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THE SPANISH AND MEXICAN BASELINE OF CALIFORNIA TREE AND SHRUBLAND DISTRIBUTIONS SINCE THE LATE 18TH CENTURY

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ABSTRACT

Historical distributions of 31 tree species, chaparral, and coastal sage scrub described by Spanish land explorers in the late eighteenth and early nineteenth centuries (1769–1806) and in land grant diseños (1784–1846) are reconstructed at 634 localities across central and southern California. This baseline predates most formal botanical surveys by nearly a century, allowing for assessment of vegetation change over the broadest time frame for comparison with pre-historical evidences and future distributions. Spanish accounts are compared with historical sources in the Mexican era (1821–1848), American settlement (1848–1929), and modern range maps of the 1929–1934 Vegetation Type Map (VTM) survey. Among tree species that were recorded in Spanish explorations, the site-specific localities are consistent with VTM maps at the spatial resolution of the land expeditions. In contrast with massive deforestation across eastern North America since European colonization, hardwood and conifer forests in California sustained inconsequential cutting during Hispanic settlement. Spanish accounts and Mexican diseños occasionally provide remarkable detail of fine-scale distributions which have not changed over the past two centuries, including *Pinus radiata* forest at Cambria and Monterey, the eastern limit of *Quercus lobata* and *Q. agrifolia* woodlands with *Aesculus californica* in the Salinas Valley, as well as isolated stands of *Cupressus macrocarpa* and *C. sargentii*. Disjunct occurrences of trees in southern California were recorded at the same places they occur today, including an isolated grove of *Q. engelmannii* at the Baldwin Park Arboretum, and the *Pinus coulteri* stand in the mountains above Santa Barbara. The southern margin of mixed conifer forest in the San Bernardino Mountains has remained on the crest of the range since Garcés' account in 1776. Long-term tree distributions are evaluated with respect to land use, grazing and climate change. We advocate the use of historical records as proxy data for climate change studies.

Key words: California trees, chaparral, coastal sage scrub, Geographical Information Systems, Google Earth, plant geography, species ranges, vegetation change, vegetation history, vegetation type map.

INTRODUCTION

To map changes in vegetation distributions at broad temporal and spatial scales it is necessary to designate a "baseline" of historical records for comparison to extant ranges. In long-lived forest and shrubland ecosystems, species change is slow and often emerges only when compared with documentation that predates formal scientific study. Inevitably, such documentation lacks precision of observations (Minnich and Franco-Vizcaíno 1998; Jackson et al. 2001; Minnich 2008): historical documentary records are limited to written accounts of land explorations and settlers, as well as cadastral surveys, newspaper accounts, and early photographs. Observers also lacked precise methods of field survey gained by modern scientific protocols and taxonomic nomenclature. Consequently, a large body of records is needed because individual sources typically provide observations incidental to the study of vegetation. Records are especially informative at fixed locations that can be traced through time (Grove and Rackham 2001). The choice of historical reference also influences the amount of change that can be detected, i.e., the "shifting baseline syndrome" in ecological studies (Jackson et al. 2001). The story you tell depends on when you start the story.

In California—the coastal region from the U.S.-Baja California Mexico boundary to San Francisco settled in the Spanish (1769–1821) and Mexican eras (1821–1848)—a central question is the extent to which the natural vegetation was modified since the onset of Spanish colonization in 1769. Previous studies have reconstructed profound change in California herbaceous ecosystems with the displacement of indigenous wildflower fields by exotic annual grasses and forbs introduced from Mediterranean Europe and the Middle East, a transformation whose onset predates the first scientific surveys of the region (Huenneke 1989; D'Antonio and Vitousek 1992; Sims and Risser 2000; Minnich 2008).

California was first described in brief encounters during the Cabrillo (1542) and Vizcaíno voyages (1602) (Minnich 2008: 10). Cabrillo sailed northward from Navidad, Mexico, and kept within sight of shore along Baja California and southern California. Vizcaíno also explored the coast of Baja California and southern California and discovered the Bay of San Diego and Monterey. Both expeditions left rare, mostly cursory, accounts of vegetation (Bolton 1916). The earliest comprehensive historical baseline of vegetation is the record of late eighteenth century Spanish land explorations by Franciscan missionaries and soldiers. By 1772, missions were already being

established between San Diego and San Francisco, but missionaries concluded they had insufficient manpower to establish missions in northern Baja California (Minnich 2008: 13). A "concordat" was made between the Franciscan and Dominican orders. The Dominicans agreed to take over the Jesuit mission system in the deserts of Baja California, and to establish new missions in Mediterranean lands of northern Baja California. The Franciscans would control the mission system in Alta California. The concordat eventually became the basis for the division of Baja California, Mexico, from California.

This study examines records of tree species' localities given in the expedition journals of Portolá (1769–1770, 1772), Anza (1774, 1776) and Palóu (1774) for coastal southern and central California (Brown 2001; Bolton 1908, 1911, 1926, 1927, 1930, 1931, 1933; CATE 2014; routes shown in Fig. 1). These sources provide a large dataset of tree species localities used to test for changes in distribution. We also examine the Zalvidea (1805) and Moraga (1806) expeditions into the great central valley, still unsettled by Spanish colonists at that time (Cook 1960, 1962). We review untranslated Spanish accounts as primary sources of information to establish the vocabulary of species or plant assemblages, which on occasion have been erroneously translated (e.g., Minnich 2008: 26–28). These accounts, as well as those of later Mexican, European and American settlers in the nineteenth century, describe vegetation at the same locations that distributions can be assessed over time (Grove and Rackham 2001: 18).

The Spanish exploration record documents that this region of Mediterranean climate of winter rain and summer drought was covered with mixed evergreen forest along the north coast, and oak woodland "parks" with vast wildflower carpets on the plains and foothills. Shrublands of coastal sage scrub and chaparral on lower mountain slopes gave way to extensive conifer forests above, pinyon-juniper woodlands on desert-facing slopes, and sparse shrub cover, succulents and cacti in the Mojave and Sonoran Deserts to the Colorado River.

Spanish accounts do not use modern botanical nomenclature. Instead, the landscape condition was documented by daily writings in journals and letters describing the kinds of plants that were encountered in terms of growth forms, morphological similarities to familiar vegetation of Europe, abundance of cover, and ethnobotanical uses by aboriginal populations. The objective of the Franciscan surveys was to provide an appraisal of natural resources to support settlement, i.e., pasture, fuel wood, and timber. Journals were requested by the Viceroy of Mexico City as a condition for obtaining funds for establishment of Franciscan missions to colonize "Alta California" (Minnich 2008).[1] Interpreting these accounts in their historical context reveals that the Spanish diarists were skillful observers as a literate class of priests and military officers (Geiger 1969). They used remarkably descriptive vocabulary to record the vegetation they encountered in the unexplored lands of Alta California, in retrospect allowing the identification of many common plants to modern species (Minnich 2008: 298–302).[2] In many cases plant descriptions could be interpreted to species level because only one member of the genus is known at the site of observation.

Another primary source in the Spanish and Mexican eras are diseños, or sketch maps of land grants across the coastal plains and valleys of California. Diseños were submitted as part of a petition submitted to the Governor of California to obtain land-grant concessions (Becker 1964; Cleland 1964; Hornbeck 1983). We examined 638 diseños archived in the California State Library.[3] Their basic annotations include a scale and north arrow, the boundaries of adjoining land-grants, and the location of a ranch house. Most include names of regional landmark features like roads, rivers, and mountains in the area. About 10% of diseños give plant names. Since the maps are impressionistic rather than planimetric, localities of plant names can be resolved only to the scale of the land grant itself.[4] Most diseños describe areas of quality pasture for cattle grazing near the coast, with symbols and Spanish plant names for trees occurring on the land grant (Minnich 2008: 90). Rare land grants in the interior central valley were described as "barrens," evidently for lack of feed to support herds of cattle.

During the American settlement period, formal surveys of California lands, including botany and vegetation, were conducted by the U.S. government-sponsored surveys. Most significant are the U.S.-Mexican Boundary survey (Emory 1857–1859) and the Pacific Railroad Survey (U.S. Department of War, 1855–1861). The most substantial work was the State Survey (Brewer and Watson 1876–1880), but the focus was inventory of the flora rather than vegetation distribution. The 2nd biennial report of the State Board of Forestry (Kinney 1887), and Forest Reserve reports of the U.S. Geological Survey (e.g., Leiberg 1899, 1900) published the first rudimentary vegetation maps of forest and woodlands.

The earliest comprehensive survey using modern methods was the Vegetation Type Map (VTM) survey of California of 1929–1934, which produced field plots and vegetation quadrangles throughout the State (Weislander 1938, 2014; Colwell 1977).[5] In spite of differences in the scale of these surveys, direct comparisons can be made between the VTM survey data and Spanish and Mexican records because of the common mandate to inventory tree distributions for lumber and fuelwood resources.

This historical analysis builds upon the seminal geographic survey of California trees in Griffin and Critchfield (1972), based on VTM data, for comparison with our maps of Spanish records. The objective of this study is to evaluate broad-scale change in the distribution of trees and shrublands from

[1] By mandate of the Spanish Crown, the route of the initial explorations generally followed the Pacific coast northward from existing Jesuit missions in northern Baja California, to search for the anchorage of Monterey, relying on accounts of the earlier "histories," i.e., the maritime reports of Cabrillo in 1542, and especially the account of Vizcaíno in 1602–1603 (Minnich and Franco-Vizcaíno 1998; Minnich 2008).

[2] Only Fages (1937) was trained in the Linnaean system of taxonomy, which he occasionally used to identify plants in his journal.

[3] Each diseño can be viewed online as scanned images at *http://content.cdlib.org*. Although many disenõs do not have an exact date of preparation, most were filed between 1833 and 1846, with nearly half claimed from 1841–1846 (Beck and Haase 1974: 24; Robinson 1948: 67).

[4] Hornbeck (1983) compiled data from diseños to reconstruct the local landscape of the northern Salinas Valley and Carmel Valley.

[5] For example, the vegetation map produced by Kinney (1887) is based on a physiographic diagram of California, while VTM maps were based on individual 1:62,500 and 1:250,000 scale topographic quadrangles.

southern to central California over the past two centuries. This new Spanish baseline, which predates the first broad-scale botanical inventories after the Gold Rush by nearly a century, will permit the comparison of the aboriginal California landscape with modern vegetation. It also provides greater historical context to implement policies and identify processes that have altered the vegetation since the twentieth century VTM survey. The results are compared with previous studies that did not fully consider the Spanish baseline.

METHODS

Recent published book and digital Spanish transcriptions of original journals and letters by Spanish explorers, as well as diseños, were interpreted and mapped as an overlay to VTM survey data to test for change in vegetation distributions.[6] The accounts give descriptions of landmark terrain features and landforms, reported distances travelled from encampments, as well as place name localities, all of which provide bases for reconstruction of their routes. For distances, we avoided literal use of "leagues," an hour's ride on a horse, because it is a highly variable length depending on the difficulty of the terrain, ca. 2–5 km (cf. Robinson 1948: 34). The routes were reconstructed in Bolton (1926, 1930, 1933) and Minnich (2008: 277–297, Appendix 1). Diseños were located from U.S. Geological Survey topographic sheets.

The routes of explorers were mapped directly onto digital aerial imagery using Google Earth™ (2015). In Google Earth, the ability to digitize Spanish journal and diseño localities directly on high-resolution aerial imagery superimposed over a digital planimetric model of terrain allows for the production of high-precision maps. Site-specific vegetation occurrences were then mapped along the reconstructed routes of Spanish explorers, independently of VTM vegetation maps. Locations of place names are shown in Appendix 1. Locations of vegetation were then overlaid on VTM maps for comparison of vegetation distributions. The database digitized on Google Earth was saved in the keyhole markup language (kml), and imported as a shapefile vector format to be processed for analysis and map presentation in a geographical information system (GIS), using ESRI ArcGIS Desktop 9.3 (Environmental Systems Research Institute, Inc.). Tree species distribution maps were overlaid onto scans of the statewide compilation of VTM maps originally presented by Griffin and Critchfeld (1972), and then superimposed over a 40 m digital elevation model of California for figure presentation.

The results are organized according to vegetation assemblages presented in Terrestrial Vegetation of California (Barbour et al. 2008). Maps and discussions are provided for tree species as well as coastal sage scrub and chaparral shrublands with reference to English-translated passages and direct Spanish quotations of the explorer's accounts. Spanish plant names are those used in late 18th century journals and diseños. Descriptions are given from south to north, in the general direction of the expeditions.[7] Site-specific vegetation localities are compared to the modern locations of botanical collections recorded by the Consortium of California Herbaria (CCH 2014–2015), as well as local flora manuals and checklists cited in the discussions.

TREE DISTRIBUTIONS IN HISPANIC CALIFORNIA

OAK WOODLANDS

Oak woodlands were the most commonly described tree assemblage at lower elevations of California in the Spanish period, with records mostly in mountainous areas along the coast, and in the foothills surrounding the great central valley.

Quercus agrifolia Née (coast live oak: encino, encinal), Fig. 2

Coast live oak, the "encino" of the Spaniards, is the best-described species from the Spanish and Mexican periods (Griffin and Critchfield 1972), and the dominant tree at low elevations of coastal California. Encino (evergreen oak) was first recorded in the 1602–1603 Vizcaíno maritime expedition at Santa Barbara and Monterey. Late 18th century land explorations and Mexican diseños in the early 19th century record "encino" throughout coastal California from San Diego to San Francisco.[8]

Even with its widespread distribution recorded in Franciscan expeditions, coast live oak epitomized the Spaniards' frustration with the lack of trees in the coastal and interior plains, which eventually became areas of settlement. In a letter to Joseph de Gálvez (Bolton 1927: 46), Juan Crespí wrote:

> "There is so much good land between San Diego and the port of San Francisco that pueblos could be placed there at any distance apart that might be desired. But the country, generally speaking, has one drawback, which is the lack of wood and trees at most of the sites [for settlement]; but those which have no wood on the spot have timber not very far off, usually in canyons and along arroyos…"

Treeless areas documented in the Spanish journals include coastal San Diego, the Los Angeles-Orange County and Ventura plains, Inland Empire, Point Conception, Santa Maria

[6] The entire Crespí journal (both the field copy and first revision) in Spanish and English is provided in Brown (2001), which is based on the original manuscripts archived in Madrid, Spain. The Bolton translations are based on scribe copies archived in Mexico City that have less detail than the Madrid documents. The Palóu translation is obtained from Bolton (1930). The Web de Anza Archives are provided by the Center for Advanced Technology in Education (CATE) at the University of Oregon, online at: *http://anza.uoregon.edu/archives.html*. We consulted the following journals: Miguel Costansó, 14 July 1769–7 February 1770 [Portolá expedition]; Juan Bautista de Anza, 8 January–27 May 1774 [first Anza expedition]; Juan Bautista de Anza, 23 October 1775–1 June 1776 [second Anza expedition]; Pedro Font, 28 September 1775–2 June 1776 [second Anza expedition]; and Pedro Font expanded, 28 September 1775–2 June 1776 [second Anza expedition]. The Fages account is in Fages (1937). The Costansó journal was translated by Teggart (1911).

[7] The land expeditions of Portolá (1769–1770, 1772) proceeded from San Fernando Velicatá in northern Baja California to San Diego, Monterey, and San Francisco. The Anza expeditions (1774, 1776) proceeded from Tubac, Arizona, to join the route of the Portolá expedition at Mission San Gabriel, then continued to Monterey and San Francisco. The Palóu expedition traversed from Monterey to San Francisco via the San Benito Valley and San Jose, and returned via the coast of the Santa Cruz Mountains to Monterey Bay.

[8] Coast live oak is reported in Spanish accounts as far south as 31° N in the Sierra San Pedro Mártir of Baja California, the southern limit of the species (Minnich and Franco-Vizcaíno 1998). Fages attributed *Quercus suber* L. (cork oak) to *Q. agrifolia*.

plain, northern Salinas Valley, Monterey Bay, and the San Francisco peninsula. Pedro Font (31 December 1775) wrote of the dry inland valleys near Riverside: "If the hills had some trees there would be nothing more to desire." In the Ventura Plain, Crespí (13 August 1769) wrote that "no trees are to be seen nearby…" The earliest non-Hispanic visitors also recorded treeless plains. In 1836, Richard Henry Dana (1911), who kept a journal on his maritime treks between the anchorages of San Diego and Santa Barbara, writes: "The land was…as the eye could reach, entirely bare of trees and even shrubs…." These gaps in coast live oak are recorded in VTM maps (Fig. 2).

Quercus agrifolia was frequently recorded in hilly areas of coastal southern California. Spanish journals chronicle "encino" north of San Diego in canyons near La Jolla, and in the foothills of the Santa Ana Mountains between San Luis Rey and San Juan Capistrano. In Orange County, Crespí wrote (27 July 1769): "The size of this plain is vastly great in leagues, [but] there is a great scarcity of wood, except at canyons where are very few trees to be seen." Similarly near Los Angeles, Spanish accounts record *Q. agrifolia* in the Puente Hills, Santa Monica Mountains, on alluvial fans at the base of the San Gabriel Mountains, in the interior basins from Camarillo to Las Virgenes, and at Newhall Pass. In the San Gabriel Valley, Crespí noted (31 July 1769) "a great many live oak groves along the skirts of the mountains". Pedro Fages saw "a lot of encino one league west of the San Gabriel Mission." Farther inland, the Anza expeditions document coast live oak in the San Jacinto Mountains at Tripp Flat and nearby Bautista Canyon. On 22 February 1776 Font traversed the Santa Monica Mountains from Camarillo to Encino, where he found plentiful live oaks. Crespí (7 August 1769) did not record trees across the San Fernando Valley but encountered them again at Newhall Pass.

Historical records from American settlement indicate a similar distribution of coast live oak woodland in southern California nearly a century after the accounts of the Spanish explorers. During the U.S.-Mexican Boundary Survey, Emory (1857–1859) described the general distribution of live oak woodlands seen presently in San Diego County:

> "As the valleys become narrower and more rocky, we find the California live-oak (Quercus agrifolia). In the more northern sections of the country [northern San Diego County] this oak is met with in the vicinity of the sea; but as far south as San Diego it grows upon the mountain slopes only…"

William Blake of the Pacific Railroad Survey (1856) stated that while the San Fernando plain was "without trees," he saw "Several miles of oaks…" at the pass. The earliest map of coast live oak woodlands in southern California (Kinney 1887) is consistent with the Spanish accounts. Along the mountainous Santa Barbara Channel, the Portolá and Anza expeditions frequently recorded "encino" from Carpinteria to Santa Barbara, as well as Dos Pueblos where Crespí (21–22 August) remarked in retrospect that "the large live oak groves dropped behind us…" Ever smaller encino were depicted along the north-south bearing canyons west of Dos Pueblos (Fig. 3A, B). The coastline at Point Conception generally lacked trees. In his second expedition at Los Pedernales, Crespí (6 May 1770) saw: "Only three or four arbolillos [i.e., bushes] in two spots on the summit of the mountains, as all of the mountains and land are bare." Trees were not mentioned in accounts of the Santa Maria coastline northward to Price Canyon near Pismo Beach.

The Franciscans were impressed with oak woodlands in the interior Santa Lucia Mountains, whose abundance and size were unlike that encountered elsewhere on the expeditions. In his second expedition, Crespí (20 May 1770) characterized the Nacimiento and San Antonio drainages as:

> "grown over in lush white oaks and live oaks, and some nut-bearing pines, that no such a throng of them has been seen in all the distance traveled, the fact being that the El Triunfo hollow [near Thousand Oaks] and the harbor of San Francisco cannot compare with here."

Diseños submitted for lands in the Santa Lucia Mountains depict widespread oak forest cover throughout the ranchos (Rancho San Miguelito de la Trinidad; Rancho el Piojo).[9]

The Franciscans left behind the oak woodlands in their descent from the Santa Lucia Mountains into the Salinas Valley near King City. Indeed, Fages (20 March 1772) described the Salinas Valley as a "plain without trees." Font, Palóu and Crespí returned to "encino" near Salinas. At Monterey, the Spanish provided several accounts of coast live oak but placed emphasis on pine forest, a view later shared by Beechey (1831: 85) who wrote: "The village and presidio of Monterey are situated upon a plain between the anchorage and a range of hills with woods of pine and oak." Crespí and Font did not mention trees of any kind on the Monterey Bay plain, although Palóu (12 December 1774) saw "a few oaks that are not very large" on the Pajaro River. Farther inland at San Benito Valley, Palóu (25 November 1774) saw a "large number of encino [i.e., live oak] growing on the hills at the entrance of valley." At the north end of this basin, Palóu ascended "some hills…although with no other trees than a live oak here and there in the canyons…" From Gilroy to Llagas Creek, Font (24 March 1776) states that "During the whole distance there are few trees," consistent with VTM maps.

The San Francisco peninsula also lacked forest (cf. Howell et al. 1958; McClintock et al. 1968). Palóu (4 December 1774) writes that the San Francisco hills are "very bare and without trees." Near San Vicente Creek, Crespí (30 October 1769) states that "There are a few trees in the beds of the arroyos…" and added that there was "Not a stick of wood anywhere." Anza (2nd expedition, 28 March 1776) insightfully noted that in places the "encino [was]….of good thickness, but bent to the ground because of the constant northwest winds of the coast." More than a century later, Behr (1891) wrote in *Botanical Reminiscences* that he had been in California since the Gold Rush and that "…the wind-swept hills of San Francisco have apparently always been deficient in trees." Brandegee (1892) wrote that the peninsula has very few trees in "shaded places and cemeteries."

Oaks were abundant elsewhere in San Francisco Bay. Spanish journals and diseños record "encino" at ca. 30 localities from Palo Alto to San Jose, and from Concord to Walnut Creek on the east bay. Anza and Font recorded coast live oak as far east as Antioch and in the Diablo Range near Mt. Hamilton. Modern

[9] The northern portion of the Santa Lucia Mountains near the Ventana wilderness was not visited by Spanish explorers. This area was not placed in land grants, i.e., remained unsettled in the Spanish and Mexican periods, and was placed into public domain in the American period to eventually become part of the Los Padres National Forest.

herbaria collections record coast live oak farther inland at Elk Grove in the Sacramento River Delta (e.g., CCH 2014–2015, e.g., UCD 73308).

Quercus lobata Née (valley oak, white oak: robles, roblar), Fig. 4

Spanish explorations and diseños document "robles" (deciduous oak) in the Coast Range and the Sierra Nevada foothills from San Francisco Bay eastward to Concord, from San Benito Valley to Gilroy, across the Santa Lucia Mountains, and in southern California from Thousand Oaks to the San Fernando Valley. The Spanish did not report deciduous oaks near the coast throughout California.[10] For example, these oaks were not observed along the coastline from the Santa Barbara Channel northward around Point Conception to San Luis Obispo. Fages provided an account of a single locality in Valle los Osos east of Morro Bay (cf. Griffin and Critchfield 1972).

We interpret most accounts of "robles" as reference to *Q. lobata* rather than the deciduous blue oak *Q. douglasii* Hook. & Arn.: the Viceroy mandate placed emphasis on discovery of timber resources. Valley oak was recognized as an impressive tree "like that found in parks in Europe."[11] In addition, the expeditions also followed paths of least resistance, following valley floors with deep soils where *Q. lobata* (valley oak) is abundant, while *Q. douglasii* routinely grows as a small tree on hill slopes. In southern California, *Q. lobata* is the only deciduous white oak in its range.

The Spaniards first saw "robles" from the San Fernando Valley to Thousand Oaks, in the Santa Clarita Valley, and "on the summits" extending west along the Santa Clara River Valley (Santa Susana Mountains), which is consistent with the map of deciduous oak woodlands in Kinney (1887). Urbanization has evidently impacted many of the southernmost populations. Crespí (4 August 1769) provided an account of *Q. lobata* in present-day west Los Angeles, where "The heathens…brought very large sweet acorns." Hasse collected a single tree near Lamanda Park in Pasadena (Abrams 1904: 105). The diseño San Pasqual (Pasadena region) shows "Punta del Roblar" on the south side of the land grant. Crespí (5 August 1769) encountered "roblez" (sic) along Sepulveda Canyon and at the town of Encino.

Robles grew extensively in the interior Santa Lucia Mountains. After ascending Arroyo San Carpoforo from the coastline to the mountain crest, Crespí (20 September 1769), noted that watersheds draining east toward the Salinas Valley have "a great many white and live oaks." Farther east, he writes (24 September 1769) that "the plains, hills and mountains are grown over with a vast number of tall, thick white oaks." In their descent of the eastern Santa Lucia Mountains to the Salinas Valley, Crespí (26 September) writes that "many large live oaks and white oaks [are] keeping with us, the whole way over level ground from one drainage to another." Near King City he "departed the hills, and the trees…," consistent with the modern distribution. At Paso Robles (the pass of deciduous oaks), Font (4 March 1776), wrote about acorn woodpecker use of white oaks:

> "All the road and all these plains are full of very large, tall robles having good and large acorns. Along here there are some birds which they call carpenters, which make round holes in the trunks of the oaks. In each hole, they insert an acorn so neatly that it can be taken out only with difficulty, and in this way they make their harvest and store, some of the oaks all dotted with the acorns in their trunks."

Font's observations are confirmed by depictions of widespread robles in diseño San Miguelito de Trinidad (the town of San Miguel, Fig. 5; extensive valley oak woodlands grow there today). To the north of King City "robles" continue off route in the mountains along the northern Salinas Valley but were not recorded in Monterey Bay and northward along the west coast of the Santa Cruz Mountains.

Deciduous oaks grew on both sides of San Francisco Bay, but not on the Peninsula. In a synopsis of the south bay, Font (28 March 1776) writes:

> "with very little trouble they can have all the timber that may be desired, for all the way from a point some six leagues on the other side of the arroyo of San Josephs Cupertino (Calabasas Creek), there runs a plain about fifteen leagues long, which is called the Llano de los Robles because it is very thickly grown with oaks of all sizes and from which very good timber may be obtained."

To the east, Font recorded valley oak in the east bay, and eastward into the central valley at Knightsen (4 April 1776). Robles were reported to be extensive in Muñoz' journal in the Sierra Nevada foothills including the Consumne River, Stanislaus River, Merced River and nearby Bear Creek, Mariposa River, Fresno River, Kings River and Kaweah River. It is unclear whether Fages (1937) made record of *Quercus lobata* at Tejon Pass in 1772 where he writes that the area is "…very thickly grown with groves of live oaks." In the Pacific Railroad Survey, Blake (1856) saw "Fine groves of oak trees…" at this pass. These expeditions traversed Tejon Pass in summer when both evergreen and deciduous oaks were in leaf.

Quercus engelmannii Greene (Engelmann oak: robles, roblar), Fig. 6

The extensive stands of Engelmann oak in the Peninsular Ranges east and south of Los Angeles were not seen close hand in Spanish explorations.[12] It may have been incidentally observed from a distance in the Santa Margarita Mountains. From their camp at modern day Camp Pendleton, Crespí (21 July 1769) wrote:

> "to the north-northeast [the route] reaches to a high mountain range that must be distant about a league and a half…In this direction there are a great many live oaks in this canyon, as also upon the skirts of the mountains, and live oaks are seen as well upon this high mountain range's crests."

Today, Engelmann oak is common in this area (Beauchamp 1986; Minnich and Everett 2001; CCH 2014–2015, e.g.,

[10] Deciduous oaks are reportedly absent from the central California coastline with cold summers (e.g., Thomas 1961).

[11] Deciduous "white oaks" occur in Spain (e.g., *Quercus robur* L.), having lobed leaves, tall stature, light furrowed bark, and large acorns similar to *Q. lobata* in California. Indeed, Fages attributed the taxonomic name *Quercus robur* to *Q. lobata*.

[12] Arrillaga must have passed through stands near Julian en route to the Franciscan Mission San Diego, but he made no record of oaks in this region. His mandate was to describe Dominican lands in northern Baja California (Robinson 1969; Minnich and Franco-Vizcaíno 1998).

SD201727, SD27143), but *Q. agrifolia* is also abundant there. Both species are in leaf during summer. Cooper (1874) made reference to Engelmann oak, identified as "*Quercus oblongifolia*" found nearby at "the head of the San Luis Rey River." The earliest unequivocal record appears to be diseño Santa Anita which records "roblar," in reference to the *Q. engelmannii* stand at the Baldwin Park Arboretum (Fig. 7A, B; CCH 2014–2015, e.g., UCD46026). The vegetation map by J. Jackson in Kinney (1887) shows deciduous oaks on the south front of the San Gabriel Mountains at Baldwin Park and the town of Sierra Madre.[13] Abrams (1904) later stated that Engelmann oak was frequent from Altadena to Glendora.

Pinus sabiniana D. Don (gray pine: pino, pinal), Fig. 8

This tree can be identified to species from most Spanish texts and diseños because *P. sabiniana* typically forms monospecific pine forest. The Spaniards document this pine primarily from the interior Santa Lucia Mountains, Mount Hamilton range, and Mount Diablo, often in association with coast live oak and white oak woodlands. The Franciscans' first account of the species is likely from the coast ranges of San Luis Obispo County. From Valle de los Ojos, Crespí (12 May 1770) wrote: "On the mountains next to it on the north are a great many pines." North of Morro Bay, Crespí (9 September 1769) reported "pines seen in the distance on the mountains." Both accounts apparently refer to woodlands on the summits of the Santa Lucia Mountains where *P. sabiniana* is the dominant pine species. At Paso Robles, Font described morphological traits at close hand which identify *P. sabiniana*: "…there are many…pines bearing good pine nuts with hard shells, and so leafy that their branches begin near the ground, and, tapering toward the top, end almost in a conical point." At the Nacimiento River, Crespí (20 September 1769) remarked "a great many pine trees with good large pine nuts." Summarizing his march from the Nacimiento Ranch to ex-Mission San Antonio, Font (6 March) wrote: "…. In the range, there is a great abundance of white oaks [robles], live oaks [encinos] and pines, and consequently plenty of pine nuts and acorns…." In eastern San Francisco Bay, the Spaniards saw pines on distant mountains with only incidental comments, but pine stands were later recorded at Pueblo de San Jose y Rancho de los Tular (San Jose), Rancho Milpitas, and Rancho San Miguel (Walnut Creek).

The Muñoz and Zalvidea journals (Cook 1960, 1962) record "pines" in the Sierra Nevada but it is unclear whether they were gray pines or members of mixed conifer forest. Muñoz' repeated reference to "pines and cedars" [almost certainly *Calocedrus decurrens* (Torr.) Florin] suggests he observed *Pinus ponderosa* Douglas ex Lawson & C. Lawson, which is a widespread associate with *Calocedrus decurrens*, rather than *P. sabiniana*.[14] In the southern San Joaquin Valley, Zalvidea (4 August 1805) ascended Grapevine Canyon to Tejon Pass, and saw "a range of hills widely covered with a pine forest," in reference to the monospecific stands of *P. sabiniana* occurring there today (Griffin and Critchfield 1972). On 5 August he traveled a route along a pine-covered range (Grapevine Mountain), and on 6–7 August headed southward downhill through the entire length of a canyon to a bog (Castaic Lake) that was "surrounded on all sides by pine forest." The diseño for Rancho los Álamos y Agua Caliente (Tejon Ranch) records "pinal." David Douglas later published the first formal botanical description of *Pinus sabiniana* from a collection taken in 1831 at Mission San Juan Bautista (Griffin 1964).

Juglans californica S. Watson (Southern California black walnut: nogales), Fig. 9A

Although "nogales" traditionally refers to the pecan tree (*Carya*) in Mexico, the Franciscan explorers used this name to record their discovery of California walnut (*Juglans*) in apparent recognition of the similar morphology of both nut-bearing trees.[15] Walnuts attracted interest for their edible nuts.

Crespí first recognized *J. californica* after one day's travel west of the La Brea Tar Pits in west Los Angeles, where he noted "a great many nogales trees" in the nearby Santa Monica Mountains (4 August 1769). Crossing this range along Sepulveda Canyon on 5 August, he wrote that the landscape had "a great many small nogalitos laden with quantities of small round nuts with very good meat, only their shells are quite thick and hard to crack." From camp in the southern San Fernando Valley, he described many aspects of its modern range there, writing: "there are a great many walnut trees and white oaks here on the slopes of the mountains belonging to this plain, with a great deal of trees visible eastward." Font (22 February 1776) recorded "nogales pequeños," i.e., small walnut trees, from Los Angeles to the eastern San Fernando Valley. "Nogales" was also recorded in diseño del sitio llamado La Brea near Griffith Park, and diseño Cañada de los Nogales near downtown Los Angeles. Near Fillmore, Crespí wrote that Indians brought him walnuts (11 August 1769).

Remarkably, Crespí missed the California walnut in the Puente Hills where the species occurs today along his route of travel. Indeed, diseños record "nogales" at Rancho de la Puente, Rancho María de Jesús García, and Rancho los Nogales, a large landholding that extends southeast into the Chino Hills. Perhaps Crespí had no experience with *Juglans* because this genus is not native to southwestern Europe (EuroMed Plant Base 2014). He traversed the Puente Hills in summer when walnuts were in leaf and fruit. The omission indicates that explorers were learning the vegetation in the course of explorations, this new species eventually being identified two days later in west Los Angeles. In 1844 Duflot de Mofras (1937: 164) described walnuts near Mission San Gabriel. He also wrote that Rancho San Bernardino had walnut in the mountains. After American settlement, Blake (1856) of the Pacific Railroad Survey stated that at San Fernando Pass (Newhall) "…one of the men found a quantity of small walnuts…." In 1867, a repeat survey of the old Rancho Muscupiabe land grant boundary near San Bernardino recorded walnut trees along the southern base of the San Bernardino Mountains (Goforth and Minnich 2009). The Kinney map of 1887 depicts the modern range of *J. californica* in the Puente Hills, Santa Monica Mountains, and Simi Hills near Newhall. Similarly, Abrams (1904) states that "*J. californica* is frequent in the Santa Monica Mountains and Puente Hills, but less so on the southern borders of the San

[13] Kinney (1887) identified Engelmann oak as *Quercus oblongifolia* Torr., which the Flora of North America treats as a conspecific taxon (Nixon 1997).

[14] The former species occurs as an associate of mixed conifer forest assemblage, while the latter forms monospecific stands in lower-elevation oak woodlands. See discussion of mixed conifer forest.

[15] Both the pecan and walnut trees are members of Juglandaceae. Both trees have pinnately compound leaves, and their nuts are actually large drupes with edible pits.

Gabriel, San Bernardino and Santa Ana Mountains." Smith (1976) found colonies farther west, from Carpinteria to Jalama Creek, and Los Olivos, at localities far from Spanish routes of exploration (Goforth and Minnich 2009).

Juglans hindsii Jeps. ex R.E. Sm. (Northern California black walnut, Hinds walnut: nogales), Fig. 9B

The pre-European distribution of Hinds walnut east of the San Francisco Bay is uncertain (Thomsen 1963; Griffin and Critchfield 1972).[16] Natural populations are confirmed to occur where Spanish explorers passed through in the northern Concord Valley at Walnut Creek. The Crespí and Anza expeditions missed the walnut tree perhaps because it was deciduous in early April. Anza (6 April 1776) recorded "nogales" at a single locality in the Mt. Hamilton Range on his route to Gilroy.[17] The first definitive record was the Father Jose Viader expedition of 15 August 1810 across the northern Concord plain, which he described as "well covered with trees, among others big walnuts…" (Cook 1957). Ertter and Bowerman (2002) find it near streambeds on the north slope of Mt. Diablo, including Mitchell Canyon, Pine Canyon, Little Pine Creek, and the Lime Ridge road cut. Richard B. Hinds reported finding scattered walnut trees further east along the pristine riparian forest of the lower Sacramento River that he explored from aboard the HMS Sulfur (Griffin and Critchfield 1972).

Aesculus californica (Spach) Nutt. (buckeye: avellanas, castaños), Fig. 10

Chrysolepis chrysophylla (Hook.) Hjelmq. (tree chinquapin: castaños, avellanas), Fig. 11

California buckeye and tree chinquapin rarely occur together in California, but are treated in tandem here because Spanish plant names were synonymous for these species. Buckeye was called both "avellanas" (hazelnut, filbert—native to Turkey and Iran) and "castaños" (chestnut—native to the Balkans and Asia Minor). But castaños was also used for *Chrysolepis chrysophylla*. This led to confusion and debate among the Franciscan explorers, but the identification of these trees can be clarified upon careful examination of their accounts. The most complete description provided by Fages (p. 68) gives characteristics unique to buckeye as:

> "another wild fruit about the size of an ordinary pear which is eaten roasted and boiled though it is somewhat bitter. The tree which bears it is rather whitish, like a fig tree, but not very tall. When it bears fruit it sheds its leaves entirely."

Buckeye is simultaneously deciduous and in fruit during summer. Evergreen chinquapin simultaneously flowers and fruits in the fall. Crespí (26 September 1769) also characterized "castaños" as very bitter. West of Santa Cruz, tree chinquapin was described by Crespí (10–14 October 1769) as "chestnut trees which are in flower and they [Native Americans] brought some nuts, which we tasted and they truly are chestnuts."

In the Diablo Range, Font (5 April) compared buckeye with chinquapin:

> "…there is a plant like a fig tree, but with smaller leaves [buckeye], and though on the outside its fruit is like figs, on the inside it is somewhat like castaños [chestnut], more like it in the shell than the color than in the form. The heathen eat it…. These doubtless must be the chestnuts which in Monterey they [Crespí & Palóu] told us were found on the road to the port of San Francisco; but they made a mistake, because they [the fruits] are not chestnut shucks, for I examined them carefully, nor are there any chestnuts in any place that I saw. The soldier also said that going from Monterey to San Francisco along the coast, which is the road taken by Señor Portolá on the first expedition, they found many avellanas [hazelnuts] before reaching the Punta de Almejas [southern Santa Cruz Mountains], which they at that time gave this name because the soldiers stopped there to gather mussels for food, for they now had nothing to eat. But I did not see the hazelnuts, if indeed there are any, because we did not go by that road."

Indeed, Font and Anza never traversed the Santa Cruz coast. Thus, accounts of hazelnut near Santa Cruz are interpreted as *C. chrysophylla,* whereas accounts of chestnut from the Nacimiento drainage of the Santa Lucia Mountains north to the Diablo Range are references to *A. californica*.[18]

Buckeye was first encountered near King City in the Salinas Valley where Miguel Costansó (26 September 1769) descended a slope "very thickly covered with different arbustos [bushes], among others some wild chestnuts [castaños]…" *Aesculus californica* was collected there in 1938 (cf. Hoover 1970, CCH 2014–2015, e.g., UC1032350). Fages (p. 78) found chestnuts, i.e., *A. californica*, "in the vicinity of the Rio San Francisco [from Concord to Antioch] … which are as good as those found anywhere." Anza and Font saw buckeye in the Diablo Range. Muñoz and Zalvidea did not record the species in the Sierra Nevada foothills where it is extensive. Although *A. californica* is common as far south as Lake Elizabeth near Palmdale (Griffin and Critchfield 1972), small populations occur in Millard Canyon in the western San Gabriel Mountains near Pasadena and in the Box Springs Mountains in western Riverside County (Roberts et al. 2004), localities off the Spanish routes of exploration. We were unable to find records of buckeye in diseños.

Chrysolepis chrysophylla was primarily recorded by the Portolá and Palóu expeditions in the southern Santa Cruz Mountains in association with coast redwood forest. Crespí (11–14 October 1769) found "a great many hills wooded with avellanas [hazelnut]." He described them as "thickets, the highest of which must be a yard and a half or seven quarter-yards tall. The hazelnuts are the same as those in Spain." Crespí (15 October) also recorded it near Santa Cruz where it grew with redwoods, and at Soquel Creek (October 16) where he went through "the thickest growth of chestnuts and

[16] Munz and Keck (1959) questioned whether *Juglans hindsii* is taxonomically distinct from *J. californica,* and suggested their disjunct distribution is related to ethnobotanical uses by Native Americans. It is given species status in the Jepson Manual (Baldwin et al. 2012). Callahan (2008) reported scattered natural populations of *J. hindsii* as far north as the Rogue River watershed in Oregon and provided DNA evidence of closer genetic relationship between *J. hindsii* and *J. major* (Torr.) A. Heller in eastern North America than between *J. hindsii* and *J. californica*.

[17] A botanical collection was made at nearby northern Adobe Valley by Helen K. Sharsmith *3567a* (UC723158).

[18] Crespí's account of "*avellanas*" at two canyons along the Santa Cruz coast (24 October 1769) could refer to buckeye, where today it is locally found on dry slopes (Thomas 1961; JEPS85125), but nearby stands of chinquapin are far more extensive.

redwoods….” Between San Lorenzo and the Pajaro River, Palóu (11 December) wrote “All these hills and in their vicinity we saw groves of hazelnuts, although it had been recently burned and had not grown up again” (cf. Thomas 1961).[19] Herbarium collections place chinquapin along the Spanish explorers’ route at Monterey (CCH 2014–2015, e.g., UCR142983), south of Half Moon Bay (UC1135216), near Watsonville (UC1135220), and along the redwood crest as far N as Hillsborough (UC5444). The Spaniards did not record remote stands of *C. chrysophylla* off route in the Berkeley Hills, and the Irish Hills west of San Luis Obispo (Griffin and Critchfield 1972).

RIPARIAN FOREST

Riparian forests were recorded throughout California, and dominant tree species were readily identified by the Spaniards because congeners grew along streams and rivers of Europe. Riparian forests were most abundant on coastlines along San Diego County, Santa Barbara Channel, Santa Lucia Mountains and the Santa Cruz Mountains, but were sparing in large intervening coastal plains, except along major rivers. Describing the Los Angeles-Orange County plain, Crespí (2 August 1769) wrote “From what we could see of how their lines of trees wound along, we guessed that all their rivers empty into the Bight of San Pedro,” implying that there were no other trees to obscure the view of riparian forests along the Los Angeles, San Gabriel and Santa Ana Rivers. At Long Beach, the diseños for Ranchos de los Parages Llamados Gertrudes, Coyotes, Bolsas, and Alamitos y Sierritos (Cerritos) show trees only along these rivers (Fig. 12). The diseños in the Sacramento Valley typically depict trees on the Sacramento River and its tributaries but do not identify the species (Becker 1964).

Platanus racemosa Nutt. (western sycamore: aliso), Fig. 13

Western sycamore was found along streams throughout the Spanish sphere of influence along the California coast, and in the Baja California peninsula as far south as lat. 31° N (Minnich and Franco-Vizcaíno 1998).[20] Its abundance generally decreases toward the interior, with only rare populations in the desert. Crespí recorded sycamore at almost every drainage between San Diego and San Juan Capistrano, a distribution later described in the U.S. Mexican Boundary Survey (Emory 1857–1859). Arrillaga recorded it at Banner Canyon and in San Diego Canyon in the Peninsular Ranges east of San Diego. The Anza expeditions document this tree along San Antonio Creek near Chino and in Bautista Canyon of the San Jacinto Mountains. Garcés found sycamore as far inland as the Mojave River near Victorville (Coues 1900).

Platanus racemosa was frequently reported along the mountainous Santa Barbara Channel to Dos Pueblos in association with *Quercus agrifolia* (Fig. 3A, B), but the Spaniards did not find it rounding Point Conception and northward along the Santa Maria plain. Sycamore was encountered again in the mountainous coast near San Luis Obispo from Price Canyon to Arroyo San Carpoforo, and inland to the interior Santa Lucia Mountains. It was not seen in the northern half of Salinas Valley, except in diseños of Alisal and Quail Creeks north of Chualar (Hornbeck 1983). Franciscan journals record sycamore in the San Benito Valley, at Gilroy, and in northern Monterey Bay, but it was evidently missing from the Pacific escarpment of the Santa Cruz Mountains northward to San Francisco, consistent with VTM maps (Griffin and Critchfield 1972). Palóu’s observation of “aliso” at Arroyo de los Frijoles near Whitehouse Creek northwest of Santa Cruz (9 December) cannot be confirmed. He saw riparian forests in a winter-deciduous state, and perhaps mistook sycamore for another deciduous tree species. The Fages-Crespí and Anza-Font expeditions recorded *P. racemosa* along streams from San Jose to Richmond and east to Antioch. While sycamore is common in riparian forests of the Sacramento Valley (Thompson 1961), it was infrequent in the Sierra Nevada foothills, where Muñoz observed it primarily on the Kings River, consistent with VTM maps.

Records of “aliso” in the journals of the Portolá and Anza expeditions were erroneously translated by Bolton and Brown as “alder” (*Alnus rhombifolia* Nutt.). While the traditional meaning of *aliso* in Mexico is indeed alder (*Alnus*), in California and northern Baja California the word refers to sycamore (*Platanus racemosa*, see Roberts 1989; Minnich and Franco-Vizcaíno 1998; Brown 2001: 69; Minnich 2008). Maps in Griffin and Critchfield (1972) show sycamore throughout the state while *Alnus rhombifolia* almost never crosses the routes of the Spanish explorations, nor does it occur in the northern part of the Baja California peninsula, Mexico, where the explorers frequently recorded “aliso” (cf. Wiggins 1980). Near San Diego, *Alnus rhombifolia* occurs off-route in the vicinity of Mt. Cuyamaca and Palomar Mountain. It is unclear if an account of aliso by Fages on 19 April 1782 identified *Alnus* or sycamores near Cuyamaca Mountain. Rensch (1955) quotes an account of “unos alisos” by Fages on 19 April 1782 as a landmark for reconstructing Fages’ excursion through Oriflamme Canyon on the desert escarpment to the crest of the Cuyamaca Mountains.[21] *Platanus racemosa* also occurs in this canyon (CCH, e.g., UCR149123), so the specific identity of aliso in this account cannot be confirmed. There is a single coastal stand on San Mateo Creek described in the U.S. Mexican boundary survey (Emory 1857–1859) and recorded on the VTM Corona quadrangle. The Anza expeditions crossed the desert distant from known stands in the Hot Springs Mountains. They traversed to the west of known stands in the San Jacinto Mountains. *Alnus* is absent from the Los Angeles plain, and stands in the Santa Ynez Mountains rarely extend downslope to the Santa Barbara coastal plain. Garcés likely traveled through a few stands on his way up to the crest of the San Bernardino Mountains but did not distinguish it from sycamore. Farther north, alders grow in rugged mountains avoided by the Spanish expeditions.

Populus fremontii S. Watson (Fremont cottonwood: álamo blanco, álamo), Fig. 14

[19] This is the only report of fire in forest or woodland during initial Spanish explorations in 1769–1776, as all other reports of burned land in California were in dried fields of wildflowers (Minnich 2008).

[20] Perhaps the abundance of sycamore relates to the ephemeral flow of coastal streams with slow-moving water because its roots are reported to be susceptible to damage in unaerated soils (Keeler-Wolf et al. 1994).

[21] Fages writes: ”We pursued our journey for about a league along this plain [Mason Valley], when we entered a canyon having steep slopes [the Oriflamme]; …..we struck a little stream fringed with aliso…”

Populus trichocarpa Torr. & A. Gray ex Hook. (black cottonwood: álamo negro, álamo), Fig. 15

Cottonwood was the dominant riparian tree along the rivers of California.[22] Spanish journals invariably record "álamo," without explicitly differentiating *Populus fremontii* from *P. trichocarpa*. Few accounts of álamo provide sufficient detail to distinguish *P. fremontii* and *P. trichocarpa*. These species generally have non-overlapping distributions with distance from the ocean along the explorer routes. *Populus trichocarpa* it most abundant in cold summer climates within 50 km of the coast and in the high mountains >2000 m. Stands occur locally inland, in particular along the Salinas, Santa Clara and Santa Ana Rivers. *Populus fremontii* occurs throughout California except in high mountains. We interpret coastal reports of álamo as *P. trichocarpa* and interior stands to *P. fremontii*. Together the range of both species is consistent with modern distributions.

Within the modern range of *P. fremontii*, the expeditions document "álamo" from the Pacific coast to the Sierra Nevada and southeastern deserts of California. The Anza expeditions document the "massive" stands of Fremont cottonwood along the Colorado River near Yuma and on a tributary of the delta midway between Yuma and Mexicali.[23] Garcés saw cottonwoods along the Mojave River as far east as Soda Lake (cf. Blake 1856). In southern California, Arrillaga recorded álamo along Banner and San Diego Canyons in the Laguna Mountains. Anza and Font record it near Anza Valley, in Bautista Canyon of the San Jacinto Mountains, and San Antonio Creek at Chino. Garcés found "álamo" along the Mojave River on the north slope of the San Bernardino Mountains (Coues 1900). Along the coast, the Franciscan explorers recorded "álamo" at Mission San Diego, San Luis Rey, San Juan Capistrano, and on the Santa Ana River at Yorba Linda and Riverside.

A large stand of Fremont cottonwood on the San Jacinto River can be traced historically since Spanish explorations. Anza and Garcés (18–19 March 1774) followed a "large cottonwood grove" along the San Jacinto River to its terminus at Mystic Lake. Anza remarked:

> "Its amenity and the beauty of its trees continued for three leagues, after which the trees came to an end, but the amenity continued. We followed it for three more leagues, till we came to the banks of a large and pleasing lake…"

This stand was depicted on the diseño Rancho San Jacinto, and Kinney (1887) wrote: "One of the handsomest of these groves is at San Jacinto."

Large gallery forests of "álamo" were reported along the Santa Ana, Los Angeles, San Gabriel, and upper Santa Clara Rivers. The latter flood plain had "several miles of …cottonwood trees" according to the Pacific Railroad Survey (Blake 1856). White cottonwood (álamo blanco) was explicitly recognized on the Santa Ana River at Yorba Linda and Santa Clara River at Santa Clarita and downstream near Santa Clara. Fremont cottonwood apparently did not extend west of the Ventura River (Griffin and Critchfield 1972).

Fremont cottonwood was dominant along the rivers of central California. Diseños depict "álamo" along the Santa Ynez River (Rancho Santa Rosa) and San Antonio River (Rancho de los Álamos). Crespí observed major populations in the San Antonio and Nacimiento Rivers of the interior Santa Lucia Mountains, as well as on the Salinas River north of King City. White cottonwood was explicitly identified on the San Antonio River. "Álamo" was recorded on the Salinas River at King City, Chualar, and Salinas, and frequently encountered in southern San Francisco Bay, Concord and the Sacramento River delta. Muñoz recorded Fremont cottonwoods in central valley flood plains along the western Sierra Nevada from the Merced River to the Tule River, and Zalvidea described "a great forest of cottonwood" on the Kern River near Bakersfield (see Thompson 1961). The diseño de Los Álamos y Agua Caliente records Fremont cottonwood on the Tejon Ranch.

Populus trichocarpa was explicitly recognized only in a few localities, all near the coast. Fages (p. 35) wrote of the Santa Barbara Channel (Ventura to Point Conception): "On the rivers and streams there are many white and black poplars." Farther north, he described both black and white cottonwoods along the Salinas River near King City (CCH 2014–2015, e.g., UC1134825), and downstream at Chualar and near the river mouth at Salinas. Black cottonwood (álamo negro) was recorded by pilot González Cabrera Bueno of the Vizcaíno maritime expedition in anchorage at Carmel in 1602 (González Cabrera Bueno 1734: 303):

> "Following the coast from the Point of Pines toward the south-southwest there is another fine harbor [Carmel] running from north to south …[which] has a river…whose banks are well grown with black poplars…" [*Populus trichocarpa*].

The many reports of "álamo" on the Pacific coast of the Santa Cruz Mountains and the San Francisco Bay are likely *P. trichocarpa*. We were unable to find specific record of "álamo negro" in diseños.

Black cottonwood seldom occurs along the routes of Spanish expeditions in southern California. On the Santa Ana River at Yorba Linda, Crespí stated (28 July 1769): "This river bed here is very much lined with trees, white cottonwoods, willows, sycamores, and other kinds we have not recognized." This particular phrasing of uncertainty was consistently used in Crespí's journal if he encountered new species. Modern CCH botanical collections document black cottonwood in the Santa Ana River canyon (e.g., RSA725795). Elsewhere, "álamo negro" was not recorded along the rivers draining the Sierra Nevada. Maps of Griffin and Critchfield (1972) show this tree at high elevations well beyond Spanish explorations.

Fraxinus velutina Torr. and *Fraxinus latifolia* Benth. (ash: fresno), Fig. 16.

The ash tree is viewed as hybrid continuum with *F. latifolia* (Oregon ash) of northern California grading to *F. velutina* (Arizona ash) in southern California (Griffin and Critchfield 1972; Baldwin et al. 2012). Most Spanish records come from the California interior where these species grow today (Griffin and

[22] Near the coast, Fremont cottonwood becomes dominant on free flowing rivers rather than sycamore which occurs on ephemeral tributary watercourses because the species recruits with episodic flooding disturbance (Mahoney and Rood 1998; Sprenger et al. 2002).

[23] These populations represent an extension of stands in the northern Gulf of California and Mexicali Valley recorded in accounts of Linck (1766; Burrus 1966) and Arrillaga (1796; Robinson 1969) (see Minnich and Franco-Vizcaíno 1998).

Critchfield 1972). Ash was readily recognized because the genus occurs across Europe. Explorations by Muñoz record "fresno" along rivers exiting the Sierra Nevada into the central valley from the Consumne River near Sacramento to the Tule River, east of Tulare. In 1796 Hermenegildo Sal recorded "fresno" in the Sacramento Delta (Cook 1960). Griffin and Critchfield (1972) speculate that ash "was probably a minor component of the pristine riparian forest of the Sacramento Valley" (cf. Thompson 1961). Franciscan journals record "fresno" at two locations in southern San Francisco Bay. Ertter (1997) provides records of ash at Concord and at Bethany Reservoir near the San Joaquin River. In southern California, *F. velutina* most commonly occurs in remote mountain streams off the routes of Spanish exploration. Crespí may have seen it in Santa Ana canyon, but he recorded only "trees never seen before" (28 July 1769). A modern collection was taken nearby on the Santa Ana River (CCH 2014–2015, e.g., UCR139446). Populations at Camp Pendleton, as well as the San Gabriel and Los Angeles Rivers escaped notice perhaps because the tree was apparently uncommon, then as now.

CLOSED CONE CONIFER FOREST

Closed cone conifer forest comprises serotinous pines and cypresses that occur in local disjunct distributions (Barbour et al. 2008), and it is remarkable that the Spaniards came upon this assemblage. The discovery of pines was inspired by their high priority as a wood resource. Serotinous conifers typically form monospecific stands in California and hence allow for site-specific species identification.

Pinus radiata D. Don (Monterey pine: pino, pinal), Fig. 17
Pinus attenuata Lemmon (knobcone pine: pino, pinal), Fig. 18

According to Griffin and Critchfield (1972), *Pinus radiata* has intrigued travelers to the Monterey Peninsula since Sebastian Vizcaíno's visit in 1602 (Bolton 1916), and indeed all of its localities in California were described long before the State Survey of the flora (Brewer and Watson 1876–1880). The Portolá expedition's search for the port of Monterey was premised on the account of pines by the pilot González Cabrera Bueno of the Vizcaíno maritime expedition who described the port as,

> "a large bay until it comes out from a point of low land, very heavily forested to the very sea, to which was given the name of Punta de Pinos….It is heavily grown with pine forest….In this port which they call Monte Rey there are many pines for masts and lateen yards."

Crespí's land exploration first sighted the Point of Pines from a vantage point near Salinas, where he writes (30 September 1769) that a ridge "…terminated in a point in the sea, and is covered with trees which look like pines." His disappointment with the forest as a timber resource was indicated later in a letter from Crespí to Fray Andres (Bolton 1927: 26): "The pines are very dilapidated and not as the [Vizcaíno] accounts describe them, and I can assure your reverence that I did not see a single one on the whole point that would do for masts or spars for these ships." In another letter to de Gálvez on 9 February 1770 (Bolton 1927: 42), Crespí wrote: "The Point of Pines….was thickly covered with pines down to the sea, but that the pines were all very scraggly, knotty, and with low branching, and they had seen never a one like those claimed in the Histories..." Upon arrival at Monterey on his second expedition (24–29 May 1770), Crespí was more appreciative of the forest: "the pinewood is a pleasure to see, and does not fail of having some thick tall pine trees in it." Fages (p. 68) noted that "the cones of the pine tree are small and the nuts are extremely so…" He also discovered from the Native Americans a method of gathering nuts by "building a fire at the foot of the tree, which in a few hours falls, making the fruit available without difficulty," in exploitation of the pine's cone serotiny. The diseño Punta de Pinos shows Monterey pine forest (pinal) across the peninsula from Monterey to Carmel (Fig. 19A, B). In 1784, John Sykes, illustrator for the Vancouver Expedition, sketched Monterey pines apparently at Toro Creek, 8 km east of present-day stands (Brown 1967).

Pinus radiata and *P. attenuata* grow together with some hybridization on the Santa Cruz Mountain coast (Griffin and Critchfield 1972). The explorers most likely traveled through Monterey pine, which is abundant along accessible coastal marine terraces (e.g., UC1083336), while knobcone pine is abundant off-route on rugged slopes above (e.g., RSA706248). From near Punta Año Nuevo, Crespí (19 October) saw "a high white mountain range that has some trees that seemingly are pines…" On 23 October, Crespí apparently saw a burn consisting of "a small, very dense grove of pine-nut pine-woods…" Thomas (1961) states that these pines are common on dry rocky outcrops, in poor soil, and on the inland marine sand deposits which have been tectonically uplifted (i.e., the white slopes noted by the Spaniards).[24] Undocumented *P. attenuata* stands in the Santa Lucia, San Bernardino and Santa Ana Mountains were remote from Spanish explorations, and grow in impenetrable dense chaparral.

The Franciscans first encountered Monterey pine at Cambria, 130 km south of Monterey, and indeed the explorers prematurely assumed they had reached their ultimate destination of Monterey. Crespí wrote (10 September 1769) they "went two leagues to stream running much sunken in the mountains through the midst of pine groves….Onward from this spot is all woods of very fine large pine trees…"[25] The following day Crespí made detailed observations of the stand, and even recorded the second pine grove extant today at Pico Canyon. They had:

> "reached shore in a quarter league..[and] went over rolling tablelands and of very high hills at the edge of the shore, with the pinewood still continuing at about a hundred paces to our right and two hundred from the sea water. The pinewood must have kept with us about a league (ca. 3–4 km). The pine trees dropped behind us here. Beyond this spot, some pine trees once again run onward not very far from the sea."

[24] Thomas (1961) discusses natural hybrids of *P. radiata* × *P. attenuata* along the explorers' route near Point Año Nuevo and coastal headlands at Waddell Creek.

[25] The Franciscans were well aware of Vizcaíno's maritime report of pines at Monterey in the "histories," as this work was their guide to relocating Monterey. They did not recognize the Vizcaíno record of "a large forest of pines" seen at a distance on Cedros Island west of the central Baja California peninsula as conspecific with trees growing at Monterey and Cambria.

The diseño for Rancho Santa Rosa shows the distribution of this forest in exquisite detail that virtually matches the modern distribution (Fig. 20A, B; Hoover 1970). The formal "discovery" of *Pinus radiata* was in 1830 when Thomas Coulter collected specimens at Monterey (Griffin and Critchfield 1972).

Pinus muricata D. Don (bishop pine: pino, pinal), Fig. 21

Scouts of the Portolá expedition discovered "pino" in the Santa Ynez Mountains west of Gaviota, almost certainly *Pinus muricata*, the only native pine near Point Conception (Smith 1976, 1998). The Franciscans describe the population in association with the cold foggy summer weather that characterizes the climate of bishop pine. Crespí (25 August 1769) wrote: "the scouts reported that from the hills they had seen mountain ranges not very far away, very much grown over with pine trees…" and added "A strong cold wind arises against us…," i.e., the cold marine layer associated with strong upwelled ocean waters north of Point Conception, and the source of fog drip from pine needles which sustains this coastal species. Farther north, the expeditions traveled the beach, bypassing inland populations in the western Santa Ynez Mountains and Purisima Hills. The expedition also missed populations in the Irish Hills by travelling through Valle de los Ojos to Morro Bay. Here, most stands face the ocean, away from view of the explorers. Perhaps the hills were obscured by coastal fogs. *Pinus muricata* was formally collected in 1830 by Thomas Coulter near San Luis Obispo (Hoover 1970).

Cupressus macrocarpa Hartw. (Monterey cypress: ciprés), Fig. 22

Spanish records of Monterey cypress can be credited to their proximity to Mission Carmel, the only major stand of the species. Crespí (24–29 May 1770) "came across a wood of what are either cypresses or junipers [cipréses o juniperos], though the berries do not seem to be those of cypress." In his letter to Fray Juan Andres (Bolton 1927: 53) concerning the Carmel River, Crespí wrote "in that vicinity there are good groves of cypress." He also saw the grove at Point Lobos, which he described as occurring "...near to the stream at the other point [where] there are groves of cypresses…" Font (11 March 1776) went to Mission Carmel "...[and] saw nearby Punta de Cipréses." Palóu "…came across a wood of cypresses at a point lying on the small bight looking southward from the Point of Pines…" (see footnote 13 in Brown 2001: 797). Monterey cypress is shown on diseño del Rancho Punta de Pinos with the place name Punta de Cipréses (Fig. 19A). CCH (2014–2015) collections document the rapid expansion of the species along coastal California due to plantings and naturalization.

Cupressus sargentii Jeps. (Sargent cypress: ciprés), Fig. 23

Cupresses sargentii populations grow exclusively on serpentine bedrock that strikes NW–SE along the southern Santa Lucia Mountains (Hoover 1970; Griffin and Critchfield 1972; Smith 1976). Crespí recorded one such stand just east of the headwaters of Arroyo San Carpoforo (17 September 1769) stating: "There are handsome cypresses in one of the canyons…" On his return trip to Monterey (18 May 1770) he saw the same grove and wrote: "There are a good many cypresses in a canyon along this march, and there are a few of them very close to this [camping] spot of Los Piñones near the crest of the sierra at Arroyo San Carpoforo." Hoover (1970) states that *C. sargentii* forms three extensive but well separated stands: northwest of Cuesta Pass, Cypress Mountain (reported by Dr. Carl B. Wolf [1948]), and from the "northeast end of the Pine Mountain ridge on the slopes above Tobacco and Little Burnett Creeks." Brown (2001) proposed in error that *C. sargentii* stands were Santa Lucia fir (*Abies bracteata* (D. Don) A. Poit.), a species which grows on precipitous slopes and bedrock cliffs distant from the expedition route. It is doubtful the Spaniards would confuse cypress and fir ("abete"). Sargent cypress populations in the North Coast Ranges were beyond the Spanish sphere of influence (Griffin and Critchfield 1972).

Pinus coulteri D. Don (Coulter pine: pino, pinal), Fig. 24

The modern range of Coulter pine extends along the coastal ranges from Mt. Diablo to the Sierra San Pedro Mártir in Baja California (Griffin and Critchfield 1972; Minnich et al. 2011). Accounts of this pine were made from a distance, but as a conspicuously tall conifer embedded in extensive low chaparral. Unambiguous identifications are sparing. In 1796 Arrillaga saw two of seven known *P. coulteri* stands in Baja California at Sierra Blanca and Cañon El Rincón in the Sierra Juárez, both monotypic pine forests (Minnich and Franco-Vizcaíno 1998). In the San Jacinto Mountains, Díaz and Garcés (15–16 March 1774) described two sierras flanking Anza Valley that had cover of pines (Bolton 1930). Cahuilla Mountain to the west of the valley has monotypic stands of *P. coulteri*, while the more elevated Thomas Mountain to the east has mixed conifer forest that includes *P. coulteri*. In the Santa Ana Mountains, a stand of Coulter pine was recorded in diseño de la Sierra del Agua Caliente por Juan Forster (Fig. 25). This land grant includes a small subgrant called "Potrero de los Pinos" which encompasses a meadow surrounded by *P. coulteri* on Los Pinos Peak.

Crespí fortuitously provided an incidental record of Coulter pine in the western San Gabriel Mountains by describing pine cones washed down the Los Angeles River (Rio Porciúncula). Near downtown Los Angeles, he wrote: "Big torrents it must carry, with dead trees from the mountains, and in its bed large pine-nut cones have been found" (2 August 1769). Coulter pine has the distinction of bearing the largest and heaviest cones in the genus *Pinus* in California that are most likely to survive long-distance transport in a flood. The source of the cone-bearing debris was almost certainly Tujunga Canyon, a tributary that hosts the only stand of Coulter pine in the Los Angeles River watershed (Minnich and Everett 2001).

In the Santa Ynez Mountains, Coulter pine populations on the ridge above Santa Barbara can be traced four centuries. They were first described in Vizcaíno's maritime account of 1602 from the Santa Barbara Channel where the coast "is fertile, for it has pine groves and oaks" (cf. Smith 1976). In the Franciscan expeditions, Font (26 February) wrote: "there is a quite high sierra that ran along our right [north], where there are seen many pines which bear good and large nuts…." Crespí and Costansó (19 August 1769) both wrote that pines grew on the summits. Fages (1937: 35) wrote: "In these mountains there are seen many pines like those of Spain."

About 150 km NW, Crespí described pines from locations where *Pinus coulteri* can be viewed along the crest of the Santa Lucia Mountains, although his accounts do not distinguish it from more extensive woodlands of *Pinus sabiniana*. From

Valle de los Ojos near San Luis Obispo (12 May 1770), he reported "…a great many pines" in the mountains to the north. Near San Simeon Crespí (12 September) wrote: "… close before reaching [camp], a great many live oaks show up upon the knolls and skirts of the mountains, which are bald ["pelonas" = treeless], but a few pine trees are visible on the summits of the nearest mountains." Today, *P. coulteri* can be plainly seen on summits of the Santa Lucia Mountains from the Franciscan expedition route, but *P. ponderosa* also grows on several peaks (Hoover 1970).

Coulter pine was recognized near Pinnacles National Monument east of Monterey. In the northern Salinas Valley, Crespí (30 September) stated: "The two mountain ranges have been keeping along with us: The very high mountains grown over with live oaks on the west [Santa Lucia Mountains]; a high range also on the north, bare, with only some patches of pine trees here and there" [the Diablo Range]. *Pinus coulteri* is presently the dominant pine species in this view. In the Mount Hamilton Range, Font (5 April 1776) recorded both "pino" and "pinabete" (literally pine-fir), clearly indicating two species of conifers. While *P. sabiniana* was likely the most abundant pine seen by Font, the other conifer is unclear. "Pinabete" traditionally refers to Douglas fir, but this species does not occur in this range. It is recognizable from a distance with its distinctly pendulous branching habit. The only conifer there today with pendulous stellate branching is *P. coulteri* (cf. Sharsmith 1982).

Near San Diego, Fages in 1782 (Rensch 1955) and Arrillaga in 1796 (Robinson 1969) passed through pine stands in the Cuyamaca-Laguna Mountains between Julian and Cuyamaca peak, where Coulter pine is abundant, but they did not distinguish it from *P. ponderosa* and *P. jeffreyi* Grev. & Balf. In the U.S.-Mexican Boundary survey, Emory (1857–1859) recorded Coulter pine as "*Pinus sabiniana*" (cf. Griffin and Critchfield 1972). Consequently, the State flora survey erroneously reported the range of *Pinus sabiniana* as extending southward to the U.S.-Mexican Border (Brewer and Watson 1876–1880). In 1831 Thomas Coulter formally described *P. coulteri* from a collection in the Santa Lucia Mountains (Griffin 1964).

Pinus torreyana Parry ex Carrière (Torrey pine)

Spanish explorers failed to spot the rare Torrey pine on the coast north of Mission San Diego. Initial accounts in the 19th century indicate a population far smaller than modern stands. Dr. C. C. Parry of the U.S. Mexican Boundary Survey first reported the species in 1850, noting that: "The bulk of the tree growth is here confined to a series of high broken cliffs and deeply indented ravines on the bold headlands overlooking the sea" (Emory 1857–1859). This account places the tree away from view of the Portolá expedition where it crossed Soledad Valley to the east. Jepson (1910) commented that the locality was "disappointing" because it consisted of few, inconspicuous trees: "They are insignificant in stature and habit, and notwithstanding that they are the only trees where they grow, they dominate the landscape so little as scarcely to be noticed…." His formal botanical description of the species states that "it is a small tree, commonly 15 to 20 feet high… (5–7 m)." Today, tall Torrey pines with broad canopies are prominent across the coastal area between La Jolla and Del Mar. Systematic plantings were undertaken throughout Torrey Pine State Reserve and in neighboring undeveloped areas in order to expand the native population (Fleming 1949). Time-series aerial photographs and pollen in sediment cores indicate the Torrey pine population is now at its greatest extent since settlement (Cole and Wahl 2000). Tree-rings date the oldest live Torrey pines to 1827 (Biondi et al. 1997), thus confirming that present-day trees established after Spanish explorations.

MIXED EVERGREEN FOREST

Tall and verdant mixed evergreen forest is well described by the Franciscan expeditionaries, especially in the San Francisco Bay region, because this assemblage was the most accessible timber in California during Spanish colonization. The spectacular appearance of redwoods veiled Douglas fir in the minds of the Spaniards. Bigcone Douglas fir forests in southern California attracted little interest.

Sequoia sempervirens (D. Don) Endl. (coast redwood: savin, sabino, palo Colorado, alerce, pinabete), Fig. 26

Spanish explorers struggled to identify coast redwood because no close relative in their experience existed in Europe. They first discovered *Sequoia sempervirens* at Pinto Lake, southeast of Santa Cruz, where it was variously named "sabino" (savino) and "palo Colorado," in recognition of the red bark and cypress-like foliage of this member of Taxodiaceae. Font called it "pinabete" (pine-fir), apparently because its foliage resembles true firs (*Abies*).[26] Redwood was later collected by Menzies on Vancouver's voyage in 1794, but it was not formally described as a species until 1824 by Thaddeus Haenke (Saunders 1914: 155). According to Crespí (8 October 1769), the Spanish began their discovery of this species at the Pajaro River where:

> "the scouts were impressed "with the straight, very thick trees, quite tall, with a very short slight leaf. Some said they were savins [trees with scale foliage]; however, they are not so to my understanding, since the wood is red; but they are not junipers either. They are not like any others that we have seen elsewhere."

In his revised journal, Crespí insightfully wrote that the leaves were:

> "not over two fingers in length; it has very sharp pointed small cones that are not over two fingers long; the heartwood of the tree is red, a very handsome wood, handsomer than cedro [cedar], so that no one knew what kind of wood it might be—we cannot tell whether it may be pinabete ["pine-fir"]; many said it was savin, and sabino it was dubbed, though I have never seen red ones before. There is a great number of this sort of trees here, of all sizes of thickness, most of them vastly tall, and straight like so many candles…"

[26] According to A. K. Brown (2001: 791, footnote 117), "Crespí seems likely to have had savin-pines and red bark as an idée fixe (if not European firs or spruces, sabinos), and not to have understood that the other expeditionaries were referring to the Mexican sabinos or [the more closely related] Montezuma cypress (*Taxodiaceae*) which is similar to these just-discovered redwoods than are the European trees that he had in mind. Besides palo colorado and madera colorado, other early names were palo de Monterey and alerce (larch)."

The Spaniards document redwoods primarily in the Santa Cruz Mountains. Crespí described redwood forest at several locations from Corralitos Creek to Santa Cruz (cf. Palóu, 11 December). Diseño Rancho San Andrés records "Palo Colorado" in the hills northeast of Watsonville (Fig. 27). Both Crespí and Palóu describe gallery forests locally descending the canyons toward the Pacific coast of the Santa Cruz Mountains. Expedition accounts from San Bruno Mountain northward on the San Francisco Peninsula do not mention redwood, as seen today. Redwoods were also observed on the eastern slope of the Santa Cruz Mountains from a distance in San Benito Valley and Hollister. From there, redwoods were seen extending down the canyons northward to Palo Alto and Crystal Springs Reservoir. Palóu described "one extremely large [individual] which had its heart burned out, forming a cave, and one of the soldiers, mounted on his horse, rode into it, saying 'now I have a house in case it rains.'" The Spaniards even made measurements of a large tree at Palo Alto (Font and Anza, 30 March 1776). Font provided a synopsis of the redwood distribution (28 March), stating that it extended "from the vicinity of the Arroyo de las Llagas…and Punta de Almejas (San Pedro Point) [is] a very high range, most of it thickly grown with pinabetes and other trees which continue as far as the valley of San Andres," in effect the modern range of the species west of the San Francisco Bay. Redwoods were also observed in the east bay near Oakland's Lake Merritt. Font (1 April 1776) wrote that a "grove of redwoods [grew] in front of the mouth of the port, although in its interior it has thickly grown groves…" Anza (1 April) "…came abreast of large groves of pines or redwoods" at this location (cf. Ertter 1997).

Redwood forests escaped notice south of Monterey because most stands grow along the inaccessible Pacific escarpment of the Santa Lucia Mountains. The only written record comes from diseño del Rancho San Jose y Sur Chiquito along the Rio Carmel near the mission, which depicts "Palo Colorado." The Franciscans were told of redwoods in the southern Santa Lucia Mountains based on hearsay. In his summary of Mission San Antonio lands, Fages (p. 57) writes: "there is here another kind of wood of the color of cedar," the Native Americans apparently telling him of redwood forests on the Pacific slope. Likewise, Font (4 March 1776) was told of large numbers of "pinabetes." It is ironic that the Portolá expedition's departure from the coast to traverse the Santa Lucia Mountains to Salinas Valley narrowly missed the southernmost redwood stand on Villa Creek, 9 km NW of their last beach camp at Arroyo San Carpoforo (cf. Hoover 1970).

Pseudotsuga menziesii (Mirb.) Franco (Douglas fir: pinabete, pino), Fig. 28

The Franciscans explorers rarely distinguished Douglas fir from redwood. The genus *Pseudotsuga* is also not native to Europe and would also be unfamiliar to an educated Spaniard. From a distance both *Sequoia sempervirens* and *Pseudotsuga menziesii* are very tall, with similar branching habits. Both species have short needles, but redwood with distinct red bark and Douglas fir with gray bark. Direct evidence that the Spaniards encountered Douglas fir is based upon the comment by Captain Rivera concerning "blisters of fluid on the bark," a trait not observed in *Sequoia sempervirens* (Brown 2001: 791, footnote 117). West of San Andreas Lake, Crespí (6 November 1769) wrote: "the [Santa Cruz] mountains that had borne woods were clad with a great deal of trees about which we are in doubt as to whether they may have been pines or of the sort that were designated savins farther back." At nearby Dolores Creek, Anza (29 March 1776) states: The timber of this area includes "both of pine and redwood" (*pinos y palo colorado*), perhaps distinguishing Douglas fir from redwood.

Umbellularia californica (Hook. & Arn.) Nutt. (California bay, laurel: Laurales), Fig. 29

The Franciscan explorers frequently recognized California laurel because of its resemblance to the European *Laurus nobilis*, and because it had use as an ethnobotanical plant. California bay is presently found across the moist coastal parts of the state, but Spanish explorations virtually missed the species south of Monterey. In southern California *Umbellularia californica* is uncommon in the Peninsular Ranges, and populations in the Transverse Ranges occur far off route of Spanish explorations. The tree was observed only by Fages (p. 35) at Santa Barbara (Smith 1976). The diseño del sitio llamado La Brea records "Cañada de los Laurales" in the Santa Monica Mountains at Griffith Park (Fig. 30). Collections of *U. californica* in the CCH (2014–2015) have been taken in the eastern Santa Monica Mountains and near Pacific Palisades (Daniel Cooper, pers. comm.; Raven and Thompson 1966; UCR170411). Font reported "some beautiful laurels" (4 March) at Cuesta Pass near San Luis Obispo, confirmed by the CCH (2014–2015, e.g., CDA16127). The Crespí journal documents *U. californica* at two localities on the San Simeon coast near Point Piedras Blancas, but we could find no botanical collections to confirm these localities. Crespí (17 September 1769) reported "laurales" to the north at Arroyo San Carpoforo. At Monterey, laurel was the namesake for Rancho los Laurales near Carmel Valley Village (Hornbeck 1983).

California bay was frequently recorded in the San Francisco Bay region. Records include diseños in the vicinity of Santa Clara (Rancho Posolmi), San Jose (Rancho Rincon de los Esteros), and Morgan Hill (Rancho las Uvas). The Franciscan journals record laurels at San Jose, Palo Alto, and near San Mateo on the west bay, and Fruitdale and Berkeley on the east bay, as well as in the interior valleys at Concord and Walnut Creek. Sharsmith (1982) states that *U. californica* is common only on the west slope of the Mt. Hamilton Range, off the routes travelled by Anza and Font in 1776. In the western Sierra Nevada, laurel grows at elevations well above explorations of the Moraga expedition. *Umbellularia californica* was first collected by Menzies of the Vancouver Expedition of 1790–1792 between Monterey and San Francisco (Griffin and Critchfield 1972).

Arbutus menziesii Pursh (Pacific madrone: madroño), Fig. 31

The Spanish name madroño in California generally refers to members of Ericaceae in the genera *Arbutus* and *Arctostaphylos* and became accepted nomenclature for chaparral early in the Spanish period. In particular, Arrillaga described *Arctostaphylos*-dominated chaparral in his 1796 expeditions of Baja California as "madroño," a vegetation term that had become accepted two decades into Spanish settlement (Minnich and Franco-Vizcaíno 1998). In 1769, members of the Portolá and Anza expeditions had not developed vocabulary for chaparral and evergreen sclerophyllous trees. The term

"manzanita" (little apple) was first used to describe *Arctostaphylos* at Crystal Springs Reservoir near San Francisco, only after 500 km of exploration in California (Brown 2001). Spanish documentation of *Arbutus menziesii* is limited to the Santa Cruz Mountains. Near San Bruno Mountain, Crespí (5 November 1769) saw "many madroños…" He also states that "although the fruit is smaller than that of Spain, it is of the same species." He seems to be comparing *A. menziesii* with the European *A. unedo* L., the strawberry madrone of Mediterranean Europe, or possibly the shrubbier *A. andrachne* L. of the Balkans and eastern Mediterranean. The next day Crespí saw madroño at the foot of the Santa Cruz Mountains near Palo Alto. Font (29 March 1776) saw "many and various trees of good timber, such as….madroños" between San Mateo and Palo Alto. On the Pacific slope of the Santa Cruz Mountains, Crespí (20 October) "found a few madroños laden with ripe fruits, though very small ones, like the beads on our rosaries." Madrone was not recognized in the Santa Lucia Mountains. At Arroyo San Carpoforo, Crespí (16 September) only recorded a "tree not seen before." Font and Anza failed to recognize an en-route population at Cuesta Pass near San Luis Obispo (CCH 2014–2015, e.g., SBBG94211). Rare stands to the south are remote from Spanish explorations (cf. Smith 1976; Sharsmith 1982). "Madroño" was not recorded in diseños.

Pseudotsuga macrocarpa (Vasey) Mayr (bigcone Douglas fir: pinabete, pino), Fig. 32

This southern California endemic grows in precipitous mountain slopes avoided by Spanish expeditions, virtually precluding close-hand observation. Bigcone Douglas fir was ambiguously called "pinabete" (pine-fir) and more commonly "pino." It is also the tallest conifer in its geographic range, which increases our confidence in its identification from Spanish records.

Pseudotsuga macrocarpa escaped Arrillaga's notice at the eventual type locality at Banner Canyon in San Diego County (Minnich 1982), and the Anza expedition traveled two canyons west of modern stands in the San Jacinto Mountains. Garcés (21 March 1776) reported "pinabete" while crossing the San Bernardino Mountains near Silverwood Reservoir, where *P. macrocarpa* is presently abundant (Minnich 1988; Minnich and Everett 2001).[27] During his descent of the southern escarpment, he saw "poca arbolada" (few trees) where *P. macrocarpa* is the only coniferous tree in the canyons. At nearby Cajon Pass, Blake (1856) wrote that "pine" can be procured from the high sheltered canyons, a habitat description which aptly describes *P. macrocarpa*'s modern distribution (Minnich 1988).

The Franciscans had vague distant views of bigcone Douglas fir in the San Gabriel Mountains. From the San Gabriel Valley, Font (3 January 1776) saw "…live oaks (encinos)…, and apparently in the sierra there are more of them, together with the pines." Crespí (31 July 1769) wrote: "trees that we think must be pines are to be seen on the summits of the mountains running upon the north." Both observations were fixed on the front range of the San Gabriel Mountains where *P. macrocarpa* in the canyons is the primary coniferous tree (Mount Wilson, Monrovia Peak). Mixed conifer forests on the higher peaks to the north would be obscured by the front range, as seen from the San Gabriel Valley.

When the Portolá expedition advanced down the Santa Clara River from the San Fernando Valley, Crespí recorded *P. macrocarpa* in the Santa Susana Mountains south of the flood plain, and the mountains of the Sespi Condor Sanctuary to the north. At Newhall Pass, Crespí saw at close range (7 August 1769): "Some pine trees … seen here and there on the mountain summits." Moving west along the river, Crespí (10 August) was impressed by "The mountains continu[ing] along side us to one side and the other—quite steep, very broken, and cliffy, …[and] bare since only in some spots some live oaks are to be seen on the summits and the slopes, and some pine trees in others." Here the northern slope of the Santa Susana Mountains has *P. macrocarpa* stands in the canyons, bounded by barren rock outcrops. On 11 August, Crespí saw "pine trees seen in the mountains on the north side (Sulphur Mountain)," and on 12 August saw "the mountains northward, upon the right [with] some pine trees here and there on their summits, and on some of their slopes" (Santa Paula Peak and other canyons near Fillmore). This is the last record of the species. Widespread *P. macrocarpa* forest in the interior mountains of Ventura and Santa Barbara Counties are distant or obscured by front ranges along Spanish routes. There are no diseño records of *P. macrocarpa*.

Quercus chrysolepis Liebm. (canyon live oak: encino), Fig. 33

Accounts of "encino" unequivocally refer to *Quercus agrifolia* at low elevations of coastal California, but the interpretation of "encino" is problematic in high elevations where other live oak species dominate the vegetation. In the southern California mountains above ca. 1500 m, "encino" credibly refers to *Q. chrysolepis*, but this oak was usually seen at a distance. In the San Jacinto Mountains, Anza (15 March 1774) and Díaz (16 March) saw "pines and encino" on Cahuilla Mountain and Thomas Mountain that bound Anza Valley. From Bautista Canyon, Font (29 December 1775) saw "on the right side from the Sierra Nevada (Mt. San Jacinto), and on the left from the high sierra (Cahuilla Mountain), both ranges having many pines and "enzinos" (sic). Oaks were also found in the canyon. Other oak species are doubtful. Deciduous *Q. kelloggii* can be ruled out because it was winter, and evergreen *Q. wislizenii* var. *frutescens* is a shrub. Garcés observed "encino" on the Spanish Trail near Silverwood Reservoir in the western San Bernardino Mountains, where *Q. agrifolia* is not native. The Pacific Railroad Survey later used the same trail in summer and recorded "two oaks in great abundance" in reference to *Q. kelloggii* and *Q. chrysolepis* (Bigelow 1856). Near Fillmore, Crespí (12 August 1769) observed "encino" on the slopes with "pines" (*Pseudotsuga macrocarpa*). *Pseudotsuga macrocarpa* grows with *Q. chrysolepis* throughout its range (McDonald and Littrell 1976; Minnich 1999). In central California, the interpretation of "encino" is equivocal because most accounts were made at elevations supporting *Q. agrifolia* and *Q. chrysolepis*. The VTM survey mapped *Q. chrysolepis* along the Portolá route in Arroyo San Carpoforo, but Crespí (16 September 1769) records only "trees we did not recognize." At Año Nuevo, Crespí (19 November 1769) also saw a live oak wood ("leña

[27] An alternative interpretation is "*Abies concolor*" but that species is uncommon on this route and entirely missing at Silverwood Reservoir and the south front of the San Bernardino Mountains.

encina") in a stream bed where *Q. chrysolepis* presently occurs. Font recorded "encino" in the Diablo Range south of Livermore where *Q. chrysolepis* grows on north-facing slopes of the highest peaks (Sharsmith 1982; CCH 2014–2015, e.g., UC1135387). In the southern Sierra Nevada, beyond the range of *Q. agrifolia*, Zalvidea (28–30 July 1805) took a forey along Tejon Creek and saw "…a nearby hill heavily covered with white oaks and live oaks," most likely *Q. lobata* and *Q. chrysolepis*. To the south Fages "went through a pass [Tejon]...very thickly grown with groves of live oaks, and are also on the hills and sierras which form these valleys," i.e., he suggests the oak extends northward along the coast range and Sierra Nevada. *Quercus chrysolepis* is the only evergreen "encino" tree at the pass (Bolton 1931; CCH 2014–2015, e.g., SD186233, RSA628484). The Pacific Railroad Survey recorded evergreen oaks, almost certainly *Q. chrysolepis*, at this pass (Blake 1856: 38).

PINYON-JUNIPER WOODLAND

Pinyon-juniper woodland was frequently recorded in Dominican explorations of the Sierra San Pedro Mártir and Sierra Juárez of Baja California (Minnich and Franco-Vizcaíno 1998). In California, the Franciscan expeditions traversed coastal plains and valleys far away from this plant assemblage. Only *Pinus quadrifolia* was described in the San Jacinto Mountains, based on hearsay from Native Americans.

Pinus quadrifolia Parl. ex Sudw. (four-needle pinyon: piñon), Fig. 34

Near Anza Valley, Font (26 December) wrote: "they [Native Americans] said that in the sierra in this vicinity there were piñones with pine nuts, though I did not see any." The party had indeed passed close to modern, widespread four-needle pinyon woodlands in Vandeventer flat and southern Thomas Mountain (CCH 2014–2015, e.g., SBBG113408, UCR47229). *Pinus quadrifolia* was first collected at Larkin's Station near the Mexican boundary by Parry during the US-Mexican Boundary Survey. Emory (1857–1859) wrote that the nut-pine, described by Dr. Torrey as *Pinus llaveana* Schiede ex Schltdl., "has a very limited range near the dividing ridge and south of the boundary line."

MIXED CONIFER FOREST (FIG. 35)

This assemblage was best described in Dominican explorations of the high Sierra Juárez and Sierra San Pedro Mártir of northern Baja California (Minnich and Franco-Vizcaíno 1998). In California, the Franciscan expeditions locally encountered mixed conifer forest in the mountains.

Pinus ponderosa Douglas ex Lawson & C. Lawson (ponderosa pine: pino)
Pinus jeffreyi Grev. & Balf. (Jeffrey pine: piño)
Pinus lambertiana Douglas (sugar pine: piño)
Abies concolor (Gordon & Glend.) Lindl. ex Hildebr. (white fir: abete)
Calocedrus decurrens (Torr.) Florin (incense cedar: savin, sabino, cedro)

In southern California, Garcés provided the best account of mixed conifer forest when he crossed the western San Bernardino Mountains from the Mojave Desert along the Spanish Trail on 21–22 March 1776 (Minnich 1988). His route took him from the site of Silverwood Reservoir, upslope to the crest of the range near Monument Peak, and then descending via Devils Canyon to the San Bernardino Valley. On 21 March 1776, he wrote:

> "I left the Mojave River [and] … continued on a southerly direction through a heavily wooded canyon that also has grass and water. In it there are many cottonwoods [*Populus fremontii*], alders [*Platanus racemosa*], oaks [*Quercus chrysolepis*], large firs [*Pseudotsuga macrocarpa*, less likely *Abies concolor*], and picturesque cedars [sabinos, *Calocedrus decurrens*]."

On 22 March he wrote:

> "After travelling three leagues, I pass over the sierra, moving in a south-southwest direction. The mountain is wooded up to its summit by the trees I saw yesterday… During the descent, there are few trees [*poca arbolada*]."

The Pacific Railroad Survey crossed the range on the Spanish Trail 80 years later and documented the same forest distribution (Bigelow 1856, vol. 4):

> "On arriving to Cajon Pass (from the north), two kinds of cedars occur [*Calocedrus decurrens*, *Juniperus californica*]; pines 3 or 4 kinds—Oregon Pine (*Pinus douglasii*) [*Pseudotsuga macrocarpa*], piñon or nut pine (*Pinus monophylla*) and on the neighboring mountain, the sugar pine (*Pinus lambertiana*), and one other species somewhat resembling, but different from, the New Mexican Yellow Pine [*Pinus ponderosa*]. Immediately on passing the crest of the Cajon the vegetation changes like magic. Many of the shrubs being such as we have never seen, the mountains and hills were covered with green with their perennial foliage. Among the most beautiful, we found several species of Ceonothus [sic]. We collected at this place a specimen of a new remarkable genus Fremontia."

Both accounts describe forest on the north-facing escarpment to the crest where trees abruptly came to an end. On the southern escarpment, the Americans of the Pacific Railroad Survey had no word for chaparral, but identified evergreen shrub genera. Garcés had made no reference to chaparral because the Spaniards had not yet developed vocabulary to describe the assemblage. The ridgeline forest–chaparral boundary was later depicted in land claim maps in 1857, 1866, 1870 and 1893 (La Fuze 1971; Minnich 1988) because only forested lands were taken from public domain for the purpose of logging. The forest–chaparral boundary was also depicted in vegetation maps by Kinney (1887), Leiberg (1900), Grinnell (1908), and the VTM Survey (Minnich 1988).

In the San Jacinto Mountains, Anza and Díaz (15–16 March 1774), and Font (27 December 1775, Bolton 1930; CATE 2014–2015 Web de Anza Archives) saw pine forests on the summit of Thomas Mountain. Díaz stated that trees "seem to be more plentiful the farther north the mountains run" toward the high summits of Mt. San Jacinto. He observed deep snow in some of the heights and was informed that it often lasted until May. Garcés stated the Thomas Mountain forest had "some pines on its crest," as seen today (CCH 2014–2015, e.g., GH246974). Farther south in the Peninsular Ranges, Fages in 1782 (Rensch 1955) and Arrillaga (25 October 1796) observed mixed conifer forest on the crest of the Cuyamaca–Laguna Mountains. Fages (19 April 1782) ascended the desert escarpment along Oriflamme

Canyon to the crest where he "found a different climate from that which we had been experiencing [the desert], and we noticed that there were numerous groves of pine and other trees in the entire neighborhood…" Arrillaga ascended the mountain along Banner Canyon just to the north. From the Vallecito desert he saw "trees on the heights to the southwest that looks like pines," here *Pinus jeffreyi*. Near Cuyamaca Peak, Arrillaga (26 October 1796) saw places "... where they take out timber for the presidio of San Diego," in reference to mixed conifer forest dominated by *Pinus ponderosa* near Cuyamaca Lake and *P. jeffreyi* to the east. Zalvidea had distant views of mixed conifer forest sky islands on his way to the southern San Joaquin Valley from Mission Santa Barbara. From the eastern Cuyama Plain he saw "mountains with a few pine trees," apparently the small stands on Big Pine Mountain (24 July 1805). To the east he saw another "range of mountains on which pine forests are growing," likely the San Emigdio Mountains and Mt. Pinos.

In central California, Spanish writings of mixed conifer forest are limited to the western Sierra Nevada. Vague accounts in the 1806 Muñoz journal (Cook 1960) suggest the expedition saw this assemblage from a distance, but the party entered forest in forays at two locations. From the Consumne River, Muñoz (4–5 October) stated that, "in the mountains there is pine," but this could refer to either *Pinus ponderosa* or *P. sabiniana.* An excursion was also taken up into the mountains along the San Joaquin River, where Muñoz (13 October 1806) recorded "pine and *savin*," i.e., cedar (scale-leafed trees, *Calocedrus decurrens*). It is doubtful they observed *Sequoiadendron giganteum* (Lindl.) J. Buchholz (giant sequoia), later discovered by John Wooster in 1850 at the Calaveras Grove (Ellsworth 1933).[28] A Spanish discovery would have doubtless elicited exclamations of sierra redwood's huge girth and size, as was provided by accounts of coast redwoods in the Santa Cruz Mountains. Muñoz (18–19 October 1806) also recorded "pine and cedar" at the Kings River. Farther south, he recorded "pine and oak" which implies foothill woodland of *Pinus sabiniana* and species of *Quercus*, not mixed conifer forest.

COASTAL SAGE SCRUB (FIG. 36)

To a Spaniard, coastal sage scrub was made attractive by shrub species morphologically and taxonomically similar to mediterranean "kitchen" herbal plants. These include mostly members of the mint and sunflower families which the journals identify as salvia, rosemary, lavender, and artemisia. In Baja California, coastal sage scrub is also comprised of succulent ethnobotanical plants that demanded careful examination by the Spanish padres, including cholla (*Opuntia* spp.), jojoba (cocoba, *Simmondsia chinensis* (Link) C.K. Schneid.) and mescale (*Agave shawii* Engelm., *Yucca* spp., Minnich and Franco-Vizcaíno 1998). The Spanish account of coastal sage scrub is consistent with the modern range of the assemblage including the San Diego coast, the hills near Riverside, Santa Clara River Valley and locally in the hills north of Point Conception.

From San Diego to San Juan Capistrano, the Portolá expedition traveled through mostly herbaceous pastures, but intermittently saw foothills covered with coastal sage scrub. When Costansó departed ship at San Diego in May 1769, he saw "rosemary [California buckwheat (*Eriogonum fasciculatum* Benth., which has similar foliage], salvia [sage] and roses of Castile" [a true rose, *Rosa californica* Cham. & Schltdl.]. At Carlsbad, Crespí (17 July 1769) saw "a great deal of sagebrush (romerillo, *Salvia* spp. or *Artemisia californica* Less.) and other small brush…" Near Santa Margarita (20 July) the tablelands had "a few wild prickly pears (tunas, *Opuntia* spp.) and sagebrush (romerillo)."

The Orange County–Los Angeles plains were devoid of shrub cover, and instead covered by extensive fields of wildflowers (Minnich 2008). Crespí saw patches of prickly pear (*Opuntia* spp.) and sage (*Salvia* spp.) in the hills near the Santa Ana River at Yorba Linda. At Santa Clarita they saw "mountains quite steep, very broken, and cliffy, of sheer soil gray to white in color," the color of coastal sage scrub from a distance (8–9 August 1769). Anza, Font and Garcés described the hills of the Riverside–Perris Plain as being covered with kitchen plants. Coastal sage scrub was first encountered in Bautista Canyon, near Hemet, where Font (29 December 1775) recognized many plants "similar to those of Spain, rose bushes (rosales, *Rosa californica*) and many fragrant herbs (hierbas odoriferas)….among which I saw and gathered lavender," i.e., some aromatic shrub, possibly *Salvia apiana* Jeps., *S. mellifera* Greene or *Artemisia californica*. At Hemet, Garcés recorded in his journal (18 March 1774): "Throughout these lands there are rosemary [romero, possibly *Eriogonum fasciculatum*], sage, better than that of Guadalaxara [sic] [perhaps *Artemisia californica*]…." He also describes ethnobotanical plants common to coastal sage scrub, stating:

> "There is great abundance of good quelites which the Indians eat in season, sour cane which they call sotole [possibly a reference to *Yucca whipplei* (Torr.) Trel. inflorescences], and a little palm (palmito) which bears dates which are not like those of Spain" [*Y. schidigera* Ortgies].

At San Jacinto and Riverside, Font (29 December 1775) wrote: "Here and there in the valley there are some hills with rocks and shrubby growths…." From near Mystic Lake to Riverside, Font states:

> "In the first and second range of hills [Mt. Russell, Box Springs Mountains], and their canyons, which are of moist earth, I saw great abundance of rosemary (romero, *Eriogonum fasciculatum*) and other fragrant plants (perhaps *Artemisia californica* and *Salvia* spp.)."

Near Riverside, (31 December) he saw "many sunflowers in bloom (mirasoles floridos)," possibly the common *Encelia farinosa* A. Gray ex Torr. Coastal sage scrub grew only on the hills, as Anza (18 March 1774) wrote of the San Jacinto Valley that "all its plains are full of flowers." The next day near Mystic Lake, Anza (19 March) makes the specific remark of "Good pasturage on the skirts of some hills." He implies that pastures and flower fields of the valley floor do not climb into the brush-covered hills, i.e., coastal sage scrub does not extend past the base of the hills.

Kitchen plants were not described in the Santa Barbara Channel where coastal sage scrub is presently rare (cf. Timbrook et al. 1982). Rounding Point Conception, aromatic shrubland was found again in the coastal hills rising above extensive sand

[28] A common name for giant sequoia is "Sierra redwood," a recognition of similarity to coast redwood.

dunes. North of the Santa Ynez River, Crespí writes (30 August 1769): "Beyond the sandy grounds is a range of hard ground clad with low scrub of brush (ramajos) and sagebrush (romerillos)." Fages states they went "over ground that is level but very much overgrown with wild rosemary (romero) and trees [shrubs] of delicate perfume." Costansó (31 August 1769) described the area as "flat land with "wild rosemary and other sweet smelling bushes…" The party then entered the Santa Maria plain near the coast in poor drained areas behind coastal dunes where Crespí writes the expedition came into a low range "with small scrub (montecillo) of sagebrush (romerillo) and other small brush." Costansó and Fages also describe patches of "wild rosemary." This is the northernmost account of coastal sage scrub along their route, as most other stands northward occur on the inaccessible Santa Lucia Mountain cliff coast. Coastal sage scrub was not identified in diseños, nor was it coined as a term until recent times (Mooney 1977). The VTM survey maps called it "sagebrush."

CHAPARRAL (CHAMIZO, FIG. 37)

Chaparral was novel to the Spaniards and poorly described in their journals despite its extensive distribution in California. The Franciscans had not developed vocabulary to describe it. The word "chaparro" was used several times by Crespí, but he used it in its traditional meaning in Mexico—"thicket"— i.e., it impedes ones' mobility. Hence, the modern use of "chaparral" does not have its origin in Crespí's journal. In Baja California Crespí informally described evergreen brushlands as "hills dotted with small trees" (Minnich and Franco-Vizcaíno 1998). The Spaniards described shrub species using morphological analogues to European plants such as "rosemary," which also has striking physical resemblance to chamise (*Adenostoma fasciculatum* Hook. & Arn.), the dominant chaparral shrub in California. More commonly, chaparral elicited words of complaint or uselessness, being referred to as barren (pelonas), dark, treeless, as well as harsh or stark (pelados). In 18th century European thought, a country field or mountain was perceived to be smooth or worn down as in a used brush, devoid of bristles, hence the word "brush." The genetic constitution of a species that determines whether a plant becomes a tree or a shrub, a.k.a. "fate or predestination," was not a concept in the 18th century, before Darwinian evolution and Mendelian genetics. All species had the potential of becoming a desired tree. Hence, a shrub is a tree that did not make it to tree stature, i.e., a dwarfed tree was a "failed" tree. Even Fremont in 1844 referred to chaparral on the north side of the San Gabriel Mountains as "crippled trees and shrubs" (Smucker 1856: 440).

A standardized nomenclature had developed by the explorations of northern Baja California by José Joaquin Arrillaga in 1796 (Minnich and Franco-Vizcaíno 1998). He used three terms to describe chaparral: "chamizo" or "chamizal" for chamise-dominated chaparral (*Adenostoma fasciculatum*), "madroño" for manzanita-dominated chaparral (*Arctostaphylos* spp.), and "big chamizo" (chamizo grande) for red-shank chaparral (*Adenostoma sparsifolium* Torr.). Indeed, the relatively complete picture of chaparral in Baja California by Arrillaga's 1796 account was not equaled in California until the late 19th century (e.g., Kinney 1887). The term "chamizo" became accepted by Mexican and American settlers in the Mexican period and used frequently in diseños, as well as early U.S. Government surveys after California Statehood. The Spanish nouns "chamizo" and "chamizal" were evidently used interchangeably and with variant spellings, including by Anglo-European claimants of diseños. In the Pacific Railroad Survey Blake (1856) stated that the Liebre Mountains had "a thick growth of green chemizal." "Chamizo" was used in Jackson's 1886 vegetation map of southern California (Kinney 1887).

The current use of "chaparral" comes from "chaparro" or scrub oak (Saunders 1914: 110; Cronemiller 1942; Hanes 1977). To prevent having their clothes cut to shreds riding through it, horse riders wear *chaparrajos*, or "chaps." It appears that Brewer (1966) was the earliest English speaker to employ "chaparral" in the 1860s, who noted that shrub vegetation in southern California was called both "chaparral" and "chamisal." Chamizo apparently fell into disuse by the 1880s (e.g., Muir 1883; Van Dyke 1886) and eventually the word referred to chamise (*Adenostoma fasciculatum*). "Madroño" became a common name for *Arbutus menziesii* rather than manzanita chaparral.

The Portolá expeditions saw chaparral several times along the San Diego coast. On the first day north from Mission San Diego, Crespí recorded "only a few small scrubby white oaks (roblita)" in apparent recognition of scrub oaks (*Quercus berberidifolia* Liebm.), a familiar congener in Europe (15 July 1769). Near San Elijo Lagoon (16 July) he ascended "bare" hills which had a "low wood of some unknown sorts of shrubs (arbolillos) and a thicket of scrubby white oaks" (roblecitos chaparros). From San Luis Rey to Soledad Valley, the party "entered some hills covered with a scrubby growth (bosque chaparro) of rosemary, small live oaks (encinillos), cactus and similar growths." At Carlsbad (17 July), Crespí appears to describe chamise as "shrubs like junipers," i.e., the fasciculate leaves of *Adenostoma fasciculatum* resemble the foliage of junipers (tascale). He also saw small white oaks (roblecitos). Early 19th century accounts confirm the presence of chaparral on the coast south of San Luis Rey. In 1831 from San Diego, Dana (1911)

> "rode off in the direction of the mission, ….The country was rather sandy, and there was nothing for miles which could be called trees… there were many bushes and thickets,… The bush…. These trees are seldom more than five or six feet high (1.8–2.0 m) and the highest I ever saw in these expeditions could not have been more than twelve (4 m)."

In 1853, Emory (1857–1859) recognized the extensiveness of the chaparral in the San Diego backcountry:

> "The ranges adjoining the coast are smooth in outline, slope up gradually into vertebrated ridges, and are covered with a dense brownish shrubbery (chamise in persistent brown, dry fruit), which gives a singular, smooth aspect to their distant outline."

Cooper (1874), on a trip in 1872 from San Diego to the Cuyamaca Mountains, states: "a narrow belt of shrubby oaks (Adenostema [sic] and Spiraea [sic] with some other shrubs), runs along within a mile of the beach,…", similar to Crespí's account.

When the Anza expedition crossed the San Jacinto Mountains from the Sonoran Desert, only Díaz (17 March 1774) captures the extensiveness of the chaparral stating: "All this mountain…is well grown with brush." Ascending from the desert, Font (26 December) noted the change in the landscape,

"for now we saw some scrub live oaks (encinos chaparros, *Quercus berberidifolia*) and other small trees." Font (27–28 December 1775) also made a rare specific reference to chaparral after leaving camp at Tripp Flat for Bautista Canyon: "we entered a growth of low oak brush (encino chaparro)…" In upper Bautista Canyon Garcés (17 March 1774) made reference to live oaks and "jucaros." The latter name is in reference to a tree from Cuba (*Bucica buceras* L.) with foliage similar to *Heteromeles arbutifolia* M. Roem. or possibly *Rhus ovata* S. Watson.

Garcés did not pause to describe the chaparral on the south front of the San Bernardino Mountains (Minnich 1988). Along the same route, Bigelow (1856, vol. 5: 17–26) of the Pacific Railroad Survey saw "many…shrubs…never before seen, the mountains and hills were covered with green and with their perennial foliage…" Neither was "chaparral" part of Bigelow's vocabulary. Crespí described the brush-covered Santa Ana Mountains as barren or sterile in distant views. Brewer (1966: 33–35) walked into the range and wrote that the "chaparral was so exceedingly dense that it seemed as if no progress could be made." He also "got into chaparral so thick that [he] tore [his] pants off almost…." Crespí (30 July 1769) writes that the San Gabriel Mountains were "dark and with many wrinkles (corrugations)…," the darkness of the range perhaps representing mature chaparral, and the wrinkles due to shadowing produced by the numerous canyons, especially in morning and evening light. At Newhall (17 January 1770), the San Gabriel Range in Crespí's words were a "bare chain of mountains." Fages saw them as "very high barren hills," and Costansó as "bald steep heights." Likewise, Blake (1856: vol. 5) states the San Gabriel Mountains had a "peculiar barren look, and in color were of various shades of brown, blue, and purple." Native Americans brought the Portolá expedition what appears to have been *Prunus ilicifolia* (Nutt. ex Hook. & Arn.) D. Dietr. stones which Crespí described as "a boiled fruit we all thought must be bitter almonds [sabrosos]," as well as "mescal," very likely *Yucca whipplei* inflorescences. After passing the La Brea Tarpits, Crespí (3 August 1769) described the Santa Monica Mountains as "a low bare range…" The chaparral-covered Sepulveda Canyon was described only as "…a canyon between sheer hillsides" (5 August). Much later in 1864 Brewer (1966: 19) wrote of this area "When there are no rocks there was an almost impenetrable thicket, or chaparral, as it is here called."

The best Spanish description of chaparral was made at El Triunfo where the Franciscans were diverted on the wrong path. Crespí (28 April 1770) writes that "Two old heathen" took them into the Santa Monica Mountains, "penetrating the most rugged and intricate part of the range. We learned, but too late, that the pack train could not pass through those thickets (*brenales*)." Costansó explains: "…they began leading us into the steepest most tangled part of the range. We realized too late, that we could not take the pack train through these slopes, turning back." In his second expedition, Crespí (29 April 1770) twice received "barbecued mescal or century plants" of *Yucca whipplei* between El Triunfo and the Ventura Plain.

In the central Coast Range, the chaparral at the Fort Ord Military Reservation elicited several descriptions. In his return trip from San Francisco, Crespí (26–27 November 1769) noted the presence of "small live oaks" near the sand dunes. Costansó writes that camp was made in "level country covered with thickets (*enmontado de matorrales*), and clumps of small live oaks (*encinos de poco*)." In 1827, Beechey (1831: 57) visited "The south end of the Llano del Rey" (Monterey Bay) where he found a "fragrant southernwood, broken here and there by dwarf oaks, and shrubs…." This oak patch was later recorded in diseños of the northern Salinas Valley (Hornbeck 1983). Chaparral is also shown on the dunes at the mouth of the Salinas River. Brooks (1848: 7) left for the Gold Rush country from Monterey and passed through the same "dense thicket of underwood" before encountering the sand dunes of southern Monterey Bay. He writes that he left "an extensive plain, with groups of oaks spread over its surface."

The Franciscan journals record chaparral south of San Francisco from San Andreas Lake to Crystal Springs Reservoir. Crespí (5 November 1769) writes that the area has "very green low woods (monte bajo) all over it." The party then followed "a southward course, with the mountain range of very dense, very green low woods of little trees (arboleda baja) continuing on our right." At Crystal Springs Lake "A great many madroños, small and large, have been met…." The madrones were either *Arbutus menziesii* (Pacific madrone) or manzanitas (*Arctostaphylos* spp.). Present-day Woodside was described as "A low place with willows, madroños, and other unknown sorts of trees ran at the foot of the mountains…" Font (26 March 1776) described the Woodside patch as "*bosque espinoso*...," possibly in reference to *Ceanothus*. In the San Andreas Valley was "…brushy growth and stretches of groves of shrubby live oaks…" Near San Bruno, Font's party "climbed another hill and then entered a very thick grove of scrubby live oak and other small trees and brush, which continues for a considerable stretch over the hills along the shore of the estuary." In Palóu's traverse of the San Andreas Valley (29 November 1774), he found "small trees which looked like junipers" (*tascale*, *Adenostoma fasciculatum*). His march between Santa Clara and Palo Alto the previous day was "very difficult…on account of the thick groves of junipers (chamise) and madrones that I spoke of yesterday." A half century later, Beechey (1831: 40) journeyed between the presidio and Mission San Francisco Dolores through "three or four miles of ground so overgrown with dwarf oaks and other trees, they were every moment in danger of being thrown from their horses, or having their eyes torn out by the branches as they passed." In San Antonio Valley of the Diablo Range, Font "reached a summit" and in a descent went through areas "thickly grown with oaks, pines, and brush." While some hills were "thickly covered with brush and trees," other slopes had "only a very open, scrubby growth, so that on the ridges and at intervals there are seen some strips and pieces of very white gravel, …and the range was red in color…" Bolton (1933) states that the red hills are just as Font describes them.

Diseños provide an impressive record of "chamizo" throughout the State. To the rancheros, it was advantageous to indicate chamizo as poor cattle pasture to justify larger land grant concessions from the Governor. An example is the proposed expansion of the Rancho Cucamonga land grant from 4 to 7 leagues into areas of fine-grained, grass-covered soils near the Jurupa Hills. The grantee stated: "that the land of this tract which is fit for any useful purpose does not reach four square leagues, for the greater part of it which is at the foot of the [San Gabriel] mountains is sterile", i.e., covered with chamizo, shown on his diseño (Black 1975: 296–297). In

Table 1. Frequency of Spanish observations of California tree species, chaparral and coastal sage scrub.

Species	OBSERVATIONS		
	Spanish expeditions	Diseños	Total
OAK WOODLAND			
Quercus agrifolia	100	29	129
Quercus lobata	49	28	77
Pinus sabiniana	13	10	23
Quercus engelmannii	1	1	2
Juglans californica	6	5	11
Juglans hindsii	2	0	2
Aesculus californica	8	0	8
Chrysolepis chrysophylla	3	0	3
RIPARIAN FOREST			
Platanus racemosa	71	21	92
Populus fremontii	46	11	57
Populus trichocarpa	25	0	25
Fraxinus velutina × *F. latifolia*	9	0	9
CLOSED CONE CONIFER FOREST			
Pinus radiata	7	2	9
Pinus attenuata	3	0	3
Pinus muricata	1	0	1
Cupressus macrocarpa	2	1	3
Cupressus sargentii	1	0	1
Pinus coulteri	10	2	12
MIXED EVERGREEN FOREST			
Sequoia sempervirens	20	9	29
Pseudotsuga menziesii	2	0	2
Umbellularia californica	11	5	16
Arbutus menziesii	5	0	5
Pseudotsuga macrocarpa	7	0	7
Quercus chrysolepis	9	0	9
PINYON-JUNIPER WOODLAND			
Pinus quadrifolia	1	0	1
MIXED CONIFER FOREST	12	0	12
COASTAL SAGE SCRUB	14	0	14
CHAPARRAL	30	42	72
TOTAL	468	166	634

southern California a succession of diseños make note of "chamizo" on the bajadas across the base of the San Gabriel and San Bernardino Mountains from Tujunga to Redlands, in agreement with maps of Kinney (1887), reports of the San Gabriel, San Bernardino, and San Jacinto Forest Reserves (Leiberg 1899, 1900), and quadrangle maps of the VTM Survey of 1929–1934 (Weislander 1938; *http://vtm.berkeley.edu/#/data/vegetation*). Chaparral was not shown in coastal plains and interior valleys, consistent with accounts of pasture and wildflower fields by the Franciscans (Minnich 2008). Other diseños that depict "chamizo" are El Cajon and the Santa Rosa Plateau, as well as Rancho Cahuenga and Rancho Guadalasca in the western Santa Monica Mountains. Chamizo was reported in the mountainous land grants near Gaviota, Purisima Hills and the Sierra Madre, as well as the Cuesta Pass region and Irish Hills near San Luis Obispo. To the north, diseños record chamizo near Monterey, San Benito Valley along the rift zone on western San Francisco Bay, and the Berkeley Hills. There are no diseño records of chamizo in the Sierra Nevada, except at Tejon Ranch.

DISCUSSION

The Spanish journals and diseños provide a wealth of written accounts on the status and distribution of California vegetation in the late 18th and early 19th centuries, including 634 site-specific descriptions that we were able to relocate and map (Table 1). The frequency and accuracy of these records by species or community is roughly proportionate with the modern distributions. These accounts hence provide a "representative sample" of the vegetation. Moreover, the robust body of expedition records compared to those provided by diseños suggests the care with which the Spaniards fulfilled the Viceroy mandate to document the resources of California. Unseen tree species from Hispanic California were geographically rare, grew in remote mountains, or were unfamiliar members of genera not native to southwestern Europe (Table 2). Among tree species that were recorded in Spanish explorations, the site-specific localities are consistent with VTM survey data. The spatial resolution of tree localities given in journals and diseños of course are not at the level of modern scientific precision, but one can assume that the location of a species is accurate to the resolution of the distance between camps (5–10 km), and the size of ranchos, typically 4–11 leagues [7.2–19.8 km^2]. Griffin and Critchfield's (1972) statewide species maps used in this study have comparable resolution.

We are confident of species identities assigned in accounts where only one member of a genus is presently found at a site, or where a tree's physical appearance is described with detail sufficient to differentiate if from other local species. In many places a tree's appearance was described by its resemblance to European species in terms of leaves, bark, fruit, and overall growth form. Primary accounts may be ambiguous for species identification without consideration of extant distributions. In evaluating long-term change in forest and shrubland distributions, it is necessary to avoid circularity of identifying species based solely on comparison of a historical account to extant occurrence. Rather, successive descriptions of the vegetation in Spanish explorer accounts, diseños, and ultimately American records, were critically evaluated in order to narrow down species identities and reconstruct the earliest possible (baseline) historical reference. For example, a general reference to "cypresses" is ambiguous, when taken out of context from successive Spanish accounts. However, a map of all localities recorded by the Spanish for "cypress" give non-overlapping, disjunct distributions found in the Santa Lucia Mountains. *Cupressus sargentii* matches Spanish accounts of "cipres" at Arroyo San Carpoforo, and *Cupressus macrocarpa* matches "cipres" stands at coastal Monterey.

Spanish accounts and diseños occasionally provide remarkable detail that suggests long-term stable distributions occur even at local scales over the past two centuries (cf. Baja California, Minnich and Franco-Vizcaíno 1998). Examples include the *Pinus radiata* forest at Monterey, the eastern limit of *Quercus and Q. agrifolia* woodlands, *Aesculus californica* observed between Jolon Road and King City, and writings that document *Pinus coulteri* forest above Santa Barbara since the Vizcaíno voyage of 1602. Even rare species such as *Cupressus macrocarpa* and *C. sargentii* were documented at modern localities. One diseño (Fig. 7A) recorded the isolated *Q. engelmannii* grove now seen at the Baldwin Park

Table 2. Tree species not recorded in the Spanish accounts.

RIPARIAN FOREST
Acer macrophyllum—Mountain streams, seldom in coastal plains.
Acer negundo—Inconspicuous, winter deciduous.
Alnus rhombifolia—Mountain streams, seldom in coastal plains.
Alnus rubra—Deciduous during Palóu and Crespí expeditions along Santa Cruz coast. Occurs on inaccessible cliff coast of the Santa Lucia Mountains.
MIXED EVERGREEN FOREST
Abies bracteata—Remote cliff slopes of the Santa Lucia Mountains.
Lithocarpus densiflorus—Remote mountains, possibly unrecognized because the genus is not native to Spain.
Torreya californica—Rare and inconspicuous. Genus is not native to Spain.
CLOSED CONE CONIFER FOREST
Cupressus abramsiana—Rare.
Cupressus forbesii—Rare, grows in inaccessible chaparral.
Cupressus goveniana—Rare.
Cupressus arizonica var. *stephensonii*—Rare, grows in inaccessible chaparral.
OAK WOODLAND
Quercus douglasii—Confused with *Q. lobata*, but less desirable due to its small size. Does not occur with *Q. lobata* in southern California.
MIXED CONIFER FOREST
Abies concolor—Possibly seen by Garcés in the western San Bernardino Mountains. Omission by Muñoz in the Sierra Nevada.
Pinus lambertiana—Omission during Garcés' crossing of the western San Bernardino Mountains. Remote from Anza expedition traverses of the San Jacinto Mountains.
Quercus kelloggii—Palóu and Portolá expeditions never met with the species. Anza and Garcés expeditions saw it in a winter-deciduous state in the San Jacinto and San Bernardino Mountains.

Table 3. California tree species beyond Hispanic exploration and settlement of California (cf. Griffin and Critchfield [1972]).

RIPARIAN FOREST
Betula occidentalis
CLOSED CONE CONIFER FOREST
Cupressus bakeri
Cupressus macnabiana
Cupressus pigmaea
Cupressus arizonica var. *nevadensis*
PACIFIC NORTHWEST FOREST
Abies grandis
Abies lasiocarpa
Abies magnifica
Abies procera
Chamaecyparis lawsoniana
Picea sitchensis
Taxus brevifolia
Thuja plicata
OAK WOODLAND
Quercus garryana
MIXED CONIFER FOREST
Cornus nuttallii
Juniperus occidentalis
Pinus washoensis
Sequoiadendron giganteum
SUBALPINE FOREST
Abies amabilis
Chamaecyparis nootkatensis
Picea engelmannii
Pinus albicaulis
Pinus aristata
Pinus balfouriana
Pinus contorta
Pinus flexilis
Pinus monticola
Populus tremuloides
Tsuga mertensiana
PINYON-JUNIPER WOODLAND
Celtis reticulata
Juniperus osteosperma
Pinus edulis
Pinus monophylla
CHANNEL ISLAND WOODLAND
Lyonothamnus floribundus
Prunus lyonii
Quercus tomentella

Arboretum. The Rancho Santa Rosa diseño captures the modern shape of the *Pinus radiata* stand at Cambria (Fig. 20 A), and the second stand 7.0 km to the northwest was noted by Crespí. Along the Sierra Nevada foothills Muñoz noted sycamore primarily along the Kings River and rarely along other rivers, consistent with VTM survey data. The southern margin of mixed conifer forest in the San Bernardino Mountains has repeatedly been described along the crest of the range since Garcés' explorations of 1776.

The broad-scale stability of California tree distributions since the late 18th century is a finding in resounding contrast with the extensive deforestation across eastern North America with European colonization and settlement (Williams 1989; Whitney 1994). Spanish and Mexican land use seldom involved the transformation or removal of forest for agriculture or settlement. Modern agricultural lands now largely under irrigation in California's semiarid climate were devoid of forest cover at Spanish contact, precluding tree clearing for cultivation and subsequent growth of California's cities. Cutting was limited in the extensive woodlands of the coastal ranges because local sources furnished sufficient timber for the needs of small coastal settlements such as San Francisco and the Presidio of Los Angeles with populations numbering only in the hundreds (Bidwell 1948: 72–73). The rancheros kept herds in modest numbers below carrying capacities (Minnich 2008). Hispanic cattle grazing was not novel with respect to California paleoecology which included mostly extinct herbivorous megafauna that exerted cattle-like disturbance for much of the Quaternary such as bison, horses, camels, antelopes, mammoths, and mastodons (Woodburne 2004; Minnich 2008: 178–181). Woodlands of encino and robles spanned the cattle pastures of Coast Ranges from San Francisco to San Diego, then as now.

There have been important changes since American settlement. The ranges of Torrey pine and Monterey cypress have been enlarged by plantings along the coast. Riparian forests have been reduced along the Los Angeles, San Gabriel, and Santa Ana Rivers due to channelization for flood control, with additional significant losses of especially riparian communities in southern California, the great central valley, and the Colorado River (Katibah 1984; Ohmart et al. 1988; Faber et al. 1989). Riparian forests were extensively extirpated in the Sacramento River Valley (Thompson 1961; Griggs and Golet 2002). Apparently rare *Q. lobata* individuals were

extirpated by urbanization in west Los Angeles. An illustration of pines at Monterey by John Sykes of the Vancouver Expedition in 1784 suggests that *Pinus radiata* forests may have extended farther east than at present. The Gold Rush led to extensive logging in mixed conifer forest of the Sierra Nevada, but this perturbation was not followed by land conversion. Recent deforestation resulted from unintended consequences of "protectionist" policies of the 20th century, long after Hispanic settlement. Although public land tenure of the National Forest and National Park systems protected forests and allowed for recolonization of cutover lands, forests became excessively dense and prone to catastrophic stand-extirpating wildfires under fire suppression management over the past century (Minnich et al. 1995; Goforth and Minnich 2008). Resultant dense forests suffered massive die-off in the extreme drought of 2001–2003 in southern California (Minnich 2008).

Spanish land explorations also provide a historical perspective on the effect of climate change on vegetation because the journals were written in the Little Ice Age (LIA, 300–600 years ago), the coldest phase of the Holocene before global warming of the past two centuries (Alley and Clark 1999; Gibbard and Van Kolfscholten 2004).[29] Stable forest distributions have transcended global warming since the end of the LIA. Tree species with life spans of centuries exhibit inertia against climate change. In subsequent generations, the recruits require centuries to reach mature phases of vegetation (Sauer 1988; Thompson 1988, 1990)[30]. In the Sonoran and Mojave Deserts, paleobotanical evidences of packrat middens show persistence in tree and shrub distributions during the late Holocene (Spaulding 1990; Van Devender 1990). This finding underscores the resilience and adaptability of plants in the face of climate change. The distributions of California species invariably span climatic gradients—from coast to interior, from low to high elevation—far greater than changes in modelled future climate scenarios. The expression of certain suites of genetic traits of species may change in response to selective pressures of climate change through their geographic ranges.

The use of Spanish records illustrates the classic trade-off inherent to long-term ecological study: a need to sacrifice precision and resolution to delve further back into past conditions (Jackson et al. 2001). This study moves back the California historical vegetation baseline nearly a full century before the first formal botanical surveys, as well as into an era before the onset of agriculture, domestic grazing, and biological invasions of Old World annual grasses and forbs. What prevailed in the late 18th century was an economy of Native American hunting and gathering.

Scholars of California vegetation previously discounted or disregarded the rich botanical heritage of the Spanish accounts and Mexican diseños. Work by Clements (1916, 1934) set forth a guiding tenant that only formal botanical collections are legitimate vouchers for reconstructing the distribution of species. As this study shows, such high standards overlook the rich Hispanic record of California vegetation. While the Spaniards did not use Linnaean taxonomy, their records were prepared under mandate to inventory vegetation, providing detail on locations and tree morphology sufficient to make retrospective identifications in areas under Spanish sphere of influence. Only the high Sierra Nevada, North Coast Range, and most deserts remained unexplored in the Hispanic era. Other California tree species were first described after the Gold Rush in areas beyond the Spanish sphere of influence, including members of Pacific Northwest rain forests, subalpine forest, mixed conifer forest (including *Sequoiadendron giganteum*), pinyon-juniper woodland, and woodlands on the southern California Islands (Table 3).

To date, hypotheses of vegetation change in California have been advanced without historical baselines. In a classical example, the coastal plains and valleys were assumed to be covered with perennial bunch grassland based on Clementsian succession views of relict and climax vegetation (a space-for-time substitution), i.e., the use of spatial vegetation pattern to deduce historical change of species and communities (after Pickett 1989), unsupported by Spanish accounts (Minnich 2008). Another example is deduction that the Los Angeles basin was extensively covered by coastal sage scrub based on potential natural vegetation theory (Küchler 1977). It was asserted that contemporary urbanization and agriculture extirpated 90% of this assemblage based on loss of potential habitat (Westman 1981; Keeley 2002). The Spanish baseline documents pasture and wildflower fields, not shrublands. The Anza and Portolá expeditions made camp at 73 localities in the southern California coastal and interior plains, and recorded pasture or wildflowers at all of them. "Kitchen plants" of coastal sage scrub shrubland were reported at only 2 camps. If one exempts the flowered southern California plains, coastal sage scrub losses have been in the order of 20%–30%. It has also been proposed that chaparral shrublands would be more extensive if it were not for Native American burning (e.g., Frenkel 1970; Hamilton 1997; Sims and Risser 2000; Keeley 2002). Spatial pattern was used to infer historical change, i.e., fragments of brush in the central coast range represented former continuous distributions that were subsequently fragmented by Native American burning. We find that the space-for-time substitution approach is consistently unsupported when tested by available historical evidence and conclude that it invites circular, ad hoc and untestable hypotheses in the historical reconstruction of complex ecosystems.

CONCLUSION

Using the Spanish record at broad scales, our basic conclusion is that aboriginal distributions are also modern distributions. The maps of the VTM survey are representative of the Hispanic period, and perhaps reach into the Holocene at

[29] During the LIA, a period of slightly cooler, wetter climate prevailed in the temperate climates of the middle latitudes. In California, small cirque glaciers in the Sierra Nevada Mountains reached their maximum advance for the Holocene (Clark and Gillespie 1997; Phillips et al. 2009; Bowerman and Clark 2011), and Mono and Silver Lakes in the Mojave Desert reached high stands (Enzel et al. 1992). The climate has warmed since the early 19th century, the termination of the LIA.

[30] Populations with multi-century scale demographic turnover have experienced perhaps an order of 100 generations in the Holocene. *Pinus longaeva* and *Sequoiadendron giganteum*, with millennial scale life spans, have perhaps experienced as few as 10 generations since the late glacial maximum.

millennial time scales. The persistence of many forest and woodland distributions across California since Spanish explorations over two centuries ago illustrates that forests and shrublands have been slow to respond to climate change. We still have insufficient record of species changes at still finer scales, such as shifts in species composition, distributions of currently rare species, density and cover of woodlands and forests arising from environmental change, disturbance, and Native American activities, but the Spanish record lays the groundwork for research that addresses such questions.

Current efforts to project species distributions based on prognostications of future climate (Lenihan et al. 2007) reflect a paradigm shift where interest in steady-state dynamics shaping species and ecosystems is supplanted by interest on their future change. These predictive efforts risk the hazards of space-for-time substitution that plague retrospective studies similarly challenged by historical data. The use of historical records to calibrate and test models should not be underemphasized. The hindsight of vegetation history provides insight and empirical constraint to the foresight of species change in modeling experiments. The Spanish record is a valuable baseline reference for the long-term study of vegetation change in California.

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Appendix 1.

Location of place names in text (decimal degrees). For rivers, the coordinates indicate the place where an expedition crossed the river.

Place name	Latitude	Longitude
Altadena	34.19	118.13
Año Nuevo	37.11	122.33
Antioch	38.00	121.80
Anza Valley	33.56	116.68
Baldwin Park	34.08	117.96
Banner Canyon	33.08	116.57
Bautista Canyon	33.67	116.83
Bear Creek	37.30	120.41
Berkeley Hills	37.90	122.20
Bethany Reservoir	37.78	121.61
Big Pine Mountain	34.70	119.65
Box Springs Mountains	33.99	117.30
Cahuilla Mountain	33.59	116.78
Calaveras Grove	38.30	120.28
Camarillo	34.22	119.04
Cambria	35.56	121.08
Camp Pendleton	33.31	117.33
Carmel	36.55	121.92
Cañon El Rincón, Mexico	31.70	115.75
Carpinteria	34.40	119.52
Castaic Lake	34.83	118.84
Cedros Island, Mexico	28.19	115.21
Chino	34.01	117.69
Chino Hills	33.99	117.70
Chualar	36.57	121.52
Concord	37.98	122.03
Consumne River	38.27	121.44
Corralitos Creek	36.99	121.81
Crystal Springs Reservoir	37.52	122.36
Cuesta Pass	35.33	120.62
Cupertino	37.32	122.03
Cuyama Plain	34.93	119.63
Cypress Mountain	35.60	120.91
Del Mar	32.96	117.27
Devils Canyon	34.21	117.33
Diablo Range	37.00	121.00
Dolores Creek	37.73	122.42
Dos Pueblos	34.44	119.96
Elk Grove	38.41	121.37
Encino	34.15	118.52
Fillmore	34.40	118.92
Fresno River	36.87	119.80
Fruitdale	37.32	121.94
Gaviota	34.47	120.21
Glendora	34.14	117.87
Gilroy	37.00	121.57
Grapevine Canyon	34.90	118.92
Griffith Park	34.13	118.31
Guadalupe Island, Mexico	29.05	118.28
Half Moon Bay	37.50	122.52
Hollister	36.85	121.40
Hot Springs Mountain	33.36	116.55
Inland Empire	34.00	117.30
Irish Hills	35.23	120.80
Kaweah River	36.40	119.00
King City	36.20	121.13
Kings River	36.72	119.48
Knightsen	37.97	121.67
Laguna Mountains	32.87	116.43
La Jolla	32.85	117.24
Lake Merritt	37.80	122.25
Las Virgenes	34.15	118.75
Livermore	37.68	121.77
Llagas Creek	37.02	121.54
Long Beach	33.78	118.16
Los Pedernales	34.60	120.64
Los Pinos Peak	33.66	117.47
Mariposa Creek	37.25	120.19
Merced River	37.42	120.50
Milpitas	37.43	121.90
Mission San Juan Bautista	36.85	121.54
Mojave River	34.35	117.25
Monrovia Peak	34.21	117.97
Monument Peak	34.25	117.35
Morro Bay	35.37	120.85
Mt. Cuyamaca	32.95	116.61
Mt. Diablo	37.89	121.91
Mt. Hamilton Range	37.33	121.60
Mt. Wilson	34.23	118.07
Mt. Pinos	34.81	119.15
Mystic Lake	33.89	117.09
Nacimiento River	35.77	121.08
Newhall Pass	34.35	118.51
Orange County	33.80	117.85
Palmdale	34.58	118.12
Palo Alto	37.44	122.14
Palomar Mountain	33.44	116.90
Pajaro River	36.92	121.72
Pasadena	34.15	118.14
Paso Robles	35.63	120.68
Pinnacles National Monument	36.50	121.20
Point Conception	34.45	120.47
Point Lobos	36.52	121.95
Point Piedras Blancas	35.66	121.28
Point of Pines	36.63	121.93
Price Canyon	35.17	120.63
Purisima Hills	34.70	120.45
Puente Hills	33.96	117.88
Riverside	33.95	117.40
Salinas Valley	36.50	121.45
San Andreas Lake	37.59	122.42
San Antonio Creek (Pomona)	34.05	117.72
San Antonio River	35.95	121.17
San Antonio River (Lompoc)	34.82	121.45
San Benito Valley	36.52	121.08
San Bernardino Mountains	34.15	117.00
San Bruno Mountain	37.69	122.44
San Carpoforo	35.75	121.29
San Diego Canyon	33.09	116.66
San Fernando Valley	34.23	118.48
San Gabriel Mission	34.10	118.11
San Gabriel Mountains	34.30	117.90
San Jacinto Mountains	33.70	116.65
San Jose	37.34	121.89
San Juan Capistrano	33.50	117.66
San Lorenzo	36.98	122.03
San Luis Obispo	35.28	120.66
San Luis Rey	33.24	117.32
San Marino	34.13	118.11
San Mateo Creek	33.47	117.43
San Miguel	35.75	120.70
San Simeon	35.65	121.18
Santa Ana Mountains	33.70	117.50
Santa Cruz	36.97	122.03
Santa Cruz Mountains	37.15	122.15

Appendix 1. Continued.

Appendix 1. Continued.

Place name	Latitude	Longitude
Santa Clara	37.35	121.95
Santa Clara River	34.40	118.70
Santa Clarita Valley	34.43	118.59
Santa Lucia Mountains	36.20	121.50
Santa Margarita Mountains	33.60	117.35
Santa Maria	34.95	120.43
Santa Monica Mountains	34.08	118.75
Santa Susana Mountains	34.35	118.70
Santa Ynez River	34.67	120.54
Santa Ynez Mountains	34.50	119.90
Sepulveda Canyon	34.11	118.48
Sespi Condor Sanctuary	34.51	118.91
Sierra Juárez	32.05	115.90
Sierra San Pedro Mártir	31.00	115.45
Sierra Blanca	32.05	116.50
Sierra Madre	34.16	118.05
Silverwood Reservoir	34.29	117.33
Simi Hills	34.22	118.73
Sorrento Valley	32.92	117.22
Stanislaus River	37.47	121.61
Sulphur Mountain	34.41	119.20
Tejon Pass	34.80	118.88
Thomas Mountain	33.62	116.68
Thousand Oaks	34.17	118.84
Tripp Flat	33.60	116.76
Tujunga Canyon	34.30	118.10
Tule River	36.00	119.00
Valle de los Ojos	35.25	120.78
Vandeventer Flat	33.55	116.53
Ventura River	34.28	119.30
Villa Creek	35.83	121.38
Walnut Creek	37.91	122.07
Watsonville	36.91	121.76
Whitehouse Creek	37.16	122.32
Yorba Linda	33.89	117.81

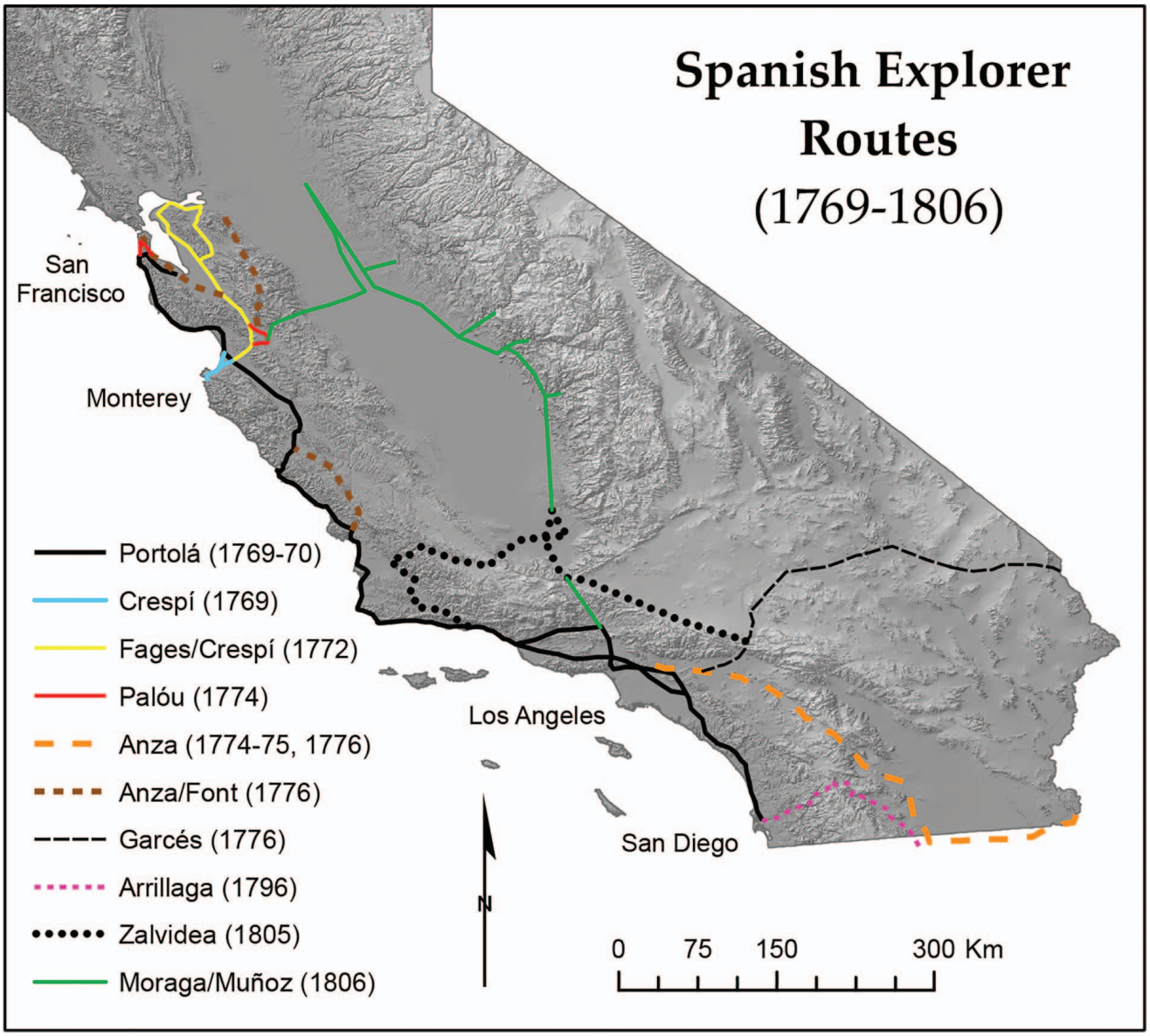

Fig. 1. Routes of Spanish explorations. Each expedition path is credited to the original explorer. The Anza expeditions joined the Portolá expedition from Mission San Gabriel to Monterey except for a short cut from San Luis Obispo to Mission San Antonio. The Palou expedition tracks the Portolá expedition in reverse from Monterey to San Francisco via Hollister and returns along the coast to Monterey. The Moraga/Muñoz expedition follows the Zalvidea expedition from Bakersfield to Los Angeles. The 1772 Fages/Crespí expedition is an extension of the original 1769 Portolá expedition, from San Jose to the Sacramento Valley near Antioch and return via Concord/Walnut Creek. See larger-scale maps of the mission routes provided by Beck and Haase (1974) and Minnich (2008).

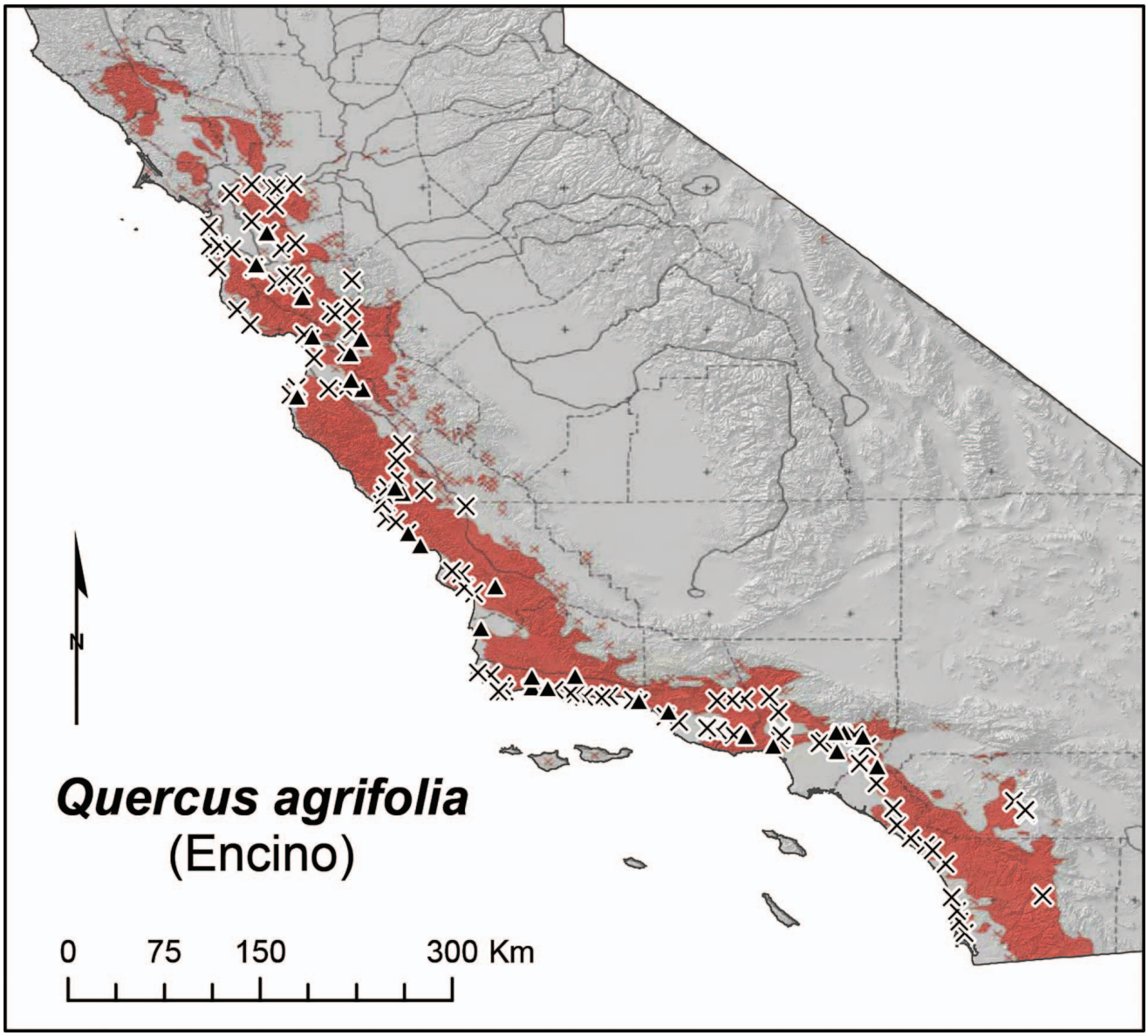

Fig. 2. Hispanic localities of *Quercus agrifolia* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. Black △ = diseño localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

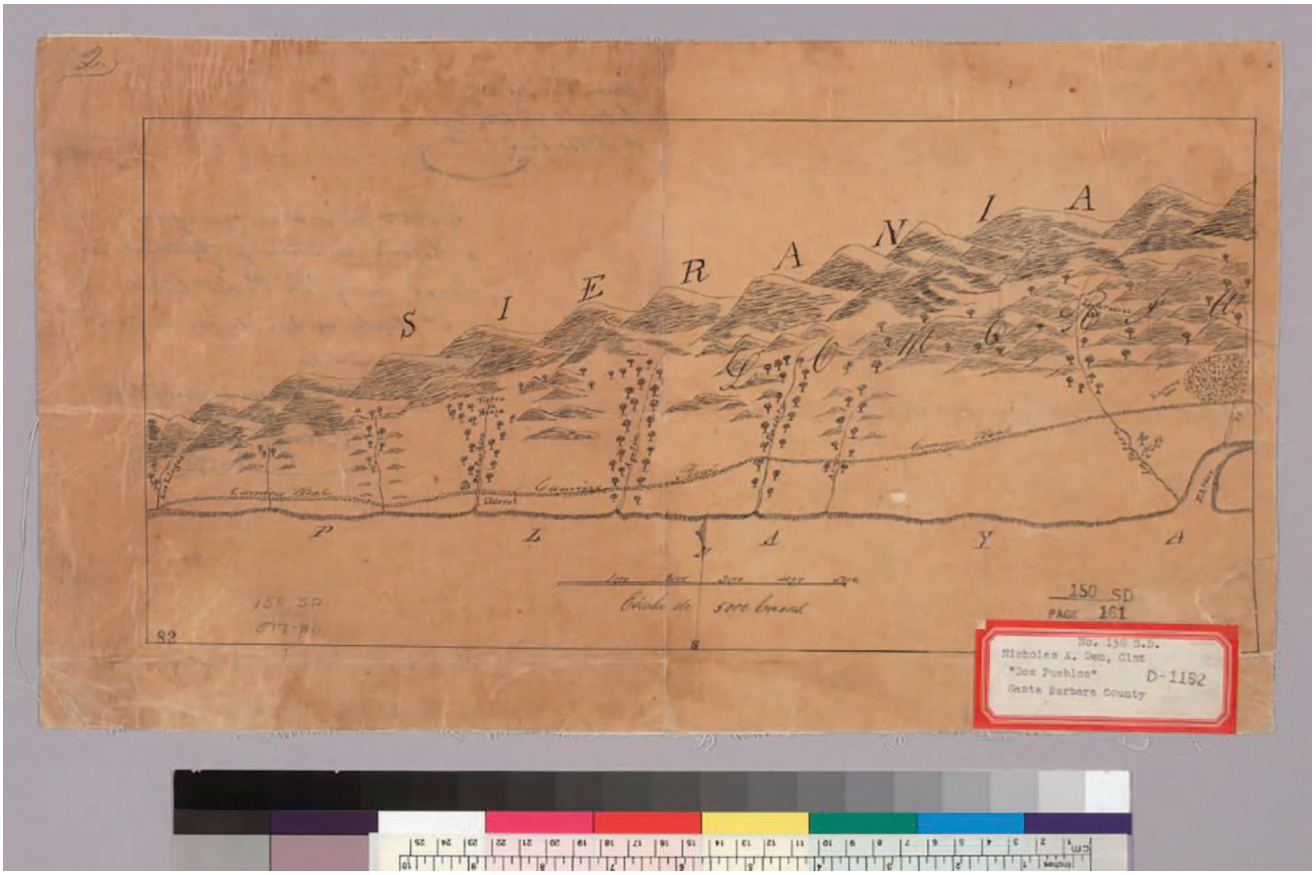

Fig. 3A. Diseño Rancho Dos Pueblos, west of Santa Barbara (concession in 1842). As required for all diseños, a scale (escala) and north arrow are shown, in this view north to the top. Trees are depicted in the foothills and along stream courses, the size of groves decreasing westward (left) as described by Crespí in 1769. The Santa Ynez Mountains (Sierania) are shown in the background with a series to north to south canyons. The Pacific Ocean in the foreground (playa) is paralleled by El Camino Real (the King's road) near the coast.

Fig. 3B. Oblique aerial view of the same area shown on Google Earth. Trees depicted along watercourses and in the foothills are predominantly *Quercus agrifolia* with *Platanus racemosa* near streams. Terrain was realistically depicted in the diseño.

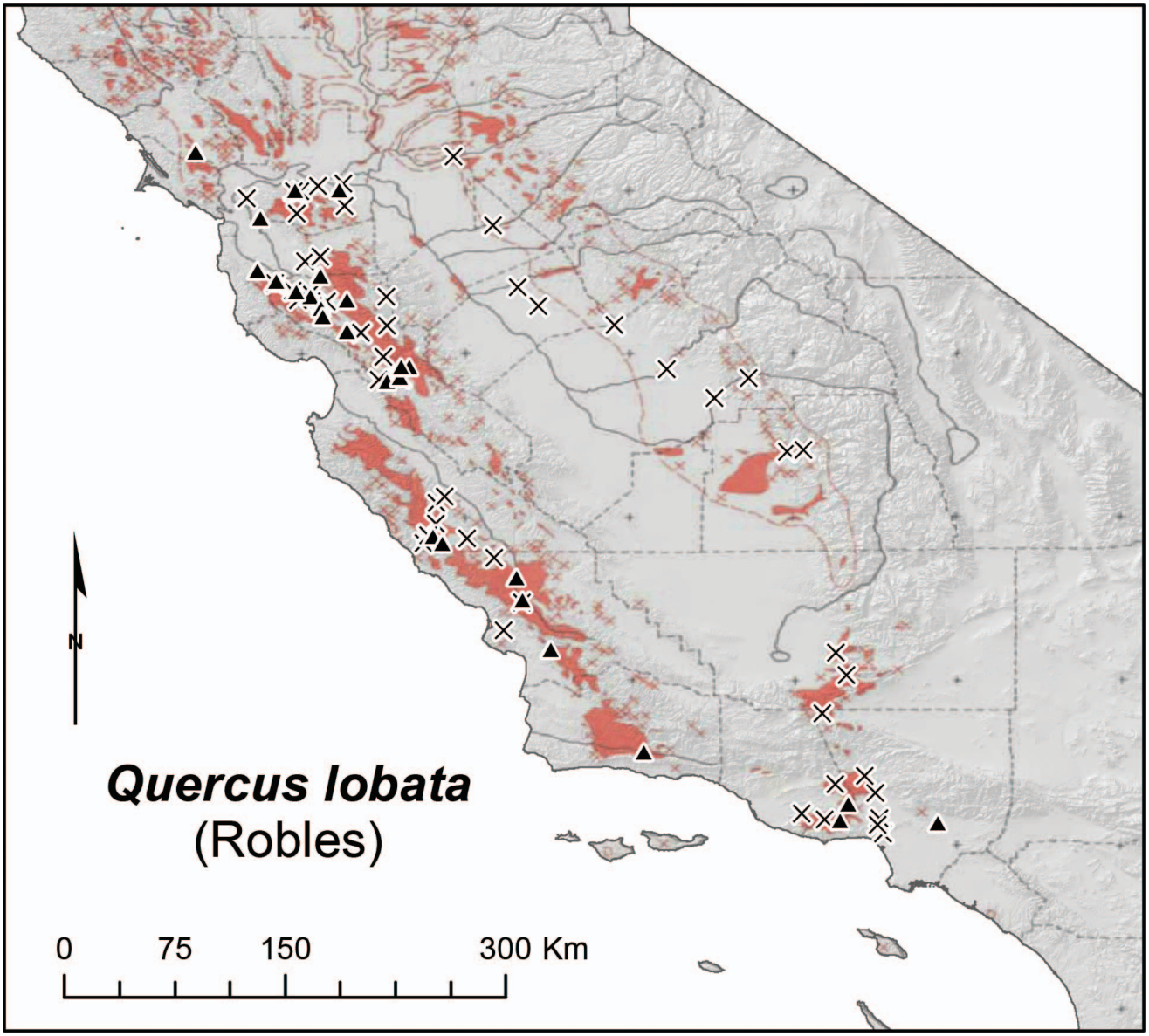

Fig. 4. Hispanic localities of *Quercus lobata* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. Black △ = diseño localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

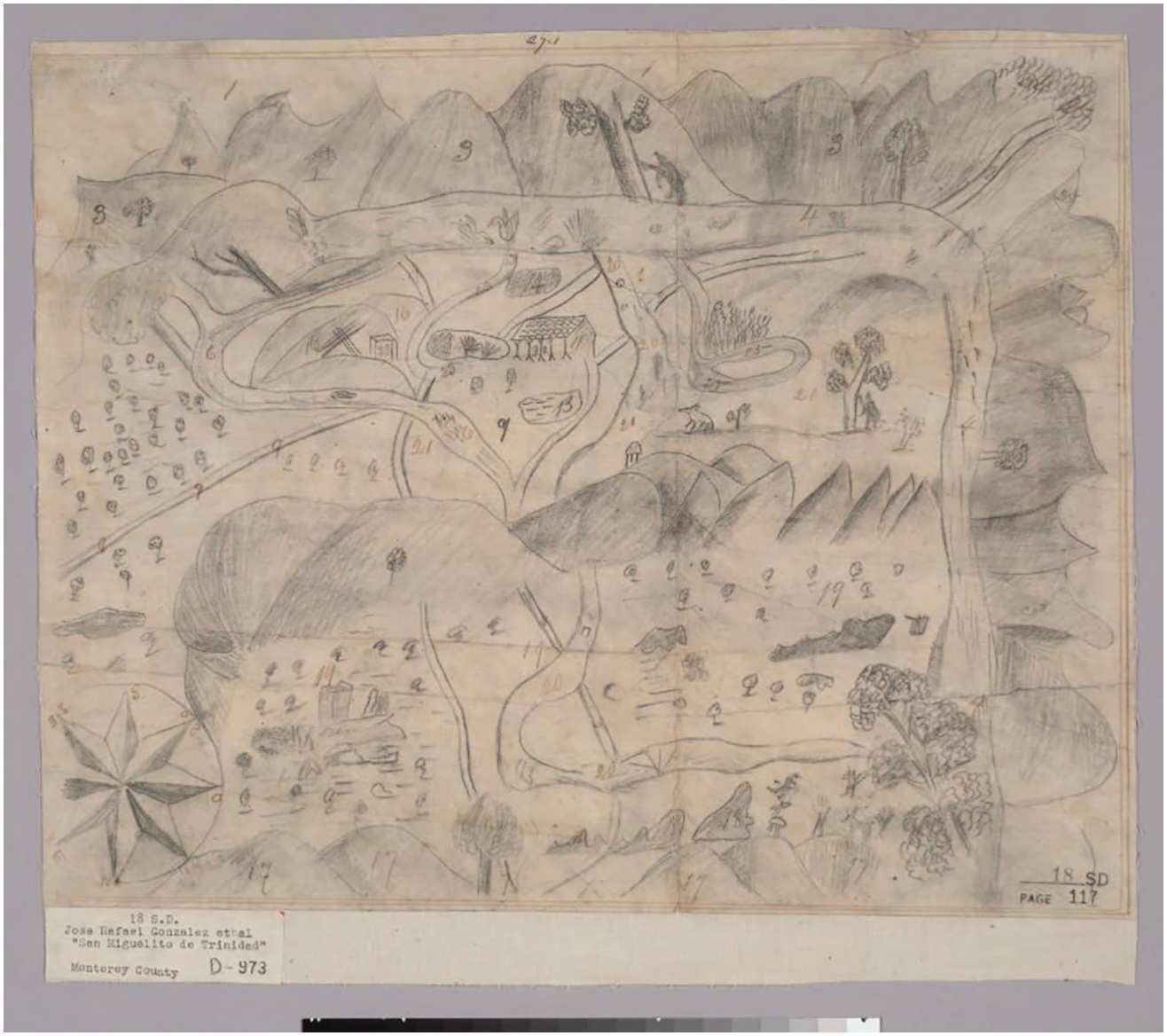

Fig. 5. Nonplanimetric depiction of diseño San Miguelito de Trinidad (1841?). Tree symbols illustrate the widespread cover of *Quercus lobata* woodland in the southern Salinas Valley.

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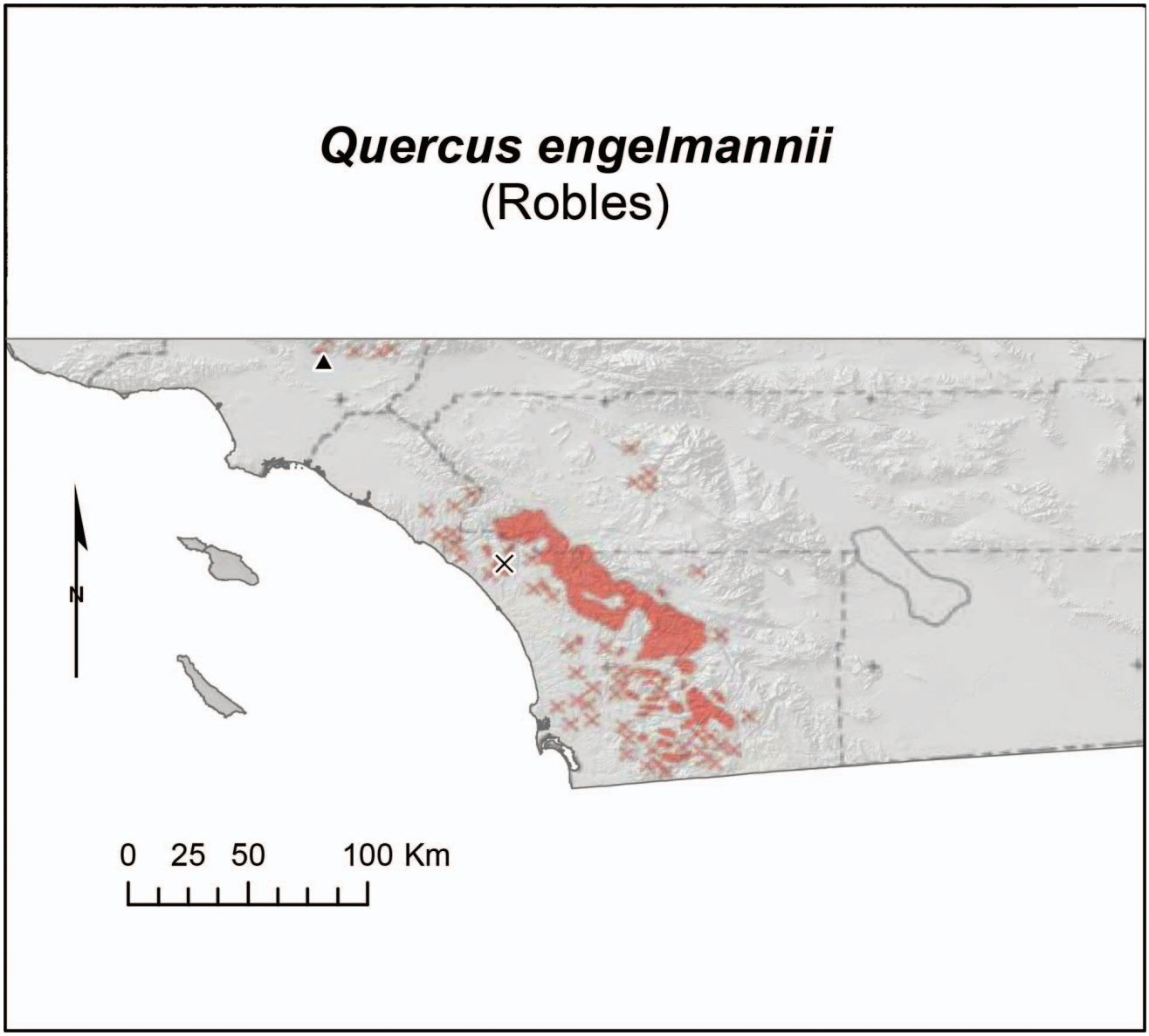

Fig. 6. Hispanic localities of *Quercus engelmannii* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. Black △ = diseño localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

Fig. 7A. Diseño Santa Anita (184-?) and the San Gabriel Mountains. The plain (llano) is covered with chamisal (chaparral), grassland (grama) and encinal (*Quercus agrifolia*). Near the mountains, the sketch map shows the words mesa and "roblar," in reference to *Quercus engelmannii* (middle top).

Fig. 7B. The same area on Google Earth, now showing suburban sprawl and the Santa Anita Racetrack (elongated circle, middle). The "roblar" stand of *Quercus engelmannii* at Baldwin Park Arboretum grows at the base of the same mesa depicted in the diseño, just west (left) of the race track.

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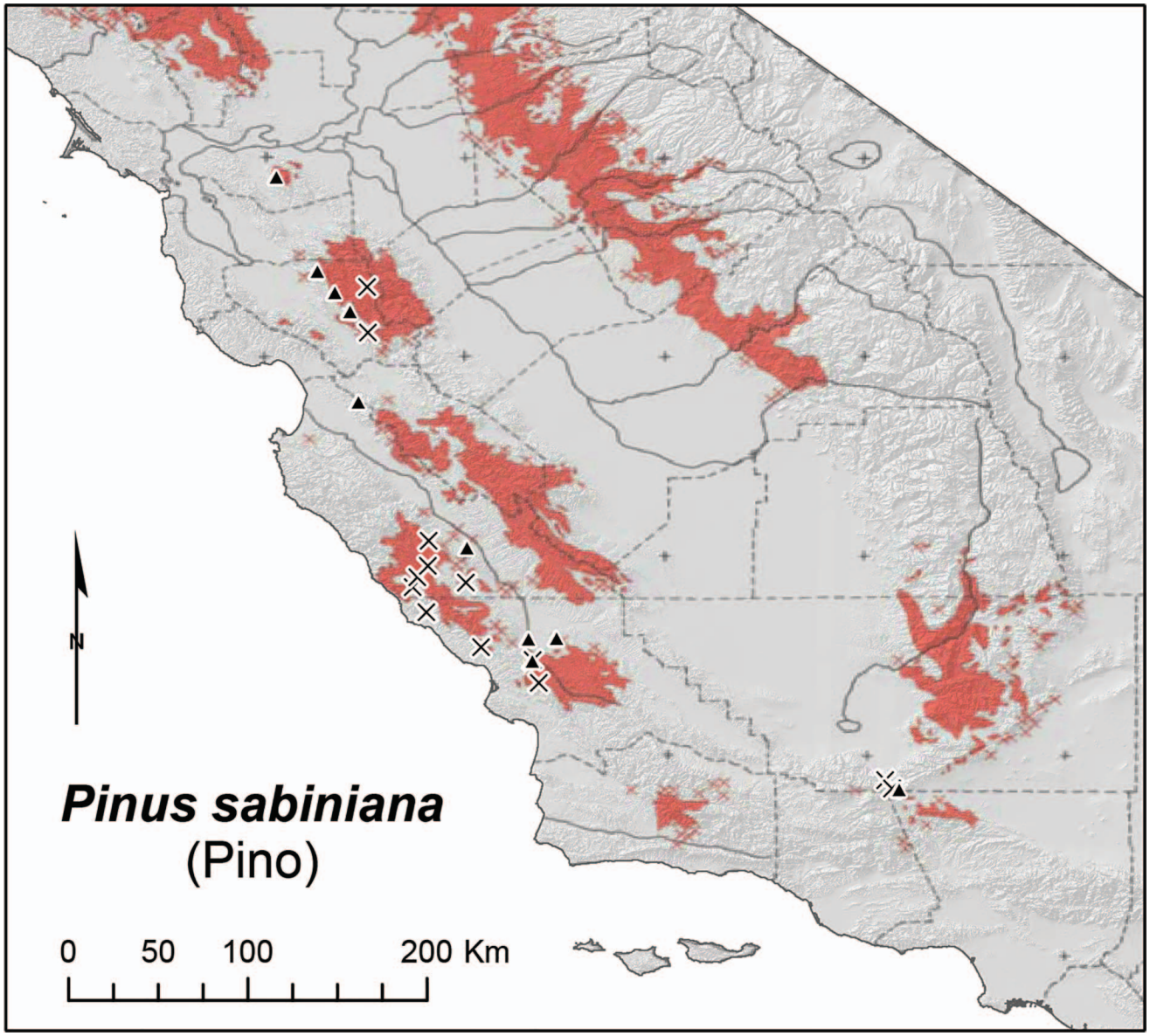

Fig. 8. Hispanic localities of *Pinus sabiniana* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. Black △ = diseño localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

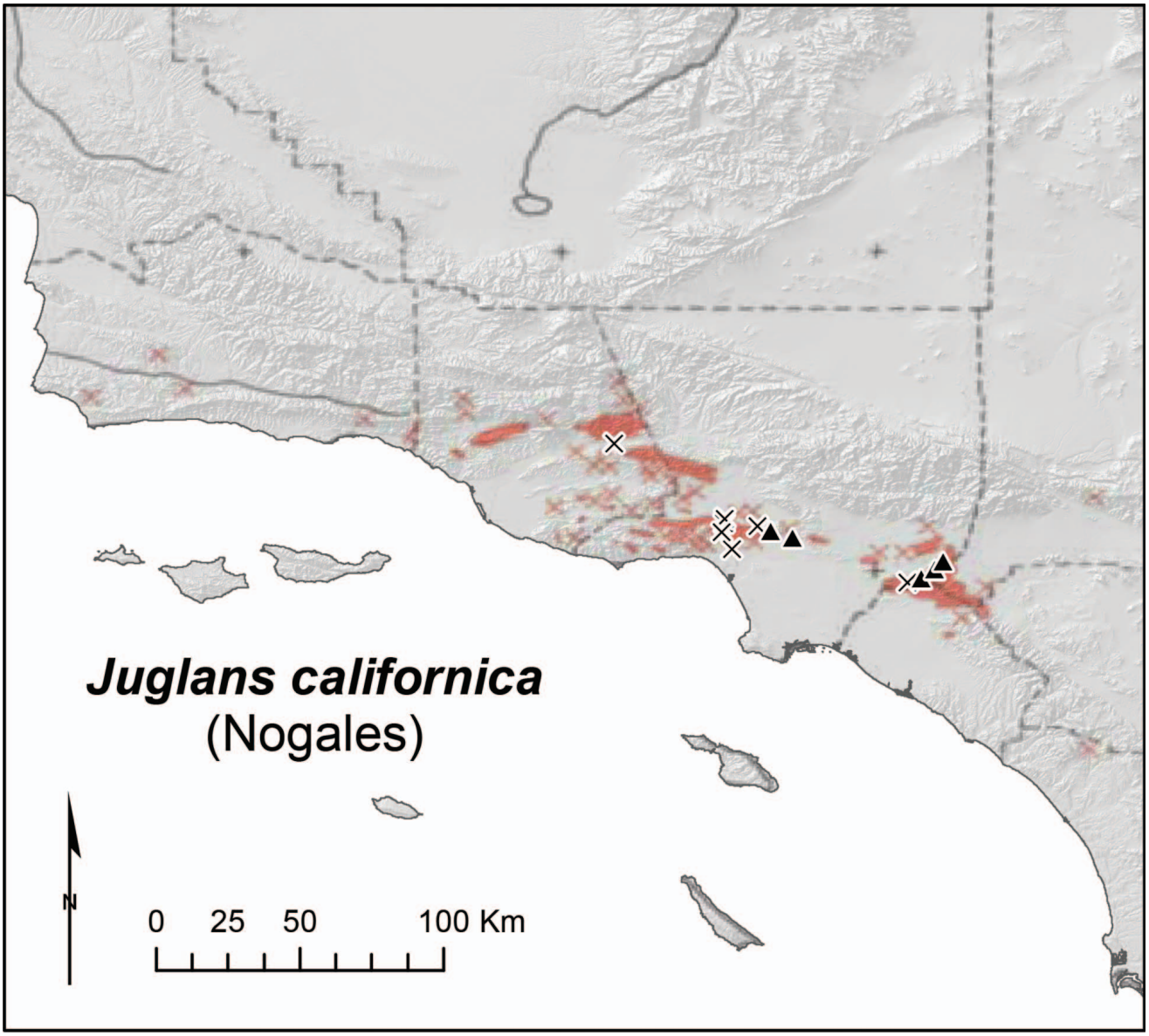

Fig. 9A. Hispanic localities of *Juglans californica* with distributions mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. Black △ = diseño localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

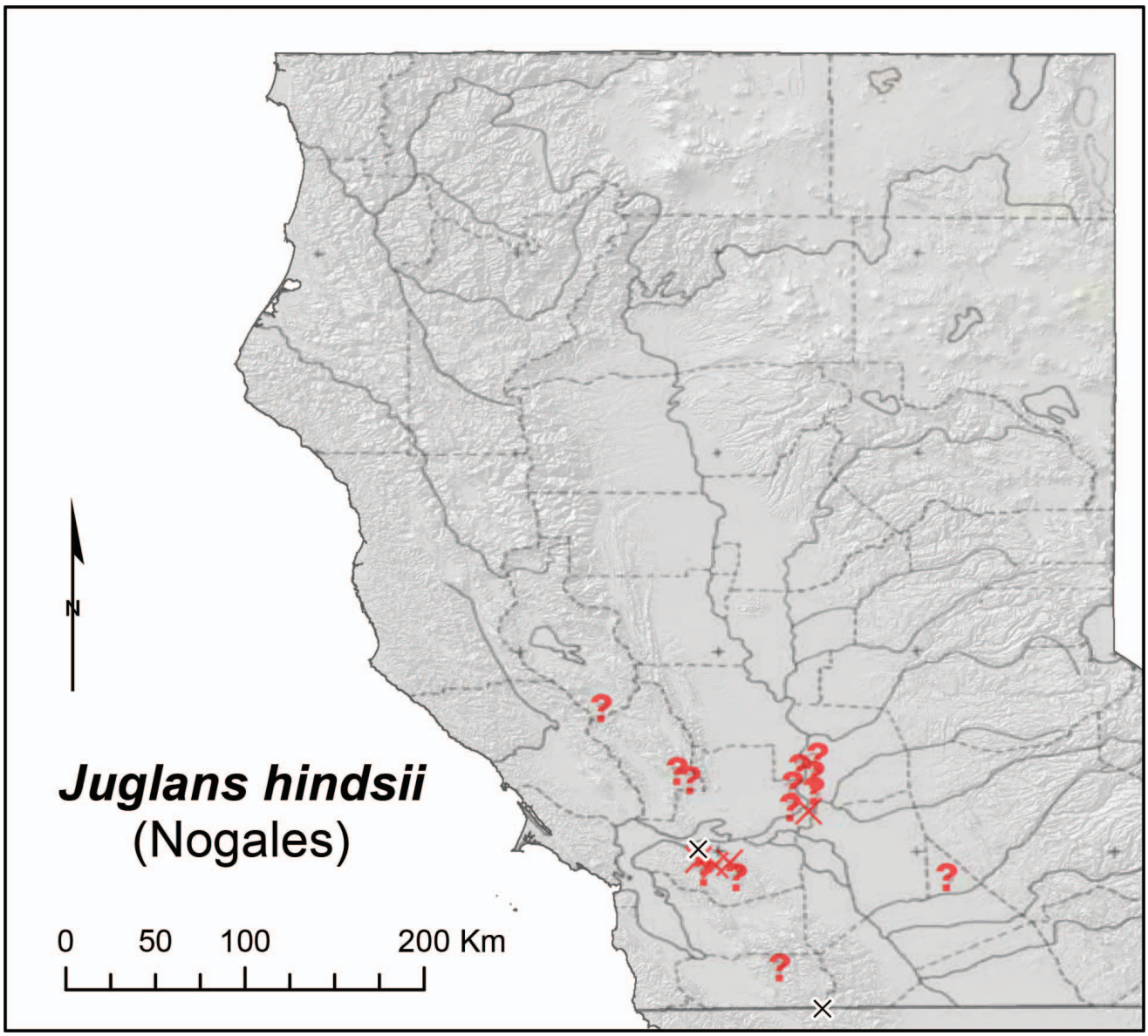

Fig. 9B. Hispanic localities of *Juglans hindsii* with distributions mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. VTM criteria: orange × = group of stands <2 miles (3.2 km) across; question marks: localities inferred by Griffin and Critchfield (1972) to have been present prior to European contact but not reported by Spanish explorers.

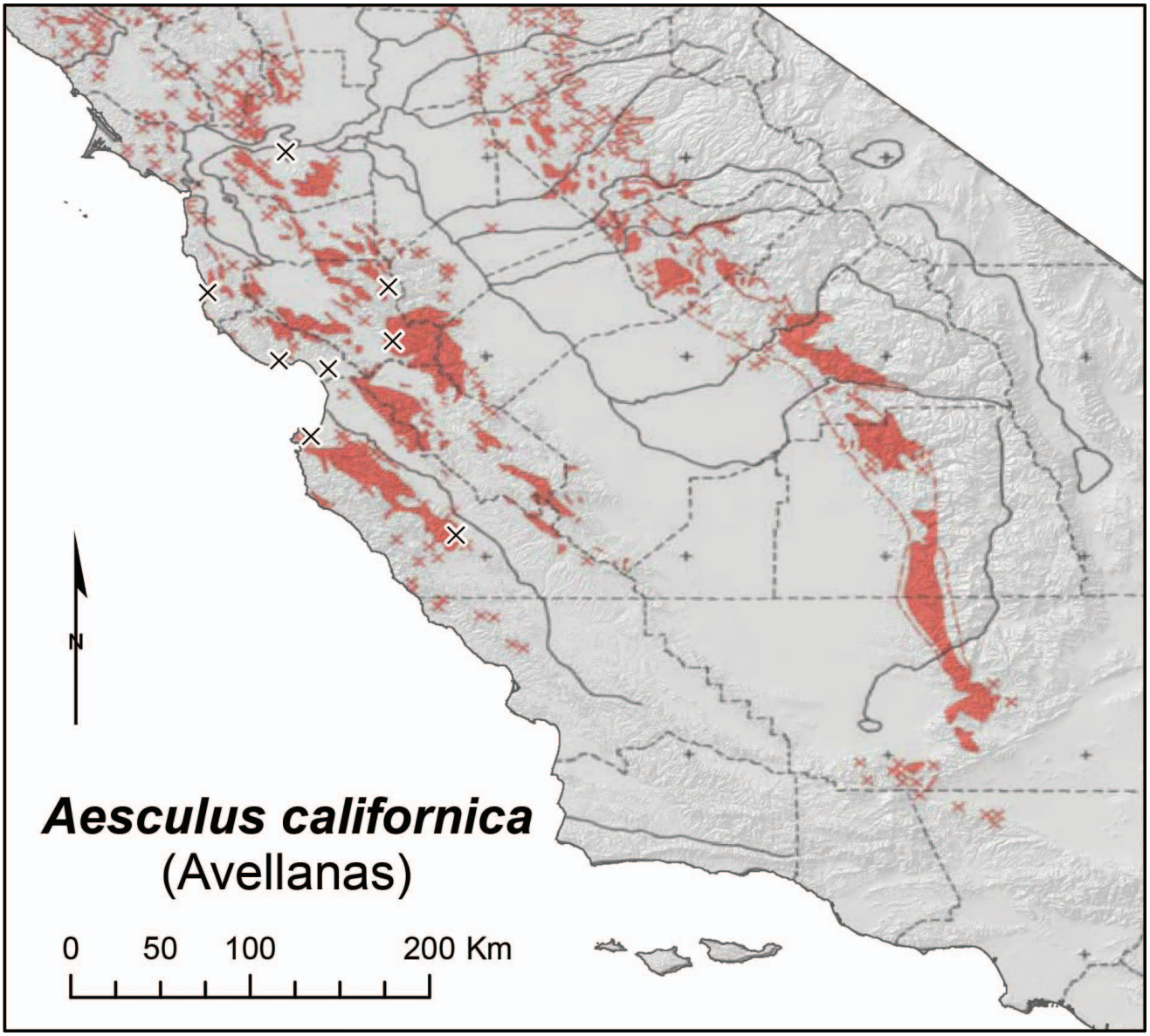

Fig. 10. Hispanic localities of *Aesculus californica* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

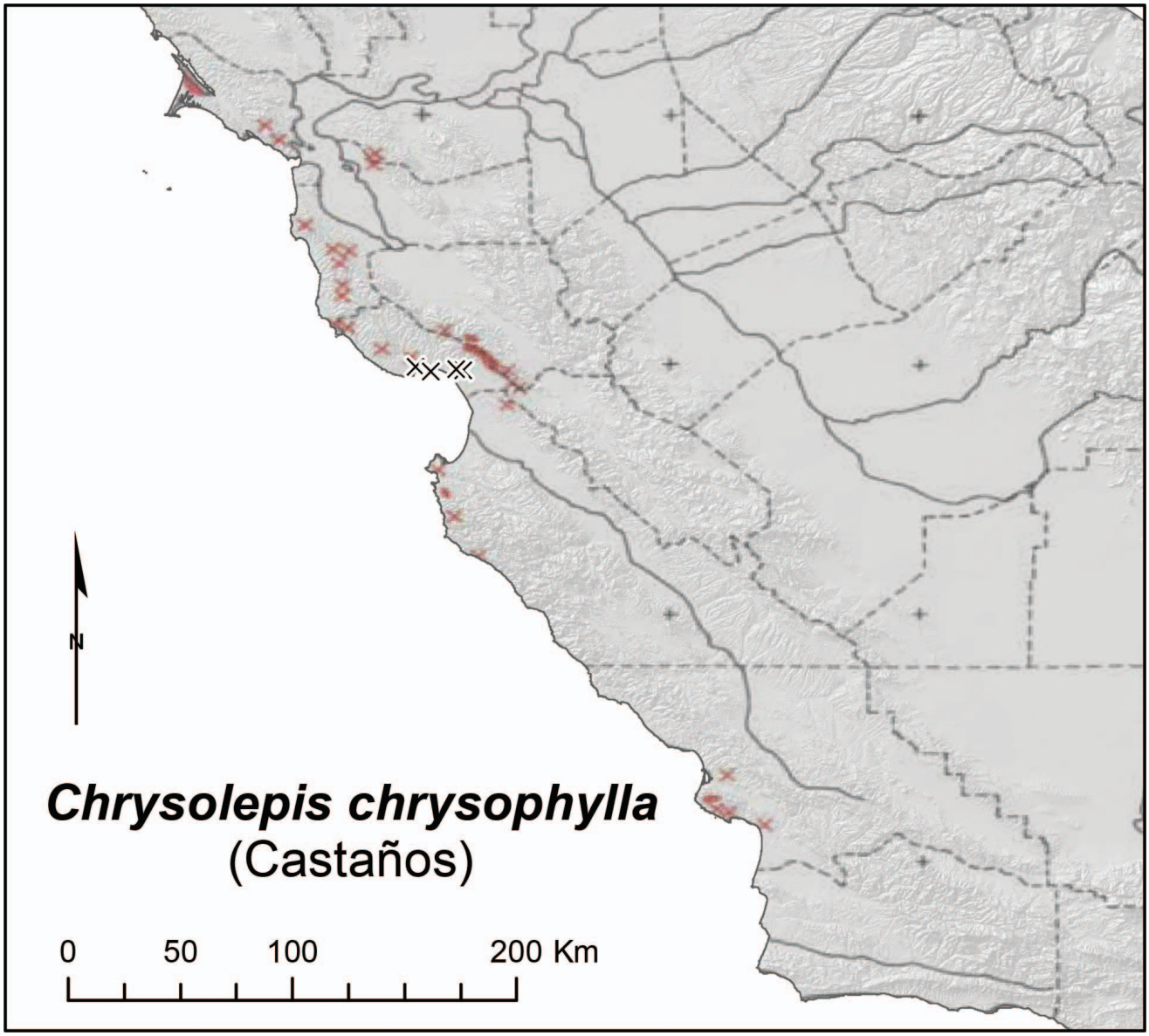

Fig. 11. Hispanic localities of *Chrysolepis chrysophylla* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

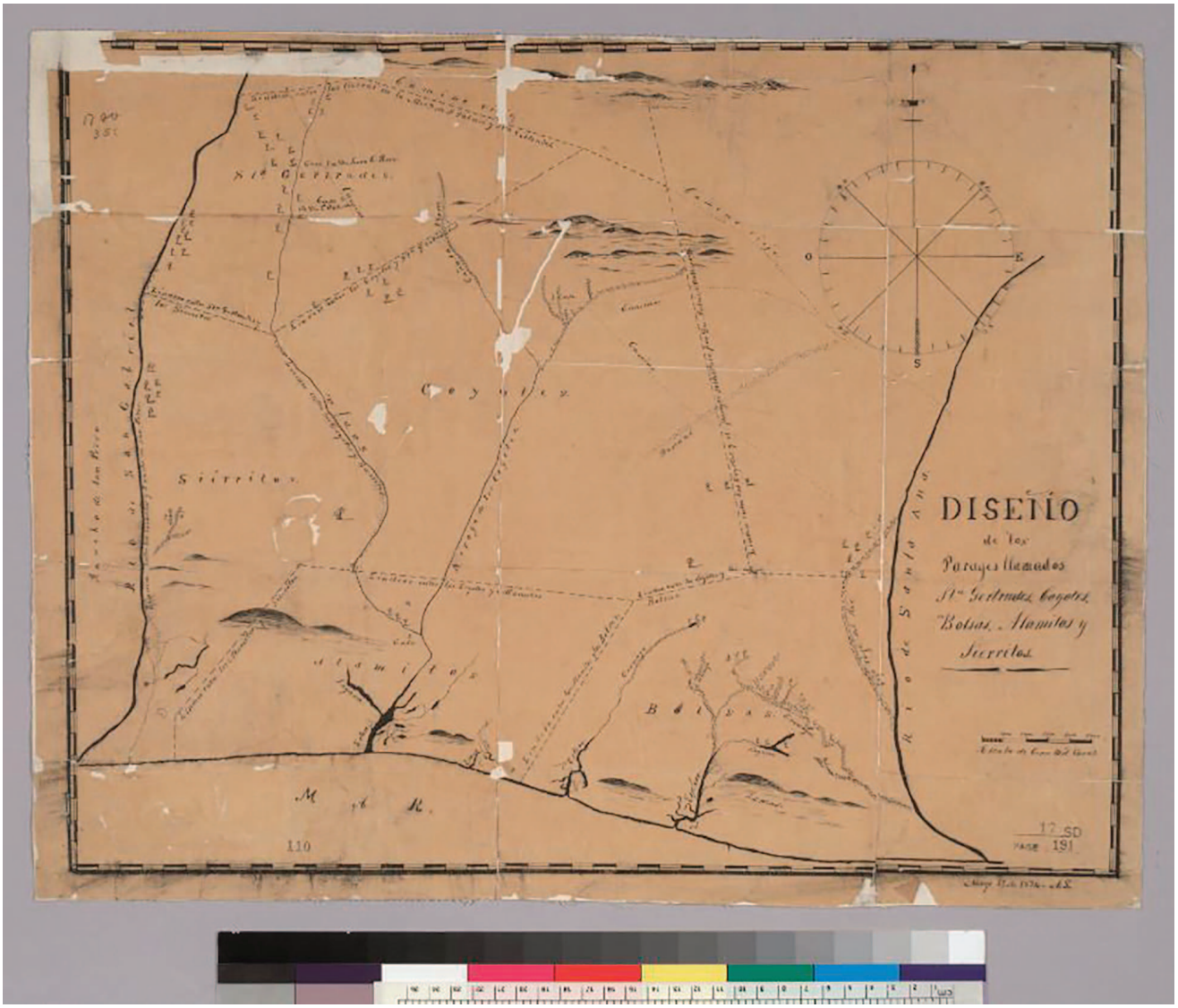

Fig. 12. Diseños for Ranchos Gertrudes, Los Coyotes, Los Bolsas, Los Alamitos and Los Cerritos (1833), created from the original concession of Rancho Los Nietos (1784). The grants cover the coastal plains near Long Beach, where the Los Angeles, Santa Ana and San Gabriel Rivers empty into the Pacific Ocean. Rancho Santa Gertrudis was ceded in 1846. The map depicts trees only along the rivers, mostly "alamitos" (small cottonwoods). The Pacific Ocean is indicated by "Mar."

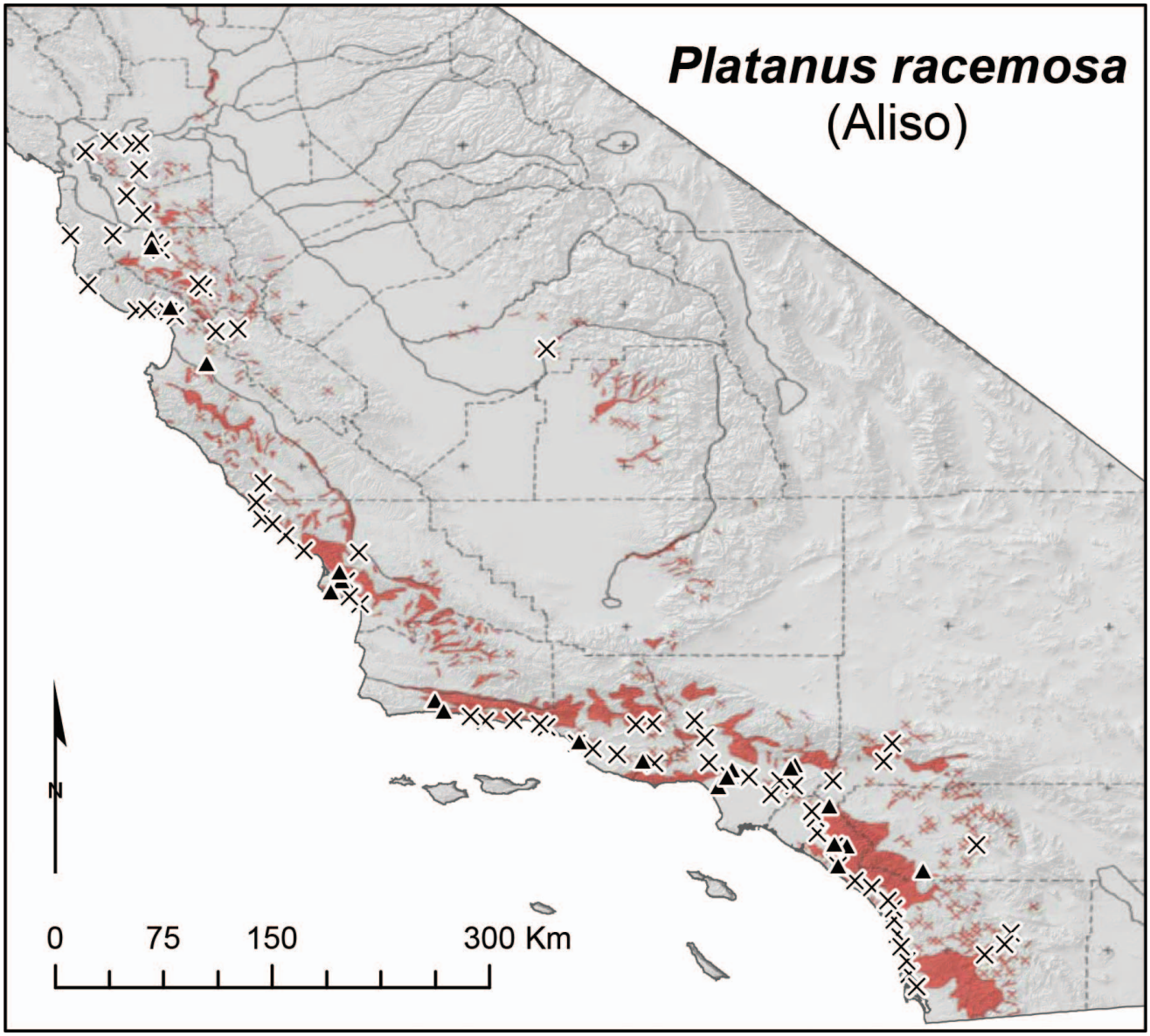

Fig. 13. Hispanic localities of *Platanus racemosa* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. Black △ = diseño localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

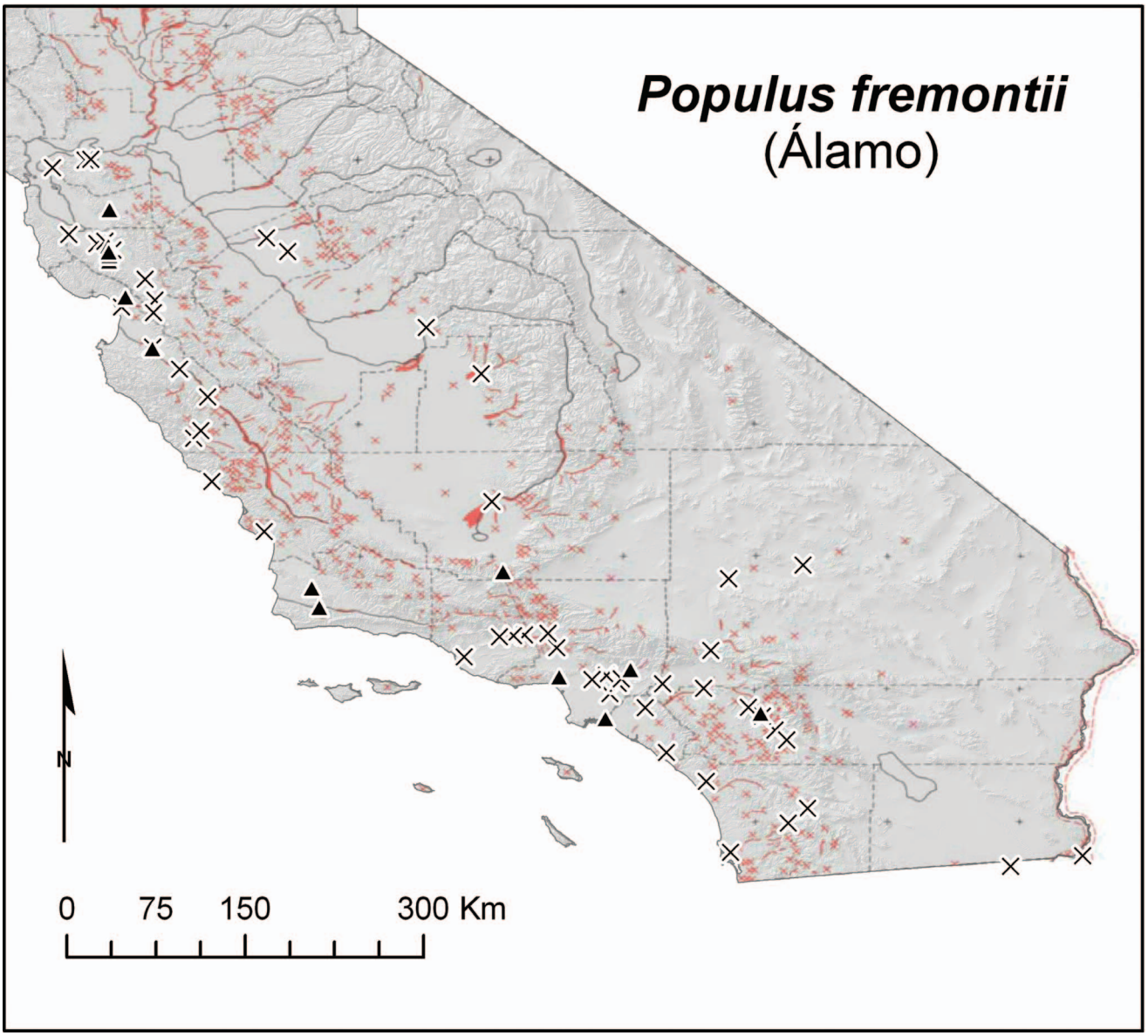

Fig. 14. Hispanic localities of *Populus fremontii* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. Black △ = diseño localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

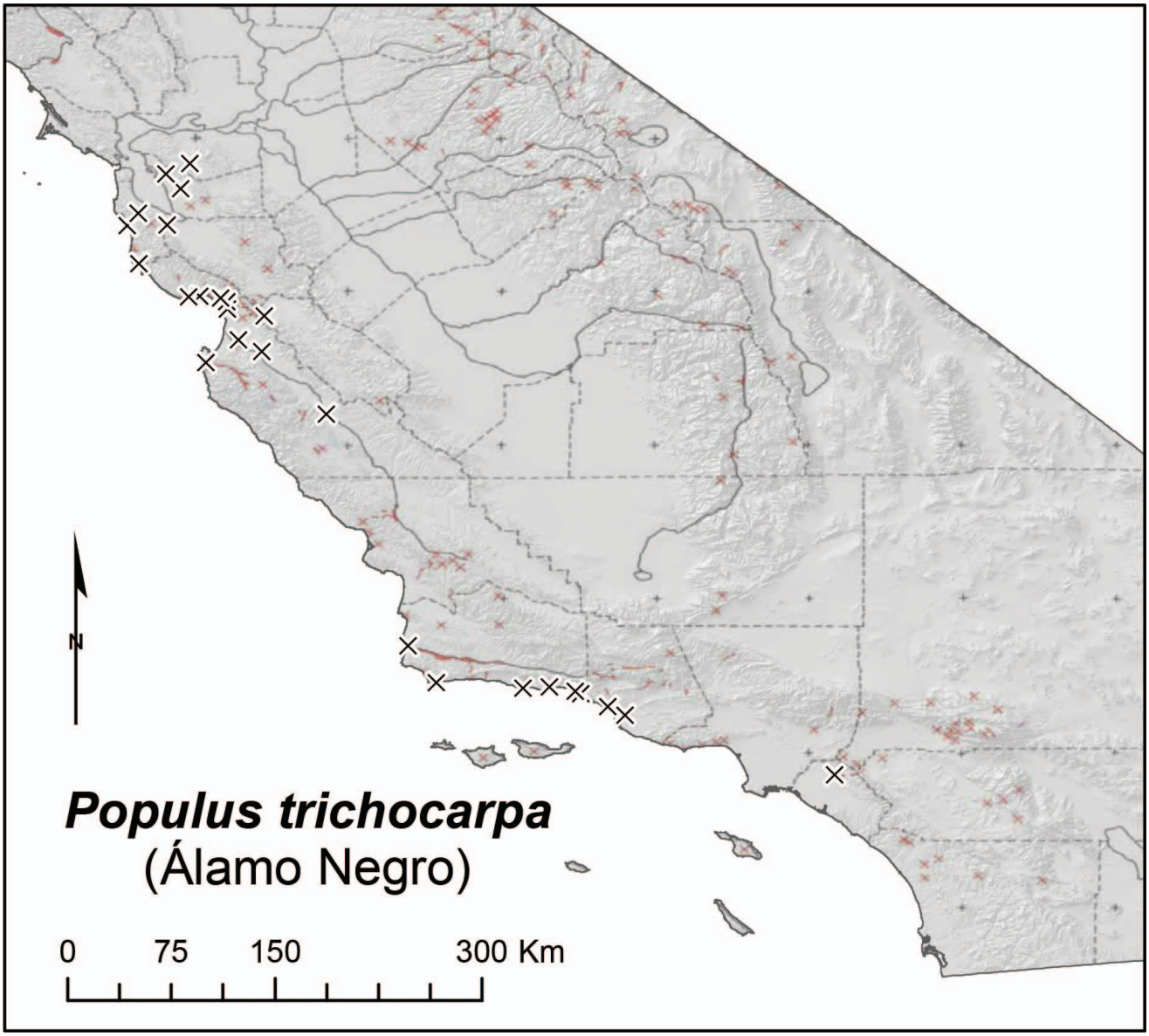

Fig. 15. Hispanic localities of *Populus trichocarpa* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

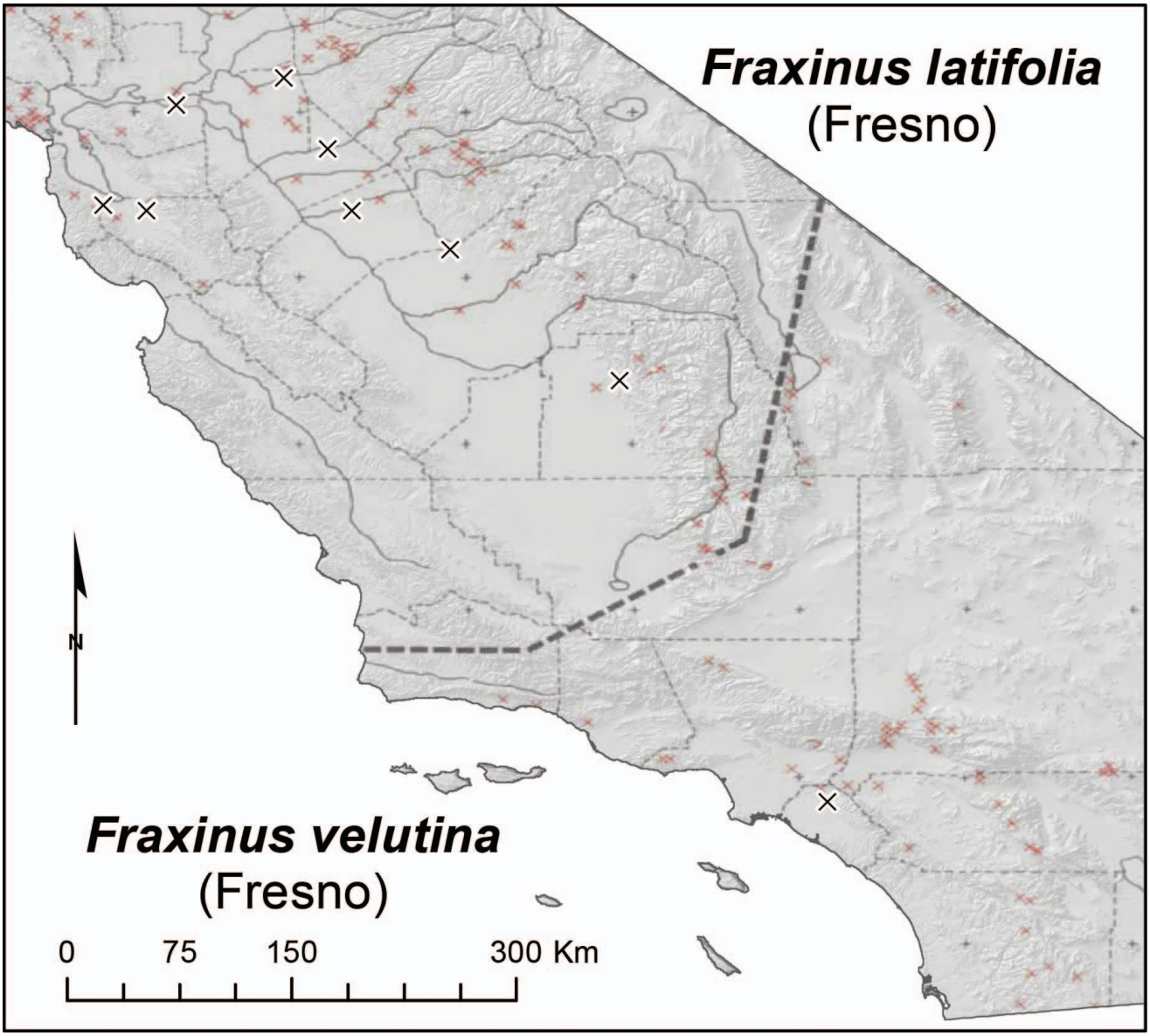

Fig. 16. Hispanic localities of *Fraxinus velutina* and *Fraxinus latifolia* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

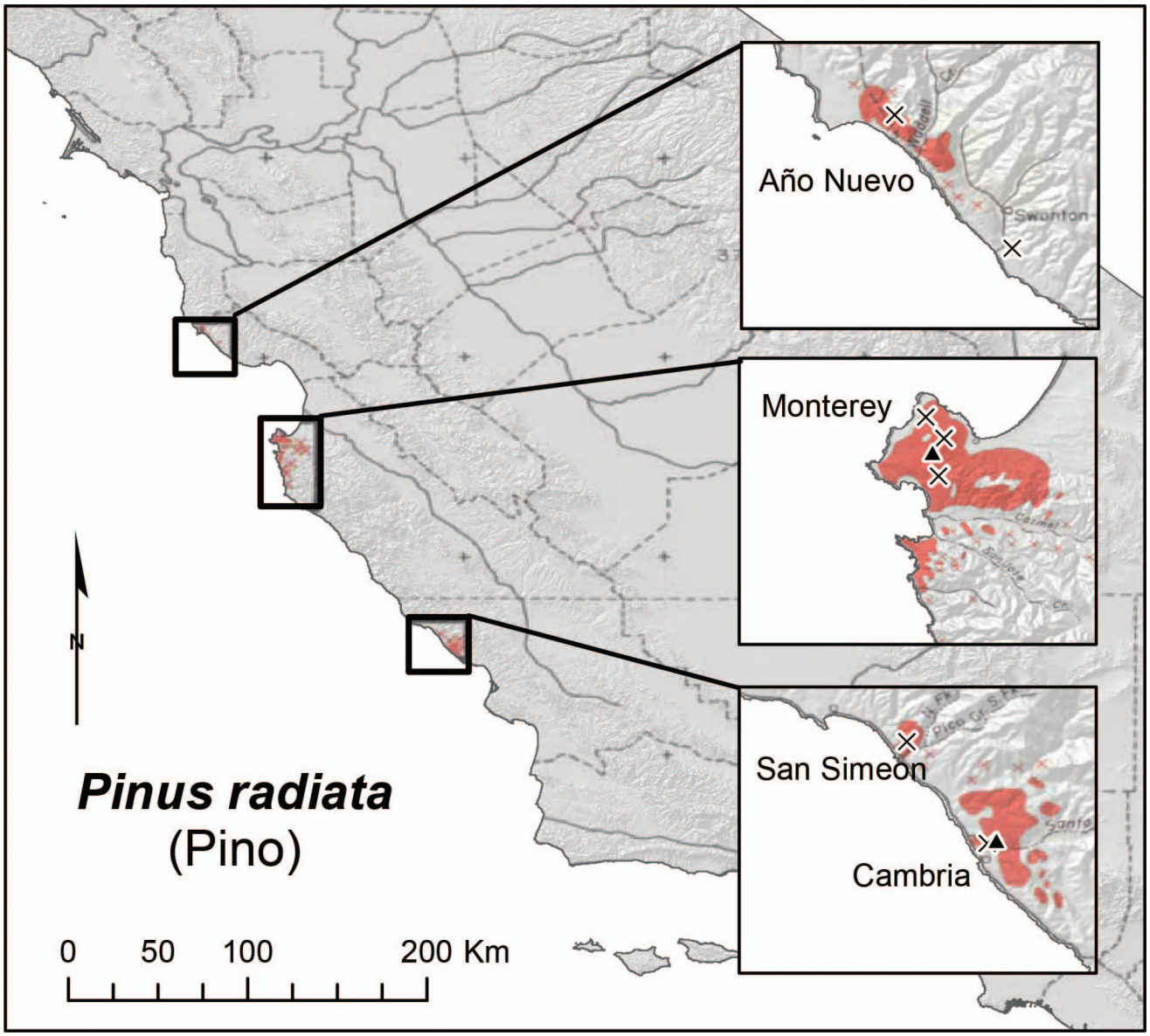

Fig. 17. Hispanic localities of *Pinus radiata* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. Black △ = diseño localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

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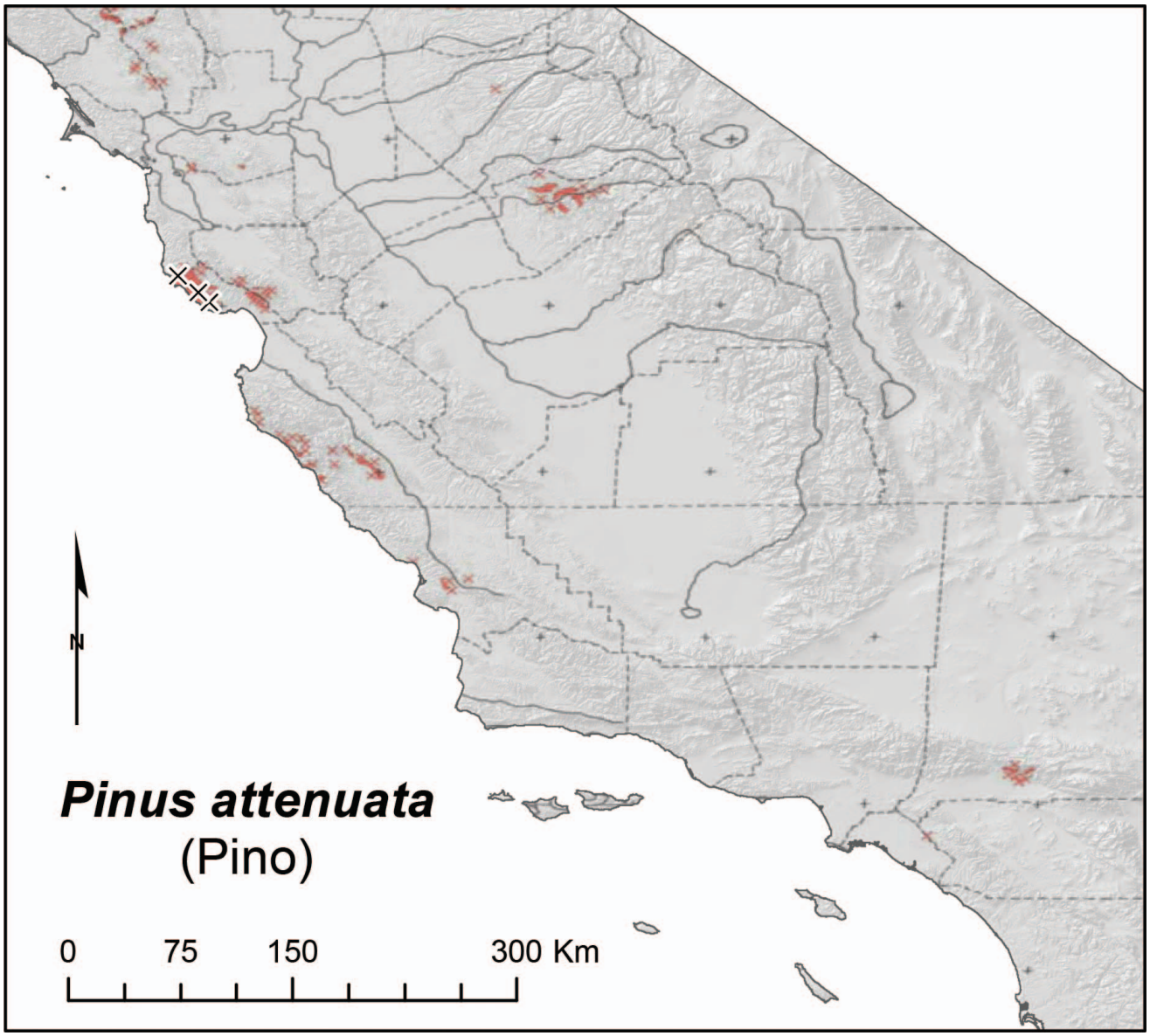

Fig. 18. Hispanic localities of *Pinus attenuata* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

Fig. 19A. Diseño Punta de Pinos (Monterey, 1833), with "pinal" shown with tree symbols across the peninsula. Punta de Cipréses (lower left) refers to rare *Cupressus macrocarpa* along the coastline.

Fig. 19B. The Monterey peninsula on Google Earth with *Pinus radiata* forest (dark areas). Trees also survive in suburban yards of Monterey.

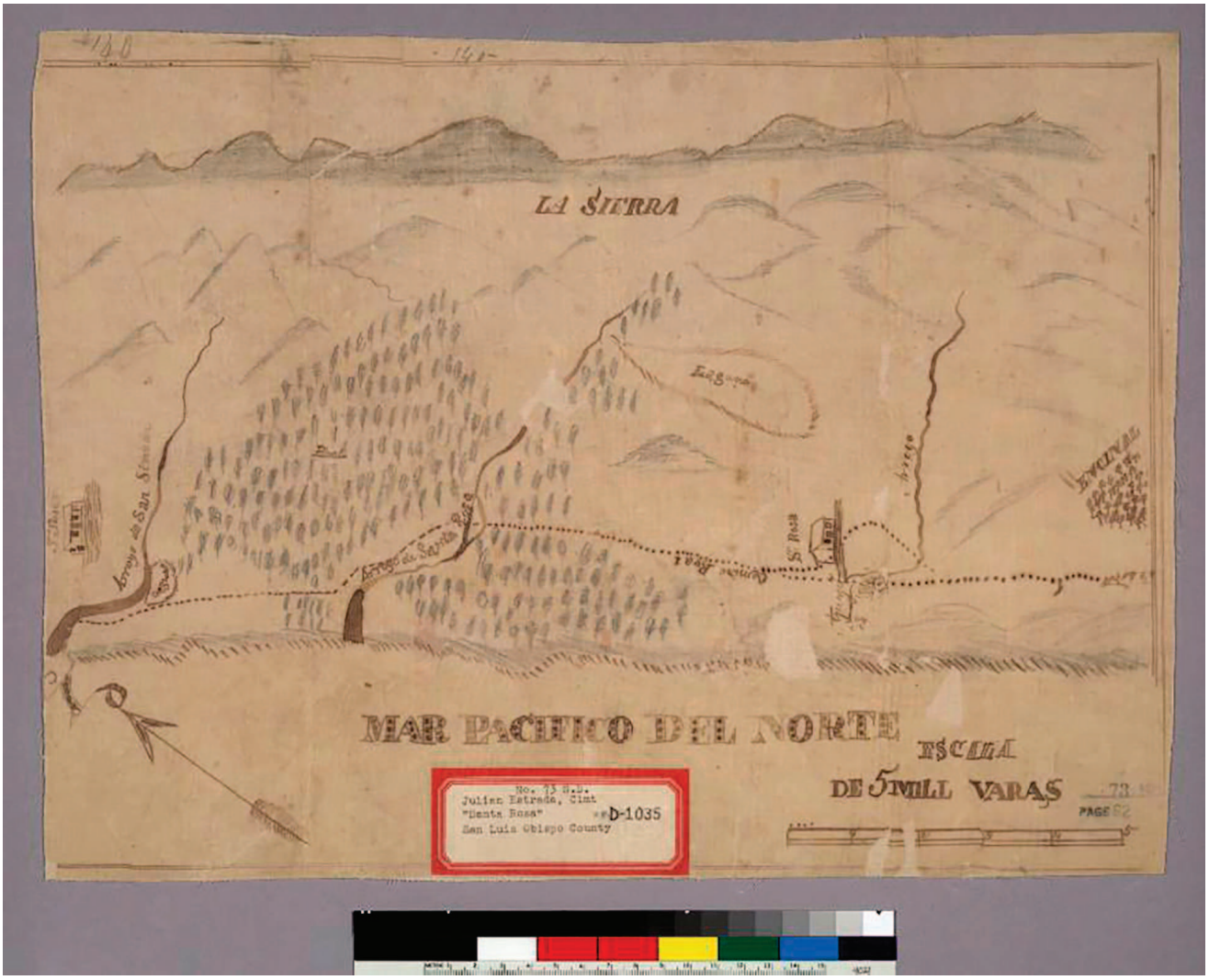

Fig. 20A. Diseño Rancho Santa Rosa (1841) showing the distribution of *Pinus radiata* (tree symbol), Arroyo San Simeon (left) and Arroyo de Santa Rosa (middle, both current place names). The ocean in the foreground is depicted "Mar Pacifico del Norte." A grove of encino (*Quercus agrifolia*) is sketched in the far right. The Santa Lucia Mountain skyline (La Sierra) is shown in the distance.

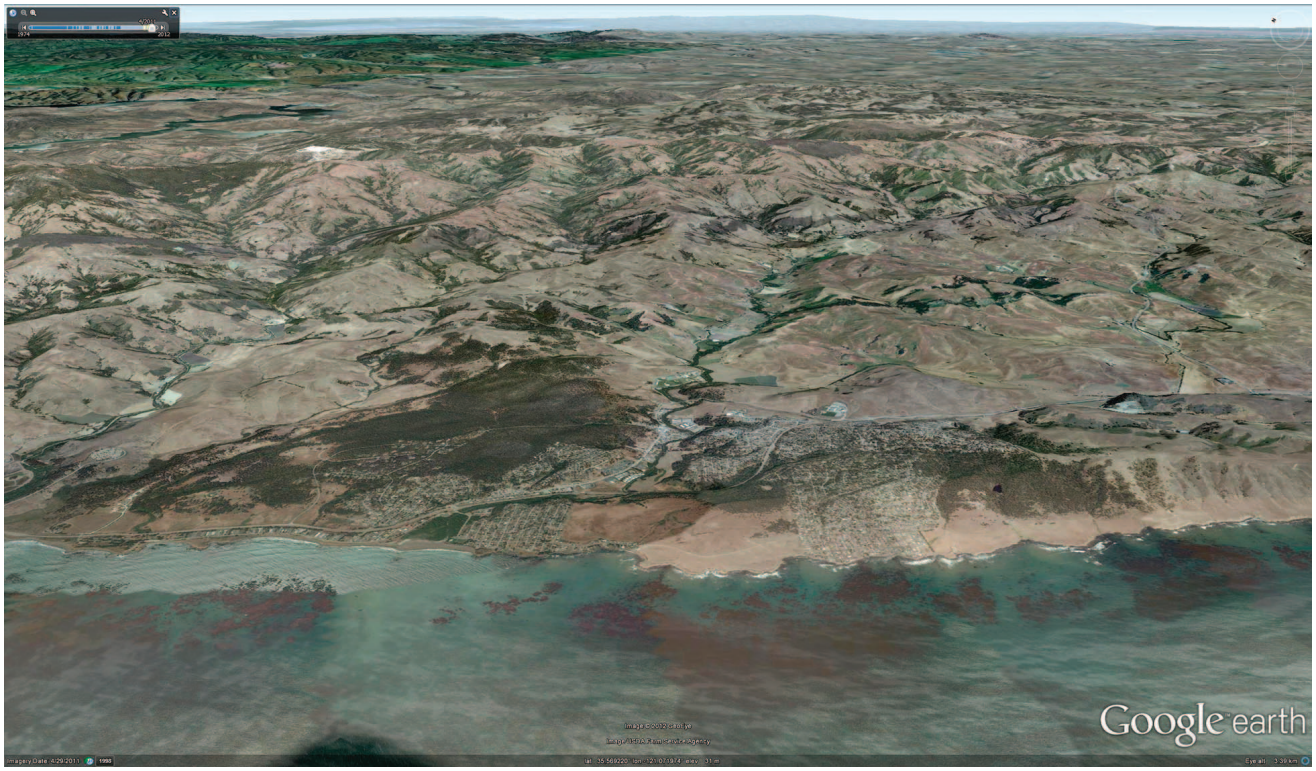

Fig. 20B. Google Earth image showing present-day Cambria and *Pinus radiata* forest (dark areas near the coast) in a similar vantage as diseño Rancho Santa Rosa. Note the remarkable similarity in forest distribution nearly two centuries after the diseño, including the ascending stand north (left) of Arroyo de Santa Rosa, and pines along the coastal bluff to the south of this arroyo.

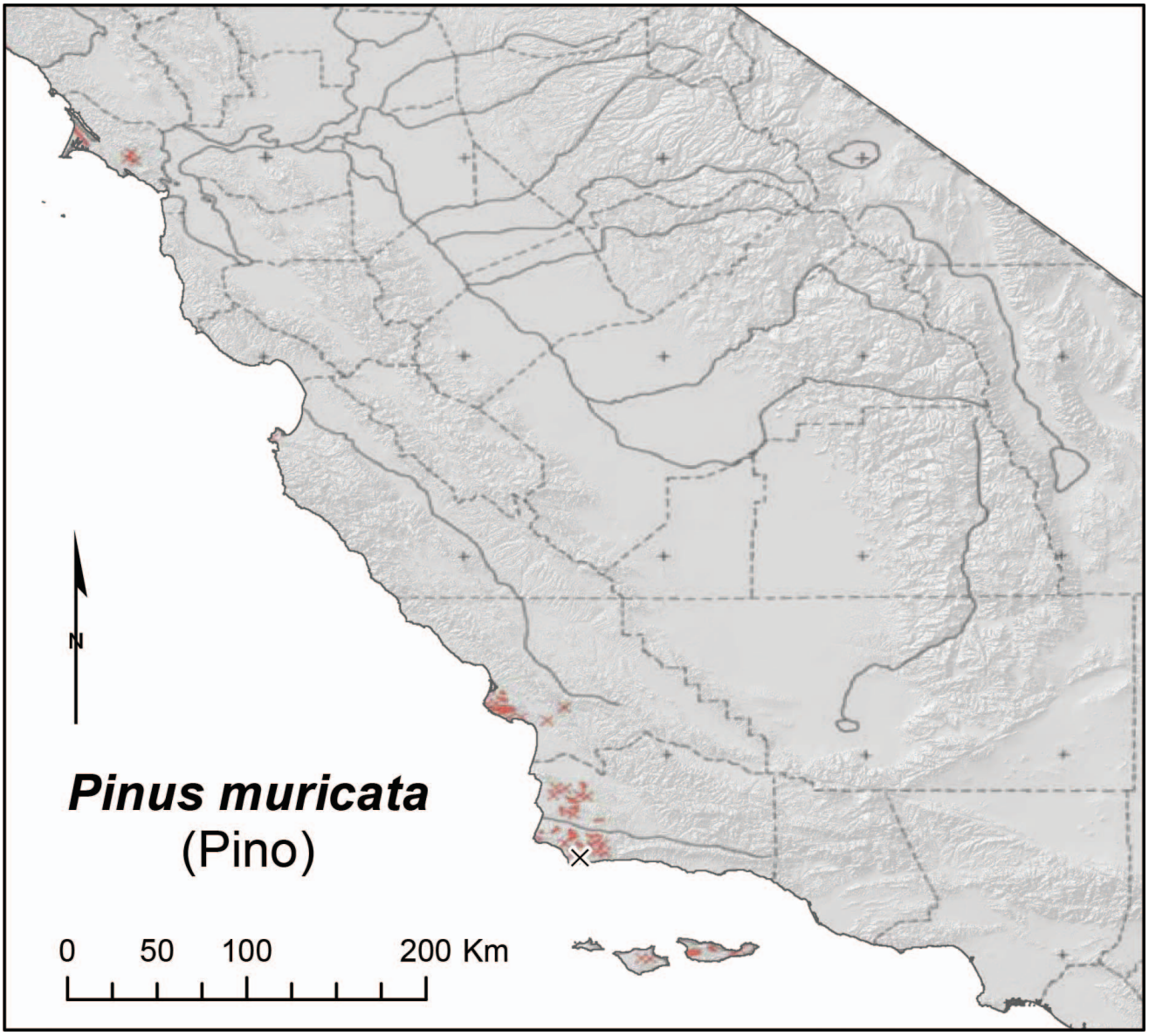

Fig. 21. Hispanic localities of *Pinus muricata* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

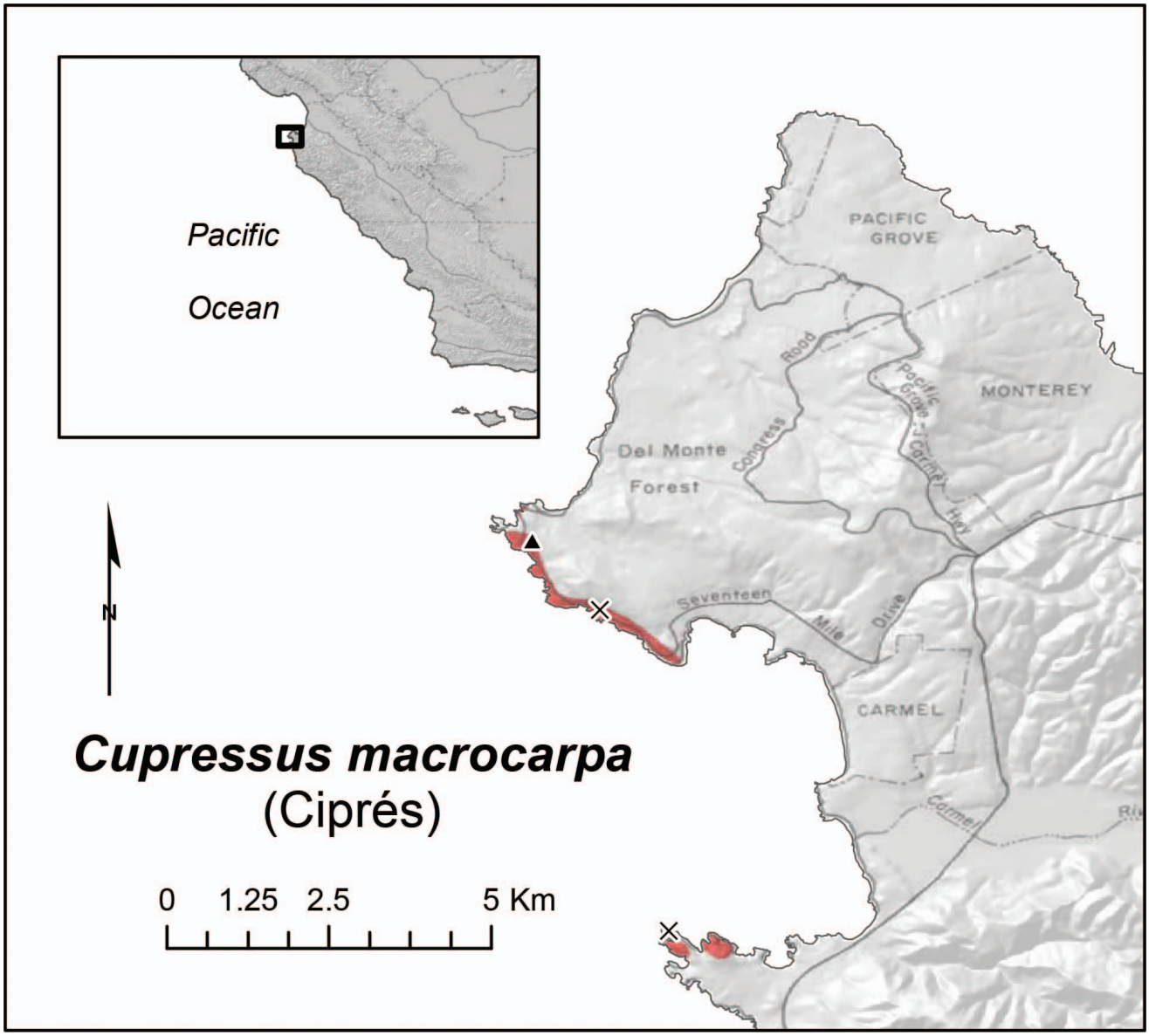

Fig. 22. Hispanic localities of *Cupressus macrocarpa* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. Black △ = diseño localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across. Note distribution in relation to "Punta de Cipréses" in Fig. 19.

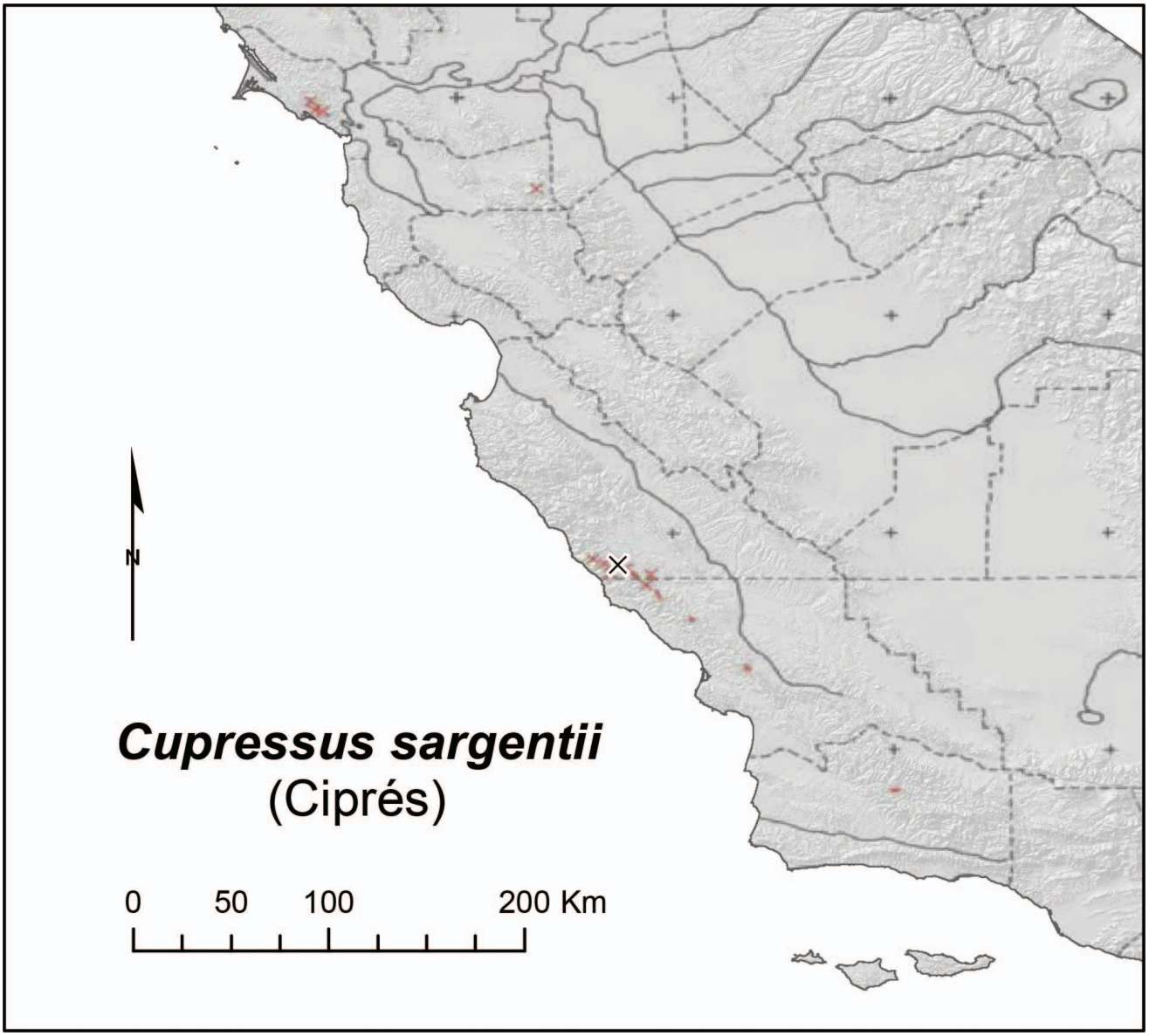

Fig. 23. Hispanic localities of *Cupressus sargentii* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

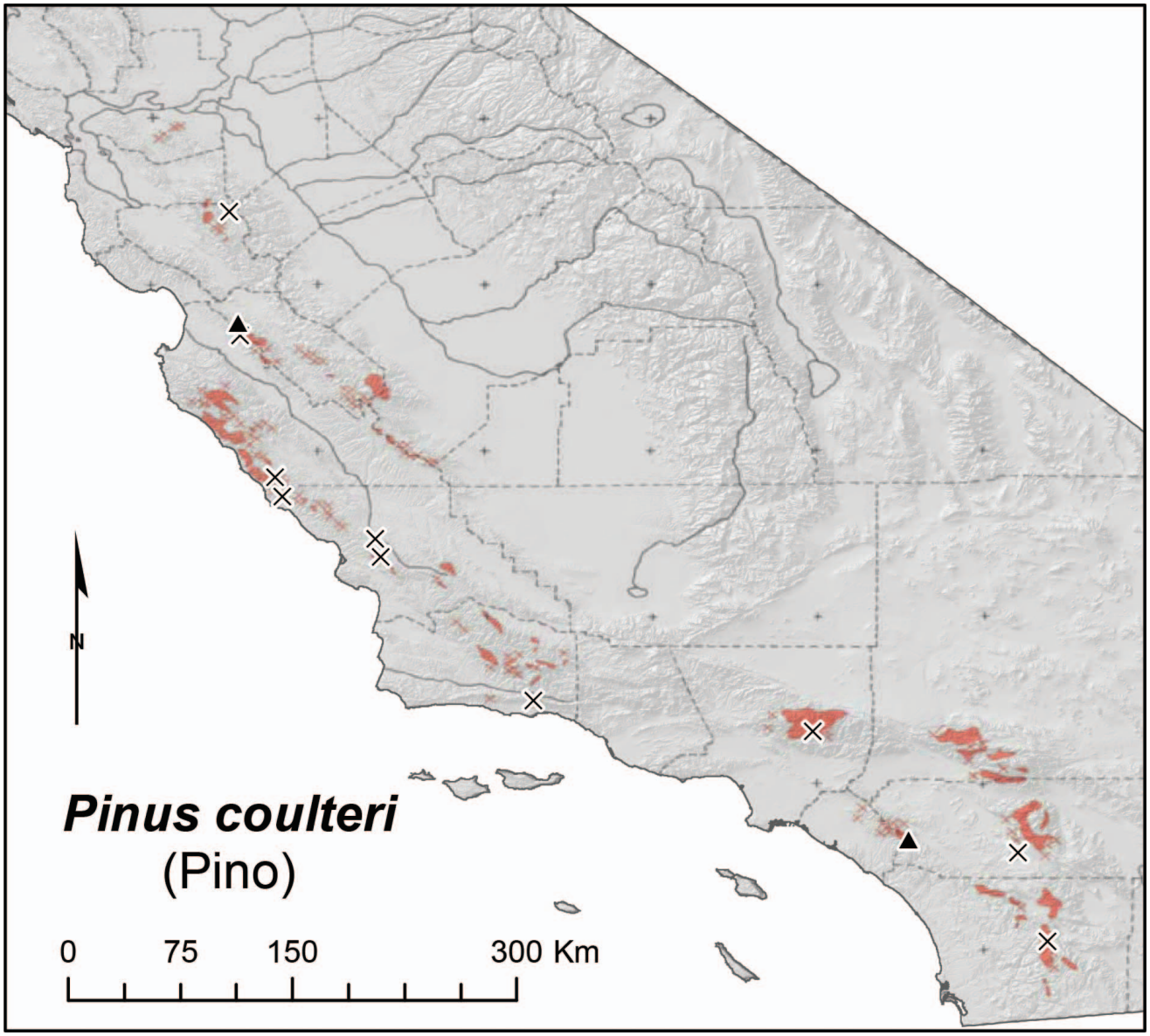

Fig. 24. Hispanic localities of *Pinus coulteri* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. Black △ = diseño localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

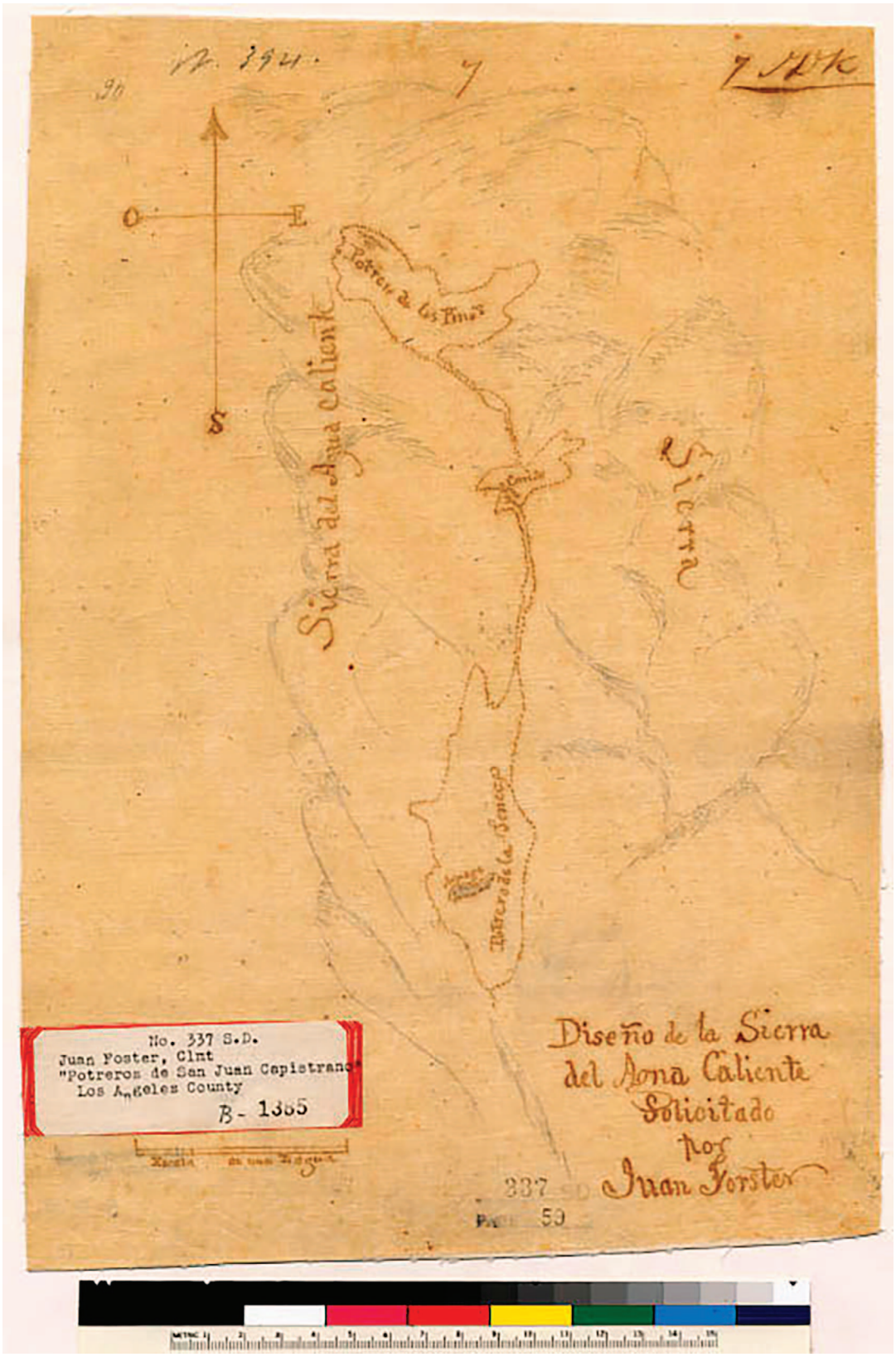

Fig. 25. Diseño Sierra del Agua Caliente por Juan Forster (184-?) in the Santa Ana Mountains of southern California. "Potrero de Pinos" is a pasture surrounded by chaparral and *Pinus coulteri*.

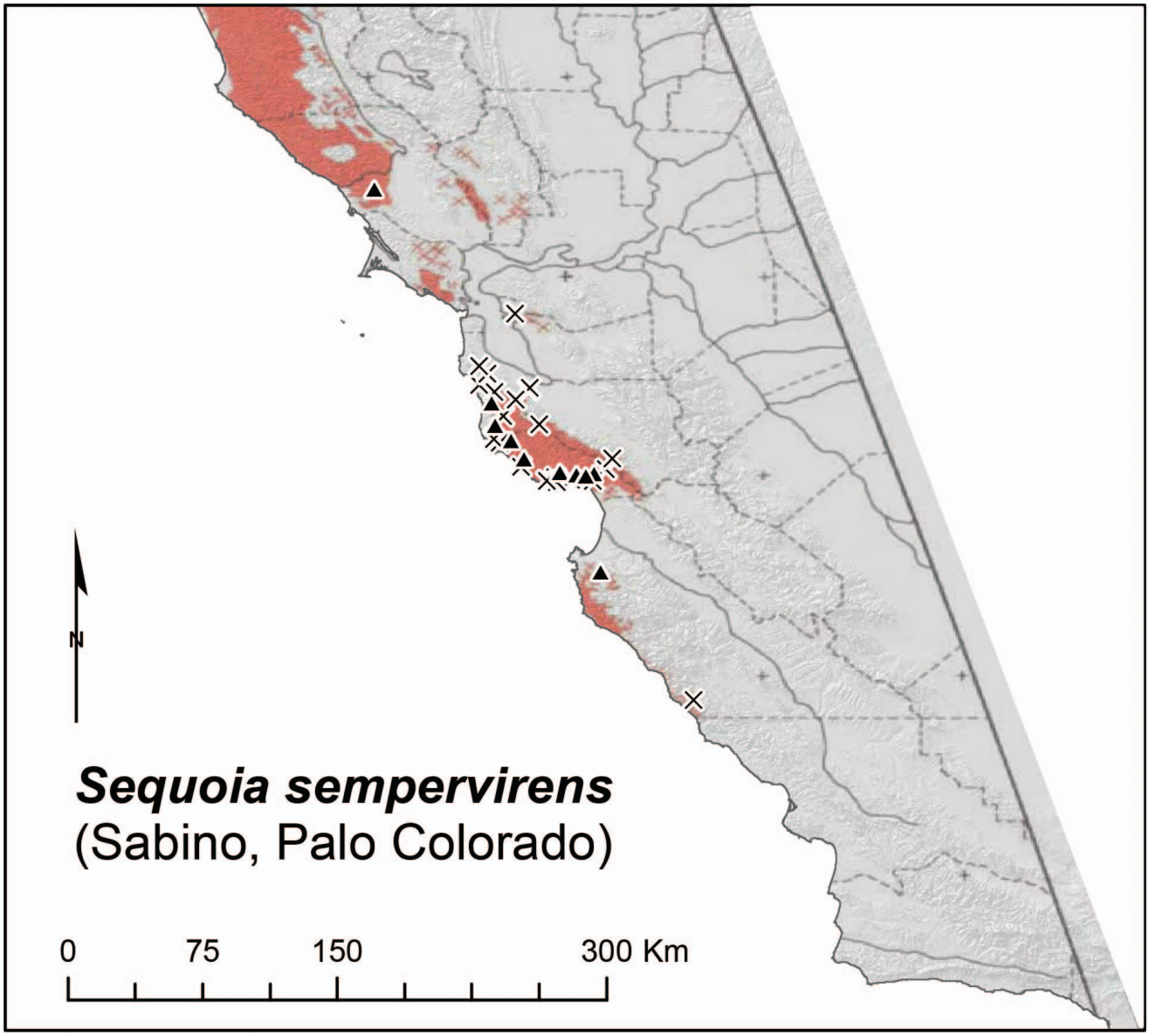

Fig. 26. Hispanic localities of *Sequoia sempervirens* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. Black △ = diseño localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

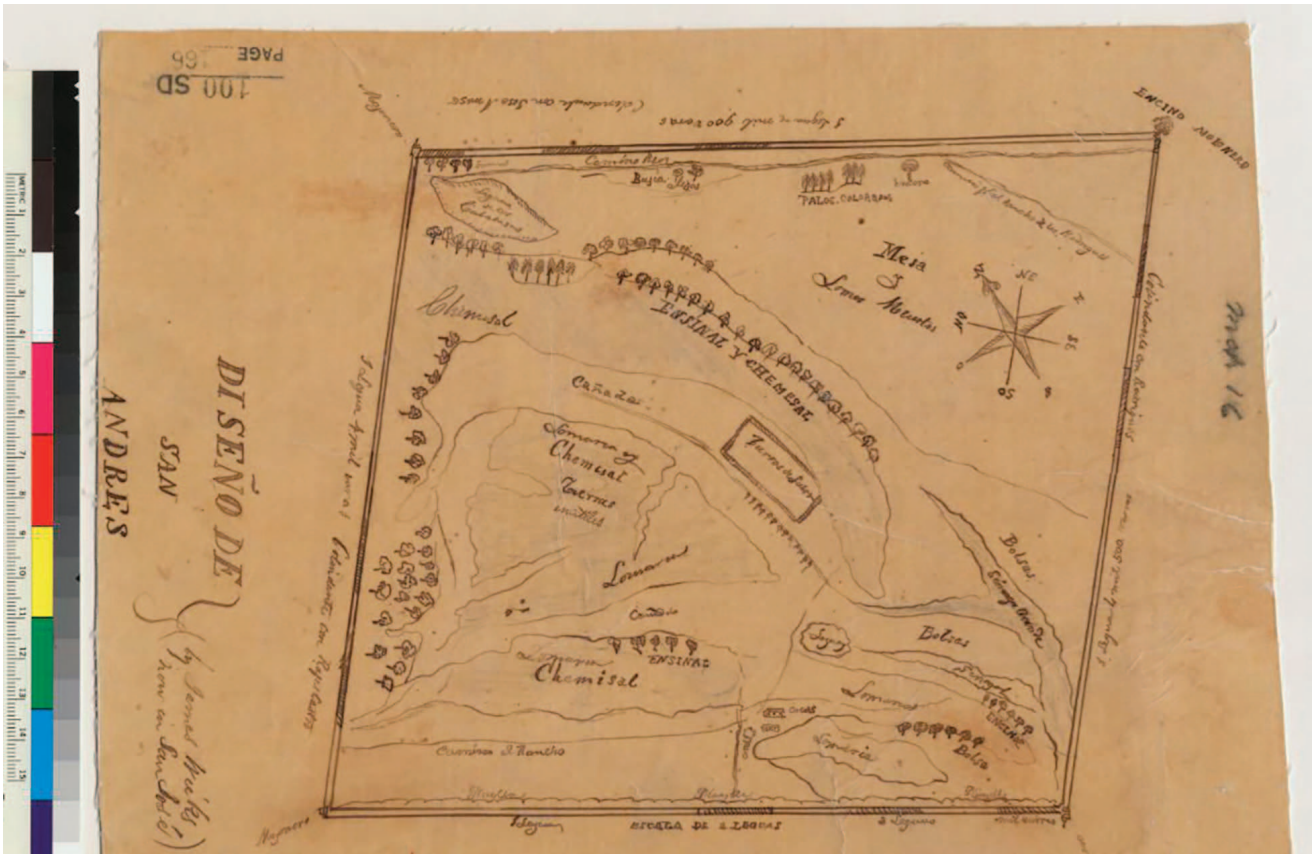

Fig. 27. Diseño Rancho San Andrés (1833) at Watsonville. The map records "Palo Colorado" (*Sequoia sempervirens*) in the southern Santa Cruz Mountains on the west flank of the land grant (top middle). The sketch map also records "chemesal" (chaparral) and encino, here *Quercus agrifolia*, which increases in abundance to the southwest approaching Santa Cruz (left). "Chemesal" is recorded at several locations.

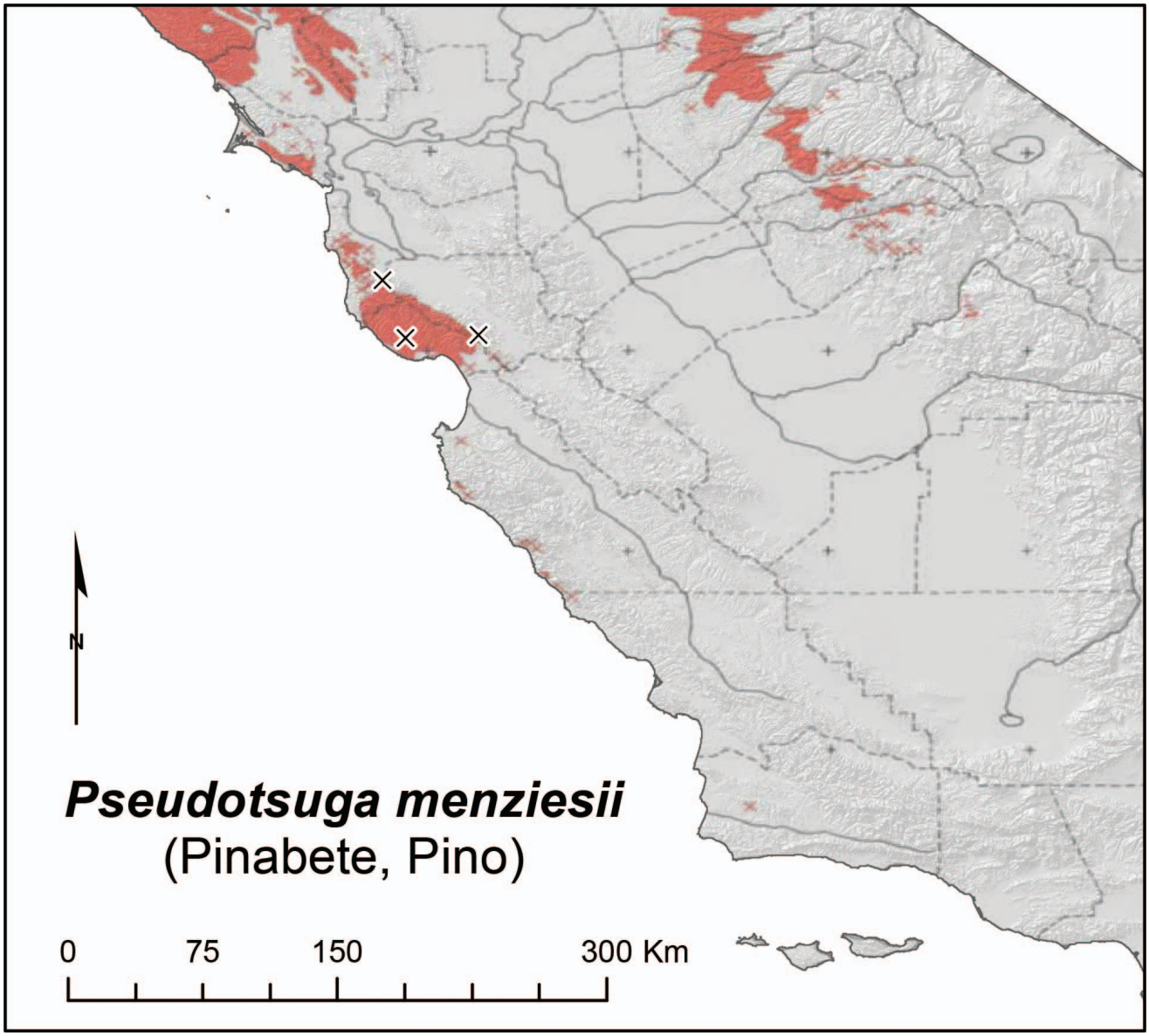

Fig. 28. Hispanic localities of *Pseudotsuga menziesii* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

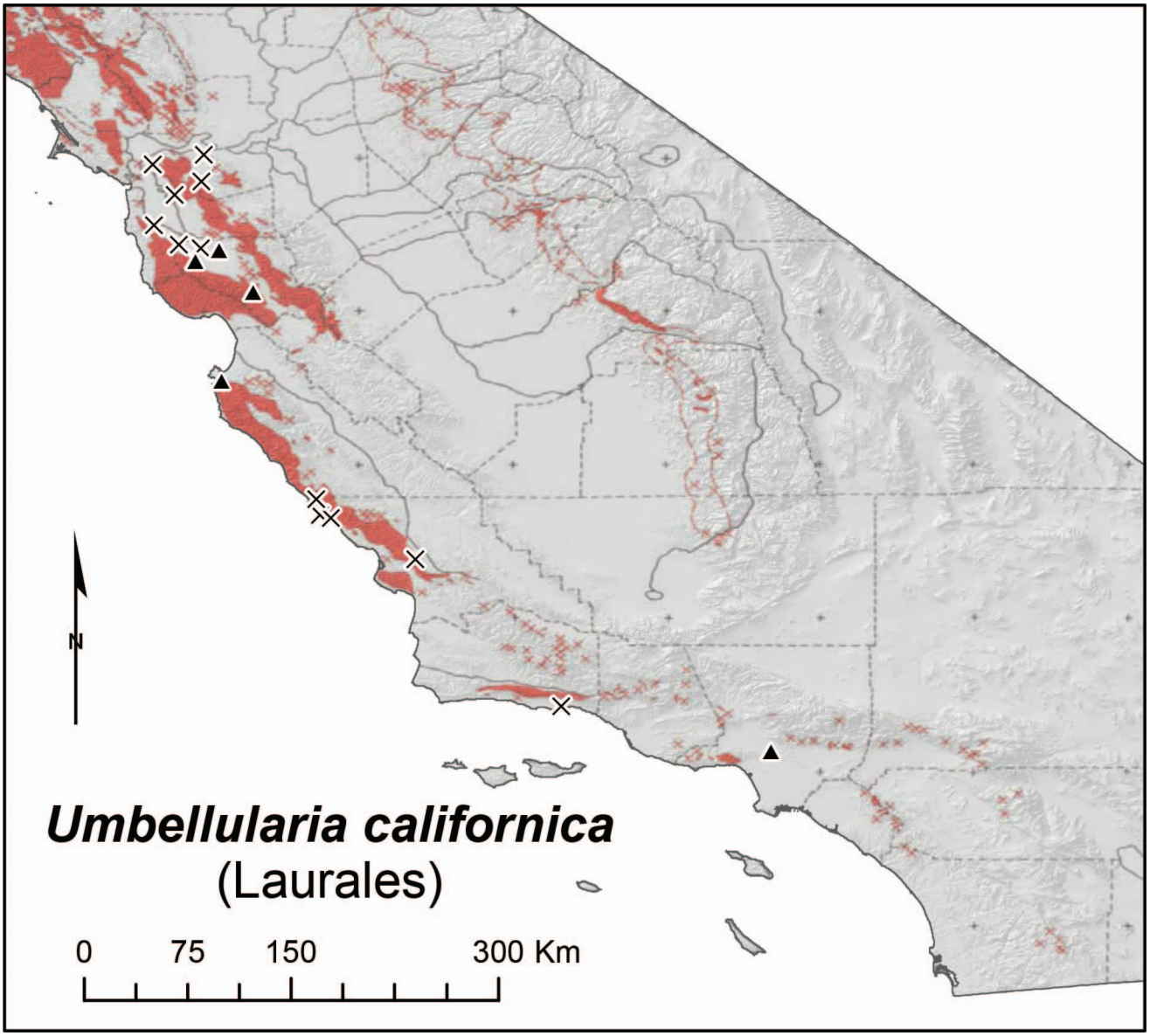

Fig. 29. Hispanic localities of *Umbellularia californica* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. Black △ = diseño localities. VTM criteria: Orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

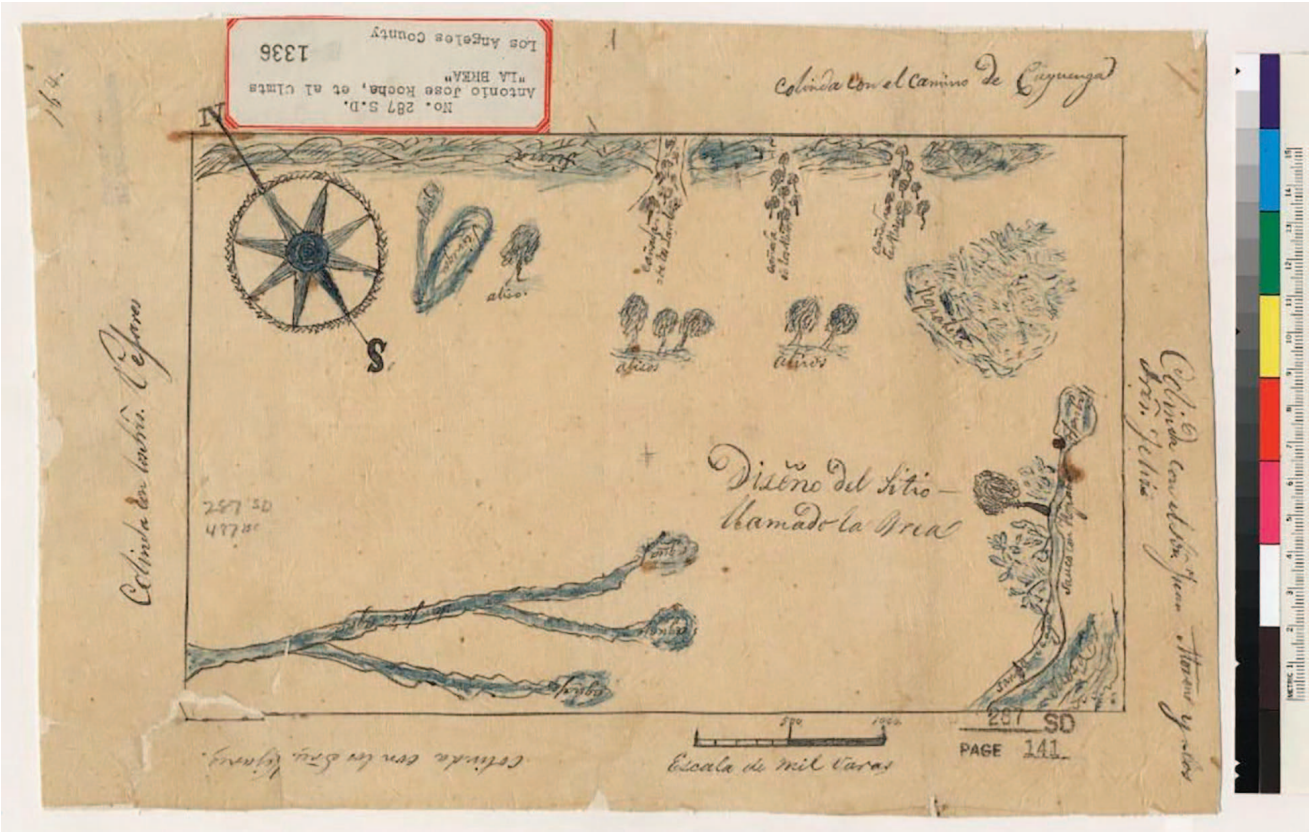

Fig. 30. Diseño del Sitio Llamado La Brea (184-?) in west Los Angeles. The sketch map records "Canada de los Laurales" in a canyon of the Santa Monica Mountains at present-day Griffith Park (top middle). The park now hosts colonies of California bay (*Umbellularia californica*) near watercourses. "Alisos" or California sycamores are recorded at three localities.

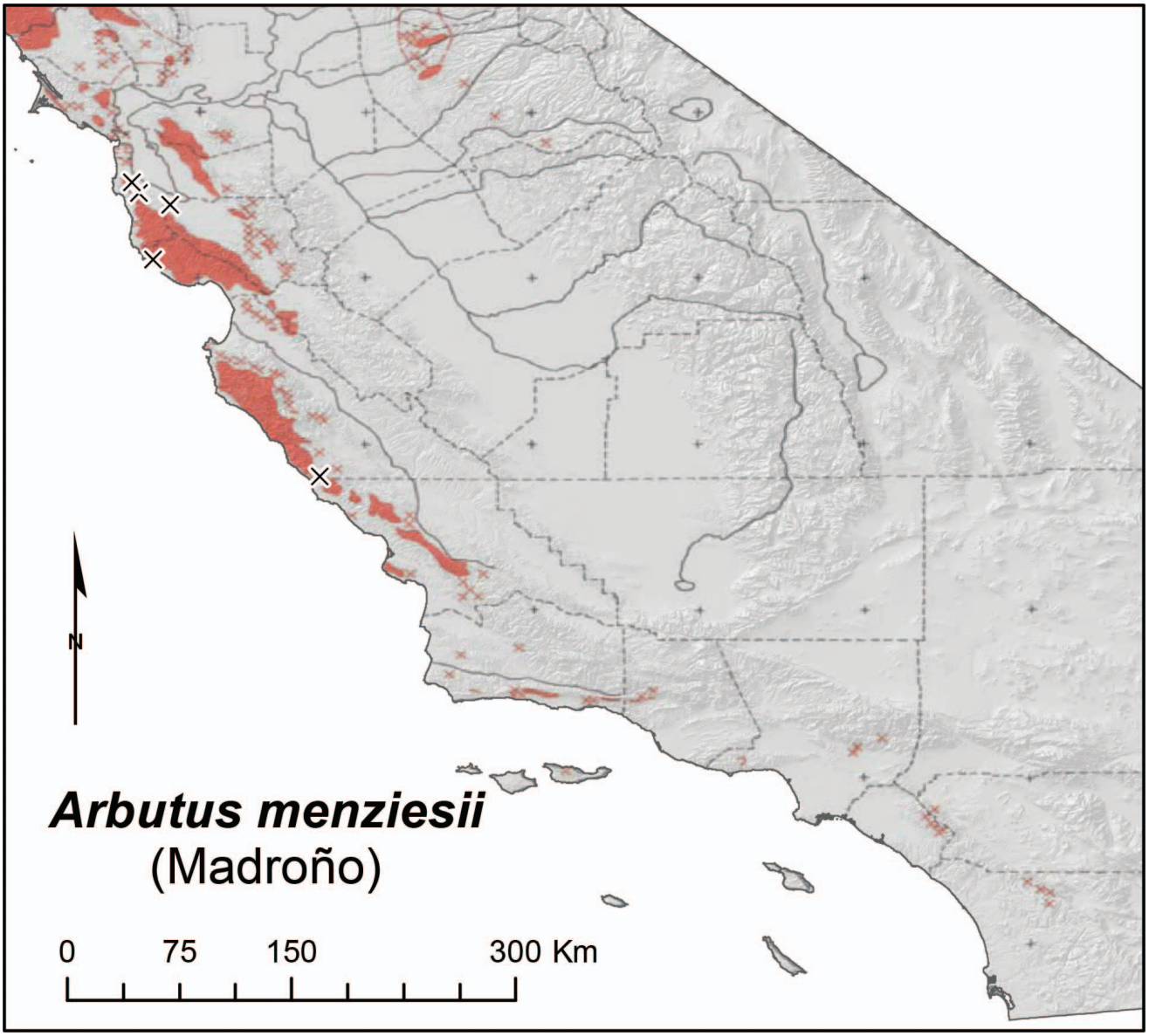

Fig. 31. Hispanic localities of *Arbutus menziesii* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

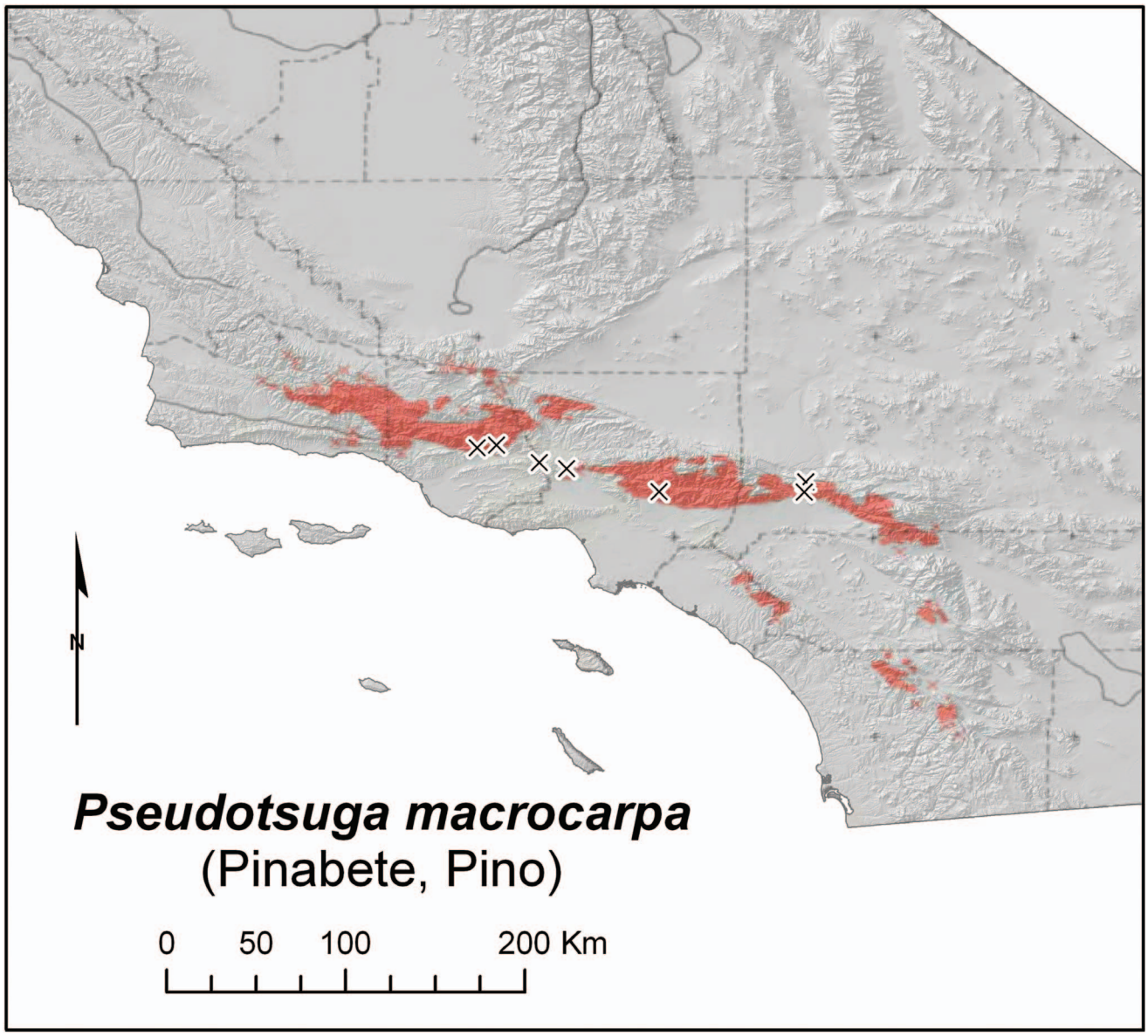

Fig. 32. Hispanic localities of *Pseudotsuga macrocarpa* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

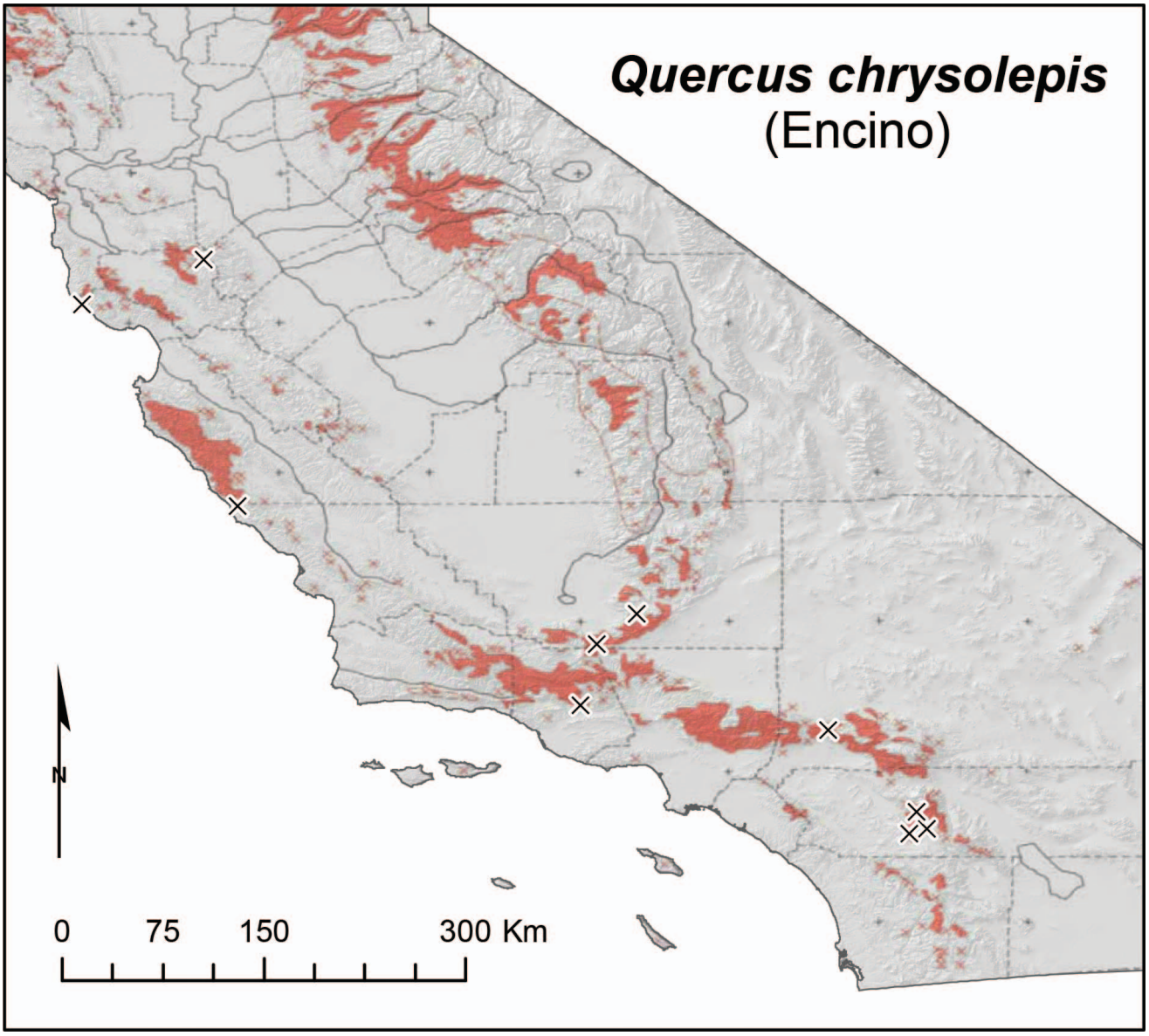

Fig. 33. Hispanic localities of *Quercus chrysolepis* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

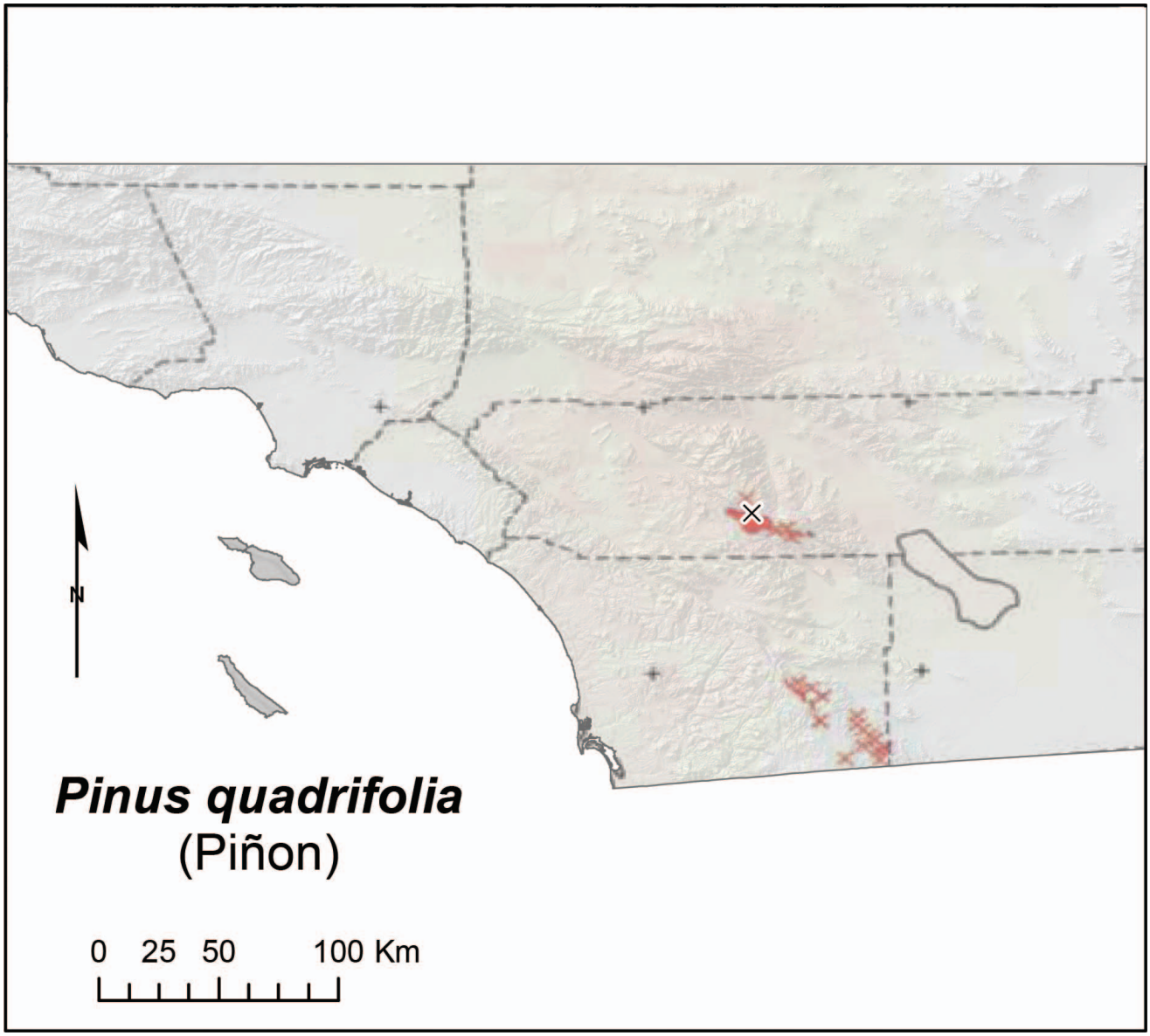

Fig. 34. Hispanic localities of *Pinus quadrifolia* with distribution mapped on the 1929–1934 VTM Survey map (Griffin and Critchfield 1972). Black × = Spanish expedition localities. VTM criteria: orange polygons = group of stands >2 miles (3.2 km) across. Orange × = group of stands <2 miles (3.2 km) across.

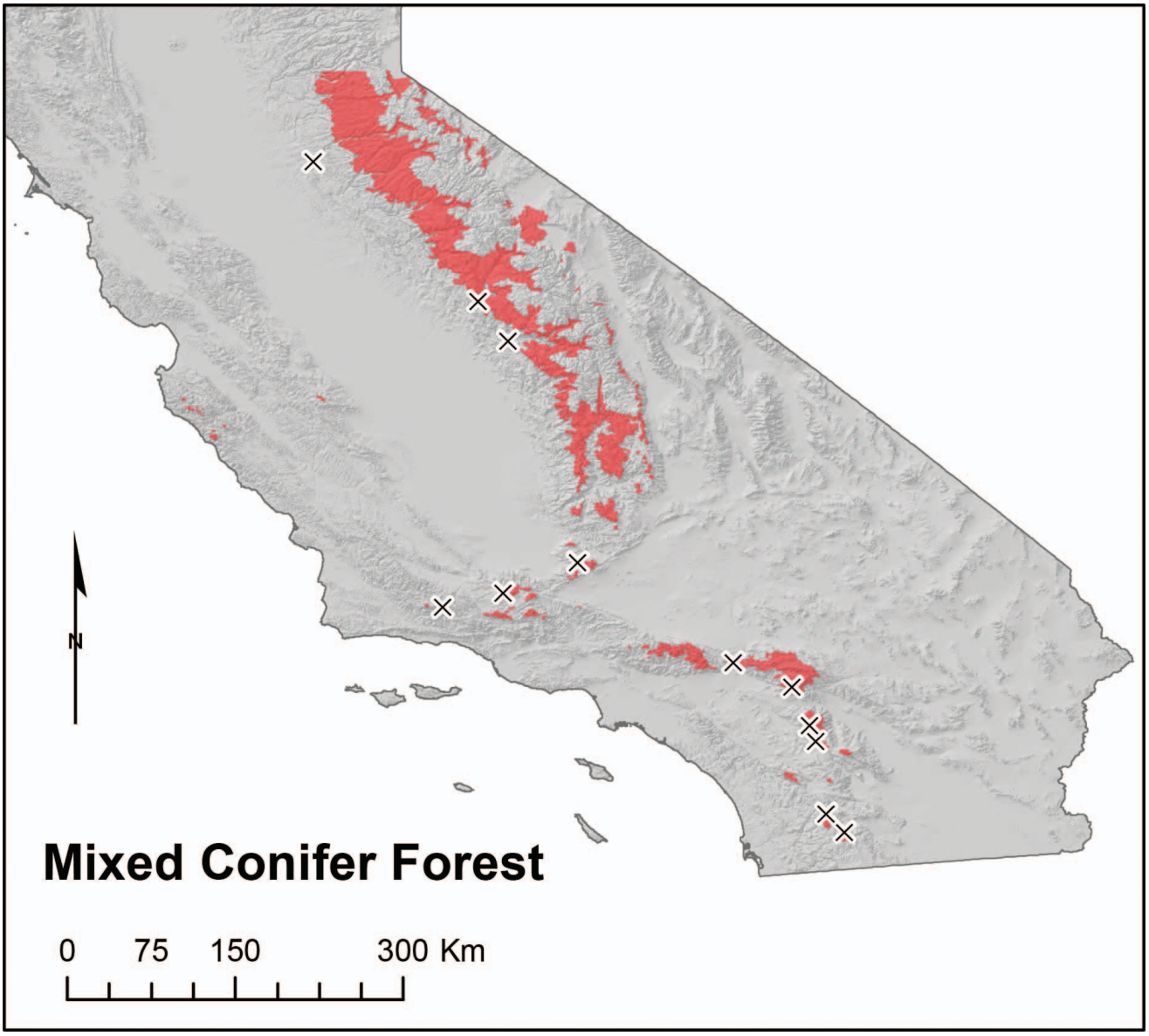

Fig. 35. Hispanic localities of mixed conifer forest (*Pinus ponderosa*, *Pinus jeffreyi*, *Pinus lambertiana*, *Abies concolor*, *Calocedrus decurrens*) with modern distribution (orange polygons) mapped from Google Earth. Black × = Spanish expedition localities.

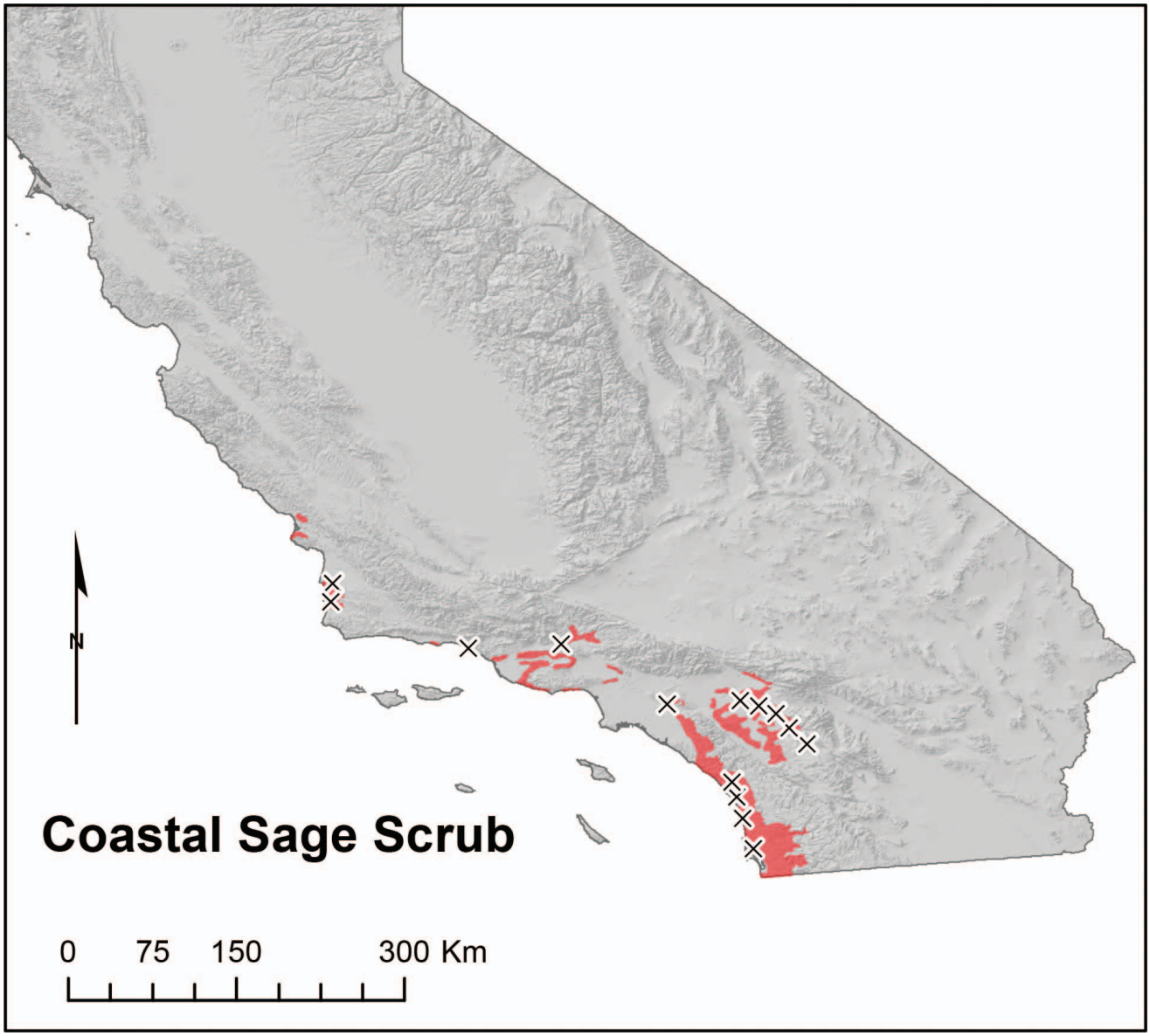

Fig. 36. Hispanic localities of coastal sage scrub with modern distribution (orange polygons) mapped from Google Earth. Black × = Spanish expedition localities.

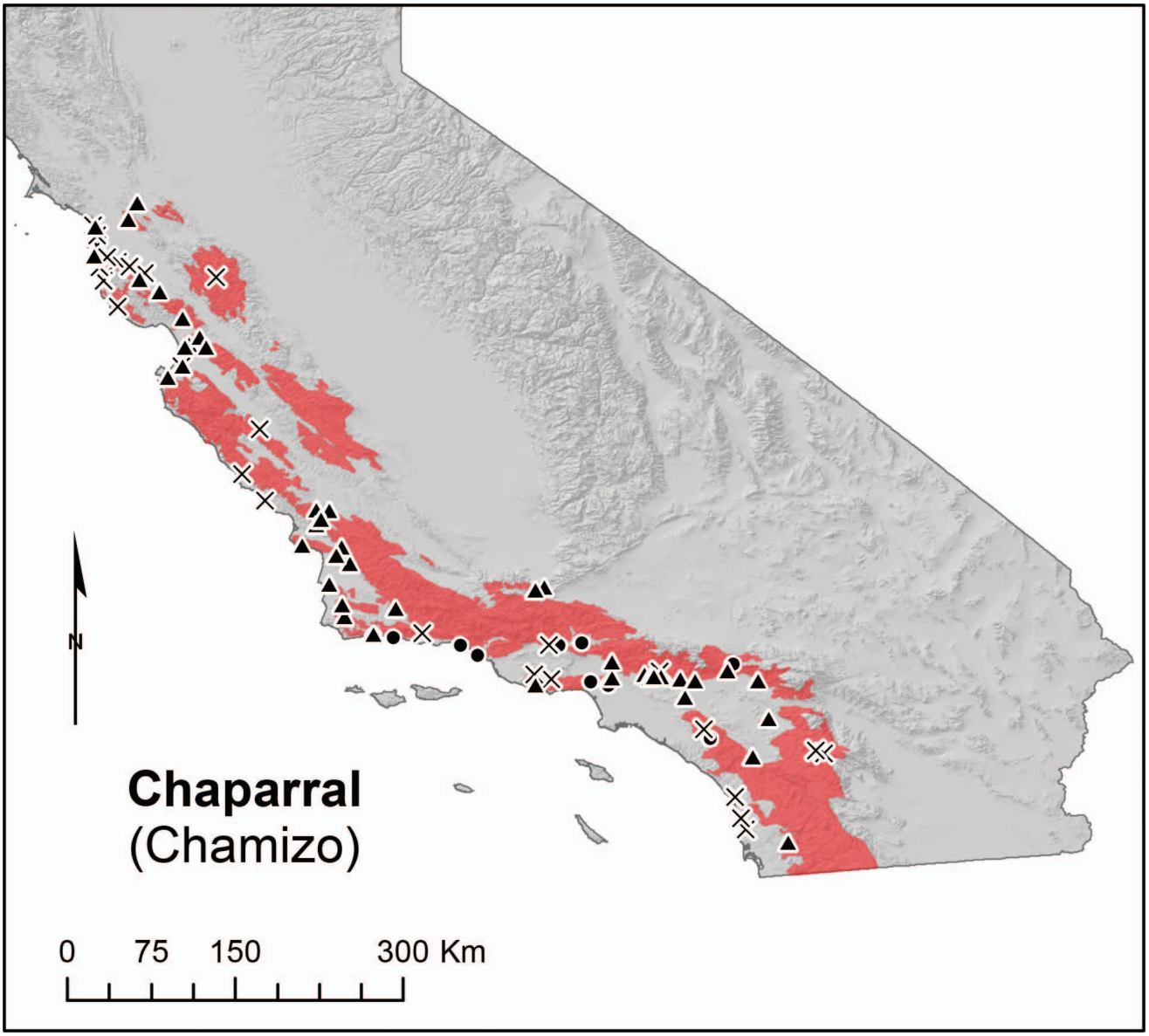

Fig. 37. Hispanic localities of chaparral with modern distribution (orange polygons) mapped from Google Earth. Black × = Spanish expedition localities. Black circles = Spanish expedition localities of slopes that are barren, dark, sterile, and bald. Black △ = diseño localities.