growing on basalt substrate on rocky slopes and mesas. The third rare species, *Hedeoma tenuiflorum* (Lamiaceae), was collected and described by T. S. Brandegee based on solely one specimen from 1889. Later in 1964 and 1966, Reid Moran found this species in two different places, one near Sierra San Borja, at the northern limit of SLL, and the other at SLL's southern limit. This endemic species was recorded and collected in one population during our first expedition at an altitude of 1,260 m, which constitutes the second occasion in which specimens have been collected with flowers. It seems to be endemic only to SLL, where it is also quite rare.

An interesting botanical note of our expeditions to SLL was the rediscovery of *Eysenhardtia peninsularis* (Fabaceae). First collected in the vicinity of the El Paraíso Canyon in 1889 by T. S. Brandegee, he later named this rare and endemic legume as *E. peninsularis* in 1911 based on his one specimen. For more than a century this species was never collected again and it was thought to be possibly extinct. In May 1992, J. Rebman, H. Cota, and L. Slauson rediscovered this rare species in the Sierra de San Francisco, BCS. Only a few shrubs severely impacted by cattle and goat browsing were observed on that occasion and one specimen was sent to R. Barneby at the New York Botanical Garden who confirmed the identification. Other taxonomic descriptions of *E. peninsularis* include: F.W. Pennell (1919); F. Shreve (1951); and I. Wiggins (1963); and one monograph of the genus *Ey-*

Figure 4. The most remote blue fan palm population inhabiting the lower parts of El Paraíso canyon and tributaries (A, B); community around blue fan palm population inhabiting the top of mesas in Sierra de La Libertad (C, D).

senhardtia by J. M. Lang (1972). Wiggins (1980) briefly describes *E. peninsularis* illustrating and comparing it with *E. polystachya*, a species from Durango and Tamaulipas to Oaxaca. All these descriptions were based on the only specimen collected by Brandegee in 1889. During our 2009 expeditions, we discovered four populations of *E. peninsularis* along a range of approximately 9.3 km. Two were small populations distributed along the canyon drainages between 720–870 m. The other two populations were found over the mesas at nearly 1,200 m, and constitute the largest populations known of this rare endemic species. These populations were found on a whitish volcanic tuff substrate with other species like *Bernardia myricifolia*, *Calliandra californica*, *Croton magdalanae*, *Cylindropuntia alcahes*, *Dalea bicolor* var. *orcuttiana*, *Dodonaea viscosa*, *Fouquieria splendens*, *Krameria erecta*, *Prosopis articulata*, *Senegalia greggii*, *Solanum hindsianum*, and in many cases with *Brahea armata* as well. Even though *E. peninsularis* had been rediscovered in 1992, large populations such as the ones found during our expeditions had not been documented. The high grazing pressure exerted by cattle and goats could be an important factor explaining its rarity and scarcity in the central peninsula. We suggest that efforts should be directed to manage cattle and goat activities in some select areas in order to preserve this unique and locally endemic shrub species.

During the 2009 expeditions, thirteen other species documented were particularly significant collections: (1) *Muhlenbergia minutissima* (Poaceae), was previously only known from a small number of voucher specimens mainly from Sierra de San Pedro Mártir; (2) *Nolina palmeri* var. *palmeri* (Ruscaceae) shows here its southernmost specimens; (3) *Oenothera brandegeei* (Onagraceae) is rare on the peninsula and only known from only a few voucher specimens; (4) *Panicum capillare* (Poaceae) is represented here in its southernmost distribution; (5) *Mimosa aculeaticarpa* var. *biuncifera* (Fabaceae), also very rare in the peninsula, shows here what is probably the southernmost specimen ever found; (6) *M. appressa* (Poaceae) is rare, not regularly documented in the peninsula, and usually distributed in small "sky islands"; (7) *Ipomoea cristulata* (Convolvulaceae) and (8) *Bidens leptocephala* (Asteraceae) are both mainly from BCS with only a pair of collections known from BC; (9) *Pseudognaphalium canescens* (Asteraceae) also shows here its southernmost specimen; (10) *Abutilon incanum* (Malvaceae) grows here with striking white flowers while the usual collections have yellow and/or orange flowers; (11) *Chenopodium fremontii* (Chenopodiaceae) has here its southernmost specimen; (12) *M. emersleyi* (Poaceae) is a rarely-collected species from the SLL; and, finally, (13) *Aesculus parryi* (Sapindaceae) shows here its southernmost specimen, collected far from the Mediterranean climate where it usually prospers.

Another interesting natural history observation of these expeditions was the presence of the mistletoe *Phoradendron brachystachyum* (synonym = *P. diguetianum*) parasitizing several host plants such as, *Celtis pallida* (Cannabaceae), *Condalia brandegeei* (Rhamnaceae), *C. globosa* var. *pubescens* (Rhamnaceae), *Fouquieria splendens* ssp. *splendens* (Fouquieriaceae), *Prunus ilicifolia*, *P. fremontii* (Rosaceae), *Schoepfia californica* (Schoepfiaceae), *Vachellia farnesiana*

Table 1. Summarized information registered from blue fan palms growing in the most isolated regions of Sierra de La Libertad (Upper canyons or 'sources'), and those from the lower and more accesible parts of the Sierra in arroyo El Toro (Lower canyons).

	Upper canyons	Lower canyons
# palms/ha	**1,140** 17.5 ± 4.5	31 9.6 ± 3.3
Height (m) median, (range), n	(14 - **22.5**), 12	(4.2 - 17.2), 26
# palms with flowers/ha (%)	**1,100** (96%)	27 (87%)
# infloresc./ha	**2,920**	all damaged
Average inflorescence stems (n; range)	9.7 ± 2.6 (30; 4 - **15**)	12 ± 4.9 (115)
# palms with fruits/ha (n), %	31 (46), 67.5%	18 (30), 60%
# infrutescence stems/ha (with fruits)	445 (**224**) 115 damaged	394 (113) 281 damaged
Average infrutescences (with fruits); n	9.7 ± 2.6 (4.9 ± 4.2); 40	13.1 ± 5.2 (4 ± 3.8); 30
# fruits/ha	**118,333**	85,500

Figure 5. Particular communities around blue fan palm populations identified in El Paraíso adjacent areas, Sierra de La Libertad: blue fan palms, vines (*Toxicodendron diversilobum*), orchids (*Epipactis gigantea*), and ferns (*Thelypteris puberula*) (A-C); community of grasses on the mesas (D); and community of ocotillos (E).

(Fabaceae), and *Vallesia laciniata* (Apocynaceae). The interaction of *Phoradendron brachsytachyum* with *F. splendens* has, to our knowledge, never been registered before on the peninsula. Other two species of mistletoe have been found in SLL, one is the widely distributed *P. californicum* that was parasitizing different shrubs and trees from the family Fabaceae; while *P. villosum* was found in trees and shrubs of the genus *Quercus* (Fagaceae).

Along the El Paraíso Canyon, their tributaries and on the mesas, we found what probably are the most remote and dense blue fan palm populations of the peninsula (Figure 4). In Table 1, we compared some biological information of these populations growing in what we called the "upper parts", or "the sources", with those distributed in the more accesible canyons, or what we called the "lower parts" of the Sierra. We registered more than 300 plant species associated with *Brahea armata* in the upper parts and along remote canyons, while in the lower parts we found more than 100 plant species. Three communities were of particular interest around blue fan palms: (1) the group of orchids, ferns, oaks, and climbing vines along canyons of El Paraíso in the upper parts or sources, and their tributaries (Figure 5A), (2) the diverse and rare species of grasses at higher altitudes on the mesas (Figure 5D), and (3) the association of ocotillo, *Fouqueria splendens*, with blue fan palms on a whitish-volcanic tuff substrate up on the mesas (Figure 5E).

Communities living along the canyons. Before reaching El Paraíso Canyon we surveyed the northern part of arroyo El Toro (635 m), which has many patches of blue fan palms imbedded on an arid matrix composed of *Aesculus parryi*, *Agave shawii* ssp. *goldmaniana*, *Cylindropuntia alcahes*, *C. cholla*, *Fouquieria columnaris*, and *Pachycereus pringlei*. Along the canyon and associated with *Brahea armata* we recorded *Ambrosia ambrosioides*, *Baccharis salicifolia*, *B. sarothroides*, *Chloracantha spinosa*, *Dodonaea viscosa*, *Prosopis articulata*, and *Vachellia farnesiana*. A rare collection was the climbing *Macroptilium atropurpureum* (Fabaceae) with dark purple flowers, which constituted a new record for BC. By walking down several mesas through a volcanic substrate covered by populations of *C. cholla*, *Encelia farinosa*, *F. columnaris*, and *P. pringlei* we reached the El Paraíso main stream where we found the abandoned San Bartolo ranch at an altitude of 500 m. Here the substrate becomes granitic and the species guild associated with *B. armata* was composed of particular riparian populations of *A. ambrosioides*, *B. salicifolia*, *C. spinosa*, *D. viscosa*, *P. articulata*, and *V. farnesiana*. Around the ranch we also found date palms, *Phoenix dactylifera*, introduced by the former inhabitants of the area and the perennial grass *Phragmites australis* reaching 2 m high. Continuing along the El Paraíso Canyon and after crossing an area with ancient cave paintings we reached the Santa Marta area at 750 m, where once a ranch was settled. Date palms, *P. dactylifera* of several age-size categories congregate here in high densities. We continued to El Paraíso Viejo, another abandoned ranch where we found 12 new plant records for the northern BC state including the new species of *Cylindropuntia*. This new and undescribed species reproduces very well vegetatively and interestingly, the fleshy fruits that fall to the ground and were not eaten by animals can develop roots and establish as new clonal individuals. Further along El Paraíso Canyon, blue fan palm concentrations increased as well as those of wild figs, *Ficus palmeri*. In April, several plant species were flowering including blue fan palms and the cochal cactus *Myrtillocactus cochal*, the scent of which was very strong along the way. Along a tributary, arroyo El Descanso (870 m), blue fan palms were particularly tall and dense, and the community around them included *A. ambrosioides*, *B. salicifolia*, *C. spinosa*, *D. viscosa*, *P. articulata*, *Toxicodendron diversilobum*, and oaks, *Quercus oblongifolia* (Figure 6). This spot has an important water hole; the canyon is very humid and deep reducing the number of light hours in it, probably determining the height of these palms (Figure 6). On the floor, we found several blue fan palm seeds oviposited by the larvae of the beetle *Coryobruchus veseyi* Horn (Bruchidae; see Wehncke *et al*., 2009).

Another wide tributary of the El Paraíso Canyon is El Olvido, into which four canyons with abundant blue fan palm populations merge (Figure 4A). We selected the most accessible of these canyons (La Misericordia) to survey the vegetation and estimated a density of 114 reproductive blue fan palm trees per /0.1 ha, of which 96% were in flower in April (Figure 5A). Contrary to what was expected, instead of finding '*yedra maligna*', *Toxicodendron radicans* (Anacardiaceae), that is normally found in the Sierra de San Francisco and BCS, most blue fan palm trees were covered by the vine '*roble venenoso*', *T. diversilobum*, which was out of its normal distribution range on the Pacific slopes of the Sierra de San Pedro Mártir and Sierra de Juárez (Figure 5A). Around blue fan palms the community was composed of *Ambrosia ambrosioides*, *Baccharis salicifolia*, *Dodonaea viscosa*, *Prosopis articulata*, *T. diversilobum*, the ferns *Adiantum capillus-veneris*, *Pellaea wrightiana*, *Pentagramma triangularis*, and *Thelypteris puberula*, and the orchid *Epipactis gigantea* (Figure 5B, C).

Communities living on the mesas. By using the old missionary road we reached a locality called Las Cuevitas in the higher parts of the mesas at 1,040 m. Bordering the mesas and cliffs and around blue fan palm individuals the community was composed of *Agave cerulata*, *Cylindropuntia alcahes*, *Dodonaea viscosa*, *Echinocereus engelmannii*, *Ficus palmeri*, *Fouquieria splendens*, *Gambelia juncea*, *Malosma laurina*, *Prunus ilicifolia*, *Quercus turbinella*, and *Vauquelinia californica*. We also found a diverse community of grasslands in a very good state of conservation with native perennial grasses such as *Melica frutescens*. This community is distributed over a remarkable landscape of volcanic rocks forming a very fractured substrate covered with high

Figure 6. Community of *Ambrosia ambrosioides*, *Baccharis salicifolia*, *Chloracantha spinosa*, *Dodonaea viscosa*, *Prosopis articulata*, and *Quercus oblongifolia* around blue fan palm population of El Descanso canyon one of the most remote tributaries of El Paraíso canyon view from outside the canyon, (A); view from inside the canyon, (B).

densities of blue fan palms (Figure 4B). Compared with the populations growing along the El Paraíso tributaries, these palms were lower in size (from 1.5 to 6 m tall, average 3.5 ± 1.3 m, n = 20). In April, these populations were flowering (average 6.9 ± 2.4 inflorescence per palm, n = 20).

In the higher parts of the mesas, between 1,050 and 1,100 m, *Brahea armata* was surrounded by *Bernardia myrcifolia*, *Cordia curassavica*, *Croton magdalenae*, *Dodonaea viscosa*, *Prosopis articulata*, and *Vachellia greggii*. Between them we also found two new records for the state of BC, a Rubiaceae, *Diodia teres*, and a Verbenaceae, *Lantana hispida*. Still on the mesas and along a deep canyon, palms produced inflorescence stems, but only 67.5% of them had green immature fruits later in October (estimated from 40 palms in 0.87 ha). Palms produced a total of 387 inflorescence stems in this patch (average: 9.7 ± 2.6; range 3–18), from which only 195 had immature fruits (average: 5 ± 4.2). Calculating the percentage of fruits produced per palm tree and considering that each inflorescence may approximately produce 1,000 fruits, we estimated that 40 palm trees produced 118,333 fruits/ha. This total represents only 27% of the fruit production that could be achieved if all the inflorescence stems that developed would have produced fruits. Furthermore, if the inflorescences would have developed 100% of fruits, the number of fruits per ha would approximately have reached 445,000. In reality, however, numerous (26%), of the infrutescence stems were damaged at the date of sampling. We registered a loss of 32.5% of the fruits due to damage in this patch, and numerous aborted fruits were found lying on the soil. The same kind of damage was also documented in the populations of the lower parts of the Sierra (E.Wehncke, unpublished data), and is related with the larva of an endemic moth, *Litoprosopus bajaensis*. Deep in Las Cuevitas canyon, the landscape presented many red and black volcanic foldings (Figure 7), and blue fan palms increase in height; the tallest size we measured was of 23 meters and represents the highest record for a blue fan palm tree (see estimation of Bullock and Heath, 2006). Here we found *Baccharis sarathroides*, *Dodonaea viscosa*, *Ficus palmeri*, *Quercus turbinella*, and *Vachellia greggii*, plus five new records for BC were found; three rare species of perennial grasses (Poaceae), one Pontedericaceae, and one Fabaceae (Appendix, Figure 7).

On the way to El Rodeo, we bordered the northern slopes of the Siete Cerritos Mountains, and found *Brahea armata* with *Celtis pallida*, *Dodonaea viscosa*, *Cylindropuntia cholla*, and *C. alcahes* growing on a basaltic substrate. Here, we found another new record for BC, the Amaranthaceae, *Amaranthus torreyi*. Once at El Rodeo at 1,220 m, and around a canyon with abundant water, we found blue fan palms of up to half a meter tall, most of which were browsed by cattle (Figure 8). Here, on a substrate formed by a whitish volcanic tuff, blue fan palms were associated with *C. pallida*, *Condalia brandegeei*, *C. cholla*, *C. alcahes D. viscosa*, and *Prosopis articulata* (Figure 8). At this site, we also documented 15 species that represent new records for BC (Appendix).

Discussion

Far from trying to exactly delimit new boundaries between the different communities of organisms inhabiting the central region of the Baja California peninsula, our intention is to provide evidence that shows the ecotone character of this area and with this to stress the special attention it deserves. Above 28° N, the SLL forms a true transition between the Central Desert and the Vizcaíno Desert, where the overlapping distribution ranges of many species create particular and unique communities. This transition and the climatic contrast between the north and the south, the topographical change, and the change in the flora have been noted by

Figure 7. Blue fan palm population between red volcanic foldings in Las Cuevitas canyon located up in the mesas.

many explorers and researchers starting with Jesuit missionaries like Consag in 1773, Longinos 1792, and subsequently Eisen 1893, Nelson 1921, Shreve 1951, Wiggins 1980, etc. (see Garcillán *et al*., 2010, for a thorough historical review), and more recently by Turner *et al*. 1995, González-Abraham *et al*., 2010. However, it was Brandegee who between 1889 and 1902 provided the first botanical data and suggested the marked change in the flora that occurs at about latitude 28° N. Later on, Shreve's (1951) observations of the Sonoran Desert suggested that life forms are distributed according to their strategies in order to survive the aridity of the desert and to conserve humidity. The combined latitudinal effects of the northern and southern climates (summer tropical rains with occasional hurricanes, and cold temperatures combined with winter rains), as well as the altitudinal effects that determine the western and eastern oceanic influences in the local weather of SLL (Reyes-Coca *et al*., 1990; Cavazos-Pérez, 2008) create a melting pot area of ca. 2,500 km^2 with numerous ecological niches where species with more northern and southern affinities coexist. This region has consecutive years with little rainfall interrupted by the sporadic passing of a hurricane and two to three winter storms. Seventy-nine percent of the annual rainfall almost exclusively depends upon extreme events (Cavazos-Pérez, 2008). Growth tolerance of *Brahea armata* can explain its more widespread distribution and higher elevation limits in the region when compared to the other palm species found on the peninsula (Minnich *et al*., 2011), and match with the high variability in the amount of rainfall over the region that is different from other areas of the Baja California Peninsula (Cavazos-Pérez, 2008). Records of new endemics and extended distributions of species documented in the brief surveys of the 2009 expeditions evidence the transition role of these canyons and mesas as well as the potential for future research in this area.

The two new species of Cactaceae and Asteraceae found along the humid stream sides of El Paraíso Canyon illustrate the scarce scientific reconnaissance that this particular sierra has had. The collection of locally endemic plant species, as well as the rare and uncommon plants that comprise 68% of the total species recorded in the area; the bulk of southern species that extend their distribution ranges to the north; and the numerous northern species that broaden their distribution areas further south from their normal distributions highlights the transitional nature of the Sierra de La Libertad. Besides filling information gaps in herbaria and other

Figure 8. Community of oaks, *Celtis pallida*, *Dodonaea viscosa*, and *Prosopis articulata*, around blue fan palm population in El Rodeo canyon and adjacent areas located up in the mesas.

specimen collections, these expeditions identified particular and unknown plant communities associated with blue fan palm populations, the dominant vegetation of desert oases at these latitudes. Thus, orchids, ferns, and climbing vines growing with palms close to water holes form a different type of tropical forest; small-sized palms growing within a matrix of diverse species of grasses that sway in the breeze of the high mesas; and the ocotillos interspersed with the palms covering the rocky landscape of whithish volcanic tuffs are some of the most noteworthy and unique communities registered in the area.

The transition between the two *Brahea* species of palms on the peninsula (*B. armata* and *B. brandegeei*) is still unclear because of taxonomic uncertainties, but seems to coincide with the 28° N parallel (Felger and Joyal, 1999; Felger *et al*., 2001). Based on Google-Earth images Minnich *et al*. (2011), indicated that blue fan palms concentrate in the southern part of SLL. They proposed that palms occur in Miocene basalt tablelands overlying granitic basement, on volcanic caprock, and exposed granitic rock. The surveys we performed in-site indicated that blue fan palm populations on the mesas were distributed over a peculiar substrate related to a layer of peralkaline ignimbrites (L. Delgado pers. comm.). These ignimbrite units, correspond to processes of simple cooling, and are composed by different lithographic layers including a black layer of volcanic glass over which there is a whiter level formed by fractures that evidence the presence of water in these valleys (Vidal-Solano *et al*., 2007). A peculiar volcanic episode represented by ignimbrites (pyroclastic peralkaline fluxes) has been recognized among the Tertiary volcanic sequences of central Sonora and part of Baja California up to SLL, as a drastic change in the Tertiary magmatism during the Middle Miocene (12 My; Vidal-Solano *et al*., 2007). Blue fan palm roots can reach the water trapped in these lithographic layers, a factor which may explain their abundance on the mesas.

Following the intermittent flow of occasional rains or bearing the intense flooding after sporadic hurricanes, the plant communities dominated by blue fan plams provide a somewhat predictable pulse of resources and create diverse ecological niches for myriad other organisms throughout this mountain range. Massive production of nectar, flowers, fruits, seeds, and leaves are the focus of a highly diverse insect community that live in the area and also use canyons as corridors to connect isolated populations. New species of insects have been found in the inflorescences, infrutescences, and leaves of blue fan palms, and astonishing interactions are starting to be noted as the area is getting more explored (E. Wehncke, unpublished data).

Numerous explorations and descriptions of the Baja California fauna, flora, geology, and local inhabitants have occurred since the arrival of the Jesuit missionaries to the peninsula. By the end of the XIX century, successive scientific explorations noted the contrasting change in climate and flora around the 28° N latitude (Brandegee, 1889, 1891, 1892; Nelson, 1921; Ewan, 1942; Wiggins, 1963). Throughout the years and with the development of new technology, several distribution ranges of organisms were incorporated with climatic and geologic data to produce the first biogeographic regionalizations for the peninsula (see Garcillán *et al*., 2010). Nonetheless, we feel that apart from trying to delimit the exact boundaries of the transitions between ecoregions, a huge and significant gap will be filled when the SLL is better understood biologically, and more importantly, recognized as a true ecotone between the northern and the southern desert regions of the Baja California Peninsula. Today, in an era of incessant scientific and technological advances, when communications go beyond distances and roads, the value of scientific expeditions to access and explore remote places is still huge.

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Appendix. Plant species registered during the expeditions of 2009 to the Sierra de La Libertad. Abbreviations in table: New Baja California record (New BC); Significant collection (Sig Coll); Collection number (Coll No.); Elevation (Elev); species registered in Sierra de San Francisco (SSF); species registered in Sierra de la Asamblea (SA). In the 'Endemism' column endemic species were classified according they are endemics to Baja California and Baja California Sur (BC/BCS E); species that are only known from southern BC and northern BCS and have a rather limited distribution (local BC/BCS E); species that are basically BC/BCS E, but they have at least one rare population outside of the BC/BCS geopolitical area (near BC/BCS E), (these three categories were considered as 'regional endemics' in the distribution classification); species that are endemics to Baja California (BC E); and those local endemics to SLL (local E, and local BC E). In the 'Distribution' column species were classified according to their extension ranges as follows: species mostly distributed in the north, but with populations in and crossing the ecotone area of SLL to the south, as far south as Sierra de Guadalupe and Volcán Tres Vírgenes (NS); species mostly distributed in the south, but with populations inhabiting and crossing the ecotone area of SLL to the north, as far as Sierra de San Pedro Mártir (SN); species distributed in the north for which SLL is the southernmost limit (SL); species distributed in the south for which SLL is the northernmost limit (NL); local endemics to SLL (LE), species that inhabit just in this ecotone area; regional endemics (RE), species that inhabit mainly this ecotone area and have few populations towards the north and the south of SLL, and species that are common for both sides of SLL (C). The SSF distribution data is based upon an unpublished specimen-based flora compiled by Rebman and the SA data is based upon the paper by Bullock *et al.*, 2008. The distribution data is based upon the specimen records in the Baja California Botanical Consortium hosted at SDNHM, which is a combined specimen database of 6 different herbaria including: SD. BCMEX, HCIB, UCR, RSA/POM, and SDSU (Note: these are the formally recognized herbarium acronyms used in taxonomy).

Family	Species	Endemism	Distribution	New BC	Sig Coll	Coll No.	Elev	SSF	SA
Acanthaceae	*Carlowrightia arizonica* A.Gray		SN			17213	635	x	
Acanthaceae	*Dicliptera resupinata* Nutt. ex Nees		SN	x		17233	735	x	
Acanthaceae	*Holographis virgata* ssp. *virgata* (Harv. ex Benth. & Hook.f.) T.F.Daniel	local BC E	LE			Obs.		x	
Acanthaceae	*Justicia califórnica* (Benth.) D.N.Gibson		C			17165	635	x	x
Acanthaceae	*Tetramerium fruticosum* Brandegee		SN	x		17226	735	x	
Adoxaceae	*Sambucus nigra* ssp. *caerulea* (Raf.) B.L.Turner		NS			17352	1,235	x	
Agavaceae	*Agave avellanidens* Trel.	local BC E	LE			Obs.			
Agavaceae	*Agave cerulata* ssp. *cerulata* Trel.	BC E	NS			18710	1,220		x
Agavaceae	*Agave shawii* ssp. *goldmaniana* (Trel.) Gentry	BC E	SL			Obs.			x
Agavaceae	*Hesperoyucca peninsularis* (McKelvey) Clary	BC E	NS			Obs.		x	x
Agavaceae	*Hesperoyucca whipplei* (Torr.) Trel.		C			Obs.		x	x
Agavaceae	*Yucca valida* Brandegee	BC/BCS E	RE			Obs.		x	x
Alliaceae	*Nothoscordum bivalve* Britton		C	x		17327	1,030	x	
Amaranthaceae	*Amaranthus torreyi* (A.Gray) Benth. ex S.Watson		SN	x	x	18667	1,195		
Amaranthaceae	*Amaranthus watsonii* Standl.		C			18715	1,220		x
Anacardiaceae	*Malosma laurina* Engl.		NS			17205	635		x
Anacardiaceae	*Rhus kearneyi* F.A.Barkley ssp. borjaensis Moran	local BC E	LE		x	17298	1,040		
Anacardiaceae	*Toxicodendron diversilobum* (Torr. & A.Gray) Greene		SL		x	17250	870		
Apiaceae	*Apiastrum angustifolium* Nutt.		SL			17307	635		x
Apiaceae	*Daucus pusillus* Michx.		NS			17274	745		
Apocynaceae	*Funastrum cf. cynanchoides* Schltr.		C			Obs.			
Apocynaceae	*Matelea hastulata* (A.Gray) Sundell.	BC/BCS E	RE		x	18622	1,300	x	x
Apocynaceae	*Metastelma californicum* Benth.		C			18672	1,055	x	
Apocynaceae	*Vallesia laciniata* Brandegee	BC/BCS E	RE	x		17272	745	x	

Family	Species	Endemism	Distribution	New BC	Sig Coll	Coll No.	Elev	SSF	SA
Araceae	*Lemna* sp.		C			18598	720	x	
Araliaceae	*Hydrocotyle verticillata* Thunb.		NS			17246	870		
Arecaceae	*Brahea armata* S.Watson	BC E	SL			17292	820		x
Arecaceae	*Phoenix dactylifera* L.		C			Obs.			
Asclepiadaceae	*Matelea cordifolia* (A.Gray) Woodson		C	x		17280	820	x	
Asteraceae	*Acourtia palmeri* (S.Watson) Reveal & R.M.King	BC/BCS E	RE			17336	1,030	x	
Asteraceae	*Amauria rotundifolia* Benth.	BC/BCS E	RE			17168	635	x	x
Asteraceae	*Ambrosia ambrosioides* (Delpino) W.W.Payne		SN			17172	635	x	x
Asteraceae	*Ambrosia camphorata* (Greene) W.W.Payne		C			Obs.		x	x
Asteraceae	*Ambrosia carduacea*(1) (Greene) W.W.Payne	near BC/BCS E	RE			17207	635	x	
Asteraceae	*Ambrosia confertiflora* DC.		C			18652	1,220	x	x
Asteraceae	*Ambrosia magdalenae*(2) (Brandegee) W.W.Payne	near BC/BCS E	RE			18604	720	x	x
Asteraceae	*Artemisia ludoviciana* ssp. *incompta* (Nutt.) Cronquist		C			18621	870	x	x
Asteraceae	*Baccharis salicifolia* Nutt. ssp. *salicifolia*		C			18610	720	x	x
Asteraceae	*Baccharis sarothroides* A.Gray		C			18613	720	x	x
Asteraceae	*Bahiopsis triangularis* (M.E.Jones) E.E.Schill. & Panero	BC/BCS E	RE			17160	635	x	x
Asteraceae	*Bebbia juncea* var. *aspera* Greene		NS			18616	720		x
Asteraceae	*Bidens leptocephala* Sherff		SN		x	18648	1,220	x	
Asteraceae	*Brickellia californica* A.Gray		NS			Obs.		x	
Asteraceae	*Brickellia glabrata* (Rose) B.L.Rob.	BC/BCS E	RE			17242	870	x	
Asteraceae	*Chloracantha spinosa* var. *spinosissima* (Benth.) G.L.Neson		NL	x		17189	635	x	
Asteraceae	*Cirsium occidentale* var. *californicum* D.J.Keil & C.E.Turner		SL		x	17275	745		
Asteraceae	*Coreocarpus parthenioides* var. *parthenioides* Benth.		C			17177	635		x
Asteraceae	*Encelia farinosa* var. *phenicodonta* I.M.Johnst.		C			17206	635	x	x
Asteraceae	*Ericameria brachylepis* H.M.Hall		SL		x	18619	1,300		x
Asteraceae	*Erigeron divergens* Torr. & A.Gray		SL		x	17312	1,030		
Asteraceae	*Gnaphalium palustre* Nutt.		C			17344	1,030	x	x
Asteraceae	*Gutierrezia califórnica* (DC.) Torr. & A.Gray		SL		x	18655	1,220		x
Asteraceae	*Gutierrezia sarothrae* (Pursh) Britton & Rusvy		C			17299	1,040		
Asteraceae	*Heliopsis parvifolia* var. *rubra* (T.R.Fisher) Wiggins		SN			17268	745	x	x
Asteraceae	*Heterosperma pinnatum* Cav.		NL	x	x	18647	1,220	x	
Asteraceae	*Logfia arizonica* (A.Gray) Holub		SL			17306	1,030		
Asteraceae	*Logfia filaginoides* (Hook. & Arn) Morefild		NS			17333	1,030		x

Family	Species	Endemism	Distribution	New BC	Sig Coll	Coll No.	Elev	SSF	SA
Asteraceae	*Pectis cylindrica* Rydb.		NL	x	x	18650	1,220	x	
Asteraceae	*Perityle califórnica* A.Gray		SN			17184	635	x	x
Asteraceae	*Pluchea serícea* (Nutt.) Coville		SL		x	Obs.			
Asteraceae	*Porophyllum gracile* Benth.		C			Obs.		x	x
Asteraceae	*Pseudognaphalium canescens* (DC.) W.A.Weber		SL	x	x	18694	1,010		x
Asteraceae	*Pseudognaphalium leucocephalum* (A.Gray) Anderb.		NL		x	17221	480		
Asteraceae	*Pseudognaphalium luteoalbum* (L.) Hillard & B.L. Burtt.		C			17331	1,030		
Asteraceae	*Rafinesquia neomexicana* A.Gray		SL			17211	635		x
Asteraceae	*Senecio lemmonii* A.Gray		NS			17256	635	x	x
Asteraceae	*Sonchus oleraceus* L.		C			17178	635	x	x
Asteraceae	*Stephanomeria* sp. nov.	local E	LE	x		17240	870		
Asteraceae	*Trixis californica* var. *califórnica* Kellogg		C			17169	635	x	
Asteraceae	*Uropappus lindleyi* (DC.) Nutt.		SL			17314	1,030		
Asteraceae	*Verbesina palmeri* S.Watson	BC/BCS E	RE			17217	1,040		x
Asteraceae	*Viguiera purisimae*[(4)] S. Brandeg.	near BC/BCS E	RE			18623	1,030	x	
Asteraceae	*Xanthisma spinulosum* var. *gooddingii* (Rydb.) D.R.Morgan & R.L.Hartm.		SL		x	17340	1,030		
Berberidaceae	*Berberis higginsiae* Munz.		SL		x	17350	1,235		
Boraginaceae	*Cordia curassavica* Roem. & Schult.		NL		x	17158	635	x	
Boraginaceae	*Cryptantha angustifolia* Greene		C			17200	635		
Boraginaceae	*Cryptantha barbigera* var. *barbigera* Greene		NS			17163	635		
Boraginaceae	*Cryptantha fastigiata* I.M.Johnst.	BC/BCS E	RE			17190	635		
Boraginaceae	*Cryptantha intermedia* var. *intermedia* Greene		SL			17318	1,030		x
Boraginaceae	*Heliotropium curassavicum* var. *oculatum* (Heller) Thorne		C			17208	635	x	x
Boraginaceae	*Pectocarya recurvata* I.M.Johnst.		NS			17329	1,030		x
Boraginaceae	*Phacelia distans* Benth.		NS			17304	1,030		x
Boraginaceae	*Plagiobothrys collinus* var. *fulvescens* (I.M.Johnst.) Higgins		SL		x	17301	1,030		x
Brassicaceae	*Brassica tournefortii* Gouan		C			17195	635		
Brassicaceae	*Caulanthus lasiophyllus* Payson		SL			Obs.			x
Brassicaceae	*Descurainia pinnata* ssp. *glabra* (Wooton & Standl.) Shinners		C			17315	1,030		
Brassicaceae	*Draba cuneifolia* Nutt. ex Torr. & A.Gray		NS			Obs.			x
Brassicaceae	*Lepidium lasiocarpum* var. *lasiocarpum* Nutt.		C			17175	635	x	x
Brassicaceae	*Lyrocarpa coulteri* var. *coulteri* Hook. & Harv.		C			17362	635		
Brassicaceae	*Sisymbrium irio* Wibel ex Steud.		C			17201	635		x
Burseraceae	*Bursera microphylla* A.Gray		C			18614	720	x	x
Cactaceae	*Cochemiea setispina* Walton	BC/BCS E	RE			Obs.		x	

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Cactaceae	*Cylindropuntia alcahes* var. *alcahes* (F.A.C.Weber) F.M.Knuth	BC/BCS E	RE	x		Obs.		x	x
Cactaceae	*Cylindropuntia cholla* (F.A.C. Weber) F.M.Knuth	BC/BCS E	RE			Obs.		x	x
Cactaceae	*Cylindropuntia lindsayi* × *C. alcahes* (Rebman) Rebman	BC/BCS E	RE			Obs.		x	
Cactaceae	*Cylindropuntia molesta* var. *molesta* (Brandegee) F.M.Knuth	BC/BCS E	RE			Obs.		x	x
Cactaceae	*Cylindropuntia* sp. nov.	local E	LE			17276	745		
Cactaceae	*Echinocereus engelmannii* (Parry ex Engelm.) Rümpler		NS			Obs.		x	x
Cactaceae	*Ferocactus peninsulae* Britton & Rose	BC/BCS E	RE			Obs.		x	
Cactaceae	*Lophocereus schottii* var. *schottii* (Engelm.) Britton & Rose		C			Obs.		x	x
Cactaceae	*Mammillaria dioica* K.Brandegee		C			Obs.		x	x
Cactaceae	*Myrtillocactus cochal* Britton & Rose	BC/BCS E	RE			Obs.		x	
Cactaceae	*Opuntia chlorotica* Engelm. & J.M.Bigelow		NS			Obs.		x	x
Cactaceae	*Opuntia* sp. (1)		C			Obs.			
Cactaceae	*Opuntia* sp. (2)		C			Obs.			
Cactaceae	*Pachycereus pringlei* Britton & Rose		C			Obs.		x	x
Cactaceae	*Stenocereus gummosus* (Engelm.) A.C.Gibson & K.E.Horak		C			Obs.		x	x
Cactaceae	*Stenocereus thurberi* var. *thurberi* (Engelm.) Buxb.		SN			Obs.		x	
Campanulaceae	*Triodanis biflora* Greene		C			17305	1,030		
Cannabaceae	*Celtis pallida* Torr.		NL	x	x	17231	735	x	
Cannabaceae	*Celtis reticulata* Boorsma		NL	x	x	17230	735	x	
Caryophyllaceae	*Silene antirrhina* Hort. Madr. ex Otth		SL		x	17187	635		
Caryophyllaceae	*Spergularia salina* J.Presl		C			17176	635		x
Chenopodiaceae	*Atriplex pacifica* A.Nelson		C			17214	792		
Chenopodiaceae	*Chenopodium album* L.		C		x	17255	870	x	
Chenopodiaceae	*Chenopodium fremontii* S.Watson		NS			18668	1,195		
Chenopodiaceae	*Chenopodium murale* L.		C			17251	870	x	x
Chenopodiaceae	*Chenopodium* sp.		C			17293	1,040		
Convolvulaceae	*Evolvulus alsinoides* var. *angustifolius* Willd.		SN			17227	735	x	
Convolvulaceae	*Ipomoea costellata* Torr.		NL		x	18653	1,220	x	
Convolvulaceae	*Ipomoea cristulata* Hall.		SN			18644	1,220	x	
Convolvulaceae	*Ipomoea* sp.		C	x	x	Obs.			
Crassulaceae	*Dudleya acuminata* Rose ex Britton & Rose	BC/BCS E	RE			18625	1,220	x	
Crassulaceae	*Dudleya gatesii* Johansen		C			17334	1,030		
Crossosomataceae	*Crossosoma bigelovii* S.Watson		SL		x	18675	1,055		x
Cucurbitaceae	*Brandegea bigelovii* Cogn.		C			17166	635		
Cucurbitaceae	*Cucurbita cordata* S.Watson	BC/BCS E	RE			18611	720	x	x
Cyperaceae	*Cyperus dioicus* I.M.Johnst.		NL			17269	745		
Cyperaceae	*Cyperus flavicomus* Michx.		C	x	x	18679	1,055		
Cyperaceae	*Cyperus hermaphroditus* Standl.		SN	x	x	18671	1,055		

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Cyperaceae	*Cyperus pallidicolor* (Kük.) G.C.Tucker		NL			18637	1,220		
Cyperaceae	*Cyperus squarrosus* Afzel. ex Kunth.		C			18707	1,220	x	
Cyperaceae	*Eleocharis parishii* Britton		C			17234	870	x	
Cyperaceae	*Lipocarpha micrantha* Peter		NL	x	x	18704	1,220		
Cyperaceae	*Schoenoplectus americanus* (Pers.) Volkart ex Schinz & R.Keller.		C			17288	820	x	
Elatinaceae	*Elatine brachysperma* A.Gray		SL		x	17322	1,030		
Ephedraceae	*Ephedra* sp.		C			Obs.			x
Ericaceae	*Xylococcus bicolor* Nutt.		NS			18678	1,055	x	
Euphorbiaceae	*Acalypha californica* Benth.		C			18664	1,220	x	x
Euphorbiaceae	*Bernardia myricifolia* (Scheele) S.Watson		NS			17294	1,040	x	x
Euphorbiaceae	*Croton ciliato-glanduliferum* Ortega		NL	x		17238	870	x	
Euphorbiaceae	*Croton magdalenae* Millsp.	BC/BCS E	RE			17185	635	x	x
Euphorbiaceae	*Ditaxis lanceolata* Pax & K.Hoffm.		C			Obs.			x
Euphorbiaceae	*Euphorbia heterophylla* L.		NL			18651	1,220		
Euphorbiaceae	*Euphorbia lomelii* V.W.Steinm.		C	x	x	Obs.		x	x
Euphorbiaceae	*Euphorbia melanadenia* Torr.		NS			18620	1,300	x	x
Euphorbiaceae	*Euphorbia pediculifera* var. *pediculifera* Engelm.		C			17262	745	x	
Euphorbiaceae	*Euphorbia serpyllifolia* ssp. serpyllifolia Greene		NS			18649	1,220	x	
Euphorbiaceae	*Euphorbia tomentulosa* S.Watson		C			17313	1,030	x	x
Euphorbiaceae	*Euphorbia xanti* Engelm. ex Boiss.	BC/BCS E	RE			Obs.		x	
Euphorbiaceae	*Jatropha cinerea* Müll. Arg.		C			18599	720	x	
Euphorbiaceae	*Tragia moranii* Urtecho.	BC/BCS E	RE			17152	635	x	
Fabaceae	*Acaciella goldmanii* Britton & Rose		NL			17316	1,220	x	
Fabaceae	*Acmispon maritimus* var. *brevivexillus* (Ottley) Brouillet		SL			17191	635		
Fabaceae	*Acmispon strigosus* (Nutt.) D.D.Socoloff.		NS			Obs.			x
Fabaceae	*Astragalus orcuttianus* S.Watson	BC E	SL			17180	635		
Fabaceae	*Astragalus prorifer* M.E.Jones Zoë	BC/BCS E	RE		x	17173	635	x	x
Fabaceae	*Calliandra califórnica* Benth.	BC/BCS E	RE			18608	720	x	x
Fabaceae	*Chamaecrista nictitans* var. *mensalis* (Greenm.) H.S.Irwin & Barneby		NL	x	x	18698	1,010	x	
Fabaceae	*Dalea bicolor* var. *orcuttiana* Barneby	BC/BCS E	RE			18701	1,030	x	x
Fabaceae	*Desmanthus covillei* (Britton & Rose) Wiggins ex Turner		NL	x	x	18654	1,220	x	
Fabaceae	*Ebenopsis confinis* Britton & Rose	BC/BCS E	RE			Obs.		x	
Fabaceae	*Eysenhardtia peninsularis* Brandegee	Local E	LE	x	x	17259	720	x	
Fabaceae	*Lathyrus vestitus* var. *alefeldii* (T.G.White) Isely		SL		x	17241	870		
Fabaceae	*Lupinus cf. concinnus* J.Agardh		NS			Obs.			x
Fabaceae	*Lupinus sparsiflorus* Benth.		NS			17188	635		
Fabaceae	*Macroptilium atropurpureum* (L.) Urb.		NL	x		17196	635	x	

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Fabaceae	*Marina orcuttii* var. *campanea* Barneby	local BC/BCS E	RE			18703	1,220	x	
Fabaceae	*Marina parryi* (Torr. & A.Gray) Barneby		C	x	x	Obs.		x	
Fabaceae	*Melilotus indicus* (L.) All.		C			17183	635		x
Fabaceae	*Mimosa aculeaticarpa* var. *biuncifera* (Benth.) Barneby		C		x	18660	1,220	x	
Fabaceae	*Olneya tesota* A.Gray		C			Obs.		x	
Fabaceae	*Parkinsonia aculeata* L.		C			18607	720	x	
Fabaceae	*Phaseolus filiformis* Benth.		C			18714	1,220	x	x
Fabaceae	*Prosopis articulata* S.Watson		SN			17161	635	x	
Fabaceae	*Rhynchosia precatoria* DC.		NL		x	17247	870	x	
Fabaceae	*Senegalia greggii* Britton & Rose		NS	x	x	17155	635		x
Fabaceae	*Tephrosia vicioides* Schltdl.		NL	x		17337	1,030	x	
Fabaceae	*Vachellia farnesiana* Wight & Arn.		C			17204	635	x	x
Fagaceae	*Quercus oblongifolia* Torr.		NL	x		17287	820	x	
Fagaceae	*Quercus turbinella* Greene		C			17300	1,040		x
Fouquieriaceae	*Fouquieria columnaris*[(3)] Kellogg	near BC/BCS E	RE			Obs.		x	x
Fouquieriaceae	*Fouquieria diguetii* I.M.Johnst.		SN			Obs.		x	
Fouquieriaceae	*Fouquieria splendens* ssp. *splendens* Engelm.		NS			Obs.			x
Gentianaceae	*Centaurium capense* C.R.Broome		NL	x		17267	745		
Gentianaceae	*Zeltnera nudicaulis* (Engelm.) G.Mans.		NL	x		17311	1,030		
Geraniaceae	*Erodium cicutarium* (L.) L'Hér.		C			18706	1,220	x	x
Grossulariaceae	*Ribes quercetorum* Greene		SL			17351	1,235		x
Grossulariaceae	*Ribes tortuosum* Hort. ex K.Kozh	BC/BCS E	RE		x	18618	1,300	x	x
Juncaceae	*Juncus acutus* ssp. *leopoldii* (Parl.) Snogerup		C		x	Obs.		x	
Juncaceae	*Juncus bufonius* var. *bufonius* L.		SL			Obs.			x
Juncaceae	*Juncus xiphioides* E.Mey		SL		x	17277	820		
Krameriaceae	*Krameria erecta* Willd. ex Schult.		C			17346	1,030	x	x
Lamiaceae	*Hedeoma tenuiflorum* Brandegee	local BC E	LE		x	17347	1,260		
Lamiaceae	*Hyptis emoryi* Torr.		C			Obs.		x	
Lamiaceae	*Mentha cf. spicata* L.		C			18597	720	x	
Lamiaceae	*Salvia peninsularis* Brandegee	BC/BCS E	RE	x		17223	640	x	
Lamiaceae	*Stachys ajugoides* var. *rigida* (Nutt. ex Benth.) Jeps. & Hoover		SL			Obs.			
Liliaceae	*Calochortus palmeri* var. *munzii* Ownbey ex Munz		SL		x	17356	1,310		
Liverworts	*Riccia cavernosa* Hoffm.		C			18691	1,010		
Loasaceae	*Mentzelia adhaerens* Benth.	BC/BCS E	RE			Obs.			
Loasaceae	*Petalonyx linearis* Greene		C			18615	720		
Malpighiaceae	*Cottsia gracilis* (A.Gray) W.R.Anderson & C.Davis		C	x	x	Obs.			
Malpighiaceae	*Cottsia scandens* Dubard & Dop		NL			17229	735	x	
Malvaceae	*Abutilon dugesii* S.Watson		NL			17283	820	x	
Malvaceae	*Abutilon incanum* Sweet		C			18693	1,010	x	
Malvaceae	*Abutilon palmeri* A.Gray		C	x	x	Obs.			
Malvaceae	*Ayenia compacta* (L.) Brizicky		C			18646	1,220	x	x

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Malvaceae	*Herissantia crispa* S.Watson		C			18656	1,220	x	x
Malvaceae	*Hibiscus biseptus* Huds.		NL	x	x	17257	870	x	
Malvaceae	*Malva parviflora* (S.Watson) Rose		C			18702	1,220	x	x
Malvaceae	*Malvastrum bicuspidatum* ssp. *bicuspidatum* L.		NL	x	x	18642	1,220	x	
Malvaceae	*Melochia tomentosa* var. *tomentosa* P.Miller.		SN			17157	635	x	
Malvaceae	*Sida abutifolia* L.		NL	x	x	17232	735	x	
Malvaceae	*Sida spinosa* L.		NL	x	x	17330	1,030		
Malvaceae	*Sphaeralcea ambigua* A.Gray		C			17156	635		x
Moraceae	*Ficus palmeri* S.Watson		SN			17253	870	x	x
Nyctaginaceae	*Allionia incarnata* L.		C			18617	720	x	
Nyctaginaceae	*Boerhavia coccinea* Mill.		C			17159	635	x	
Nyctaginaceae	*Boerhavia intermedia* M.E.Jones		C			18690	1,010	x	
Nyctaginaceae	*Commicarpus scandens* Standl.		SN			17224	735	x	
Nyctaginaceae	*Mirabilis laevis* var. *crassifolia* (Choisy) Spellend.		C			17360	1,310	x	
Oleaceae	*Forestiera phillyreoides* Torr.		NL	x		17358	1,310		
Oleaceae	*Menodora scabra* var. *glabrescens* A.Gray		SL		x	17357	1,310		x
Onagraceae	*Camissoniopsis cf. hirtella* (Greene) W.L.Wagner & Hoch		SL			Obs.			
Onagraceae	*Eulobus californicus* Nutt. ex Torr. & A.Gray		NS		x	17218	480		x
Onagraceae	*Oenothera brandegeei* P.H.Raven	BC/BCS E	RE		x	18705	1,220		
Orchidaceae	*Epipactis gigantea* Douglas		C			17222	640		
Orobanchaceae	*Castilleja bryantii* Brandegee	BC/BCS E	RE	x	x	17193		x	
Orobanchaceae	*Castilleja lanata* A.Gray		C			18606	720		x
Orobanchaceae	*Cordylanthus involutus* Wiggins	BC E	SL		x	18624	1,300		
Orobanchaceae	*Orobanche cooperi* A.Heller		C			17215	792		x
Oxalidaceae	*Oxalis californica* (Abrams) R.Knuth		NS			18628	1,220		
Papaveraceae	*Argemone gracilenta* Greene		C			17197	635	x	
Papaveraceae	*Eschscholzia californica* Cham.		SL		x	17261	745		
Passifloraceae	*Passiflora palmeri* Rose	BC/BCS E	RE			17339	1,030		
Phrymaceae	*Mimulus guttatus* Fisch.		C			17265	745	x	x
Plantaginaceae	*Antirrhinum nuttallianum* ssp. *subsessile* (A.Gray) D.M.Thomps.		C			17325	1,030	x	x
Plantaginaceae	*Antirrhinum watsonii* Vasey & Rose		C			Obs.			x
Plantaginaceae	*Bacopa monnieri* L.		SN			Obs.			
Plantaginaceae	*Gambelia juncea* (Benth.) D.A.Sutton		C			18686	1,040	x	x
Plantaginaceae	*Nuttallanthus texanus* (Scheele) D.A.Sutton		C			17317	1,030		x
Plantaginaceae	*Plantago erecta* E.Morris		SL			17343	1,030		
Plantaginaceae	*Plantago patagonica* Jacq.		NS		x	17308	1,030	x	x
Plantaginaceae	*Plantago rhodosperma* Decne.		NS			17321	1,030	x	
Plantaginaceae	*Stemodia durantifolia* var. *durantifolia* SW.		SN			17236	870	x	
Plantaginaceae	*Veronica peregrina* ssp. *xalapensis* L.		NS			17302	1,030		
Plumbaginaceae	*Plumbago zeylanica* L.		NL	x	x	17225	735	x	

Family	Species	Endemism	Distribution	New BC	Sig Coll	Coll No.	Elev	SSF	SA
Poaceae	*Agrostis viridis* Gouan		C			17235	870		
Poaceae	*Aristida adscensionis* Walter		C			Obs.		x	x
Poaceae	*Aristida ternipes* var. *ternipes* Cav.		NL	x	x	18627	1,055	x	
Poaceae	*Bothriochloa barbinodis* (Lag.) Herter		C			18630	1,220	x	
Poaceae	*Bouteloua hirsuta* var. *hirsuta* Lag.		SN			18629	1,220	x	
Poaceae	*Bouteloua reflexa* Swallen		NL	x	x	18697	1,010		
Poaceae	*Bouteloua* sp.		C			Obs.			
Poaceae	*Chloris virgata* SW.		NL		x	18712	1,220	x	
Poaceae	*Cynodon dactylon* (L.) Pers.		C			17174	635	x	x
Poaceae	*Digitaria californica* (Benth.) Henrard		C			18657	1,220	x	
Poaceae	*Echinochloa colona* (L.) Link		C			17320	1,030	x	
Poaceae	*Enneapogon desvauxii* P.Beauv.		C			18700	1,220	x	
Poaceae	*Eragrostis cilianensis* (All.) Vignolo ex Janch.		C			18713	1,220	x	
Poaceae	*Eragrostis intermedia* Hitchc.		C			18626	1,220		x
Poaceae	*Eragrostis pectinacea* var. *pectinacea* Nees		C			17345	1,220	x	
Poaceae	*Heteropogon contortus* Beauv. ex Roem. & Schult.		C			18659	1,220		
Poaceae	*Hilaria cenchroides* Kunth		NL	x	x	18643	1,220	x	
Poaceae	*Leptochloa dubia* (Knuth) Nees		C	x	x	18635	1,220	x	
Poaceae	*Leptochloa fusca* ssp. *fascicularis* (Lam.) Dorn		NL			17319	1,010		
Poaceae	*Leptochloa viscida* (Scribn.) Beal		NL			Obs.		x	
Poaceae	*Melica frutescens* Scribn.		NS			17335	1,030		x
Poaceae	*Muhlenbergia appressa* C.O.Goodd.		C		x	17324	1,220	x	x
Poaceae	*Muhlenbergia arizonica* Scribn.		NL		x	18658	1,220		
Poaceae	*Muhlenbergia emersleyi* Vasey		C			18669	1,195		
Poaceae	*Muhlenbergia microsperma* Trin.		C		x	17285	820	x	
Poaceae	*Muhlenbergia minutissima* (Steud.) Swallen		NS	x	x	18665	1,220		
Poaceae	*Muhlenbergia rigens* Hitchc.		C			18634	1,220		
Poaceae	*Panicum capillare* Hook. & Arn.		SL		x	18663	1,220		
Poaceae	*Paspalum hartwegianum* E.Fourn. ex Hemsl.		C	x	x	18696	1,055		
Poaceae	*Paspalum pubiflorum* Rupr. ex Galleoti		C	x	x	18695	1,010		
Poaceae	*Paspalum vaginatum* SW.		NL	x		17266	745		
Poaceae	*Phragmites australis* (Cav.) Steud.		C			17219	480		
Poaceae	*Polypogon monspeliensis* (L.) Desf.		C			Obs.		x	x
Poaceae	*Schismus barbatus* (L.) Thell.		C			17167	635		
Poaceae	*Setaria parviflora* (Poir.) Kerguélen		NL	x	x	18673	1,055		
Polemoniaceae	*Eriastrum diffusum* (A.Gray) H.Manson		SL			17202	1,030		x
Polygonaceae	*Chorizanthe rosulenta* Reveal	BC/BCS E	RE			17264	745		x
Polygonaceae	*Eriogonum abertianum* Torr.		C	x	x	18699	1,220		
Polygonaceae	*Eriogonum elongatum* var. *areorivum* Reveal	BC/BCS E	RE			18605	720	x	x

Family	Species	Endemism	Distribution	New BC	Sig Coll	Coll No.	Elev	SSF	SA
Polygonaceae	*Eriogonum fasciculatum* var. *flavoviride* Munz & I.M.Johnst.		NS			17170	635		x
Polygonaceae	*Eriogonum orcuttianum* S.Watson	BC/BCS E	RE			17296	1,040	x	
Polygonaceae	*Eriogonum pilosum* S.Stokes	BC/BCS E	RE		x	17363	635		
Polygonaceae	*Eriogonum wrightii* var. *membranaceum* S.Stokes		SL			17303	1,030		x
Polygonaceae	*Persicaria hydropiperoides* Small		NL	x		17239	870		
Pontederiaceae	*Heteranthera limosa* Vahl		NL	x	x	18688	1,010	x	
Portulacaceae	*Portulaca suffrutescens* Engelm.		SN			18680	1,055	x	
Potamogetonaceae	*Potamogeton foliosus* Raf.		C			18596	720	x	
Pteridaceae	*Adiantum capillus-veneris* L.		C			17290	820	x	
Pteridaceae	*Astrolepis sinuata* SW.		C			18631	1,220	x	x
Pteridaceae	*Cheilanthes lindheimeri* Hook.		C	x	x	17341	1,030	x	
Pteridaceae	*Cheilanthes wrightii* Hook.		NL			18708	1,220	x	
Pteridaceae	*Notholaena californica* ssp. *leucophylla* Windham		C			17216	480		
Pteridaceae	*Pellaea truncata* Goodd.		C			17220	480	x	
Pteridaceae	*Pellaea wrightiana* Hook.		C			17281	820	x	
Pteridaceae	*Pentagramma triangularis* ssp. *maxonii* (Weath.) Yatsk.		C			17278	820	x	
Ranunculaceae	*Clematis lasiantha* Fisch.		C			17359	1,310	x	
Ranunculaceae	*Delphinium cardinal* Hook.		SL			17153	635		
Ranunculaceae	*Delphinium parryi* ssp. *parryi* A.Gray		SL		x	17355	1,310		
Rhamnaceae	*Colubrina californica* I.M.Johnst.		C			Obs.		x	
Rhamnaceae	*Condalia brandegeei* I.M.Johnst.	BC/BCS E	RE			17270	1,220	x	
Rhamnaceae	*Condalia globosa* var. *globosa* I.M.Johnst.		C			Obs.			
Rhamnaceae	*Condalia globosa* var. *pubescens* I.M.Johnst.		C			17203	635		
Rhamnaceae	*Rhamnus insula* Kellogg	BC/BCS E	RE			17295	1,300	x	x
Rhamnaceae	*Sageretia wrightii* S.Watson		NL	x	x	18639	1,220		
Rhamnaceae	*Ziziphus obtusifolia* var. *canescens* (A.Gray) M.C.Johnst.		C			17186	635	x	x
Rosaceae	*Prunus fremontii* S.Watson		NS			17349	1,235	x	x
Rosaceae	*Prunus ilicifolia* ssp. *ilicifolia* (Nutt. ex Hook. & Arn.) Walp.		NS			17228	735	x	x
Rosaceae	*Prunus ilicifolia* ssp. *lyonii* (Eastw.) P.H.Raven		C			17279	820	x	
Rosaceae	*Vauquelinia californica* ssp. *californica* (Torr.) Sarg.	BC/BCS E	RE			17286	820	x	x
Rubiaceae	*Diodia teres* var. *angustata* A.Gray		NL	x	x	18684	1,100		
Rubiaceae	*Galium moranii* ssp. *aculeolatum* (Dempster) Dempster	local BC/BCS E	RE	x	x	18719	1,055	x	
Rubiaceae	*Galium stellatum* var. *eremicum* Hilend & J.T.Howell		NS			17297	1,040		x
Ruscaceae	*Nolina palmeri* var. *palmeri* S.Watson		SL		x	18666	1,220		
Salicaceae	*Salix bonplandiana* Kunth.		C			17248	870		
Sapindaceae	*Aesculus parryi* A.Gray	BC E	SL		x	17151	625		

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Sapindaceae	*Cardiospermum corindum* L.		C			Obs.		x	x
Sapindaceae	*Dodonaea viscosa* Jacq.		C			17182	635	x	x
Schoepfiaceae	*Schoepfia californica* Brandegee		NL			18683	1,100	x	
Scrophulariaceae	*Penstemon eximius* Keck	BC/BCS E	RE			17181	635		x
Selaginellaceae	*Selaginella bigelovii* Underw.		C			18600	720	x	x
Simmondsiaceae	*Simmondsia chinensis* C.K.Schneid.		C			18601	720	x	x
Solanaceae	*Capsicum annuum* var. *aviculare* (Dierb.) D'Arcy & Eshbaugh		NL	x	x	17252	870		
Solanaceae	*Datura discolor* Bernh.		C			Obs.		x	x
Solanaceae	*Lycium* sp.		C			Obs.			
Solanaceae	*Nicotiana obtusifolia* M.Martens & Galeotti		C			17164	635	x	x
Solanaceae	*Petunia parviflora* Juss.		C			17192	635		
Solanaceae	*Physalis crassifolia* Benth.		C	x	x	17260	745	x	x
Solanaceae	*Physalis pubescens* R.Br.		NL			17244	870	x	
Solanaceae	*Solanum douglasii* Dunal		NS			17284	745	x	x
Solanaceae	*Solanum hindsianum* Benth.		C			Obs.		x	x
Stegnosperma-taceae	*Stegnosperma halimifolium* Benth.		C			18603	720	x	x
Thelypteridaceae	*Thelypteris puberula* var. *sonorensis* A.R.Sm.		C			17243	870		
Themidaceae	*Dichelostemma capitatum* ssp. *pauciflorum* (Benth.) Alph. Wood		NS			17361	1,310		x
Typhaceae	*Typha domingensis* Pers.		C			18681	1,055		
Urticaceae	*Parietaria hespera* var. *hespera* Hinton		C			17179	635	x	x
Verbenaceae	*Lantana hispida* Kunth		NL	x	x	18685	1,100	x	
Verbenaceae	*Verbena gooddingii* Briq.		C			17348	1,260	x	x
Violaceae	*Hybanthus verticillatus* (Ortega) Baill.		NL	x	x	17212	635		
Viscaceae	*Phoradendron brachystachyum* Nutt.		NL			18717	1,220		
Viscaceae	*Phoradendron californicum* Nutt.		C			17209	635	x	x
Viscaceae	*Phoradendron villosum* Nutt.		C			18636	1,220		
Vitaceae	*Vitis girdiana* Munson		C			17254	870		
Zygophyllaceae	*Kallstroemia californica* Vail		C			18718	1,220		

Footnotes:

[(1)] *Ambrosia carduacea*: This species is known to have at least one population in Sonora, but it is definitely most common in BC/BCS.

[(2)] *Ambrosia magdalenae*: This species is known to have at least one population in Sonora, at least on Tiburon Island, but it is definitely most common in BC/BCS.

[(3)] *Fouquieria columnaris*: This species is known to have at least 2 small populations in Sonora along the coast, but it is definitely most common in BC/BCS.

[(4)] *Viguiera purisimae*: This species is known to have at least one population in San Diego County, but other is restricted to BC/BCS.