Title
Exchange of medicinal plant information in California missions.

Permalink
https://escholarship.org/uc/item/59v1t8sz

Journal
Journal of ethnobiology and ethnomedicine, 16(1)

ISSN
1746-4269

Authors
McBride, Joe Rayl
Cavero, Rita Yolanda
Cheshire, Anna Liisa
et al.

Publication Date
2020-06-15

DOI
10.1186/s13002-020-00388-y

Peer reviewed
Exchange of medicinal plant information in California missions

Joe Rayl McBride1*, Rita Yolanda Cavero2, Anna Liisa Cheshire3, María Isabel Calvo4 and Deborah Lea McBride5

Abstract

Background: Missions were established in California in the eighteenth and nineteenth centuries to convert Native Americans to Christianity and enculturate them into a class of laborers for Californios (Spanish/Mexican settler). The concentration of large numbers of Native Americans at the Missions, along with the introduction of European diseases, led to serious disease problems. Medicinal supplies brought to California by the missionaries were limited in quantity. This situation resulted in an opportunity for the sharing of knowledge of medicinal plants between the Native Americans and the Mission priests. The purpose of this study is to examine the degree to which such sharing of knowledge took place and to understand factors that may have influenced the sharing of medicinal knowledge. The study also examines the sharing of medicinal knowledge between the Native Americans and the Californios following the demise of the California Missions.

Methods: Two methods were employed in the study: (1) a comparison of lists of medicinal plants used by various groups (e.g., Native American, Mission priests, Californios) prior to, during, and after the Mission period and (2) a close reading of diaries, reports, and books written by first-hand observers and modern authorities to find accounts of and identify factors influencing the exchange of medicinal information.

Results: A comparison of the lists of medicinal plants use by various groups indicated that only a small percentage of medicinal plants were shared by two or more groups. For example, none of the 265 taxa of species used by the Native Americans in pre-Mission times were imported into Spain for medicinal use and only 16 taxa were reported to have been used at the Missions. A larger sharing of information of medicinal plants took place in the post-Mission period when Native Americans were dispersed from the Missions and worked as laborers on the ranches of the Californios.

(Continued on next page)
Background
The migration of people to North America began about 21,000-40,000 years BP over a great land bridge between Siberia and Alaska [1]. Evidence of human settlement dates from about 13,000 years BP on the Channel Islands off the coast of California and from about 10,330 years BP on the mainland near San Luis Obispo (2]). These early immigrants moved along a coastal route from Alaska either on foot or by boat. Later, Native Americans migrated to coastal California from inland California and from more eastern areas of North America. They brought with them about 100 languages belonging to seven major language groups [3]. The immigrants also brought with them knowledge of medicinal herbs used in their homelands. For example, roots of the species in genus *Rubus* (blackberries) were used to control diarrhea by people in Asia as well as by Native Americans living in different parts of North America [4]. When people immigrated to California, they adopted local species of *Rubus* to combat diarrhea [5]. Once in California, the immigrants adapted new species for medicinal use. The Pomo, for example, used the bark of the California buckeye (*Aesculus californica*), a California endemic, to treat snakebites [6]. Various researchers have examined medicinal use of plants by Native Americans in California since the nineteenth century [7–19]. These studies served as important references in the study reported here.

The culture and economy of Native Americans was changed significantly beginning in 1769 with the European colonization of California. An integral part of the Spanish colonization process was the establishment of a system of Missions (Fig. 1). The first Mission was located in what was to become the city of San Diego. Subsequently, Franciscan priests supported by the military moved northward along the California coast to establish a total of 21 Missions [20]. These Missions were established to christianize the Native Americans and to prepare them to serve as a peasant class in the new Spanish territory [21].

In the early Mission period, the priests staffing the Missions were mostly from Spain. The Franciscan priests who established and staffed Missions came primarily from Spain [22, 23]. Thirty-six (72%) of the priests came from northern Spain (Basque territory and the adjacent provinces, Navarra mainly), one from central Spain (2%), and none from the south of Spain. The remaining priests were from Mallorca (8 individuals, 16%) and Mexico (5 individuals, 10%). The Basque territory, Navarra, and Mallorca were the homelands of one-half of the priest at the early California Missions. These priests brought with them knowledge of medicinal herbs used in their homelands. They also brought seeds and cuttings of plants [21] used for medicinal purposes in Mexico and Spain [24].

The California Missions were under the control of Spain from 1769 to 1821. During this time the Native Americans who were converted to Christianity at the Missions were known to as *neophytes*. The medical care of the *neophytes*, not being immune to European diseases, succumbed in large numbers to epidemics of measles and smallpox [25]. Contagious native ailments (e.g., colds, dysentery) also spread among the *neophytes* due to their congregation in large numbers at the Missions. The priests responded to the increasing numbers of sick *neophytes* by establishing hospitals at many of the Missions. Although there was a significant power imbalance between the priests and the *neophytes*, the situation called for a sharing of information about medicinal herbs and the employment of *neophytes* in the treatment of the sick. *Enfermeros* (neophytes selected by the priests to serve as nurses) were assigned to care for the sick in these hospitals. The *enfermeros* used medicinal herbs and Spanish medicine to treat the *neophytes*. Medicinal

---

**Conclusions:** Sharing of information concerning medicinal plants did occur during the Mission period, but the number of documented species was limited. A number of possible factors discouraged this exchange. These include (1) imbalance of power between the priests and the Native Americans, (2) suppression of indigenous knowledge and medical practices by the Mission priests, (3) language barriers, (4) reduction of availability of medicinal herbs around the Mission due to introduced agricultural practices, (5) desire to protect knowledge of medicinal herbs by Native American shaman, (6) administrative structure at the Missions which left little time for direct interaction between the priests and individual Native Americans, (7) loss of knowledge of herbal medicine by the Native Americans over time at the Missions, and (8) limited transportation opportunities for reciprocal the shipment of medicinal plants between California and Spain. Three possible factors were identified that contributed to a greater sharing of information between the Native Americans and the Californios in the post-Mission period. These were (1) more one-to-one interactions between the Californios and the Native Americans, (2) many of the Californios were mestizos whose mothers or grandmothers were Native Americans, and (3) lack of pressure on the part of the Californios to suppress Native American beliefs and medicinal practices.

**Keywords:** Medicinal plants, Native Americans, California Missions, Spanish priests, Information transfer, Californios
herbs used by the Native Americans were collected from around the Missions [21], while Spanish medicinal supplies were shipped periodically to California from Mexico [7]. The quantity of medicinal supplies imported from Mexico often became inadequate to treat the increasing number of neophytes succumbing to both native and exotic diseases. At times of shortages of medical supplies, the priests and enfermeros exchanged knowledge of medicinal plants to broaden the supply of medicines to treat the sick [26]. Neophytes were sometimes dispatched by the priests to collect medicinal plants from the wild (Engelhardt 1922).

During the Mission period, seeds of plants for the mission gardens periodically arrived via ships from Europe, South America, and Mexico. Walled gardens, known as huertas, were an essential part of the Mission landscapes. They provided growing space for food plants, as well as trees, flowers, and medicinal herbs. Plants grown in the huertas were used by both the priests and the Native Americans. The importation of seeds and other goods was curtailed after 1810 when shipping from Spain and the Spanish colonies in the New World was interrupted by the rebellion in Mexico [21]. Mexico gained its independence from Spain in 1821. Following the Mexican rebellion, the independent Mexican government exerted its authority over the Missions. The Mexican authorities attempted to expel the Franciscan priests from the Missions, sell or transfer Mission lands to Mexican citizens, and convert the Mission churches to local parish churches. This process was known as “secularization.” Some missions were abandoned while others assumed the role of parish churches. Mission in more remote locations in California still housed limited number of Native American neophytes, but most neophytes were transferred to nearby ranches during the Mexican period (1821-1848) were they worked as laborers. Some Native Americans were paid modest salaries for their labor, while most worked for food and a place to live. Individual Native American families and extended families lived on the ranches. A striking contrast to the hundreds who had resided at the missions. The relocation of Native Americans to local ranches provided an opportunity for the sharing
of information concerning medicinal plants between the Native Americans and the Californios.

The secularization period ended in 1848 with the annexation of California by the USA following the war with Mexico. Following the annexation, most of the Missions were abandoned and began to fall into disrepair. Without active parishes to maintain the Missions, the old buildings fell prey to the weather. Their roofs gave way first, exposing the soluble adobe walls to the rain. Many of the old buildings were abandoned as unsafe or unsalvageable, many were torn down. For many decades the decay of buildings at the Missions, the missions continued until citizens began to take an interest in them and to propose their restoration. Old records, drawing, and photographs were studied to perform reconstruction of historic buildings, patios, and gardens. At several Missions, medicinal plants were incorporated into the restored gardens.

The purpose of this study is to examine the exchange of medicinal plant information at the California Missions during the Mission and post-Mission periods. Specifically, the exchange between the Native Americans and the priests during the Mission period and the exchange between the Native Americans and the Californios during and following the secularization of the Missions. We hypothesize that an exchange of information on medicinal plants can be identified by comparing the numbers of taxa from Spain that were introduced into California and adopted for use by the Native Americans and the number of taxa from California that were introduced into Spain and adopted by Spanish citizens for medicinal purposes. Furthermore, the exchange of information concerning medicinal plants between the Native Americans and the Californios can be identified by the number of medicinal taxa from Spain and Mexico that were introduced into California and used by the Native Americans and the number of California taxa adopted for medicinal use by the Californios.

Methods

Two methods were employed in this study: (1) comparison of lists of medicinal plants used by Native American in California before the Mission period, medicinal plants used in Spain, medicinal plants used in Mexico before it gained its independence from Spain, and medicinal plants used by Californios and Native Americans in the post-Mission period and (2) a close reading of diaries, journals, reports, and books written by (i) first-hand observers during the Mission and post-Mission periods and, (ii) modern anthropologists, ethnobotanists, and historians to find accounts of the sharing of information about medicinal plants and to identify reasons why an exchange of information may or may not have taken place.

The lists of medicinal plants and their uses were assembled from a number of sources (Table 1) for the pre- and Mission period (before and during colonization) and the post Mission Period (during and after secularization).

The data provided were grouped into 14 categories depending on the pathology they treated [37, 38, 44]: (1) cardiovascular diseases; (2) depurative; (3) dermatology; (4) digestive or gastrointestinal problems; (5) metabolic syndromes; (6) infections; (7) skeletal-muscular system; (8) nervous system; (9) senes (eye and ear problems); (10) gynecology; (11) respiratory complaints; (12) urology; (13) ritual procedures; (14) various other ailments (Table 2). Botanical family classification and nomenclature for species names were authenticated according to Hickman [45], Stevens [46] and [47] (www.ipni.org).

To determine if any California species were introduced in Spanish and/or European botanical gardens a literature review was carried conducted [48–54]. Several databases were also consulted: www.floraiberica.es; www.fitoterapia.net [55–57].

A comparison of the assembled lists identified medicinal plant taxa that were used in two different areas (e.g., California and Spain). If taxa native to California were reported to be used in present-day Spanish medicinal gardens, then we assumed information of the medicinal use of these plants had been shared between the Native Americans and the Spanish priest. Likewise, if taxa native to Spain were present in herb gardens at the Missions or reported to have been used by Native Americans.

Table 1 Bibliographic sources used to assemble the lists of medicinal plants used in different areas

| Area                        | Source                                      |
|-----------------------------|---------------------------------------------|
| California (Native Americans) | Barrows [27]                               |
|                             | Bean and Saubel [8]                         |
|                             | Faber and Lasagna [28]                     |
|                             | Heinsen [29]                               |
|                             | Lightfoot and Parrish [30]                 |
|                             | Mead [31]                                  |
|                             | Timbrook [18]                              |
|                             | Wilken-Robertson [32]                      |
| Spain                       | Akerreta et al. [33, 34]                    |
|                             | Alarcón et al. [35]                        |
|                             | Carrió and Vallés [36]                     |
|                             | Cavero et al. [37, 38]                     |
|                             | Menendez-Baceta et al. [39]                |
| Mexico (Viceroyalty of New Spain) | Argueta and Gallardo [40]         |
|                             | Heinrich et al. [41]                       |
|                             | Simpson [42]                               |
| California (Californios)     | Beebe and Senkewicz [43]                   |
|                             | Weber [19]                                 |
Americans during the post-Mission period, we assumed that sharing of knowledge had taken place.

**Results**

A total of 822 taxa belonging to 136 botanical families were identified (Table 3). Seven hundred twelve of them had been used during pre- and Mission Period; 265 of them were plants used by Native Americans in California before colonization, 448 taxa were used for medicinal purposes in Spain or in Mexico (Table 3). The most commonly used plants were employed to treat sores, wounds, and skin problems, for respiratory diseases, gastrointestinal tract problems, reproductive affections, and cardiovascular diseases (Fig. 2). The preparation and application of plant materials for medicinal purposes by the Native Americans in California included the direct application of leaves to the affected area (e.g., *Rubus ursinus* Cham. & Schldl—treat diarrhea; application of a poultice prepared from the plant material (e.g., *Malva parviflora* L.—treat wounds), eating the plant or plant part (e.g., *Rorippa nasturtium* (L.) Hayek—treat liver ailments), bathing the skin with water in which to plant had been boiled (e.g., *Wyethia helenioides* (Engelm.) Cov., *Larrea tridentata* (DC.) Cov., *L. tenuifolia* (Hook. & Arn.) C.A. Mey.—treat pain). Stringent application of leaves to the affected area (e.g., *Rubus californica* Eschsch.—treat skin problems, for respiratory diseases), the Native Americans in California included the direct application of plant materials for medicinal purposes by the Spanish priests some of these species would have been subsequently introduced to Spain as had medicinal plants from Mexico and South America.

Twelve of 265 taxa used by Native Americans were also used in Mexico: *Adiantum aleuticum* (C. Mewyer) Steudel—treat pain).

We assumed if information concerning California medicinal plants was shared by the Native Americans with the Spanish priests some of these species would have been subsequently introduced to Spain as had medicinal plants from Mexico and South America.
| Botanical family | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|-----------------|-------------------|--------|--------------------|---------------|--------------------|
| Acanthaceae     | Acanthus mollis L. | Europe | 3                  |               |                    |
|                 | Justicia spicigera Schltdl. | Mexico | 3, 4               |               |                    |
| Adoxaceae       | Sambucus ebulus L. | Eurasia | 3                  |               |                    |
|                 | Sambucus sp.       | California | 3, 11               | 3, 6, 10      |                    |
|                 | Sambucus mexicana C. Pedr. [S. nigra L. ssp. caerulea (Raf. R. Bolli)] | California, Mexico | 1, 3, 4, 6, 7, 8, 10, 11 | 7, 10 | 8, 11 |
|                 | Sambucus nigra L. ssp. nigra | Europe, Africa | 1, 2, 3, 4, 6, 7, 8, 9, 10, 11 | | |
| Agavoideae      | Agave sp.          | California and Mexico | 4           |               |                    |
|                 | Agave americana L. | Mexico, USA introduced from Europe | 11          |               |                    |
| Amaranthaceae   | Amaranthus hybridus L. | Eastern U.S.A. introduced from Europe | 1, 3, 4 | | |
|                 | Atriplex sp.       | California | 10                   |               |                    |
|                 | Atriplex lentiformis (Torrey) S. Watson | California | 3, 9, 10 | | |
|                 | Beta vulgaris L. var. conditiva Alef. | Eurasia, Africa | 1               |               |                    |
|                 | Beta vulgaris L. var. mantima (L.) Moq. | Eurasia, Africa | 5               |               |                    |
|                 | Chenopodium ambrosioides L. [Dysodia ambrosioides (L.) Mosyakin & Clemants] | California | 4, 10           |               |                    |
|                 | Chenopodium californicum (S. Watson) S. Watson | Mexico | 4                  |               | 3                  |
|                 | Chenopodium grevolesens Wild. | Mexico | 4, 10              |               |                    |
|                 | Chenopodium rubrum L. [Oxybasis rubra (L.) S. Fuentes, Uotila & Borsch] | California | 3               |               |                    |
|                 | Dysphania ambrosioides (L.) Mosyakin & Clemants | Mexico | 3               |               |                    |
|                 | Dysphania botrys (L.) Mosyakin & Clemants | Europe | 3               |               |                    |
|                 | Iresine celosia L. | Mexico | 3, 6, 12           |               |                    |
| Amaryllidaceae  | Allium sp.         | California | 3, 4, 11           | 10, 11        |                    |
|                 | Allium cepa L.     | Asia introduced from Europe | 1, 3, 4, 11, 12 | | |
|                 | Allium porrum L.   | Europe | 1, 4, 11           |               |                    |
|                 | Allium sativum L.  | Asia introduced from Europe | 1, 3, 4, 5, 6, 7, 8, 10, 11 | | |
| Anacardiaceae   | Mangifera indica L. | India | 4                  |               | 9                  |
|                 | Pistacia lentiscus L. | Mediterranean region | 3, 4           |               |                    |
|                 | Rhus aromatic L. (R. tribbata Nutt.) | California | 4 | | |
|                 | Rhus ovate S. Watson | California | 1, 10 | | |
|                 | Schinus molle L.   | South America | 4, 6, 7, 9, 10 | | |
|                 | Spondias purpurea L. | Mexico | 4, 6, 9, 10 | | |
|                 | Toxicodendron diversilobum (Torrey & A. Gray) E. Greene | California | 1, 3, 4, 6, 9 | | 3 |
|                 | Toxicodendron venenosum (S. Watson) Rydb. var. venenosum (Zizyadenus venenosus S. Watson) | California | 3 | | |
| Anacardiaceae   | Malosma laurina (Nutt.) Abrams | California | 6 | | |
| Annonaceae      | Annona cherimola Mill. | South America | 4, 6 | | |
|                 | Annona reticulate Linn. | Mexico | 3, 4 | | |
| Apocynaceae     | Angelic和平 L. | California | 3, 4, 7, 8 | | |
|                 | Apium graveolens L. | Europe | 1, 2, 11, 12 | | 4 |
|                 | Aralia californica S. Watson | California | 3 | | |
Table 3 Medicinal plants used before, during and after the Mission period, and present time at Mission Gardens. The numbers refer to emic and etic illness groupings (see Table 2) *(Continued)*

| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|------------------|-------------------|--------|--------------------|----------------|---------------------|
| Carum carvi L.   | Europe, naturalized in California |  |  |  |  |
| Coriandrum sativum L. | Europe, naturalized in California |  |  |  |  |
| Crithmum maritimum L. | Eurasia, Africa | 2, 4, 14 |  |  |  |
| Daucus carota L.  | Eurasia | 1, 3, 9 |  |  |  |
| Daucus pusillus Michaux | California | 1, 3, 8, 11 | 1, 8, 10, 11 |  |  |
| Eryngium campestre L. | Europe | 2, 10 |  |  |  |
| Foeniculum vulgare Mill. | Europe | 1, 2, 3, 4, 10, 11 | 4 |  |  |
| Hedera helix L.    | Europe | 3, 4, 10 | 3, 10 |  |  |
| Lomatium californicum (Torey & A. Gray) Mathias & Constance (Leptotaenia californica Nutt.) | California | 4, 7, 8, 10, 11 |  |  |  |
| Lomatium utriculatum (Torey and Gray) J. Coulter & Rose | California | 11, 13 |  |  |  |
| Petroselinum crispum (Mill.) Fuss | Europe | 2, 3, 4, 5, 8, 9, 10, 14 | 4, 13 |  |  |
| Pimpinella anisum L. | Asia Minor, introduced from Europe | 4 |  |  |  |
| Apocynaceae        | Gonolobus niger (Cav.) R. Br. | Mexico | 6 | |  |
| Gomotisium L.      | Europe |  |  |  |  |
| Plumeria rubra L.  | Eurasia, Africa | 3 |  |  |  |
| Saniculargua J. Coult. & Rose | California | 5 |  |  |  |
| Arecaceae          | Chamaerops humilis L. | Europe | 3, 4 |  |  |
| Cocos nucifera L.  | Malaysia | 6 |  |  |  |
| Aristolochiaceae   | Aristolochia maurorum L. | Mexico | 8 |  |  |
| Aristolochia monticola Brandegee | Mexico | 3, 4 |  |  |  |
| Asclepiadaceae     | Asclepias sp. | California | 4 |  |  |
| Asclepias curassavica L. | Mexico | 3, 9 | 9 |  |  |
| Asclepias eriocarpa Benth. | California | 3, 4, 10 |  |  |  |
| Asclepias lemonnui A. Gray | Mexico, South West USA | 11 |  |  |  |
| Asparagaceae       | Asparagus acutifolius L. | Mediterranean region | 2 |  |  |
| Asparagus horridus L. in J.A.Murray | Europe | 12 |  |  |  |
| Camassia sp.       | California | 3, 7 |  |  |  |
| Chlorogalum pomeridianum (DC.) Kunth | California | 2, 3, 5 | 9, 11 |  |  |
| Maianthemum racemosum (L.) Link [Smilacina racemosa (L.) Link] | California | 7 |  |  |  |
| Ruscus aculeatus L. | Eurasia, Africa | 1 |  |  |  |
| Urginea maritima (L.) Baker | Eurasia, Africa | 7 |  |  |  |
| Yucca baccata Torrey | California | 3 |  |  |  |
| Yucca schidigera Roezl ex Ortgies | California, Mexico | 1, 3, 4, 7, 8 |  |  |  |
| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|------------------|-------------------|--------|-------------------|----------------|-------------------|
| Asphodelaceae     | Aloe sp.          | California | 1, 3, 4 |               |                   |
|                   | Aloe maculata All.| Africa introduced from Europe | 3, 7 |               |                   |
|                   | Aloe vera (L.) Burm. fil. | Asia introduced from Europe | 3 | | |
| Aspleniaceae      | Asplenium trichomanes L. ssp. trichomanes | Eurasia, California | 10, 11 | | |
|                   | Ceterach officinarum Wild. | Eurasia, Mediterranean | | | 1, 4 |
| Asteraceae        | Acamptopappus sphaerocephalus (A. Gray) A. Gray | California | 11 | | |
|                   | Achillea sp.      | California | 9, 11 | | |
|                   | Achillea ageratum L. | Europe | 6, 8 | | |
|                   | Achillea millefolium L. ssp. millefolium | California, Europe | 1, 3, 9, 10, 11 | 1, 3, 4, 7, 8, 10, 11 | |
|                   | Acoutia microcephala DC. [Pennisetum microcephalum (DC) A. Gray] | California | 1, 3, 4, 10, 11 | | |
|                   | Agarathina sp.    | California | 3, 11 | | 3, 11 |
|                   | Ageratina adenophora (Spreng.) R.M.King & H.Rob. | Mexico | 3, 11 | | |
|                   | Ambrosia monogyna Torr. & Gray | California | 3, 11 | | |
|                   | Ambrosia pilostachya DC. | California | 3, 7 | | |
|                   | Amphipterygium adstringens (Schidt) Schiede ex Standl. | Mexico | 1, 4, 7 | | |
|                   | Anacyclus clavatus Pers. | Europe | 4, 8 | | |
|                   | Anthemis arvensis L. ssp. arvensis | Eurasia, Africa | 1, 4, 8, 9 | | |
|                   | Arctium minus Beth. | Europe | 3 | 7 | |
|                   | Artemisia sp.     | California | 4, 5, 7, 9, 10, 11 | | |
|                   | Artemisia abrotanum L. | Eurasia, Africa | 3 | | |
|                   | Artemisia absinthium L. | Europe | 4 | | |
|                   | Artemisia alba Turra | Europe | 4 | | |
|                   | Artemisia californica Less. | California | 3, 5, 7, 8, 9, 10, 11 | | |
|                   | Artemisia cana Pursh ssp. bolanderi (A. Gray) G. Ward | California | 1, 3, 8 | | |
|                   | Artemisia douglasiana Besser (A. heterophylla Nutt.) | California | 1, 3, 4, 5, 6, 7, 8, 9, 10, 11 | | |
|                   | Artemisia dracunculoides L. | California, Europe | 1, 4, 6, 7, 8, 9, 11 | 8 | |
|                   | Artemisia herba-alba Asso | Europe | 11 | | |
|                   | Artemisia mexicana Wild. | Mexico and South West USA | 4, 7 | | |
|                   | Artemisia ludoviciana Nutt. | California, Mexico | 3, 8, 10, 11 | 4, 6, 10, 11 | 4 |
|                   | Artemisia pycnocephala DC. | California | | | |
|                   | Artemisia tridentata Nutt | California | 3, 4, 8, 10, 11 | | |
|                   | Baccharis glutinosa Pers. [B. salicifolia (Ruiz Lopez & Pavara) Pers.] | California, Mexico | 3, 9, 11, 13 | 3, 4, 11 | |
|                   | Baccharis pilulans DC. | California | 3, 11 | | |
|                   | Baccharis plummerae A. Gray | California | 8, 13 | | |
|                   | Baccharis pteronioides A. Gray | Mexico, South West USA | 3, 7, 8, 11 | | |
|                   | Baccharis sarothroides A. Gray | California | 7, 10 | | |
|                   | Balkanorhiza sagittata (Pursh) Nutt. | California | 4, 6, 8, 10, 11 | 8, 10, 11 | |
|                   | Bidens aurea (Aiton) Sherff | Mexico | 4 | | |
|                   | Calea urticifolia (Mill.) DC. | Mexico | 6, 12 | | |
Table 3 Medicinal plants used before, during and after the Mission period, and present time at Mission Gardens. The numbers refer to emic and etic illness groupings (see Table 2) (Continued)

| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|-------------------|-------------------|--------|--------------------|----------------|---------------------|
| *Calea zacatechichi* Schltdl. (C. ternifolia Kunth.) | Mexico | 4, 12 |
| *Calendula arvensis* L. | Europe | 3, 8, 10, 11 |
| *Calendula officinalis* L. | Europe, naturalized in California | 3 |
| *Carduus pycnocephalus* L. ssp. pycnocephalus | Europe | 3 |
| *Carlina acanthifolia* All. ssp. cynara (Pourret ex Duby) Rouy | Europe | 13 |
| *Centaurea aspera* L. | Europe | 1, 5 |
| *Chamaemelum nobile* (L.) All. | Europe, naturalized in California | 2, 3, 4, 8, 9, 10, 11, 14 |
| *Chamomilla recutita* (L.) Rauschert (Matricaria chamomilla L.) | Europe, naturalized in California | 4 |
| *Chrysanthemum balsamita* L. (Tanacetum balsamita L.) | Europe, naturalized in California | 4 |
| *Chopelia nutans* (L.) Polak. | California | 3, 7 |
| *Corethrogyne filaginifolia* (Hook. & Arn.) Nutt. | California | 1, 10, 11 |
| *Cynara scolymus* L. | Mediterranean region | 4, 5 |
| *Deinandra fasciculata* (DC.) Greene [Hemizonia fasciculata (DC) Tort. & A. Gray] | California | 8 |
| *Encelia californica* Nutt. | California | 1, 9 |
| *Encelia farinose* Torrey & A. Gray | California | 1, 9 |
| *Ericameria arboreascens* (A. Gray) E. Greene | California | 1, 3, 4, 5, 7, 9, 10, 11 |
| *Ericameria lancifolia* (A. Gray) Shinn. | California | 11 |
| *Ericameria nauseosa* (Pall. Ex Pursh) G. L. Nesom & Baird [Oligocephala nauseosa M. E. Jones; Chrysothamnus nauseus (Pall. Ex Pursh) Britton] | California | 1, 9, 10 |
| *Ericameria palmeri* (A. Gray) H. M. Hall var. pachyplepis (H. M. Hall) G. Nesom [E. acutifolius (Greene) S. F. Blake; Haplopappus palmeri A. Gray; Haplopappus palmeri Gray] | California | 3, 10, 11 |
| *Engronon canadensis* L. [Conyza canadensis (L.) Cronq.] | California | 4, 8, 13 |
| *Engronon foliosus* Nutt. var. foliosus (E. foliosus Nutt. var. stenophyllus; *E. utahensis* Gray) | California | 11 |
| *Engronon kawinskiianus* DC. | Mexico | 4, 6, 14 |
| *Enophyllum confertiflorum* (DC.) A. Gray | California | 7 |
| *Eupatorium perfoliatum* L. | Eastern USA | 3, 11 |
| *Franseria ambrosioideae* (Cav.) Payne | California | 3, 7 |
| *Gnaphalium sp.* | California | 10, 12 |
| *Gnaphalium bicolor* Bioletti | California | 1, 4 |
Table 3 Medicinal plants used before, during and after the Mission period, and present time at Mission Gardens. The numbers refer to emic and etic illness groupings (see Table 2) (Continued)

| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|-------------------|-------------------|--------|--------------------|----------------|--------------------|
| Pseudognaphalium bioletti (Bioletti) A. Anderb. | Grindelia camporum E. Greene (G. robusta Nutt.) | California | 1, 3, 4, 10, 11 | | |
| Pseudognaphalium canescens DC. | Grindelia hirsutula Hook. & Arn. | California | 1, 3, 10, 11 | | |
| Pseudognaphalium stricta DC. (G. latifolia Kellogg) | Gutierrezia microcephala (DC.) A. Gray | California | 3 | | |
| Helium mexicanum Kunth | Helenium puberulum DC. | California | 3, 6, 10, 11 | | |
| Helianthus annuus L. | Helichrysum italicum G. Don f. | Mediterranean region | 4 | | |
| Helichrysum stoechas (L.) Moench spp. stoechas | Heterotheca grandiflora Nutt. | California | 3, 6 | | |
| Heterotheca inuloides Cass. | Inula montana L. | Western Mediterranean | 3 | | |
| Inula viscosa (L.) Ait. | Jasonia glutinosa (L.) DC. | Mediterranean region | 3 | | |
| Jasonia tuberosa (L.) DC. | Leptosyne maritima (Nutt.) A. Gray | California | 4 | | |
| Matricaria discoidea DC. | Madia sativa Molina | California | 7, 10 | 7 | |
| Matricaria recutita L. | Malva trinodis DC. | Asia, North West USA | 4, 8 | 4, 6, 7, 10 | |
| Mikania sp. | Montanoa tomentosa Cerv. | Mexico and West USA | 4, 12 | | |
| Onopordum acanthium L. | Parthenium hysterophorus L. | Europe, Africa | 4, 8, 14 | | |
| Parthenium hysterophorus L. | Phagnalon saxatile (L.) Cass. | Mediterranean region | 2 | | |
| Pectocnthus spinosus (Nutt.) Rydb. | Pleiocanthus spinosus (Nutt.) | California | 2 | | |
| Polyopria maculata Cav. | Pseudognaphalium californicum (DC.) Anderb. (Graspahalium decurrens E. Ives) | Mexico | 3, 4, 6 | | |
| Pseudognaphalium canescens (DC.) W. A. Weber [Gdaphalium canescens DC.] | Santolina chamaeopannus L. | Europe | 3, 4, 8 | | |
| Santolina chamaeopannus L. ssp. squarrosa (DC.) Nyman | Santolina chamaeopannus L. ssp. magonico O.Boles, R.Mol. et P.Monts. var. incertorum O.Boles et Vigo | Europe | 3, 4, 7, 8, 9, 10, 11, 12 | | |
| Senecio angulifolius DC. | Senecio glaucus Less. var. douglasii (DC.) B.L. Turner & T.M. Barkley (S. douglasii DC.) | California | 3, 6, 7, 10, 13 | | |
| Solidago californica Nutt. [S. velutina DC. ssp. californica (Nutt.) Semple] | Sonchus asper (L.) Hill | Eurasia, Africa | 3 | | |
| Sonchus oleraceus L. | | Eurasia | 3 | | |
| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|------------------|-------------------|--------|-------------------|----------------|--------------------|
| **Sonchus tenerrimus L.** | Europe, Africa, Middle East | 4 |
| **Tagetes erecta L.** | Mexico | 4, 6, 9, 10, 12 |
| **Tagetes lucida (Sweet) Voss** | Mexico | 3, 4, 7, 12 |
| **Tanacetum balsamita L.** | Europe | 3, 4 |
| **Tanacetum coyossum (L.) Sch. Bip.** | Europe | 4 |
| **Tanacetum parthenium (L.) Sch. Bip.** | Eurasia | 4, 8, 13 |
| **Tanacetum vulgare L.** | Europe | 4, 8 |
| **Taxacum officinale Weber** | Europe | 1, 3, 4, 12 |
| **Thelesperma gracile (Torr.) A. Gray** | Mexico and South West USA | 4, 8 |
| **Tithonia diversifolia (Hemsl.) A. Gray** | Mexico | 3, 6, 9 |
| **Trails california Kellogg** | California and Mexico | 3, 9 |
| **Tussilago farfara L.** | Eurasia | 3, 11 |
| **Verbesina sp.** | California | 3 |
| **Wyethia angustifolia (DC. Nutt.** | California | 3, 10 |
| **Wyethia helioloxides (DC. Nutt.** | California | 3, 5, 9, 10 |
| **Xanthium strumarium L.** | California | 3, 13 |
| **Begoniaceae** | Begonia heracleifolia Cham. & Schltdl. | Mexico | 3, 4 |
| **Berberidaceae** | Berberis aquifolium Pursh | California | 11 |
| **Betulaceae** | Berberis nevii A. Gray | California | |
| **Betula sp.** | California | 3, 4 |
| **Alnus arguta (Schltldl.) Spach** | Mexico | 3, 12 |
| **Betula occidentalis Hook.** | California | 4, 10, 11 |
| **Betula pendula Roth** | Europe | 2 |
| **Corylus comata var. californica (A. DC.) E. Murray** | California | 11 |
| **Bignoniaceae** | Crescentia cujete L. | Mexico | 3, 4 |
| **Parmentiera edulis DC.** | Mexico | 9, 10, 12 |
| **Tabebia rosea (Bental) DC.** | Mexico | 3, 7, 12 |
| **Bixaceae** | Bixa orellana L. | Mexico | 3, 6 |
| **Cochlospermum vitifolium (Wild) Spreng.** | Mexico | 3, 4 |
| **Boraginaceae** | Borago officinalis L. | Europe, naturalized in California | 1, 2, 3, 6, 11, 1, 4, 10 |
| **Conida curassavica (Jacq.) Roem. & Schult.** | Mexico | 3, 5, 8, 10 |
| **Ehretia trifolii L.** | Mexico | 12 |
| **Eridericyon californicum (Hook. & Am. Torrey** | California | 1, 3, 4, 6, 7, 8, 10, 11 |
| **Eridericyon crassifolium Benth.** | California | 1, 3, 7, 10, 11 |
| **Eridericyon trichoclyx A. Heller** | California | 1, 3, 6, 7, 10, 11 |
| **Heliotropum curassavicum L. var. oculatum** | California | 5 |
| **Lithospermum officinale L.** | Europe | 4 |
| **Phacelia distans Benth.** | California | 1, 3, 4, 10 |
| **Phacelia ramosissima Lehm.** | California | 6, 10, 11 |
| **Pulmonaria longifolia (Bast.) Boreau** | Europe | 11 |
| **Symphytum asperum Lepech.** | Asia, introduced from Europe | 1, & 10 |
Table 3 Medicinal plants used before, during and after the Mission period, and present time at Mission Gardens. The numbers refer to emic and etic illness groupings (see Table 2) (Continued)

| Botanical family* | Medicinal plants* | Native          | Pre-Mission period | Mission period | Post-Mission period |
|-------------------|-------------------|-----------------|--------------------|----------------|---------------------|
| Symphytum officinale L. | Europe | 7 |
| Symphytum tuberosum L. ssp. tuberosum | Europe | 7 |
| Tournefortia hartwegiana DC. | Mexico | 4, 7, 10, 13 |
| Brassicaceae | Brassica nigra (L.) Koch | Eurasia, Africa | 11 |
| Brassica oleracea L. ssp. oleracea | Europe | 3, 4, 8 |
| Brassica rapa L. | Europe, Asia | 7, 10 |
| Capsella bursa-pastoris (L.) Medik. | Eurasia | 1, 4, 5, 10 |
| Coronopus didymus (L.) Sm. | South America | 1, 6, 11 |
| Coronopus squamatus (Forsk.) Asch. | Mediterranean region | 1, 2 |
| Descuriania pinnata (Walter) Britton [Symbrum coneceans (PWh) Reiche., Symbrum pinnatum (Walter) Britton] | California | 4 |
| Lepidium latifolium L. | Eurasia | 12 |
| Lepidium nitidum Torrey & Gray | California | 4, 6 |
| Raphanus raphanistrum L. ssp. sativus (L.) Domin | Europe | 3 |
| Rorippa sp. | California | 11 |
| Rorippa nasturtium-aquaticum (L.) Hayek (Nasturtium officinallis W. T. Aiton) | Europe, Asia, naturalized in California and Mexico | 1, 4, 6, 12, 14 |
| Burseraceae | Bursera grandifolia (Schltdl.) Engl. | Mexico | 4, 8, 12 |
| Bursera microphylla A. Gray | California | 3 |
| Bursera simaruba (L.) Sarg. | Mexico | 3, 12 |
| Protium capad Engl. | Mexico | 1, 3, 4, 7 |
| Buxaceae | Buxus balearica Lam. | Eurasia, Africa | 4 |
| Buxus sempervirens L. | Europe | 4 |
| Cactaceae | Cylindropuntia acanthocarpa (Engelm. & Bigelov) F. M. Knuth (Opuntia acanthocarpa Engelm. & Bigelov) | California | 3 |
| Lemaireocereus thurberi (Engel.) Britton & Rose [Stenocereus thurberi (Engel.) Britton & Rose] | Mexico | 1, 3, 12 |
| Lophophora williamsii (Lem.) J. M. Coulter. | Mexico, Texas | 3, 1, 4 |
| Opuntia maxima A. Berger | Mexico introduced from Europe | 1, 2, 3, 4, 5, 11, 12 |
| Opuntia sp. | California and Mexico | 1, 3, 7, 14 |
| Opuntia imbricata DC. [Cylindropuntia imbricata (DC.) Haw.] | Mexico | 4, 10 |
| Opuntia leucotricha DC. | Mexico | 1, 4, 12 |
| Opuntia tuberosus (Pfeiff.) Britton & Rose | California and Mexico | 8 |
| Cannabaceae | Cannabis sativa L. | Eastern Asia |
| Humulus lupulus L. | Europe | 8 |
| Caprifoliaceae | Lonicera sp. | California | 7, 10 |
| Lonicera impexus Ait. | Europe | 1, 3, 5 |
| Lonicera interrupta Benth. | California | 3, 9, 10 |
| Lonicera subspicata Hook. & Am. var. subspicata | California | 3, 10 |
| Scabiosa sp. | Europe | 1 |
| Valeriana officinalis L. | Europe |
| Caricaceae | Carica papaya L. | Europe | 3, 4, 10 |
Table 3 Medicinal plants used before, during and after the Mission period, and present time at Mission Gardens. The numbers refer to emic and etic illness groupings (see Table 2) (Continued)

| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|-------------------|-------------------|--------|--------------------|----------------|---------------------|
| Caryophyllaceae    | Herniaria hirsuta L. ssp. cinerea (DC. in Lam. et DC.) Arcang. | Eurasia, Africa | 2, 8, 12 | |
|                   | Paronychia argentea Lam. | Mediterranean region | 1 | |
|                   | Silene laciniata Cav. ssp. major C. Hitchc. & Maguire (S. laciniata Cav. ssp. laciniata) | California | 5, 7 | |
|                   | Sparganium salina J. Presl & C. Presl (S. marina (L.) Besser) | California | 1, 3, 4, 9, 10, 11 | |
|                   | Stellaria media (L.) VIII. | Europe | | |
| Celastraceae       | Hippocratea excelsa Kunth | Mexico | 3 | |
|                   | Torreya californica Torrey [Toroyun californicurn (Torrey) Greene] | California | 4, 8, 11 | |
| Cistaceae          | Cistus albidus L. | Europe, Africa | 3, 8, 11 | |
|                   | Cistus salviifolius L. | Eurasia, Africa | 3, 12 | |
| Commelinaceae      | Commelina erecta L. | Mexico | 4, 7, 12 | |
|                   | Rheoa discolor (L'Hér.) Hance [Tradescentia spathacea Sw.] | Mexico | 3, 6, 7 | |
| Convolvulaceae     | Cuscuta sp. | California and Mexico | 4, 12 | |
|                   | Cuscuta californica Hook & Am. | California | 11 | |
|                   | Ipomoea arborescens [Humb. & Ropogl. Ev. Wild] G. Don | Mexico | 1, 4, 8, 12 | |
|                   | Ipomoea stans Cav. | Mexico | 4, 8 | |
| Compositae         | Comarum sericeum L. ssp. californica [C. californica CAZ. Meyer] | California | 11 | |
| Crassulaceae       | Dudleya pulverulenta (Nutt.) Britton & Rose | California | 3, 10 | |
|                   | Hylotelephium maximum (L.) Holub | Eurasia | 3, 8 | |
|                   | Hylotelephium telephium (L.) H. Ohba | Eurasia | 3 | |
|                   | Kalanchoe pinnata (Lam.) Pers. | Madagascar | 3 | |
|                   | Sedum olympicum Kunth | Mexico | 3 | |
|                   | Sedum spathulifolium Hook. | California | 3, 10, 11 | |
|                   | Sedum spurius M. Bieb. | Asia introduced from Europe | 3 | |
|                   | Sempervivum tectorum L. | Europe | 9 | |
|                   | Umbilicus rupestris (Salisb.) Dandy | Europe | 3 | |
| Cucurbitaceae      | Citrullus lanatus var. lanatus (Thunb.) Matsum. & Nakai | Africa | 6, 11 | |
|                   | Cucumis sativus L. | Asia, introduced from Europe | 4 | |
|                   | Cucurbita foetidissima Kunth | California and Mexico | 3, 4, 7, 11, 12 | 3, 7 |
|                   | Cucurbita maxima Duchesne. | South America | 4 | |
|                   | Cucurbita palmarata S. Watts. | California | 4, 11 | |
|                   | Cucurbita pepo L. | South America | 12 | |
|                   | Ibervillea sonorae S. Watts. | Mexico | 6 | |
|                   | Luffa aegyptiaca Mill. | Egypt, introduced from Europe | 3 | |
|                   | Morah fabacea (Naudin) Greene | California | 3, 13 | 3 |
|                   | Morah macrocarpus E. Greene | California | 1, 3, 4, 5, 7, 9, 11 | |
|                   | Momordica charantia L. | South Indian | 4, 8, 12 | |
| Cupressaceae       | Hesperocypris macrocarpa | California | 7 | |
Table 3. Medicinal plants used before, during and after the Mission period, and present time at Mission Gardens. The numbers refer to emic and etic illness groupings (see Table 2) (Continued)

| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|-------------------|-------------------|--------|--------------------|----------------|---------------------|
| (Hartw.) Bartel (Cupressus macrocarpa Hartw.) | Juniperus californica Carr. | California | 7, 11, 13 | | |
| | Juniperus chinensis L. | Asia | 3, 4, 7, 9 | | |
| | Juniperus communis L. | Eurasia | | | |
| | Juniperus depeana Steud. | Mexico and South West USA | 7, 12 | | |
| | Juniperus phoenicea L. | Mediterranean region | 3 | | |
| | Sequoia sempervirens (D. Don) Endl. | California | 3, 9, 10, 11 | | |
| | Taxodium mucronatum Ten. | Mexico and South West USA | 3, 6, 9 | | |
| Cyperaceae | Schoenoplectus sp. | California | 3, 7 | | |
| | Scirpus sp. | California | 7 | | |
| | Scirpus acutus L. var. occidentalis (S. Watson) Beetle (Schoenoplectus acutus Muhl. Ex Bigelow) A. Love & D. Love var. occidentalis (S. Watson) S. G. Sm.] | California | 3, 7 | | |
| | Scirpus californicus (C. Meyyer) Steudel (Schoenoplectus californicus C. A. Mey. Palla) | California | 3 | | |
| Datiscaceae | Datisca glomerata (C. Presl) Baillon | California | 3, 7, 8, 10 | | |
| Dennstaedtiaceae | Pteridium aquilinum (L.) Kuhn. | California, Europe, Mexico | 1 | 11, 13 | |
| Dioscoreaceae | Dioscorea sp. | Mexico | 5, 7, 8 | | |
| | Tamus communis L. | Europe | 3, 7 | | |
| Dryopteridaceae | Dryopteris arguta (Kaulf.) Watt [Aspidium rigidum Sw. arguta (DC.) Eat.] | California | 3, 11 | | |
| | Dryopteris filix-mas (L.) Schott | Europe, California | 4 | | |
| Ebenaceae | Diospyros kaki L.f. | Asia introduced from Europe, California | 1, 4 | | |
| Ephedraceae | Ephedra sp. | California | 6 | | |
| | Ephedra californica S. Wats. | California | 1, 3, 4, 6, 10, 11, 13 | | |
| | Ephedra viridis S. Watson | California | 1, 3, 4, 6, 11, 13 | | |
| Equisetaceae | Equisetum sp. | California | 4, 10, 11, 13 | | |
| | Equisetum arvense L. | California, Europe, Mexico | 3 | 1, 2, 3, 7, 11, 12 | 1, 11 |
| | Equisetum hyemale L. | Europe, Mexico | 1 | 1, 11, 12 | |
| | Equisetum laevigatum A. Braun (E. funstonii A. A. Eaton) | California | 3, 5, 7, 11, 13 | | |
| | Equisetum ramosissimum Desf. | Eurasia, Africa | 1, 2 | | |
| | Equisetum telmateiae Ehrh. | Eurasia, Africa | 1, 3, 7, 12 | | |
| Ericaceae | Arbutus unedo L. | Europe | 1 | | |
| | Arbutus menziesii Pursh | California | 3, 4, 10 | | |
| | Arbutus xalapensis Kunth | Mexico, South West USA | 7 | | |
| | Arctostaphylos glauca Lindl. | California | 3, 4, 13 | 2, 12 | |
| | Arctostaphylos uva-ursi (L.) Spreng. | California and Europe | 12 | | 3 |
| | Erica cinerea L. | Europe | 12 | | |
| | Vaccinium sp. | California | 12 | | |
| Euphorbiaceae | Acalypha alopecuroides Jacq. | Mexico | 4 | | |
| | Chamaesyce sp. (Euphorbia sp.) | California | 3, 9, 11 | | |
| | Cnidoscolus chayamansa (MILL.) J. M. Johnst. | Mexico | 3, 13, 12 | | |
| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|-------------------|-------------------|--------|--------------------|----------------|---------------------|
| Cnidoscolus urens L. ssp. stimulosus (Michx.) Govaerts | Mexico | 11 |
| Croton sp. | Asia | 4 |
| Croton californicus Muell | California | 7, 9, 10 |
| Croton draco Schldtl. | Mexico | 9 |
| Croton fragilis Schltr. | Mexico | 4, 6 |
| Croton setiger Hook. [Eremocarpus setiger (Hook.) Bentham.] | California | 4, 6, 8, 11 |
| Eremocarpus setigerus (Hook.) Benth. | California | 1, 10, 11 |
| Euphorbia sp. | California | 3, 6, 9, 11 | 3 |
| Euphorbia albo-marginata Torrey & A. Gray | California |
| Euphorbia amygdaloideae L. ssp. amygdaloideae | Europa | 3 |
| Euphorbia antisyphilitica Zucc. | Mexico and South West USA | 4, 6, 8, 9 |
| Euphorbia characias L. ssp. characias | Europe | 3 |
| Euphorbia grantii Oliv. | Mexico, South West USA | 3 |
| Euphorbia lathyrus L. | Eurasia, Africa | 4 |
| Euphorbia ocellata Durand & Hilg. ssp. ocellata | California |
| Euphorbia peplus L. | Eurasia, Africa | 3 |
| Euphorbia polyacapa Bentham. | California | 11 |
| Euphorbia senata L. | Europe, Africa | 3 |
| Euphorbia villosa Waldst. & Kit. ex Willd. | Europe | 3 |
| Jatropha cinerea (Orege) Mull. | Mexico and South West USA | 3, 9 |
| Jatropha curcas L. | Mexico | 4, 7, 9 |
| Jatropha dioica Sesse | Mexico and Texas | 3, 9 |
| Ricinus communis L. | Africa introduced from Europe | 4, 8, 12 |
| Symadendrium grantii Hook. | Asia | 3 |
| Fabaceae | Acacia cochlacantha Bonpl. ex Willd. | Mexico | 4, 6, 10, 12 |
| Acacia camigera (L.) Willd. | Mexico | 3 |
| Acacia farnesiana (L.) Willd. [Vachellia farnesiana (L.) Wight & Arn.] | Mexico | 1, 4, 6, 11 |
| Acnision globus (Vogel) Brouillet [Lotus scoparius (Nutt. in Torr. & A. Gray) Ottley] | California | 10 |
| Ajospermum panamense (Benth.) Yakovlev | Mexico | 4, 10, 12 |
| Bauhinia dianthiflora L. | Jamaica | 4, 6, 10, 12 |
| Cassiopia puicanima (L.) Sw. | Mexico | 10 |
| Calliandra californica Bentham. | California and Mexico | 12 |
| Ceratonia siliqua L. | Mediterranean region | 3, 4, 11 |
| Cestia occidentalis Torrey | California |
| Crotalaria incana L. | Mexico | 10 |
| Desmodium incanum DC. | Mexico | 3, 4, 6, 10, 12 |
| Enterolobium cyclocarpum (Jacq.) Griseb. | Mexico | 3 |
| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|------------------|-------------------|--------|--------------------|----------------|-------------------|
| Erythrina corallodendron L. | Mexico | 11 |
| Eysenhardtia polystachya (Ortega) Sarg. | Mexico | 13 |
| Gliricidia sepium (Jacq.) Kunth ex Walp | Mexico | 6, 12 |
| Glycyrrhiza glabra L. | Eurasia | 4 |
| Haematoxylon brasiliense H. Kuntz | Mexico | 8, 12, 13 |
| Haematoxylon campechianum L. | Mexico | 1, 4, 6 |
| Haeta macrostachya (DC.) Rydb. | California | 3, 11 |
| Haeta orbicularis (Lindl.) Rydb. | California | 1, 11 |
| Indigofera suffruticosa Mill. | Mexico | 3, 4, 6, 11 |
| Inga janicul G. Don | Mexico | 1, 4, 6 |
| Lathyrus vestitus Nutt. | California | 4, 11 |
| Lens culinaris Medic. | Asia | 14 |
| Lupinus sp. | California | 11, 13 |
| Lupinus arboreus Sims | California |
| Lupinus cytisoides J. Agardt (L. sativus J. Agardt) | California |
| Lysiloma acapulcensis Benth. | Mexico | 3 |
| Medicago sativa L. | Asia introduced from Europe | 1, 8 |
| Mimosa tenuiflora (Willd.) Poir. | Mexico | 3, 4 |
| Mucuna pruriens (L.) DC. | Africa | 4 |
| Ononis spinosa L. | Eurasia, Africa | 4 |
| Olneya tesota A. Gray | California and Mexico | 4, 10, 12 |
| Phaseolus vulgaris L. | Central America cultivated from all continents | 5 |
| Pismum sativum L. | Mediterranean region | 14 |
| Pithecellobium dulce (Roxb.) Benth. | Mediterranean region |
| Prosopis sp. | California and Mexico | 3, 4, 9 |
| Prosopis juliflora (Sw.) DC. | Mexico | 3, 4, 9 |
| Prosopis glandulosa Torr. | California | 3, 9 |
| Stylosanthes viscosa (L.) Sw. | Mexico | 4, 6 |
| Tamarindus indica L. | India |
| Trifolium sp. | California | 4 |
| Vicia faba L. | Eurasia | 4, 10 |
| Vicia gigantean Hook. | California | 4 |
| Castanea sativa Mill. | Eurasia | 4 |
| Notholithocarpus densiflorus (Hook. & Arn.) Manos, C. H. Cannon, & S. Oth [Lithocarpus densiflorus (Hook. & Arn.) Rehd.] | California | 3, 11 |
| Quercus sp. | California, Mexico | 1, 3, 9 | 1, 9, 11 |
| Quercus agrifolia Nee | California | 1, 3, 4 | 3, 4, 10 |
| Quercus dumosa Nutt. | California | 3, 9, 11 |
| Quercus lobata Nee | Mediterranean region |
| Quercus ilex L. | Europe | 1, 3, 4, 14 | 3, 4, 10 |
| Quercus ilex ssp. ballota (Desf.) Samp. | Mediterranean region | 2, 3 |
| Quercus oleoides Schidl. & Cham. | Mexico | 9 |
| Quercus lobata Nee | California | 4 |
Table 3 Medicinal plants used before, during and after the Mission period, and present time at Mission Gardens. The numbers refer to emic and etic illness groupings (see Table 2) (Continued)

| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|-------------------|-------------------|--------|-------------------|----------------|---------------------|
| Quercus robur L.  | Eurasia           | 4      |                   |                |                     |
| Quercus turbinella Greene | California | 3, 9  |                   |                |                     |
| Frankeniaceae     | Frankenia salina (Molina) I. M. Johnst. (F. grandifolia Cham. & Schltdl.) | California | 4 |                   |                     |
| Gentianaceae      | Centaurea erythraea Raf. | Europe | 1, 4, 8, 11 | 1, 10, 11 |                     |
|                   | Centaurea venustum (A. Gray) B. L. Rob. [Zeltnera venusta (Gray) GMans.] | California | 1, 11 |                   | 1, 11               |
|                   | Zeltnera venusta (A. Gray) Mansion (Erythraea venusta A. Gray) | California | 1, 6, 11 |                   |                     |
| Geraniaceae       | Geranium lucidum L. | Eurasia, Africa | 3 |                   |                     |
|                   | Geranium robertianum L. | Europe | 4 |                   |                     |
|                   | Pelargonium sp. | South Africa, Introduced from Europe | 4 |                   |                     |
| Gesneriaceae      | Konilinia deppeana (Schr. & Cham.) Fritsch | Mexico | 4, 13 |                   |                     |
| Grossulariaceae   | Ribes inercedum Eastvr. | California | 9 |                   |                     |
| Hypericaceae      | Hypericum androsaemum L. | Eurasia | 3 |                   |                     |
|                   | Hypericum balearicum L. | Spain’s Balearic Islands | 5 |                   |                     |
|                   | Hypericum perforatum L. | Eurasia | 3, 4, 7, 8, 12 |                   |                     |
| Illiciaceae       | Illicium verum Hook.f. | Asia | 4 |                   |                     |
| Indiaceae         | Crocus sativus L. | Europe | 8 |                   |                     |
|                   | Iris sp. | California | 4 |                   |                     |
|                   | Iris douglasiana Herbert | California | 4, 5, 7, 11 | 10, 11 |                     |
| Jujulandaceae     | Juglans californica S. Wats. | California | 1 |                   |                     |
|                   | Juglans regia L. | Balkan Peninsula, Asia | 1, 2, 3, 4, 5, 6, 7, 10, 11 |                   |                     |
| Juncaceae         | Juncus sp. (mainly, J. effusus L.; J. inflexus L., and J. conglomeratus L.) | Eurasia, Africa | 3 |                   |                     |
|                   | Juncus textilis Buchenau | California | 3 |                   |                     |
| Krameriaceae      | Krameria grajyi Rose & Painter (K. bicolor S. Watson) | California | 3, 4, 12 |                   |                     |
| Lamiaceae         | Agastache mexicana (Kunth) Lint & Eppling | Mexico | 8 |                   |                     |
|                   | Calamintha nepeta (L.) Savii | Europe, Africa | 8 |                   |                     |
|                   | Clinopodium douglasii (Benth.) Kuntze [Micromeria douglasii (Benth.) Kuntze; Satureja douglasii (Benth.) Brig.] | California | 3, 4, 5, 8, 9, 10, 11 | 4 |                     |
|                   | Dracocephalum moldavica L. | Asia, introduced from Europe | 1 |                   |                     |
|                   | Hyptis mutabilis (Rich.) Brig. | Mexico | 4 |                   |                     |
|                   | Hyptis stellata Benth. | Mexico | 3, 4, 7, 8, 9 |                   |                     |
|                   | Hyptis verticillata Jacq. | Mexico | 3, 4 |                   |                     |
|                   | Hyptis emonyi Torrey [Condea emonyi (Torr.) Harely & J. F. B. Pastore] | California | 1 |                   | 1                    |
|                   | Lavandula angustifolia Mill. (L. vera DC.; L. spica L.) | Europe |                   |                     |                     |
|                   | Lavandula latifolia Medik. | Mediterranean region | 3, 8, 14 |                   |                     |
|                   | Lavandula spica L. | Mediterranean region | 4 |                   |                     |
|                   | Leonurus japonicus Houtt | Asia | 5, 6, 10 |                   |                     |
Table 3 Medicinal plants used before, during and after the Mission period, and present time at Mission Gardens. The numbers refer to emic and etic illness groupings (see Table 2) (Continued)

| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|-------------------|-------------------|--------|--------------------|----------------|----------------------|
| Lepechinia calycina (Benth.) Epling | California | 7, 10, 11 |
| Lepechinia caulescens (Ortega) Epling | Mexico | 4, 6 |
| Marrubium vulgare L. | Europe | 3, 4, 11 | 3, 6, 8, 10 |
| Melissa officinalis L. | Europe | 1, 4, 8, 11 | 1 |
| Mentha sp. | California | 3, 4, 7, 8, 9, 13 |
| Mentha arvensis L. | Eurasia, California | 9 | 13 |
| Mentha longifolia (L.) Huds. | Eurasia, Africa | 4 |
| Mentha pulegium L. | Eurasia, Africa introduced from America | 4, 1 |
| Mentha spicata L. | Europe introduced from California | 4, 8 | 10 |
| Mentha suaveolens Ehrh. | Mediterranean region | 3, 4, 10 |
| Mentha x gentilis L. | Europe | 8 |
| Mentha x piperita L. (M. aquatica L. x M. spicata L.) | Europe introduced from California | 4, 8 | 10 |
| Monarda villosa Benth. | California | 1, 4, 10 |
| Ocimum basilicum L. | Africa | 8 |
| Origanum majorana L. | Europe | 6, 7 |
| Origanum vulgare L. ssp. vulgare | Europe | 4, 8, 11 |
| Pseudostachys officinalis L. | Europe | 4 |
| Rosmarinus officinalis L. | Europe | 1, 3, 4, 5, 6, 7, 8, 9, 11, 14, 3, 4, 9, 10, 11 |
| Salvia sp. | California, Mexico | 8, 11 | 3, 5 | 3, 8 |
| Salvia aethiopis L. | Europe | 3, 8 |
| Salvia apiana Jepson [Ramona polystachya (Benth.) Greene] | California | 4, 8, 9, 10 |
| Salvia carduacea Benth. | California | 5 |
| Salvia columbiana Benth. | California | 1, 3, 4, 6, 9, 11 |
| Salvia lavandulifolia Vahl | Europe | 8 |
| Salvia lavanduloides Kunth | Mexico | 10 |
| Salvia leucanthe Cav. | Mexico | 7, 12 |
| Salvia mellifera E. Greene [Ramona stachyoides (Benth.) Briq.] | California | 1, 4, 8, 9, 10 | 3 |
| Salvia officinalis L. | Europe | 1, 3, 8, 10, 14 |
| Salvia spathacea E. Greene | California | 1, 7, 11 |
| Salvia verticillata L. | Eurasia, Africa | 2, 4, 5, 11 |
| Satureja douglasii (Benth.) Briq. [Clinopodium douglasii (Benth.) Kuntze] | California | 1, 3, 4, 5, 7, 8, 9, 10, 11, 13 | 3, 4, 7, 8 |
| Satureja hortensis L. | Eurasia | 3, 10 |
| Satureja macrostema (Moc. & Sesse ex Benth.) Briq. | Mexico | 4, 6 |
| Stachys albicans A. Gray | California | 3, 4, 10 |
| Stachys byzantina Benth | California | 3, 9, 10 |
| Teucrium chamaedrys L. | Mediterranean region | 9 |
| Teucrium scorodonia L. | Europe, Africa | 3 |
| Thymus sp. | Eurasia, Africa | 7, 11 |
| Thymus mastichina (L.) L. | Spain | 11 |
| Thymus praecox Opiz | Europe | 8 |
| Thymus vulgaris L. | Mediterranean region | 1, 2, 3, 4, 6, 7, 8 |
| Botanical family* | Medicinal plants* | Native Pre-Mission period | Mission period | Post-Mission period |
|------------------|-------------------|---------------------------|----------------|---------------------|
| Lamiaceae        | Thymus zygis L.   | Spain, Africa             | 11, 12         |                     |
|                  | Trichostema lanatum Benth. | California              | 3, 4, 5, 6, 7, 8, 11 |                     |
|                  | Trichostema lanceolatum Benth. | California              | 3, 4, 6, 7, 9, 10, 11, 13 | 3, 6, 8, 9, 10 |
| Laminariae       | Laminaria sp.     | California                | 4              |                     |
|                  | Macrocystis sp.   | California                | 4              |                     |
| Lauraceae        | Laurus nobilis L. | Europe                    | 3, 4, 7, 11    |                     |
|                  | Umbellulara californica (Hook. & Arn.) Nutt. | California              | 3, 4, 7, 8, 10 | 8                   |
| Liliaceae        | Lilium candidum L. | Balkan Peninsula, Middle East | 3              |                     |
|                  | Prosartes parvifolia S. Watson [Disporum hookeri (Torr.) G. Nicholson] | California | 13 |                     |
|                  | Hesperanthon californicum (Benth.) Small | California              | 11             |                     |
|                  | Linum usitatissimum L. | Asia, Africa            | 11             |                     |
| Loasaceae        | Mentzelia sp.     | California                | 11             |                     |
|                  | Mentzelia aspera L. | California and Mexico     | 6              |                     |
|                  | Mentzelia hispida Willd. | California              | 4              | 6                   |
| Lythraceae       | Cuphea aequipetala Cav. | Mexico                  | 3              | 4                   |
|                  | Helianthus salicifolia Link. | Mexico                  | 3, 12          |                     |
| Magnoliaceae     | Magnolia grandiflora L. | Mexico and South West USA | 1, 8         |                     |
| Malpighiaceae    | Byrsonima crassifolia (L.) Kunth. | Mexico              | 3              | 4                   |
|                  | Galphimia glauca Cav. | Mexico                  | 3              | 7                   |
| Malvaceae        | Abutilon palmeri A. Gray | California             | 1, 3, 11       |                     |
|                  | Alcea rosea L.    | China introduced from Europe | 8, 11          |                     |
|                  | Althaea officinalis L. | Eurasia, Africa         | 4, 11          |                     |
|                  | Ceiba pentandra (L.) Gaertn. | Mexico                | 3, 4, 8       |                     |
|                  | Chiranthodendron pentadactylon Larreategui | Mexico | 1, 8 |                     |
|                  | Fremontodendron californicum (Torrey) Cav. | California | 10 |                     |
|                  | Guazuma tormentosa Kunth (G. ulmifolia Lam.) | Mexico | 3, 4, 6, 12 |                     |
|                  | Hibiscus sabdariffa L. | West of Africa           | 4, 8, 12, 13  |                     |
|                  | Hibiscus rosa-sinensis L. | West of Africa         | 9, 12         |                     |
|                  | Malacothamnus sp. (Malvastrum sp.) | California | 4, 5, 7 |                     |
|                  | Malacothamnus fasciculatus (Torrey & A. Gray) E. Greene | California | 4 |                     |
|                  | Malva moschata L. | Eurasia                   | 11             |                     |
|                  | Malva neglecta Wallr. | Eurasia                 | 3, 4, 11, 14  |                     |
|                  | Malva parviflora L. | Europe                   | 3              | 4                   |
|                  | Malva sylvestris L. | Europe                   | 1, 3, 4, 6, 5, 7, 8, 1, 3, 11 | 9, 10, 11, 14 |
|                  | Malvaviscus arboreus Cav. | Mexico              | 4              | 6                   |
|                  | Pavonia schiedeano Steud. | Mexico                | 1, 3, 4, 6 |                     |
|                  | Pseudobombax ellipticum (Kunth) Dugard | Mexico | 10 |                     |
Table 3: Medicinal plants used before, during and after the Mission period, and present time at Mission Gardens. The numbers refer to emic and etic illness groupings (see Table 2) (Continued)

| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|-------------------|-------------------|--------|--------------------|----------------|---------------------|
| Sida acuta Burm.  | Mexico            | 3, 4, 13 |
| Sida rhombifolia L. | Mexico            | 7, 8   |
| Sphaeralcea emoryi Torr. ex A. Gray | California |         |
| Theobroma cacao L. | Mexico, Amazon basin | 11    |
| Tilia sp.         | Eurasia, Mexico   | 8      |
| Tilia cordata Mill. | Europe            | 8      |
| Tilia platyphyllos Scop. ssp. platyphyllos | Eurasia | 4, 8 |
| Martyniaceae      | Martynia annua L. | Mexico | 8                 |
| Melanthiaceae     | Trillium chloropetalum (Torrey) Howell | California | 1, 4 |
| Tilia cordata Mill. | Europe            | 8      |
| Tilia platyphyllos Scop. ssp. platyphyllos | Eurasia | 4, 8 |
| Melastomataceae   | Miconia albicans (Sw.) DC. | Mexico | 4, 13 |
| Meliaceae         | Cedrela odorata L. | Mexico | 4, 9, 12 |
| Menispermaceae    | Cissampelos parelia L. | Africa | 1, 4 |
| Montiaceae        | Claytonia perfoliata Willd. | California | 4 |
| Moraceae          | Brosimum alicastrum Sw. | Mexico | 3, 10, 13 |
| Dostenia contajevna L. | Mexico   | 7, 12  |
| Ficus canica L.   | Middle east, western Asia | 3, 11 |
| Ficus petiolaris Kunth | Mexico     | 1, 4, 7 |
| Muntingiaceae     | Muntingia calabura L. | Mexico | 3, 6, 7 |
| Musaceae          | Musa sp.         | Asia   | 11                |
| M. sapientum L. (Musa x paradisiac L.) | Indonesian, grown in countries with tropical climate | 4 | 3, 11 |
| Myrtaceae         | Eucalyptus sp.    | Australia | 8   |
| Eucalyptus globulus Labill. | Australia | 3, 11 |
| Eugenia acapaxenis Steud. | Central America | 4, 6, 10 |
| Myrtus communis L. | Europe            |        |
| Psidium guava L.  | Central America and Mexico | 4    |
| Nyctaginaceae     | Abronia sp.       | California | 13 |
| Oleaceae          | Forestiera pubescence Nutt. (F. neomexicana A. Gray) | California | 8 |
| Fraxinus angustifolia Vahl ssp. angustifolia | Europe | 2 |
| Fraxinus dipetala Hook. & Arn. | California | 3, 11 |
| Fraxinus excelsior L. |           | 1, 3   |
| Fraxinus latifolia Benth. | California | 11 |
| Fraxinus uhdei (Wenz.) Lingel. | Mexico | 12 |
| Jasminum officinale L. | Middle East, India, China | 4, 6, 8 |
| Ligustrum porteri Coutt. & Rose | Europe | 1, 3 |
| Olea europaea L. var. europaea | Mediterranean region | 1, 3, 4, 13 |
| Olea europaea L. var. sylvestris (Mill.) Brot. | Mediterranean region | 1 |
| Onagraceae        | Ludwigia octovalvis (Jacq.) P. H. Ravens | Central America | 3 |
| Epilobium canum (E. Greene) Raven | California | 3, 7, 11, 13 |
Table 3 Medicinal plants used before, during and after the Mission period, and present time at Mission Gardens. The numbers refer to emic and etic illness groupings (see Table 2) (Continued)

| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|------------------|-------------------|--------|--------------------|----------------|---------------------|
| (Zauschneria californica C. Presl) | | | | | |
| Gaura cocinea Nutt. Ex Pursh | California | | 1, 4 | | |
| [Oenothera suffrutescens (Ser.) W. L. Wagner & Hoch) | | | | | |
| Oenothera albicaulis Pursh | Mexico, West USA | | 11 | | |
| Oenothera elata Kuth | California | | | | |
| Oenothera hookeri Torrey & A. Gray | California | | | | |
| Oenothera rosea L’Her. Ex Aiton | Mexico and Texas | | 3, 4 | | |
| Orobanchaceae | Castilleja sp. | California | 3 | | |
| Castilleja affinis Hook. & Arn. | California | | 3 | | |
| Castilleja attenuata (A. Gray) Chuang & Heckard | California | | 10 | | |
| Castilleja elatissima Sesse ex Cerv. | Mexico | | 7, 12 | | |
| Castilleja tenuiflora Benth. | Mexico and South West USA | | 1, 3, 7, 12 | | |
| Orthocarpus sp. | California | | 10 | | |
| Paeonaceae | Paeonia brownii Hook. | California | | 1, 4, 10 | |
| Paeonia californica Torrey & A. Gray | California | | 1, 3, 4, 5, 7, 8, 10, 11, 13 | | 3, 4, 8, 10 |
| Papaveraceae | Argemone mexicana L. (A. sanguinea Greene) | Mexico | | 3, 7, 9, 12, 13 | |
| Chelidonium majus L. | Eurasia | | 1, 3, 8, 11 | | |
| Eschscholtzia sp. | California | | 8 | | |
| Eschscholtzia californica Cham. | California | | 3, 4, 8, 9 | | |
| Fumaria officinalis L. ssp. officinalis | Eurasia, Africa | | 3 | | |
| Papaver rhoeas L. | Eurasia, Africa | | 4, 8, 11 | | |
| Papaver somniferum L. | Eastern Mediterranean, introduced from Eurasia | | 8 | | |
| Romneya coulteri Harv. | California | | 3, 4, 9 | | |
| Pelieaeae | Pellia californica Cham. | California | | 11 | |
| Petiveriaceae | Petiveria alliacea L. | Mexico | | 3, 8, 12 | |
| Rivina humilis L. | Mexico | | 3, 4, 12 | | |
| Phrymaceae | Mimulus aurantiacus Curtis (M. puniceus Nutt.) | California | | 3, 5, 13 | |
| Mimulus guttatus DC | California | | 4 | | |
| Pseuderanthaceae | Petalostigma pubescens Domin | Australia, New Guinea | | 10, 11 | |
| Pinaceae | Abies concolor (Gardn & Glend.) Lindley | California | | 4, 6 | |
| Pinus sp. | California | | 1, 3, 7, 8, 9, 10, 11 | | 1, 3, 4, 11, 7, 8 |
| Pinus halepensis Mill. | Mediterranean region | | 3, 11, 12 | | |
| Pinus monophylla Torrey & Fremont | California | | 10, 11 | | |
| Pinus patula Schiede ex Schidt. & Cham. | Mexico | | 10 | | |
| Pinus pinaster Aiton. | Europe | | 3 | | |
| Pinus sabina L. Douglas | California | | 3, 7 | | |
| Pinus sylvestris L. | Eurasia | | 11 | | |
| Pseudotsuga menzisii (Mirb.) Franco | California | | | | 6, 11, 13 |
| Piperaceae | Peperomia pellucida Kunth | South and Central America | | 3, 4 | |
| Piper sanctum (Miq.) Schltdl. & Ex. C. DC. | Mexico | | 8 | | |
Table 3 Medicinal plants used before, during and after the Mission period, and present time at Mission Gardens. The numbers refer to emic and etic illness groupings (see Table 2) (Continued)

| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|-------------------|-------------------|--------|-------------------|----------------|---------------------|
| Plantaginaceae     | Antirrhinum nuttallianum Benth. | California | 10 | | |
|                   | Digitalis minor L. | Spain’s Balearic Islands | 1 | | |
|                   | Digitalis purpurea L. | Europe | | | |
|                   | Globularia alypum L. | Mediterranean region | 1 | | |
|                   | Keckiella antirrhinoides (Benth.) Straw | California | | | |
|                   | Keckiella breviflora (Lindley) Straw | California | 3, 10 | | |
|                   | Keckiella cordifolia (Benth.) Straw (Penstemon cordifolius Benth.) | California | 3, 10 | | |
|                   | Penstemon centranthifolius Benth. | California | 3 | | |
|                   | Plantago sp. | California | 1, 3, 9, 10, 11 | | |
|                   | Plantago lagopus L. | Eurasia, Africa | 5, 11, 12 | | |
|                   | Plantago lanceolata L. | Eurasia | 3, 4, 5, 7, 11, 12, 14 | | |
|                   | Plantago major L. | Eurasia | 1, 3, 7, 11, 12, 14, 4, 9, 11 | | |
| Platanaceae        | Platanus lindeliana Mart. & Gal. | Mexico | 7, 8, 10 | | |
|                   | Platanus racemosa Nutt. | California | 10, 11 | | |
|                   | Platanus x hispanica Mill. ex Münch. | Europe | 1 | | |
| Plumbaginaceae     | Limonium californicum (Boiss.) A. A. Heller | California | 1, 6, 10, 11 | | |
|                   | Plumbago pulchella Boiss. | Mexico | 3, 6, 12 | | |
| Poaceae            | Arundo donax L. | Mediterranean region, Asia | 2, 10 | | |
|                   | Avena sativa L. | Europe and naturalized in California | 4 | | |
|                   | Bouteloua eriopoda (Torrey) Torrey | California | | | |
|                   | Coix lachrymal-jobi L. | Asia | 1 | | |
|                   | Cynodon dactylon (L.) Pers. | Africa | 4 | | |
|                   | Distichlis spicata (L.) E. Greene | California | 1, 3, 4, 6, 8, 10 | | |
|                   | Elymus condensatus (J. Presl) A. Love (Elymus condensatus J. Presl) | California | 4, 6, 11 | | |
|                   | Elymus repens (L.) Gould | Europe | 6, 13 | | |
|                   | Oryza sp. | Asia and Europe | 3, 4 | | |
|                   | Oryza sativa L. | Africa, Asia, introduced from all continents | 4, 3, 4 | | |
|                   | Triticum aestivum L. | Europe | 3, 4, 5, 7, 9, 11, 14 | | |
|                   | Zea mays L. | Mexico | 1, 2, 3, 4, 11, 12, 3, 11 | | |
| Polemoniaceae      | Loeselia mexicana (Lam.) Brand | Mexico | 3 | | |
|                   | Navarretia atractyloides (Benth.) Hook. & Arn. | California | 3 | | |
| Polygonaceae       | Chorislanthe sp. | California | 3, 11 | | |
|                   | Eniogonum sp. | California | 4, 5, 8, 9 | | |
|                   | Eniogonum elongatum Benth. | California | 1, 10, 11 | | |
|                   | Eniogonum fasciculatum Benth. | California | 4, 5, 7, 8, 9, 3, 6, 8, 10 | | |
|                   | Eniogonum nudum Benth. [E. latisilium Smith ssp. nudum (Douglas ex Bentham) S. Stokes] | California | 1, 3, 10, 11, 10 | | |
|                   | Rheum rhabarbarum L. | Asia, introduced to California from Europe | 7 | | |
|                   | Rumex sp. | California | | | |
|                   | Rumex crispus L. | Eurasia | 4, 6, 11 | | |
|                   | Rumex hymenosepalus Torrey | California | 3, 4, 7, 8, 10, 4, 8, 10 | | |
Table 3 Medicinal plants used before, during and after the Mission period, and present time at Mission Gardens. The numbers refer to emic and etic illness groupings (see Table 2) (Continued)

| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|------------------|-------------------|--------|--------------------|----------------|---------------------|
| **Polypodiaceae** | **Polypodium californicum** Kauff. | California | 1, 3, 7, 11 | | |
| **Portulacaceae** | Portulaca oleracea L. | Eurasia, introduced to Mexico | 1 | | |
| **Primulaceae** | Anagallis arvensis L. [Lysimachia arvensis (L. U. Manns & Anderb.)] | Europe | 3, 6 | 1, 3, 6, 11 | |
| | Anagallis foemina Mill. (Lysimachia foemina Mill.) | Europe | 6 | | |
| | Primula elatior L. ssp. elatior | Europe | 7 | | |
| | Primula veris L. | Eurasia | 3 | | |
| **Pteridaceae** | Adiantum aleuticum (Rupr.) C.A. Paris (A. pedatum L.) | California, Europe, Mexico | 1, 4, 7 | | |
| | Adiantum capillus-veneris L. | California | 3, 4, 5, 10, 11, 13 | 1, 3, 4, 7 | |
| | Adiantum jordani Mueller | California | 1, 4, 5, 7, 8, 11 | 1, 4 | |
| | Pellaea andromedifolia (Kauff.) Fee | California | 1, 4, 5, 7 | | |
| | Pellaea atropurpurea (L.) Link | Mexico | 3, 11, 13 | | |
| | Pellaea mucronata (D. Eaton) D. Eaton (P. ornithopus Hook) | California | 1, 3, 4, 11 | | |
| | Pentagamma triangularia (Kauff.) G. Yatskievych, Windhan & Wollenweber | California | 3, 7 | | |
| **Ranunculaceae** | Actaea rubra (Alton) Willd. | California | 11 | | |
| | Aquilegia sp. | California | 4 | | |
| | Aquilegia truncate Fisch. ex DC. | California | | | |
| | Clematis lasiantha Nutt. | California | 3, 6 | | |
| | Clematis ligusticifolia Nutt. | California | 1, 3, 6, 10 | 1, 3, 10, 11 | |
| | Clematis pauciflora Nutt. | California | 3, 10, 11, 13 | | |
| | Clematis virginiana L. | Eastern U.S.A. | 4 | | |
| | Helleborus viridis L. ssp. occidentalis (Reut.) Schifflin. | Europe | 4 | | |
| | Ranunculus sp. | California | 3 | | |
| | Ranunculus ficaria L. | Eurasia | 3 | | |
| **Resedaceae** | Reseda alba L. | Eurasia, Africa | 4 | | |
| **Rhamnaceae** | Ceanothus sp. | California | 3 | | |
| | Ceanothus arboreus Greene | California | | | |
| | Ceanothus leucodermis Greene | California | | 7 | |
| | Ceanothus thyrsiflorus Eschsch. | California | | | |
| | Ceanothus verrucosus Nutt. | California | | | |
| | Frangula californica (Eschsch.) A. Gray ssp. occidentalis (Rhamnus californica Eschsch.) | California | 1, 3, 4, 6, 7, 11 | | |
| | Frangula purshiana (DC.) Cooper (Rhamnus purshiana DC.) | California | 4 | | |
| | Gouania polygama (Jacq.) Urb. | Mexico | 6, 8, 10 | | |
| | Kalmisia humboldtiana (Schult.) Zucc. (Rhamnus humboldtiana Schult.) | Mexico and Texas | 8 | | |
| | Rhamnus alaternus L. | Mediterranean region | 1, 11 | | |
| | Rhamnus californica Eschsch. (Frangula californica (Eschsch.) A. Gray) | California | 3, 4, 7 | 4 | |
Table 3 Medicinal plants used before, during and after the Mission period, and present time at Mission Gardens. The numbers refer to emic and etic illness groupings (see Table 2) (Continued)

| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|-------------------|-------------------|--------|-------------------|----------------|---------------------|
| Rhamnus crocea Nutt. | California | 6, 10 |
| Rhamnus ilicifolia Kellogg | California | 1, 6, 13 |
| Rhizophoraceae | Rhizophora mangle L. | Mexico | 4 |
| Rhodomelaceae | Alsidium helmintochacton (Schw.) Kütz. | Not documented | 3, 4, 7, 8 |
| Rosaceae | Adenostoma sp. | California | 3, 5, 7, 11 |
| | Adenostoma fasciculatum Hook. & Arn. | California | 1, 3, 4, 6, 8, 9, 10, 11 |
| | Adenostoma sparsifolium Torr. | California | 1, 4, 6, 8, 10, 11 |
| Agrimonia eupatoria L. ssp. eupatoria | Europe | 4, 11 |
| Chamaebatia foliolosa Benth. | California | 3, 4 |
| Cercocarpus betuloides Torrey & A. Gray | California | 4, 10 |
| Crataegus monogyna Jacq. | Eurasia, Africa | 1, 3, 4, 8, 11, 14 |
| Cydonia oblonga Mill. | Asia introduced to California from Europe | 4, 8, 9 |
| Enkonypha japonica (Thunb.) Lindl. | Asia | 4 |
| Heteromeles arbutifolia (Lindley) Roemer (Photinia arbutifolia Lindl.) | California | 3, 5 |
| Horkelia cuneata Lindl. | California | 1, 4, 6, 8, 10, 11 |
| Malus domestica (Borkh.) Borkh. | Asia introduced from Europe, North America | 1, 3, 4, 8, 11 |
| Malus sylvestris Mill. | Europe | 4 |
| Potentilla glandulosa Lindl. [Drymocallis glandulosa (Lindl.) Rydb.] | California | 1, 4, 6, 8, 10, 11 |
| Potentilla reptans L. | Eurasia, Africa | 1, 3, 4, 8, 11 |
| Prunus avium (L.) L. | Eurasia | 2, 4, 12 |
| Prunus cerasus L. | Eurasia | 4, 10 |
| Prunus domestica L | Asia | 4 |
| Prunus dulcis (Mill.) D.A. Webb | Asia | 11 |
| Prunus emarginata (Hook.) Walp. | California | 3, 7, 11 |
| Prunus ilicifolia (Nutt. Ex Hook. & Arn.) Walp. [Cerasus ilicifolia Nutt. Ex Hook & Arn.] | California | 4, 10 |
| Prunus integrifolia (C. Presl) Walp. | South America | |
| Prunus serotina Ehrh. | Mexico, South West USA | 10 |
| Prunus spinosa L. | Eurasia | 1, 3, 4, 10, 11 |
| Prunus virginiana L. var. demissa (Nutt.) Torrey [Cerasus virginiana (L.) Michx.] | California | 4, 10 |
| Rosa sp. | Eurasia | 9 |
| Rosa agrestis Savi | Europe | 4, 14 |
| Rosa californica Cham. & Schldl. | California | 3, 4, 7, 9, 10, 11, 13 |
| Rosa canina L. | Eurasia, Africa | 9 |
| Rosa gallica L. | Europe | 4, 11 |
| Rubus ulmifolius Schott | Europe, Africa, introduced from California | |
| Rubus urinaria Cham. & Schldl (R. vitifolius Cham. & Schldl.) | California | 3, 4, 5, 6 |
| Sorbus domestica L. | Eurasia, Africa | 4 |
| Rubiaceae | Cinchona officinalis L. | South America | 10 |
Table 3 Medicinal plants used before, during and after the Mission period, and present time at Mission Gardens. The numbers refer to emic and etic illness groupings (see Table 2) (Continued)

| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|-------------------|-------------------|--------|--------------------|----------------|---------------------|
| *Rutaceae*        | *Amyris madrensis* | S. Watson | Mexico | 3, 7 | 3, 12 |
|                   | *Amyris texana*    | (Buckley) P. Wilson | Mexico | 3 | 7 |
|                   | *Casimiroa edulis* | La Llave & Lex. | Mexico | 1, 8 | |
|                   | *Citrus sp.* | Australia, introduced from Europe | 1, 3, 4, 5, 6, 8, 11 | 7, 11 | |
|                   | *Citrus limon* (L.) Burm fl. (pro. sp.) | Asia, introduced from Europe | 4, 8, 11, 14 | 7, 8, 10 | |
|                   | *Citrus sinensis* | L. Osbeck | Asia, introduced from Europe | 4, 8, 11, 14 | 7, 8, 10 |
|                   | *Ruta chalepensis* | L. | Eurasia, Africa | 1, 4, 10 | |
|                   | *Ruta graveolens* | L. | Europe | 8, 9 | |
| *Salicaceae*      | *Populus balsamifera* L. ssp. trichocarpa (Torrey & A. Gray) Brayshaw (P. trichocarpa Hook) | California | 3, 7 | 3 | |
|                   | *Populus fremontii* | S. Watson | California | 3, 7, 8 | 3, 11 |
|                   | *Populus tremuloides* | Michaux | California | 3 | |
|                   | *Salix sp.* | California | 3, 10 | | |
|                   | *Salix exigua* Nutt. | California | 3, 8 | | |
|                   | *Salix laevigata* Bebb | California | 4, 11 | | |
|                   | *Salix lasiolepis* Benth | California | 1, 6, 8, 10, 11 | | |
| *Salviniaceae*    | *Salvinia minima* | Baker | Mexico | 4 | |
| *Santalaceae*     | *Aesculus californica* (Spach) Nutt. | California | 1, 3, 4, 5, 6 | 3 | |
|                   | *Phoradendron californicum* | Nutt. | California | 3, 4, 6 | |
|                   | *Phoradendron junipinum* | Engelm. Ex A. Gray | California | 3, 9 | |
|                   | *Phoradendron macrophyllum* | (Engelm.) Cocke | California | 5, 7, 9 | |
|                   | *Phoradendron serotinum* (Raf.) M. C. Johnst. ssp. macrophyllum (Engelm.) Kuijt | California | 5, 7 | | |
|                   | *Phoradendron serotinum* (Raf.) M. C. Johnst. ssp. tomentosum (DC.) Kuijt | California | 3, 7, 11 | | |
|                   | *Phoradendron villasum* Nutt. | California | 3, 5, 7, 9 | | |
|                   | *Phoradendron villasum* Nutt. [P. flavescens (Pursh.) Nutt.] | California | 5, 7, 9 | | |
|                   | *Viscum album* L. ssp. album | Eurasia | 1, 10 | | |
| *Sapindaceae*     | *Aesculus californica* (Spach) Nutt. | California | 1, 3, 8, 9 | 1 | |
|                   | *Aesculus hippocastanum* | L. | Europe | 1, 7, 13 | |
|                   | *Dodonaea viscosa* Jacq. | Mexico | 3, 4, 6, 7, 12 | | |
| *Sapotaceae*      | *Achras zapota* L. [Manilkara zapota (L.) P. Royen] | Mexico | 4, 7, 8, 9, 12, 13 | | |
|                   | *Manilkara sp.* | Mexico | 3 | | |
| *Sarraceniacae*   | *Darlingtonia californica* Torr. | California | | | |
| *Saururaceae*     | *Anemopsis californica* (Nutt.) Hook. & Arn. | California, Mexico | 1, 2, 3, 6, 7, 8, 10, 11, 13 | 3, 5, 7, 11 | 1, 3, 7, 10 |
| *Scrophulariaceae* | *Buddleja americana* L. | Mexico | 13 | | |
|                   | *Capraea bifora* L. | Mexico | 10 | | |
Table 3 Medicinal plants used before, during and after the Mission period, and present time at Mission Gardens. The numbers refer to emic and etic illness groupings (see Table 2) (Continued)

| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|-------------------|-------------------|--------|--------------------|----------------|--------------------|
| Russelia sarmentosa Jacq. | Europe | 3, 4, 8 |
| Scrophularia aepetris Gay ex Benth. | Europe | 3 |
| Scrophularia balbisii Hornem. ssp. balbisii | Eurasia, North America | 3, 7 |
| Scrophularia californica Cham. & Schldl. | California | 3, 6, 9, 11 |
| Verbascum sinuatum L. | Eurasia, Africa | 1, 3, 11, 13 |
| Verbascum thapsus L. | Europe | 9, 11 |
| Selaginellaceae | Selaginella lepidophylla (Hook. & Grev.) Spring | Mexico | 12, 13 |
| Simaroubaceae | Castela texana (Torr. & A. Gray) Rose | Mexico and Texas | 4 |
| | Castela tartuosa Liebm. | Mexico | 6 |
| Simmondsiaceae | Simmondsia chinensis (Link) C.K.Schneid. | California, Mexico | 3, 7, 11 |
| Smilacaceae | Smilax ornata Lem. | Mexico | 1, 10 |
| | Smilax lanceolata L. | Southeastern USA | 1, 3, 4, 7, 10, 12 |
| Solanaceae | Atropa bella-donna L. | Europe, naturalized in California | |
| | Capsicum annuum L. | Mexico | |
| | Datura innoxia Mill. | California | 10 |
| | Datura stramonium L. | Mexico introduced from Europe | 3, 7, 10, 11, 12 |
| | Datura wrightii Regel | California | 1, 3, 4, 7, 8, 9, 10, 11 |
| | Hyoscyamus albus L. | Eurasia | 4, 8, 11 |
| Nicotiana sp. | California | 3, 4, 5, 6, 7, 9, 10, 11 |
| | Nicotiana attenuata Torrey | California | 3, 4, 6 |
| | Nicotiana clevelandii A. Gray | California | 11 |
| | Nicotiana glauca Graham | South America | 7, 8, 10, 12 |
| | Nicotiana quadrivalis Pursh (N. bigelovii Torr.) | California | 3, 4, 8, 9, 10, 11 |
| Nicotiana psuillo Blanco, (N. rustica L.) | Mexico | 7, 8, 10, 12 |
| Nicotiana tabacum L. | Mexico | 4, 8, 10 |
| Solanum sp. | California | 3 |
| Solanum carolinense L. | USA | |
| Solanum douglasii Dunal | California | 3, 9, 11 |
| Solanum lycopersicum L. | Central and South America | 3 |
| Solanum melongena L. | Asia | 4 |
| Solanum nigrum L. | California | 3, 6, 9 |
| Solanum tuberosum L. | South America | 3, 7 |
| Sterculiaceae | Waltheria americana L. | Mexico | 3, 10, 12 |
| Tropaeolaceae | Tropaeolum majus L. | California | 11 |
| Turneraeae | Turnera diffusa Willd. ex Schult. | Southern Texas, Mexico, South America, Caribbean | 7, 8, 10, 11 |
| Typhaceae | Typha latifolia L. | California | 1 |
| Urticaceae | Cecropia obtusifolia Bertol. | Mexico | 4, 13 |
| | Parthenaria judaica L. | Eurasia, Africa | 1, 3, 4, 12 |
| Urtica sp. | California | 1, 3, 5, 7, 8 |
| Urtica dioica L. | Eurasia, Africa | 1, 2, 3, 4, 5, 6, 7, 8, 11, 14 |
| Urtica dioica L. ssp. holosericea (Nutt.) Thorne | California | 7, 8, 10, 11 |
| Urtica urens L. | Eurasia | 4, 6 |
| | Urtica urens L. | Eurasia | 1, 3, 7 |
Rorippa nasturtium-aquaticum (L.) Hayek, Salvia sp. and Sambucus mexicana C. Presl. (Table 3). It is important to point out that these medicinal plants were not necessarily used to treat the same ailments. It is evident that many of the Mission priests and early Spanish explorers were open to the use of Native American medicinal plants and adopted them when medicinal supplies from Spain and Mexico were not available [26, 58–61].

The close reading of diaries, journals, reports, and books indicate there are reasons to believe that sharing of information about medicinal plants did take place at the Missions, but conditions at the Missions and other factors also interfered with the exchange. Table 4 summarizes references that report on the sharing of information. The primary support comes from diaries and reports of priests and others present during the Mission period who observed the use of plants native to California and the introduction of European species period (see Table 4). Direct evidence of the sharing of information comes from reports that neophytes were sent out to collect both food and medicinal plant in times of shortages [64]. A survey conducted in 1812 asked the priests at each Mission to report on the customs and conditions of indigenous people living at or near the Missions [23]. Question no. 15 of the survey asked specifically about the medicinal practices of the people and their use of plants in the treatment of illness. In response to this question, the priest at 13 of the 18 missions reported that the local Native Americans used plants for medicinal purposes. Reports from the other five missions stated that no plants were used by the Native Americans for medicinal purposes. Plant species were identified, ranging in number from one to 14, at eight of the 13 missions reporting the use of medicinal herbs. A total of 16 different plants were reported from all the California Missions.

Table 5 summarizes references that suggest eight reasons for the impediments to the transfer of information. These are the following:

1. A significant power imbalance existed between the priests and the Native Americans.
2. Priests thought the Native Americans were savage heathens or children who knew nothing.
3. Language barriers to communication.
4. Reduction in the availability of medicinal herbs due to the elimination of Native American burning and the introduction of Spanish livestock.
5. Knowledge of medicinal plants was a source of power and income for the Native American shamans who did not want to share it.
6. Structural organization of the administration of Missions left little time for direct communication between priests and neophytes.
7. Knowledge of herbal medicine was lost at the Missions by the neophyte’s children and grandchildren.

Table 3 Medicinal plants used before, during and after the Mission period, and present time at Mission Gardens. The numbers refer to emic and etic illness groupings (see Table 2) (Continued)

| Botanical family* | Medicinal plants* | Native | Pre-Mission period | Mission period | Post-Mission period |
|-------------------|-------------------|--------|-------------------|----------------|-------------------|
| Ustilaginaceae     | Ustilago maydis (Persoon) Roussel | Mexico | 7                 |                |                   |
| Verbenaceae        | Aloysia citrodora Palau | South America introduced from Europe | 4, 8                 | 1, 10           |                   |
|                    | Aloysia triphylla (L’Her.) Britton | South America introduced from Europe | 4, 8                 |                |                   |
|                    | Verbena bipinnatifida Nutt. [Glandularea bipinnatifida (Nutt.) Nutt.] | Mexico | 10                |                |                   |
|                    | Verbena lasiostachys Link var. lasiostachys | California | 3, 4, 6, 11 |                |                   |
|                    | Verbena officinalis L. | Europe | 1, 3, 4, 6, 7, 11, 14 |                |                   |
| Violaceae          | Viola sp. | California | 3                 | 6              |                   |
|                    | Viola riviniana Rchb. | Europe | 1                 |                |                   |
| Vitaceae           | Vitis sp. | California | 1                 |                |                   |
|                    | Vitis vinifera L. | Europe | 1, 3, 4, 7, 10, 11, 7, 10 |                |                   |
| Zosteraceae        | Phyllospadix torreyi S. Wats. | California | 11                |                |                   |
| Zygophyllaceae     | Guaiacum officinale L. | Caribbean | 3, 10             |                |                   |
|                    | Guaiacum sanctum L. | Mexico | 4, 6, 10           |                |                   |
|                    | Kalidromia grandiflora A. Gray | Mexico and South West USA | 3, 7, 12 |                |                   |
|                    | Larrea divaricata (DC.) Cov. (l. californica DC.; l. mexicana Moric) | California, Mexico | 1, 3, 4, 6, 7, 8 | 3, 4, 5, 6, 7, 11, 10, 11 | 13 |

*Botanical family classification and nomenclature for species names were authenticated according to Hickman [45], Stevens [46], and the International Plant Names Index (www.ipni.org).
Transportation limitations during the Mission period may have limited reciprocal shipments of medicinal plants between Spain and California.

**Post-Mission Period**
The list of medicinal plants used both by Natives Americans and Californios indicates a much greater sharing of medicinal knowledge following the secularization of the Missions [19, 43]. The lists indicate 148 taxa were used to treat 288 ailments in 14 therapeutic groups (Fig. 2). Forty-four (30%) of these 148 taxa occur on the list of medicinal plants used by the Native American prior to the Mission period, forty-two taxa (28.4%) were in use during the Mission period.

**Discussion**
The results of this study suggest limited sharing of information about medicinal plants occurred during the Mission Period. There are direct reports of the sharing of information such as the dispatching of neophytes to collect food plants and herbs during times of shortages [64]. Additionally, the priest at eight of the Missions responded to the 1812 survey that the local Native Americans used plants for medicinal purposes. One might assume that some of these plants would have been exported to Spain because of their medicinal value. However, none of the 15 species most commonly used by Native Americans occurs on the registry of plants introduced to Mediterranean area during the eighteenth and nineteenth centuries ([48]; Flora [49, 52, 53, 81]). Furthermore, none of these California species were reported to have been grown in present-day herb gardens in northern Spain [37, 38]. The exchange of information on medicinal plants is further supported by the presence of both European and Californian species in present-day Mission gardens and apothecary shops further supports the exchange of information.

Much more evidence was discovered in this study to suggest many possible factors contributed to constraining the sharing of information about medicinal plants. These factors and the sources of information about these factors are presented in Table 5. We elaborate on these factors as follows:

**A significant power imbalance existed between the priests and the Native Americans**
The priests maintained significant power over the Native Americans at the missions. Their power was enforced by corporal punishment and confinement of the neophytes who did not work or who behaved badly in the eyes of the priests [61, 82]. This power imbalance resulted in the neophytes hiding some information concerning medicinal plants and shaman treating neophytes out of
### Table 4 Published sources supporting the exchange of information on medicinal plants

| Comments | Source |
|----------|--------|
| Native American teach priests about their medicinal plants (pp. 73-74) (example of exchange of information between Native Americans and priests) | Anderson [26] |
| Compilation of medicinal plants by Father Garriga (pp. 443-445) (example of exchange of information between Californios and priests) | Beebe and Senkewicz [43] |
| Father Crespi reports vineyard-like plantings by Native Americans (pp. 45) (example of exchange of information between Native Americans and priests) | Blackburn and Anderson [62] |
| Sick sailors taken ashore in hope that medicinal herbs could be found (pp. 143) (example of the use of medicinal plant by Spanish explorers in California) | Brown [58] |
| Dr. Prat searches for medicinal herbs after first ship land in San Diego (pp. 144) (example of the use of medicinal plant by Spanish explorers in California) | Goerke [65] |
| List of California plants identified by Portola (pp. 209-293) (example of interest in plants by Spanish explorers) | Geiger and Meighan [23] |
| Native American knowledge of medicinal plants (pp. 66) (example of exchange of information between Native Americans and priests) | Boscana [63] |
| Junipero Serra’s leg treated by muleteer using local herbs (pp. 69) (example of exchange of information between Mestizo and priests) | Castillo [59] |
| Friars unable to reduce death rate even with help from Native American shaman (pp. 156) (example of exchange of information between Native Americans and priests) | Engelhardt [64] |
| Dr. Prat searches for medicinal herbs (pp. 14) (example of the use of medicinal plant by Spanish explorers in California) | Geiger and Meighan [23] |
| 1812 survey of Missions asking about medicinal practices of Native Americans (example of exchange of information between Native Americans and priests) | Kryder-Reid [66] |
| Gardens at Mission Delores (pp. 58) (example of garden at a Mission where both medicinal plants from Europe and California were grown together for medicinal purposes) | Guerrero [60] |
| Watercress reported at Mission San Gabriel (pp. 152) (example of medicinal plant native to both Spain and California observed at a Mission) | Kryder-Reid [66] |
| Father Font identifies flora (pp. 176) (example of priest identifying native plants in California and referencing them to plant species in Spain of medicinal value) | Guerrero [60] |
| Anza becomes sick and is treated with medicinal (pp. 187) (example of exchange of information between Native American and Spanish explorers) | Guerrero [60] |
| Shared indigenous knowledge (pp. 33) (example of exchange of information between Native Americans and priests) | Kryder-Reid [66] |
| Neophytes were sometimes dispatched by the priests to collect medicinal plants from the wild (p. 576) (example of exchange of information) | Engelhardt (1922) |

### Table 4 Published sources supporting the exchange of information on medicinal plants (Continued)

| Comments | Source |
|----------|--------|
| at Mission San Jose the Native Americans retained their native customs (pp. 50-53) (example of Native Americans continuing their use of medicinal plants at the Missions) | Milliken [67] |
| Continued practice of native medicine at Soledad Mission (pp. 119) (example of Native Americans continuing their use of medicinal plants at the Missions) | Land [67] |
| Practice of herbal medicine (pp. 173) (example of Native Americans continuing their use of medicinal plants at the Missions) | Timbrook [68] |
| Use of Datura toothache (pp. 175-178) (example of Native Americans continuing their use of medicinal plants at the Missions) | Sandoz (2004) |
| Use of horehound (pp. 180-181) (example of Native Americans continuing their use of medicinal plants at the Missions) | Sandoz (2004) |
| Gardens at San Buenaventura (pp. 86) (example of Native American medicinal plants being planted in Mission gardens) | Webb [61] |
| Exchange of information about medicinal plants (pp. 160-161) (example of exchange of information between Native Americans and priests) | Weber [69] |

### 2. Mission gardens and apothecary shops

| Comments | Source |
|----------|--------|
| Shaman cultivated medicinal herbs (pp. 44) (example of Native American medicinal plants being planted in Mission gardens) | Blackburn and Anderson [62] |
| Seed imported from Mexico for Mission gardens (example of plants from a variety of sources being planted in Mission gardens) | Brown [58] |
| San Carlos Mission garden (pp. 186) (example of Native American medicinal plants being planted in Mission gardens) | Guerrero [60] |
| San Diego Mission gardens (pp. 36) (example of Native American medicinal plants being planted in Mission gardens) | Kryder-Reid [66] |
| Mission San Buenaventura gardens (pp. 294) (example of Native American medicinal plants being planted in Mission gardens) | Lamb [70] |
| San Luis Rey Mission gardens (pp. 96, 98) (example of Native American medicinal plants being planted in Mission gardens) | Tac [71] |
| Native American gardens (pp. 60) (example of Native American medicinal plants being planted in Mission gardens) | Webb [61] |
| Mission San Luis Rey gardens (pp. 76) (example of Native American medicinal plants being planted in Mission gardens) | Webb [61] |
| Domestication of native herbs (pp. 125) (example of Native American medicinal plants being planted in Mission gardens) | Weber [69] |
| Apothecary shops (pp. 129-131) (example of Native American medicinal plants being planted in Mission gardens) | Weber [69] |
| Native Americans encouraged to domesticate local plants (pp. 133) (example of Native American medicinal plants being planted in Mission gardens) | Weber [69] |
Priests thought the Native Americans were savage heathens or children who knew nothing
Many of the priests regarded the Native Americans as pagan savages whose customs needed to be suppressed. Interest in or communication about native medicinal plants would have been considered a way of endorsing native beliefs that the priests were dedicated to eliminating.

Language barriers to communication
Language was also a barrier to communication between the priests and the Native Americans. Several quite distinct languages and dialects were spoken by Native Americans living along the California coast. Although the Mission priests were expected to learn the native languages and instruct the Native Americans in their native languages this was seldom the case [59]. The language barrier was limited not only to the difficulty and reluctance of the Mission priests to learn the native languages, but also to the first generation of Native Americans neophytes who learned only a minimum of Spanish. Spanish was acquired by Native Americans born at the Missions [61], but this and subsequent generations of Mission born Native Americans had less knowledge of native medicinal plants to share with the priests.

Reduction in the availability of medicinal herbs due to the elimination of Native American burning and the introduction of Spanish livestock
The use of land for farming and livestock grazing along with the elimination of Native American burning of the landscape resulted in fewer medicinal plants in the vicinity of the Missions [30, 62, 74]. The resulting lack of access to native medicinal plants further interfered with the transfer on information.

Knowledge of medicinal plants was a source of power and income for the Native American shamans who did not want to share it
The power and income Native American shamans received from their use of medicinal herbs were values that they would not have wanted to give up. The shamans continued their treatment of sick Native Americans at the Missions, but not in situations where they would be observed by the priests ([21, 74]; Timbrook 2000). Since the shaman’s knowledge of healing was acquired over many years and was not shared with the general population of Native Americans [80], one would not have expected they would be eager to share it with the priests.

Structural organization of the administration of Missions left little time for direct communication between priests and neophytes
The Missions were initially organized to be administered by only two priests. They were assisted by a limited number of soldiers, cowboys, farmers, and craftsmen brought from Mexico [77]. Wives of some of these individuals were put in charge of the girl’s and unmarried women’s dormitories. Others worked as cooks. The priests selected neophytes to serve as acaldes and enfermeros in intermediate positions between the assistants brought from Mexico and the common neophytes [76]. The priests organized the work force of neophytes into four classes: first—skilled artisans; masons, carpenters, etc.; second—fishermen, stockmen, herdsmen, cowboys, tallow makers, hide cleaners, butchers; third—horticulturalists who tended mission gardens; fourth—laborers and field hands [76]. This administrative structure was necessary to manage the large numbers of neophytes at the Mission and to raise food [67]. The administrative structure limited one on one communication between the neophytes and the priests except in the catechism classes initially conducted by the priests. The priests had limited contact with the Native American women, some of whom were lower-level shamans possessing considerable knowledge of medical plants [79].

Knowledge of herbal medicine was lost at the Missions by the neophyte’s children and grandchildren
An important impediment to the transfer of knowledge of herbal medicine was the loss of such knowledge by the initial generation of neophyte’s children and grandchildren [32, 59, 74]. The individuals who were born at the Missions had fewer contacts with native medicinal plants than Native Americans living away from the Missions. Sandos [76] suggests that previous customs changed the longer the neophytes were at the Missions.
Table 5 Limitations to the exchange of information on medicinal plants

1. A significant power imbalance existed between the priests and the Native Americans

| Comments                                                                 | Source                        |
|--------------------------------------------------------------------------|-------------------------------|
| The power of the priests was maintained by the presence of soldiers at the missions (p. 22) | Webb [61]                     |
| Priests used corporal punishment to enforce their power (p. 113)          | Castillo [59]                 |
| Native Americans avoided a sharing of their knowledge of medicinal plants and healing practices by conducting healing activities at night out of sight of priests from fear of losing power to the priests (47-51; 71-80, 97-100, 119-120) | Geiger and Meighan [23]       |

2. Priests thought the Native Americans were savage heathens or children and their pagan ways should be suppressed

| Comments                                                                 | Source                        |
|--------------------------------------------------------------------------|-------------------------------|
| Boscana’s view of the character of the Native American (pp. 52)           | Castillo [59]                 |
| Spanish attitude toward Native Americans (pp. 64)                        | Engelhardt [64]               |
| Fr. Boscana’s views of Native Americans (example of disrespect on the part of priests for Native American knowledge) | Hanke [72]                    |
| Controlling and acculturating Native Americans (pp. 110)                 | Kryder-Reid [66]              |
| Spanish hold native culture in contempt (p. 30)                          | Langsdorff [73]               |
| Priest force Native Americans to alter their traditional practices (pp. 59) | Lightfoot [21]                |
| Shamans considered sorcerers and wizards by priests (pp. 109)            |                              |
| Missionaries sought to make Native Americans ashamed of their traditional ways of life (pp. 223) | Milliken [74]                 |
| Native rituals and beliefs identified as work of the Devil (pp. 225)      | Rawls [75]                    |
| Priests prohibit Native American from dancing at San Gabriel Mission (pp. 5) | Sandos [76]                   |
| Fr. Boscana compares Native Americans to monkeys (pp. 21)                 | Shipek [77]                   |
| "denaturalizing" of Native Americans (pp. 92)                            | Skowronek [78]                |
| Shamans practiced sucking of objects from bodies of the afflicted (pp. 118) | Wilken-Robertson [32]         |
| Tribal lore kept secret by Shaman (pp. 181-182)                          |                               |
| Native Americans viewed as deceivers (pp. 481)                          |                               |
| Native Americans viewed as devil worshipers (pp. 68)                      |                               |
| Challenge to indigenous medicinal practice (pp. 17)                       |                               |

3. Language barriers to communication

- Original languages spoken by some neophytes usurped by other languages spoken by neophytes from different tribes (pp.51)
- Native American languages unworthy of study or preservation (pp. 51)
Table 5 Limitations to the exchange of information on medicinal plants (Continued)

1. A significant power imbalance existed between the priests and the Native Americans

| Comments                                                                 | Source            |
|--------------------------------------------------------------------------|-------------------|
| No record that teachers were sent or that the friars established to teach Native Americans Spanish (pp. 128b) (example of barrier to sharing of information due to different languages) | Guerrero [60]     |
| Policy of not teaching Native Americans to read or write Spanish (pp. 128-129) (example of barrier to sharing of information due to different languages) |                       |
| Missionaries did not learn native languages (pp. 140) (example of barrier to sharing of information due to different languages) | Rawl (1984)       |
| Persistence and hard work required of the missionaries to learn Native American languages (pp. 177) (example of barrier to sharing of information due to different languages) | Webb [61]         |
| Missionaries should make greater effort to learn Native American languages (pp. 39) (example of failure of priests to learn native languages) |                       |
| Language barriers (pp. 26 and 45) (example of barrier to sharing of information due to different languages) |                       |
| Variety of crude and barbarian languages among the Native Americans (pp. 46) (example of barrier to sharing of information due to different languages) |                       |
| Native Americans born in the Missions learned Spanish (pp. 47) (example of greater opportunity of second generation neophytes to exchange information on medicinal plants) |                       |
| Interpreters employed to neophytes since most padres did not learn the native languages (pp. 48a) (example of barrier to sharing of information due to different languages) |                       |
| Only those Native Americans born in the Mission all speak Castilian (pp. 48b) (example of greater opportunity of second generation neophytes to exchange information on medicinal plants) |                       |
| After 1840 Native Americans reported to speak Spanish (pp. 308) (example of greater opportunity of second generation neophytes to exchange information on medicinal plants) |                       |
| Great variety of Native American languages and dialects (pp. 15) (example of greater opportunity of second generation neophytes to exchange information on medicinal plants) |                       |
| Majority of the friars taught neophytes in Spanish, rather than in their native languages (pp. 124) (example of greater opportunity of second generation neophytes to exchange information on medicinal plants) |                       |

4. Reduction in the availability of medicinal herbs due to the elimination of Native American burning and the introduction of Spanish livestock.

| Comments                                                                 | Source            |
|--------------------------------------------------------------------------|-------------------|
| Subsistence practices constrained at Missions (pp. 79) (example of Native American customs, including medicinal practices constrained at the Missions) | Lightfoot [21]    |
| Plant management practices by Native Americans that would have been curtailed around the Missions (pp. 83) (example of Native American customs, including medicinal practices constrained at the Missions) | Lightfoot and Parrish [30] |
| Native American spiritual practices connected to plant harvesting curtailed by Missionaries (pp. 84) (example of Native American customs, including medicinal practices constrained at the Missions) |                       |
| Cessation of native fire management practices (pp. 27-28) (example of land management practices used by Native American to promote medicinal plants constrained at the Missions) | Milliken [74]     |
| Change of lifestyle resulted in a loss of interest in traditional commodities (pp. 222) (example of Native American customs, including medicinal practices constrained at the Missions) |                       |
| Use of fire by Native Americans (pp. 12) (example of land management practices used by Native American to promote medicinal plants constrained at the Missions) | Timbrook [18]     |
| Spanish soldiers destroy Native American field by grazing (pp. 48-49) (example of land management practices used by Native American to promote medicinal plants constrained at the Missions) | Blackburn and Anderson [62] |
| Native American burning to produce more seeds (pp. 81) (example of Native American land management practices used to promote medicinal plants) |                       |
| Native American burning (pp. 117) (example of Native American land management practices used to promote medicinal plants) |                       |
| Crespi's observation of Native American burning (pp. 121-122) (example of Native American land management practices used to promote medicinal plants) |                       |
| Evidence of Native American burning (pp. 124) (example of Native American land management practices used to promote medicinal plants) |                       |
| Governor Arrillaga bans Native American burning in 1793 (pp. 126-127a) (example of land management practices used by Native American to promote medicinal plants constrained at the Missions) |                       |
| Moncada's 1774-1777 observations of Native American burning (pp. 126-127b) (example of Native American land management practices used to promote medicinal plants) |                       |
| Longinos' observation of Native American burning (pp. 129) (example of Native American land management practices used to promote medicinal plants) |                       |
| Native American use of fire to influence plant growth (pp. 134) (example of Native American land management practices used to promote medicinal plants) |                       |
| Medicinal plants encouraged by Native American burning (pp. 145) (example of Native American land management practices used to promote medicinal plants) |                       |
| Adoption of Native Americans to colonist's land management practices (pp. 27) (example of land management practices | Wilken-Robertson [32] |
Table 5 Limitations to the exchange of information on medicinal plants (Continued)

| Comments                                                                 | Source       |
|--------------------------------------------------------------------------|--------------|
| A significant power imbalance existed between the priests and the Native Americans |              |
| used by Native American to promote medicinal plants constrained at the Missions) |              |
| Spanish authorities prohibit Native Americans from burning (pp. 45) (example of land management practices used by Native American to promote medicinal plants constrained at the Missions) |              |
| 5. Knowledge of medicinal plants was a source of power and income for the Native American shamans who did not want to share it |              |
| Structure of shamanism among California Native Americans (pp. 55-56) (example of Native American power structure effecting the use of medicinal plants) | Bean [79] |
| Secret knowledge (pp. 3) (example of Native American power structure effecting the use of medicinal plants) | Boscana [63] |
| Continued native practice of medicine (pp. 110) (example of Native American power structure effecting the use of medicinal plants) | Lightfoot [21] |
| Native practices took place in neophyte quarters (pp. 112-113) (example of Native American power structure effecting the use of medicinal plants) |              |
| Priests lament continued pagan practices of shamans at missions (pp. 183) (example of difficulty priest had in curtailing Native American customs) |              |
| Shaman’s skills required a “lifetime” of experience (pp. 132-133) (example of Native American power structure effecting the use of medicinal plants) | Margolin [80] |
| Shaman’s methods of healing (pp. 27-28) (example of Native American power structure effecting the use of medicinal plants) | Milliken [74] |
| Shamans were skilled at the arts of healing (pp. 10) (example of Native American power structure effecting the use of medicinal plants) | Rawls [75] |
| Neophytes preserved much of their culture after baptism without the knowledge of the priests (pp. 94) (example of Native Americans attempting to preserve their knowledge and use of native plants for medicinal purposes) | Sandos [76] |
| Different kinds of shamans (pp. 142) (example of Native American power structure effecting the use of medicinal plants) | Timbrook [68] |
| Shamans secretive about their remedies (pp. 173) (example of Native Americans attempting to preserve their knowledge and use of native plants for medicinal purposes) |              |
| 6. Structural Organization of the administration of Missions left little time for direct communication between priest and neophytes |              |
| Alcaldes appointed by priests (pp. 112) (example of priests using intermediaries in dealing with Native Americans) | Lightfoot [21] |
| Priest’s organization of neophyte community at the missions (pp. 9) (example of priests using intermediaries in dealing with Native Americans) | Sandos [76] |
| Number of Spanish/Mexican people at the mission compared to number of neophytes (pp. 488) (example of the large numbers of Native Americans at the mission compared to priest) | Shipek [77] |
| 7. Knowledge of herbal medicine lost by the neophyte’s children and grandchildren |              |
| Traditional customs forgotten at the missions (pp. 192) (example of knowledge lost by second and third generation neophytes) | Castillo [59] |
| Undermining of traditional knowledge from one generation to the next at the missions (pp. 221) (example of knowledge lost by second and third generation neophytes) | Milliken [74] |
| Gradual impoverishment of Native American lifestyle at the missions (pp. 222) (example of knowledge lost by second and third generation neophytes) |              |
| Previous ways changed the longer neophytes were at the missions (pp. 157) (example of knowledge lost by second and third generation neophytes) | Sandos [76] |
| Neophytes lost touch with their culture quickly at the northern mission, but not so quickly at the southern missions (pp. 181-182) (example of knowledge lost by second and third generation neophytes) |              |
| Impact of mission system on indigenous medical knowledge (pp. 17) (example of knowledge lost by second and third generation neophytes) | Wilken-Robertson [32] |
| Impact of historical processes on ethnobotanical knowledge (pp. 15-16) (example of knowledge lost by second and third generation neophytes) |              |
| 8. Limitations to transportation |              |
| Spanish restriction of exclusion and restriction of foreign trade with their possessions in the New World would have limited the transport of medicinal plants back to Spain (pp. 436-437) (example of constraints on the transportation of medicinal plants) | Engelhardt [64] |
| Every year a transport ship arrived in San Diego, Santa Barbara, Monterey, and San Francisco with supplies for the Missions. Priests were required to pay for and to pay for any materials shipped back to Spain. The costs restricted shipment of medicinal herbs. (pp. 437) (example of constraints on the transportation of medicinal plants) |              |
| In 1825 Governor Echeandia forbid the missionaries to trade with any vessel outside of the four Presidio ports. This required the expensive transport of materials on the backs of mules from Missions distant |              |
Transportation limitations during the Mission period may have limited reciprocal shipments of medicinal plants between Spain and California

Transportation from Spain to California and vice versa during the Mission period was limited. Most materials brought from Spain were shipped to ports on the east coast of Mexico, transported over land to Puerto Vallarta, and then shipped to ports in San Diego, Santa Barbara, Monterey, and San Francisco. Occasionally, ships from Europe would travel around the tip of South America to reach ports in California. Prior to the Mexican revolution, at least one ship would arrive annually with supplies for the Missions. During the Mexican War of Independence (1810-1821) shipments to California were for the most part halted [21, 69]. The Spanish priests did import European plants, including medicinal plants for gardens at the Missions [24]; however, observers at the time reported that the Native Americans received inadequate medical care mostly because of limited supplies of medicines [23, 73, 82]. As transportation was limited, especially during the conflict between Spain and Mexico there may have been little opportunity to ship medicinal plants back to Spain or to import them.

A greater exchange of information occurred during the post-Mission Period. The high number of plants used for medicinal purposes might be explained by the closer working relationships that occurred on the local ranches between the Native Americans and the Californios. Furthermore, the Californios had less incentives to “deculturalize” the Native Americans. Preparation of 46 of the herbal remedies reported by Garriga included ingredients (e.g., milk, whisky, castor oil) that were not available to the Native Americans in pre-Spanish times [19]. This suggests a sharing of information between the Californios and the Native Americans. We believe the greater sharing of information about the medicinal use of plants during the secularization and post-secularization period was due to (1) more one-to-one interactions between the Californios and the Native Americans, (2) many of the Californios were mestizos whose mothers or grandmothers were Native Americans, and (3) the lack of pressure on the part of the Californios to suppress Native American beliefs.

Conclusions

We conclude from this study that there was a limited transfer of information on the medicinal use of plants between the Native American and Spanish priests during the Mission period. Many factors related to the obligations of the priests, their attitudes toward the Native Americans, language barriers, and cultural differences interfered with a more complete sharing of information. A primary factor in the lack of transfer of medicinal information between the Native American and the priest was the imbalance of power. This imbalance of power kept the Native Americans from sharing information. The fact that none of the 15 most commonly used California species were not transported to Spain for medicinal uses presents an interesting question: were these plants not considered of superior value to the plants in Spain for the treatment of illnesses or did the Native American not share their knowledge of these plants with the priests? The magnitude sharing of information about medicinal plants between the Native Americans and the Californios increased in the post-Mission Period. This increase was due to a greater contact between the Native Americans and the Californios and a different relationship that existed between the two groups. Important aspects of this relationship were increased one-on-one communication, mestizo background of the Californios, and the lack of responsibility on the part of the Californios to convert the Native Americans to Christianity.

Acknowledgements

Not applicable

Authors’ contributions

McBride, J.—40%; Cavero—35%; Cheshire—10%; Calvo—10%; McBride, D.—5%. JRM initiated the study, developed the research plan, identified references for plants used by Native Americans, developed the lists of medicinal plants from Mexico and medicinal plants used by the Californios and Native Americans during the post-Mission period, conducted the "close reading" of historical and current documents concerning the sharing of medicinal information during the Mission and post-Mission periods in California, and wrote the first draft of the paper. RYC developed data on the use of medicinal plants in Spain, consulted historical sources for introduction of California plants into Spain, served as principal editor of the manuscript, formatted tables, and produced Fig. 2. ALC compiled the list of plant species used by the Native Americans, developed the historical background for the California Missions, and produced Fig. 1. MIC assisted RYC in the development of the lists of medicinal plants used in Spain. DLM provided information on the
disease epidemics at the California Mission and assisted in the editing of the initial manuscript.

Author's information
JRM—Plant Ecologist. Professor Emeritus, Department of Environmental Science, Policy, and Management and Department of Landscape Architecture and Environmental Planning, University of California, Berkeley, USA
RYC—Botanist. Professor, Department of Environmental Biology, School of Sciences, University of Navarra.
ALC—Art Historian. Student. School of Art, San Francisco State University, San Francisco, CA.
MIC—Ethnobotanist. Professor. Department of Pharmaceutical Technology and Chemistry, School of Pharmacy and Nutrition, University of Navarra.
DLM—Pediatrics. Professor. School of Nursing, Samuel Merritt University, Oakland, CA.

Funding
This research was funding out of the salaries paid to the authors from their institutions. No direct research funding supported the research and manuscript preparation.

Funding for publication costs will be covered by the University of California (Digital Library 15%) and personal funds of Joe R. McBride. Any discount would be appreciated.

Availability of data and materials
All data generated or analyzed during this study are included in this published article.

Ethics approval and consent to participate
No ethics approval was required for this research at any of the Universities where the authors worked because the research did not involve human subjects, live animals, or live plants.

Consent for publication
Not applicable

Competing interests
There are no financial and non-financial competing interests involved in this research or its publication.

Author details
1. Department of Environmental Science, Policy and Management, University of California, Berkeley, CA, USA. 2. Department of Environmental Biology, School of Sciences, University of Navarra.
3. School of Art, San Francisco State University, San Francisco, CA, USA.
4. School of Pharmacy and Nutrition, University of Navarra, Irunlarrea 1, 31008 Pamplona, Spain.
5. School of Nursing, Samuel Merritt University, Oakland, CA, USA.

Received: 2 February 2020 Accepted: 3 June 2020
Published online: 15 June 2020

References
1. Bonatto SL, Salzano FM. A single and early migration for the peopling of the Americas supported by mitochondrial DNA sequence data. PNAS. 1997;94:1866–71.
2. Jones TL, Fitzgerald RT, Kenneth DJ, Meksic KH, Fagan JL, Sharp J, Erlander JM. The cross creek site (CA-SLO-1979) and its implications for new world colonization. Am Antiq. 2002;67:213–30.
3. Coding BF. Jones TL. Environmental productivity predicts migration, demographic, and linguistic patterns in prehistoric California. PNAS. 2013; 110:14569–73.
4. Verma R. Ganga K, Tunis A, Ghulaxe C. Rubus fruticosus (blackberry) use as an herbal medicine. Phcog. Rev. 2014;8:101–4.
5. Dixon RB. The Northern Maidu. Bull. Am. Mus. Nat. Hist. 1905;17:119–346.
6. Barrett SA. The Ethno-Geography of the Pomo and neighboring Indians. Berkeley: University of California; 1908.
7. Bard CL. A contribution to the history of medicine in southern California, Annual Address of the Retiring President of the Southern California Medical. San Diego: Society; 1894.
8. Bean LJ, Saubel KS. Temalpakh: Cahuilla Indian knowledge and usage of plants. Morongo Indian Reservation. Maliki Museum Press; 1972.
9. Garcia C, Adams JD. Healing with medicinal plants of the west - cultural and scientific basis for their use. La Crestena: Abedus Press; 2005.
10. Gardner L. The surviving Chumash. Archaeol. Survey Annu. Univ. California. 1965:2:277–302.
11. Mead GR. The ethnobotany of the California Indians: a compendium of the plants, their users, and their uses. Museum of Anthropology: University of Northern Colorado, Greeley; 1972.
12. Moerman DE. Native American Ethnobotany. Portland: Timber Press; 2000.
13. Murphye EVA. Indian uses of native plants. Fort Bragg: Mendocino County Historical Society; 1953.
14. Sparman PS. Culture of the Luiseno Indians. American Archaeology and Ethnology. 1908;8:187–234.
15. Strike SS. Aboriginal uses of California's indigenous plants, ethnobotany of the California Indians, vol. 2. Champaign: Koeltz Scientific Books; 1994.
16. Timbrook J. Virtuous herbs: plants in Chumash medicine. J. Ethnobotany. 1987;7:171–80.
17. Timbrook J, Ethnobotany of Chumash Indians, California, based on collections by John P. Harrington. Economic Botany. 1990;44:236–53.
18. Timbrook J, Chumash ethnobotany: plant knowledge among the Chumash people of Southern California. Berkeley: Heyday Books; 2007.
19. Weber FJ, editor. Andrew Garriga's compilation of herbs and remedies used by the Indians & Spanish Californians. Los Angeles: Archdiocese of Los Angeles; 1978.
20. Heizer RF, editor. Handbook of North American Indians. Vol. 8, California. Washington: Smithsonian Institution; 1978.
21. Lightfoot KG. Indians, missionaries, and merchants. Berkeley: University of California Press; 2005.
22. Geiger M. Biographical data on the missionaries of San Fernando College serving the California Missions from 1817 to 1820. Calif. Hist. Soc. Q. 1969:48:125–51.
23. Geiger M, Meighan CW. As the padres saw them. In: California Indian life and customs as reported by the Franciscan Missionaries 1813-1815. Santa Barbara Mission Archive Library: Santa Barbara; 1976.
24. Dunmire WW. Gardens of New Spain. Austin: University of Texas Press; 2004.
25. Cook SF. Population trends among the California Mission Indians. Berkeley: University of California Press; 1967.
26. Anderson MK. Tending the wild. Berkeley: University of California Press; 2005.
27. Barrows DP. The ethnobotany of the Coahulla Indians of Southern California. Chicago: University of Chicago Press; 1909.
28. Faber G, Lasagna M. Whispers from the first Californians. Alamo, CA: Mabpie Publications; 1980.
29. Heinsen V. Mission San Antonio de Padua Herbs. Jolon: Printed by Old Mission San Antonio; 1989.
30. Lightfoot KG, Parish O. California Indians and their environment: an introduction. Berkeley: University of California Press; 2009.
31. Mead GR. The ethnobotany of the California Indians. La Grange: E-Cat Worlds Press; 2014.
32. Wilken-Roberson M. Kumeyaay Ethnobotany. Inc; San Diego: Sunbelt Publications; 2018.
33. Akerreta S, Caverro RM, Calvo ML. First comprehensive contribution to medical ethnobotany of Western Pyrenees. J. Ethnobiol. Ethnomed. 2007;6:26–39.
34. Akerreta S, Caverro RM, López V, Calvo ML. Analyzing factors that influence the folk use and phytomyony of 18 medicinal plants in Navarra. J. Ethnobot. Ethnomed. 2007b;3:16.
35. Alarcón R, Pardo-de-Santayana M, Priestley C, Morales R, Heinrich M. Medicinal and local food plants in the south of Alava (Basque Country, Spain). J Ethnopharmacol. 2015;176:207–34.
36. Carrío, E., Vallès, J., 2012. Ethnobotany of medicinal plants used in Eastern Spain. J. Ethnopharmacol. 2015;176:207–34.
37. Cavero RY, Akerreta S, Calvo ML. Pharmaceutical ethnobotany in northern Navarra (Iberian Peninsula). J. Ethnopharmacol. 2011a;133:138–69.
38. Akerreta RM, Pardo-de-Santayana M, Heinrich M. Contribución a la etnobotánica de los pueblos de la región del norte de Navarra, España. J. Ethnopharmacol. 2011b;137:844–55.
39. Mann Z, Caverro RM, Calvo ML, et al. The ethnomedical ethnobotany of the middle Basque Country (Biscay and Alava). Iberian Peninsula. J. Ethnopharmacol. 152, 113-134.
