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Systematics of *Emmenanthe, Eucrypta,* and *Phacelia* sect. *Ramosissimae* (Hydrophyllaceae; Boraginales)

By

Genevieve Kathryn Walden

A dissertation submitted in partial satisfaction of the

requirements for the degree of

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in

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in the

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of the

University of California, Berkeley

Committee in charge:

Professor Bruce Baldwin, Chair

Professor Brent Mishler

Professor Rosemary Gillespie

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Abstract

Systematics of *Emmenanthe, Eucrypta,* and *Phacelia* sect. *Ramosissimae* (Hydrophyllaceae; Boraginales)

by

Genevieve Kathryn Walden

Doctor of Philosophy in Integrative Biology

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The systematics of Hydrophyllaceae (Boraginales) were investigated at three levels: a study of the pink-flowered and yellow-flowered plants in the genus *Emmenanthe*, an examination of the polyphyly of the genus *Eucrypta*, and molecular systematics of the taxa included in *Phacelia* sect. *Ramosissimae*. Pink-flowered *Emmenanthe* occurs in California in the Diablo Range and the Southern California mountains, and is occasionally sympatric with yellow-flowered *Emmenanthe*. Phylogenetic analyses of the internal transcribed spacer (ITS) region supported two reciprocally monophyletic evolutionary lineages corresponding to yellow-flowered and pink-flowered plants. Based on their evolutionary divergence and ability to remain distinct in sympatry, the two lineages in *Emmenanthe* are worthy of taxonomic recognition at the rank of species, as *E. penduliflora* and *E. rosea* (Brand) Constance, and are of evolutionary interest as examples of partially sympatric sister-species. Phylogenetic analyses of sequences from populations and specimens determined as *Eucrypta chrysanthemifolia* and *E. micrantha*, together with sequences representing major clades of tribe Hydrophylleae demonstrate that the two species in *Eucrypta* are not each other's closest relatives and represent disparate lineages in Hydrophyllaceae, confirming previous molecular studies. These results require recognition of a narrowed circumscription of *Eucrypta* sensu stricto (equivalent to *E. chrysanthemifolia* and varieties), a new genus, **Vermisperma**, and a new combination, **Vermisperma micranthum**, for *E. micrantha*. Evidence from the literature, museum specimen collections (databased and digitized), and molecular phylogenetic analyses were used in combination to revise the taxonomy of *Phacelia* sect. *Ramosissimae* (Rydb.) Walden & R.Patt.

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INTRODUCTION

The systematics of Hydrophyllaceae (Boraginales) were investigated at three levels: a study of the pink-flowered and yellow-flowered plants in the genus *Emmenanthe* (Chapter One), an examination of the polyphyly of the genus *Eucrypta* (Chapter Two), and molecular systematics of the taxa included in *Phacelia* sect. *Ramosissimae* (Chapter Three).

Pink-flowered *Emmenanthe* (=*E. penduliflora* Bentham var. *rosea* Brand) is generally restricted to serpentine soils, while yellow-flowered *Emmenanthe* (=*E. penduliflora* Benth. var. *penduliflora*) is generally on non-serpentine soils. However, yellow-flowered plants can tolerate serpentine soils, especially following chaparral burns. Pink-flowered *Emmenanthe* occurs in California in the Diablo Range and the Southern California mountains, and is occasionally sympatric with yellow-flowered *Emmenanthe*. Phylogenetic analyses of the internal transcribed spacer (ITS) region from samples of both groups supported two reciprocally monophyletic evolutionary lineages corresponding to yellow-flowered and pink-flowered plants. No intergradation has been observed in the field, although the two lineages co-flower and share pollinators, and previous studies found lowered but partial fertility in hybrids from reciprocal crosses. Based on their evolutionary divergence and ability to remain distinct in sympatry, the two lineages in *Emmenanthe* are worthy of taxonomic recognition at the rank of species, as *E. penduliflora* and *E. rosea* (Brand) Constance, and are of evolutionary interest as examples of partially sympatric sister-species. Based in part on the ecology of closely related members of Hydrophyllaceae, the widespread *E. penduliflora* likely represents the ancestral ecology of *Emmenanthe*, with a secondary divergence onto serpentine soils in the ancestry of *E. rosea*, possibly followed by reinforcement of ecological and reproductive barriers.

Bentham described *Emmenanthe* from collections sent by Douglas from California (see discussion regarding type locality) (Bentham 1835 [read June 17th, 1834, issue published 1835, volume published 1837]). Since its discovery the genus has been included in taxonomic circumscriptions and molecular systematics in the "core" Hydrophyllaceae clade of Ferguson (equivalent to Hydrophylloideae of Boraginaceae sensu lato of the recent APG series of classifications, and Hydrophyllaceae sensu Boraginales Working Group 2015) (Bremer et al. 1998; Ferguson 1998, 1998 [1999]; APG II 2003; APG III 2009; Luebert et al. 2015 *in revision*). *Emmenanthe* has been well placed within "clade I" of the "core" Hydrophyllaceae (Ferguson 1998 [1999]), but resolved as a separate lineage with uncertain placement in phylogenies with low sampling (Ferguson 1998, 1998 [1999]; Walden 2010). This study clarifies relationships of pink-flowered and yellow-flowered plants within the genus *Emmenanthe*, confirms placement of the genus in tribe Hydrophylleae, and contributes future work toward understanding the placement of *Emmenanthe* within the family.

Phylogenetic analyses of sequences from populations and specimens determined as *E. chrysanthemifolia* and *E. micrantha*, together with sequences representing major clades of tribe Hydrophylleae demonstrate that the two species in *Eucrypta* are not each other's closest relatives and represent disparate lineages in Hydrophyllaceae, confirming previous molecular studies. These results require recognition of a narrowed circumscription of *Eucrypta* sensu stricto (equivalent to *E. chrysanthemifolia* and varieties), a new genus, **Vermisperma**, and a new combination, **Vermisperma micranthum**, for *E. micrantha*. Although sampling was not adequate to address the molecular support for varieties of *E. chrysanthemifolia* (var. *chrysanthemifolia* and var. *bipinnatifida*), there is a clear geographic separation of the varieties.

This, in addition to differences between them in morphological characters and chromosome numbers, supports my decision to retain these varieties as taxonomic entities here. Although placement of *Eucrypta* sensu stricto and *V. micranthum* in Hydrophyllaceae is well supported, reconciliation of previous infrafamilial classifications is extremely complicated, requiring substantial family level sampling and falling outside the scope of this study.

Phacelia sect. *Ramosissimae* (Hydrophyllaceae: Boraginales), an entirely New World section of *Phacelia*, is a well-represented and recognizable group of the California Flora. Herbaria accession metadata (annotations, georeferencing, specimen citations) were used to investigate spatiotemporal patterns of taxonomic discovery, description, and delimitation in *P.* sect. *Ramosissimae*. Evidence from the literature, museum specimen collections (databased and digitized), and molecular phylogenetic analyses are used in combination to revise the taxonomy of *Phacelia* sect. *Ramosissimae* (Rydb.) Walden & R.Patt.

This dissertation does not constitute effective publication for purposes of taxonomy and nomenclature, and will be formally published following criteria of the International Code of Nomenclature.

Literature Cited

APG II. 2003. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG II. Botanical Journal of the Linnean Society 141:399–436.

APG III. 2009. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants. Botanical Journal of the Linnean Society 161(2):105–121.

Bentham, G. 1835 [read June 17th, 1834, issue published 1835, volume published 1837]. Review of the order of Hydrophylleae. Transactions of the Linnean Society 17:267–282.

Bremer, K., M. W. Chase, P. F. Stevens, A. A. Anderberg, A. Backlund, B. Bremer, B. Briggs, P. K. Endress, M. F. Fay, P. Goldblatt, M. H. G. Gustafsson, S. B. Hoot, W. S. Judd, M. Kallersjö, E. A. Kellogg, K. A. Kron, D. H. Les, C. M. Morton, D. L. Nickrent, R. G. Olmstead, R. Price, C. J. Quinn, and J. E. Rodman. 1998. An ordinal classification for the families of flowering plants. Annals of the Missouri Botanical Garden 85(4):531–553.

Ferguson, D. M. 1998. Phylogenetic systematics of Hydrophyllaceae. Ph.D. Dissertation, Biology, Harvard, Cambridge.

———. 1998 [1999]. Phylogenetic analysis and relationships in Hydrophyllaceae based on *ndh*F sequence data. Systematic Botany 23(3):253–268.

Luebert, F., L. Cecchi, M. W. Frohlich, M. Gottschling, H. H. Hilger, J. S. Miller, M. Mittelbach, M. Nazaire, M. Nepi, D. Nocentini, D. Ober, R. Olmstead, F. Selvi, K. Sutorý, B. Valdés, G. K. Walden, and M. Weigend. 2015 *in revision*. Familial classification of the Boraginales (Boraginales Working Group). Taxon.

Walden, G. K. 2010. Phylogeny of infrageneric relationships within *Phacelia* (Boraginaceae) inferred from chloroplast sequence data. M.S. Thesis, Biology, San Francisco State University, San Francisco.

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CHAPTER ONE

RECOGNITION OF TWO SPECIES IN *EMMENANTHE* (HYDROPHYLLACEAE; BORAGINALES)

ABSTRACT

Pink-flowered *Emmenanthe* (=*E. penduliflora* Bentham var. *rosea* Brand) is generally restricted to serpentine soils, while yellow-flowered *Emmenanthe* (=*E. penduliflora* Benth. var. *penduliflora*) is generally on non-serpentine soils. However, yellow-flowered plants can tolerate serpentine soils, especially following chaparral burns. Pink-flowered *Emmenanthe* occurs in California in the Diablo Range and the Southern California mountains, and is occasionally sympatric with yellow-flowered *Emmenanthe*. Phylogenetic analyses of the internal transcribed spacer (ITS) region from samples of both groups supported two reciprocally monophyletic evolutionary lineages corresponding to yellow-flowered and pink-flowered plants. No intergradation has been observed in the field, although the two lineages co-flower and share pollinators, and previous studies found lowered but partial fertility in hybrids from reciprocal crosses. Based on their evolutionary divergence and ability to remain distinct in sympatry, the two lineages in *Emmenanthe* are worthy of taxonomic recognition at the rank of species, as *E. penduliflora* and *E. rosea* (Brand) Constance, and are of evolutionary interest as examples of partially sympatric sister-species. Based in part on the ecology of closely related members of Hydrophyllaceae, the widespread *E. penduliflora* likely represents the ancestral ecology of *Emmenanthe*, with a secondary divergence onto serpentine soils in the ancestry of *E. rosea*, possibly followed by reinforcement of ecological and reproductive barriers.

Key Words: *Emmenanthe*, endemism, fire follower, Boraginales, Hydrophyllaceae, serpentine, sympatry

Introduction and Background

Comparative studies of co-occurring floral morphs have yielded valuable ecological and evolutionary insights, for example, within populations, as in *Linanthus parryae* (A. Gray) Greene (Epling and Dobzhansky 1942; Wright 1943; Schemske and Bierzychudek 2001, 2007), where floral morphs are maintained by selection, and linked to physiological traits that confer fitness advantages to water stress on differing substrates (Schemske and Bierzychudek 2001, 2007). Floral morphs can occur in clines, as in *Eschscholzia californica* Cham. (Cook 1962; Godoy et al. 1975), or inherited as a recessive mutation resulting in white California poppies (A. M. Wakelin et al. 2003). Floral morphs occurring in distinct populations have been treated as ecotypes in *Streptanthus polygaloides* A. Gray and associated with different habitats and climate (Turesson 1922; Boyd et al. 2009; Pope et al. 2014), and as subspecies in *S. glandulosus* Hook. (Kruckeberg 1957; Mayer and Soltis 1999; Mayer and Beseda 2010). Edaphically separated floral morphs often correspond to phylogenetic species, as in the flavonoid pigment variants of the *Lasthenia californica* complex (Rajakaruna and Bohm 1999; Chan et al. 2001, 2002; Rajakaruna 2003; Rajakaruna, Baldwin, et al. 2003; Rajakaruna, Bradfield, et al. 2003; Rajakaruna, Siddiqi, et al. 2003; Yost et al. 2012; Barry 2013). Some studies investigating putative intraspecific variation have supported the recognition of distinct lineages in areas of contact or occurring in sympatry, based on molecular evidence of divergence and lowered fertility of progeny between adjacent floral morphs (Mayr 1942; Baldwin et al. 2001).

The genus *Emmenanthe* Benth. (Hydrophyllaceae, Boraginales) comprises pink-flowered plants and yellow-flowered plants. *Emmenanthe* is a western North American genus, currently circumscribed as bitypic, with operational units sometimes treated at species rank, most recently treated at the rank of variety (Constance 1951; Halse et al. 1993; Patterson and Halse 2012; Jepson Flora Project [eds.] 2015). Pink-flowered plants sometimes have been treated as *E. penduliflora* var. *rosea* or *E. rosea*, due to restriction of pink-flowered plants to serpentine soils, but also repeated observations of pink-flowered populations co-occurring and co-flowering with populations of yellow-flowered plants treated as *E. penduliflora* var. *penduliflora* or *E. penduliflora* sensu stricto on serpentine soils (Wicklow 1966; Taylor 1968; Kennedy 1971; Wicklow 1977; Jones and Schlesinger 1980). These areas of co-occurring pink-flowered and yellow-flowered populations have been considered to represent either intraspecific variation (varieties) or sympatric taxa (species) in *Emmenanthe*. The uncertain taxonomic status of the pink-flowered and yellow-flowered plants in *Emmenanthe* have been a matter of some disagreement for the last century. Part of the difficulty in finding a consensus for taxonomic relationships in *Emmenanthe* was due to broad taxonomic circumscription of the genus and historic inclusion of *Miltitzia* A.DC. as a subgenus (as *Emmenanthe* subg. *Miltitzia* A. Gray).

Emmenanthe was described as a genus by Bentham (1835) in a treatment of the family Hydrophyllaceae R.Br., alongside the genera *Hydrophyllum* L., *Ellisia* L. (which included taxonomic entities now placed in *Eucrypta* Nutt., *Nemophila* Nutt. *Pholistoma* Lilja, and *Phacelia*), *Nemophila* Nutt., *Eutoca* R.Br. (included now as a synonym of *Phacelia*), and *Phacelia* Juss. The diagnostic characters of *Emmenanthe* were marcescent corollas, oblong-compressed capsules, narrow linear placentae, and glandular ovaries and capsules (Bentham 1835 [read June 17th, 1834, issue published 1835, volume published 1837]). The genus *Miltitzia* A.DC. (de Candolle 1845) also has distinctive yellow or white marcescent corollas, and was sometimes included within (what would today be a paraphyletic) *Emmenanthe*. For example, Gray included *Miltitzia* A.DC. in *Emmenanthe* as a subgenus, indicating this parenthetically and in discussion (pp. 84–85 in Newberry 1855), because both genera are easily identified in the field and herbarium by the similar morphological characteristics of yellow, marcescent corollas (J. S. Newberry 1855; Howell 1944b). The infrequently used autonym, *Emmenanthe* subg. *Emmenanthe*, is from this earlier publication, and not from the later 1875 *Conspectus* (Gray 1875; Howell 1944b; Walden and Patterson 2012). Gray (1875) published a larger treatment for *Emmenanthe* and subgenera in his *Conspectus of Hydrophyllaceae* (as 1. EMMENANTHE MILTITZIA Gray and § 2. EMMENANTHE VERA). Dalla Torre and Harms (1904) followed the treatment of Gray with two subgenera in *Emmenanthe* (as Subg. I. Euemmenanthe). Torrey (1871) included the taxa of *Miltitzia* A.DC. wholly within *Emmenanthe*.

With additional collections and descriptions of taxa of Hydrophyllaceae for comparison, it became increasingly clear that *Miltitzia* and *Emmenanthe* were morphologically distinct groups. Brand (1913) treated *Emmenanthe* and *Miltitzia* as separate genera in his revision of the Hydrophyllaceae, as did Rydberg in his *Flora* (1913), separating the genera by fruit shape (capsule not compressed in *Miltitzia*, compressed in *Emmenanthe*), flower position (erect in *Miltitzia*, pendulous in *Emmenanthe*), and habit (prostrate to ascending in *Miltitzia*, erect in *Emmenanthe*). Brand's names have priority from publication in May of 1913, while Rydberg's names are homonyms published in September of 1913. Howell (1944a) revised the taxa of *Miltitzia,* and then conclusively transferred them to *Phacelia* as a section (Howell 1944b), based on morphology and geography. Howell (1944b) noted that marcescent corollas occurred in other taxa of *Phacelia*, and that the taxa of *P.* sect. *Miltitzia* were morphologically more similar to *Phacelia* with laterally attached ovules to fleshy parietal placentae (basally attached ovules to margins of membranaceous parietal placentae in *Emmenanthe*), and plump, transversely corrugated seeds (compressed, reticulate pitted seeds in *Emmenanthe*).

Halse (1979, 1981) completed a thorough biosystematic study and revision of *Phacelia* sect. *Miltitzia* J. T. Howell, and excluded *Emmenanthe* due to differences in chromosome numbers (*P.* sect. *Miltitzia* has haploid counts of n = 11, 12, and 13, and *Emmenanthe* has n = 18) (Cave and Constance 1947, 1950, 1959; Constance 1963; Halse 1979, 1981), seed shape and seed surface texture using scanning electron microscopy (SEM) (*E. penduliflora*, fig. 1A, p.19–20 in Halse 1979), and pollen micromorphology (*P.* sect. *Miltitzia* exine reticulate-rugulate, 20–23 μm, and *Emmenanthe* exine rugulate-foveolate or foveo-reticulate, 32–33 μm [fig. 4D, pp. 27–28]) (Erdtman 1966; Constance and Chuang 1982).

Placement of *Phacelia* sect. *Miltitzia* outside of *Emmenanthe* sensu stricto (=*Emmenanthe* subg. *Emmenanthe*) was confirmed with molecular systematic study of Ferguson (1998, 1998 [1999]) for Hydrophyllaceae. *Phacelia* sect. *Miltitzia* and *P.* sect. *Euglypta* S. Watson were placed within *Phacelia* subg. *Microgenetes*. Ganong (2002) completed a well-sampled molecular systematic study of *Phacelia* sect. *Miltitzia*, which was combined with the molecular systematic study of Dempcy (1996) for *Phacelia* sect. *Euglypta* and the nrITS sequences from the dissertation of Ferguson (1998) in the publication of *Phacelia* subg. *Phacelia* by Gilbert et al. (2005). These investigations, and additional phylogenetic studies (Hansen et al. 2009; Walden 2010; Walden et al. 2014), have consistently supported *Phacelia* sect. *Miltitzia* within *Phacelia*. The taxonomic treatment below provides a full list of names excluded from the circumscription of the genus *Emmenanthe* sensu stricto, and Walden and Patterson (2012) present a list of names included in *Phacelia*.

The modern taxonomy of the genus *Emmenanthe* is equivalent to *Emmenanthe* subg. *Emmenanthe* (*Emmenanthe* sensu stricto), with *Emmenanthe* subg. *Miltitzia* excluded and placed within *Phacelia*. Treatments of the genus have been in the context of floristic treatments or studies of the entire family Hydrophyllaceae, perhaps because of the low level of described taxonomic diversity. Substantive sampling in a phylogenetic study within *Emmenanthe* has not previously been a priority. Molecular studies including representatives of *Emmenanthe* sensu stricto (=*Emmenanthe* subg. *Emmenanthe*) have been limited to a single representative of the yellow-flowered *Emmenanthe* (Ferguson 1998 [1999]).

Emmenanthe penduliflora var. *rosea* was distinguished from typical yellow-flowered *E. penduliflora* based on morphological differences of the corollas at anthesis ("Flores albido-rosei" [The flowers are whitish-pink] p. 134) (Brand 1913). Some floras treated var. *rosea* as a pink-flowered morph and in synonymy with *E. penduliflora* (Munz 1935). Sharsmith (1945) and Taylor (1968) provided the fullest set of descriptive and morphological characteristics to distinguish var. *rosea*, supported by edaphic and ecological considerations. Jepson (1943) and Sharsmith (1945) argued for recognition for the taxon (var. *rosea*) at the rank of species, based on morphological, ecological, and edaphic characters. Constance (1950a) elevated var. *rosea* to species rank in the fourth installment in the series of chromosome counts in Hydrophyllaceae, recognizing two species in *Emmenanthe* (Cave and Constance 1950). This was based on cytological studies in Hydrophyllaceae (Cave and Constance 1942, 1944, 1947, 1950, 1959), as well as investigations in the systematics of tribe Hydrophylleae (1939a), including *Ellisia* (1940), *Eucrypta* (1938), *Nemophila* (1941), *Hydrophyllum* (1942), *Pholistoma* (1939b), as well as other genera and tribes of Hydrophyllaceae, such as *Phacelia* (1943, 1948, 1949, 1950b, 1953).

In a chronological hiccup, Constance (1951) then treated the taxon again at rank variety in the Hydrophyllaceae treatment in the third volume of the *Illustrated Flora of the Pacific States* (Abrams and Ferris 1951). This 1951 treatment has sometimes been interpreted as a revision of *Emmenanthe* by Constance, in which he reduced the species to varieties. Constance's treatment (1951) does not cite his species name in the list of synonyms for var. *rosea*, and so it is most likely that the 1951 Hydrophyllaceae treatment (var. *rosea*) was submitted for publication before submission of the new species name (*E. rosea*), but the species name was eventually published first (1950a). Publication of Cave and Constance (1950) preceded Abrams and Ferris (1951), and editorial or publication constraints of the *Flora* so close to deadline may have precluded revision. Rather than a revision of the genus and reduction from species (1950a) to variety (1951), Constance's 1951 treatment represented a continuation of Brand's (1913) taxonomy of two varieties. The earlier (1950a) publication and recognition of two species is best considered as Constance's revision of *Emmenanthe.*

Except for the Hydrophyllaceae treatment (Constance 1951), Constance consistently recognized two species within *Emmenanthe* in all later works (Constance 1963; Constance and Chuang 1982). However, there were now alternative treatments of the taxonomic entities in *Emmenanthe* (as varieties or as species) that could be adopted by other researchers, depending on taxonomy need. Constance's (1950a) "two species" classification of *Emmenanthe* was implemented by Raven and Axelrod (1978), and by workers studying the ecology and biology of the genus (Tadros 1957; Wicklow 1966; Taylor 1968; Kennedy 1971; del Pilar Rodríguez-Rojo et al. 2001). The treatment of taxonomic units as varieties in *Emmenanthe* was not applied until the original and second editions of *The Jepson Manual* (Halse et al. 1993; Baldwin et al. 2012), following Constance's "revised" 1951 treatment.

Yellow-flowered *Emmenanthe*, currently treated as *E. penduliflora* Benth. var. *penduliflora* (=*Emmenanthe penduliflora*), are widespread annual herbs of the arid southwestern United States (Arizona, California, Nevada, Utah) and northwestern México (Baja California), that are abundant following disturbances (e.g., fire) (Constance 1951; Wicklow 1966). They have long been recognized as postfire annuals or "burn" plants, occurring in abundance on first-year burns of chaparral (Jepson 1943; Sweeney 1956; Keeley et al. 2012). Abundance greatly declines in the second year following a burn, with plants rare in the third year (Sweeney 1956; Wicklow 1977). The seeds are heterogeneous (refractory) in the germination responses, with the majority requiring scarification for germination, germinating within a week following cues (Sweeney 1956; Tadros 1957; Jones and Schlesinger 1980). Fire can provide chemical scarification, smoke increasing the permeability of the seed coat, with deactivation of inhibitory compounds (Egerton-Warburton and Ghisalberti 2001). Yellow-flowered *Emmenanthe* occurs in rocky, sandy, talus slopes, generally on non-serpentine soils (Tadros 1957). For some time, it was considered that yellow-flowered *Emmenanthe* did not occur on, or avoided, serpentine soils (Sharsmith 1945; Sweeney 1956). However, some populations are tolerant, or at least indifferent to, serpentine soils, although less abundant than on non-serpentine soils (Wicklow 1966, 1977).

Pink-flowered *Emmenanthe*, currently treated as *E. penduliflora* Bentham var. *rosea* (Brand) Constance (=*Emmenanthe rosea*), are narrowly distributed within California, less abundant (in comparison to yellow-flowered *Emmenanthe*), and less associated with disturbances (Tadros 1957; Wicklow 1966). Pink-flowered *Emmenanthe* have not been popularly recognized as characteristic fire followers, due to their restricted distribution and decreased abundance. However, plants do occur in pulses of increased abundance following fires (Wicklow 1964, 1966; Taylor 1968). The seeds are also heterogeneous in germination response, but the majority do not require scarification for germination (Wicklow 1977), but have inhibitory seed coat compounds that result in seed germination in successive years, which creates a stratified and persistent seed bank. The absence (loss) of scarification as the major requirement and associated differences in the seed coat of pink-flowered *Emmenanthe* may reflect linked phenotypic changes that evolved subsequent to specialization to serpentine substrate (the putatively derived state), with maintenance of ancestral germination requirements and seed coat characteristics in yellow-flowered *Emmenanthe*. Pink-flowered *Emmenanthe* have long been observed only occurring on serpentine soils. Sharsmith (1945) documented the affinity of pink-flowered *Emmenanthe* with serpentine soils and outcrops of the Mt. Hamilton Range, Tadros (1957) studied germination of pink-flowered and yellow-flowered *Emmenanthe* on a range of serpentine soils from the inner Coast Range of California, Wicklow (1964, 1966, 1977) documented occurrence of pink-flowered and yellow-flowered *Emmenanthe* on serpentine in the Clear Creek area near Idria, and Taylor (1968) studied the ecology of pink-flowered and yellow-flowered *Emmenanthe* on Mt. Hamilton.

In areas where yellow-flowered and pink-flowered *Emmenanthe* co-occur, populations are closely intermixed, but no intergradation or morphological hybrids have been observed in the field. Taylor (1968) studied the fertility of progeny between the yellow-flowered and pink-flowered plants by performing reciprocal artificial crosses. Progeny from various combinations of reciprocal crosses demonstrated lower fertility, and some crosses yielded few seeds, all of which were small, lacked endosperm, had abnormal embryos lacking cotyledons, and all failed to germinate (Taylor 1968). Although incomplete, this degree of hybrid sterility may impart some level of post-zygotic isolation, and contribute to the ability of taxa to remain distinct in sympatry (Epling and Dobzhansky 1942; Dobzhansky 1943; Grant 1971).

There have been characterizations of ecological separation of the pink-flowered plants and yellow-flowered plants based on site and habitat differences. Brand (1913) speculated, based on label metadata and examined specimens, that there might be an elevational differentiation in the field separating the two taxa ("Diese Varietät wächst in einer Höhe von 1900 m, während die typische Form nur bis 1700 m emporzusteigen scheint." [This variety grows at a height of 1900 m, while the typical form seems to rise only up to 1700 m.] p. 134, 1913). Sharsmith (1945) noted "a lack of a geographical segregation between species [*penduliflora*] and variety [*rosea*], but in the Mount Hamilton Range there is indication of an ecological separation" (p. 354), where pink-flowered *Emmenanthe* were limited to serpentine talus [serpentine soils and serpentinized rocks], and yellow-flowered *Emmenanthe* were excluded from those soils. Taylor (1968) found similar pollinators and flowering times for pink-flowered *Emmenanthe* and yellow-flowered *Emmenanthe* (see pollination and phenology section for additional discussion).

Tadros (1957) identified a "two-way ecological barrier" in *Emmenanthe* from germination studies. Serpentine soil excludes yellow-flowered *Emmenanthe*, except when nutrient availability following burns provides surplus resources for otherwise extremely low soil calcium, phosphorous, and potassium profiles. Pink-flowered *Emmenanthe* were found to be wholly restricted to serpentine soils, and excluded from non-serpentine soil. This was due to susceptibility of pink-flowered *Emmenanthe* to soil microbiota that infected seedlings on non-serpentine soils, a situation which also occurred in yellow-flowered *Emmenanthe*, but in a very low percentage of seedlings (Tadros 1957). This susceptibility to infection on non-serpentine soils set a limiting boundary on pink-flowered *Emmenanthe*, effectively restricting plants to serpentine soils. The pathogen-refuge hypothesis for serpentine endemic or tolerant plants also has gained support from recent studies by Springer (2009) in *Hesperolinon* (A. Gray) Small (Linaceae). When non-serpentine soils were autoclaved, pink-flowered *Emmenanthe* were able to survive to germinate and reach seedling stage, which Tadros attributed in part to increased nutrients from the autoclave process and in part to removal of serpentine specific fungal pathogens by heat sterilization. With the contribution from nutrients provided by chaparral fires, and the high heat of a chaparral fire and subsequent surface sterilization, pink-flowered *Emmenanthe* could temporarily increase extent of occurrence beyond serpentine soils. However, this has not been observed in field conditions. Serpentine soils are host to diverse fungal communities, and associations between plants and mycorrhizal fungi can increase success on serpentine soils (Schechter and Bruns 2008). Although unstudied, pink-flowered *Emmenanthe* may have serpentine fungal associations that aid success on serpentine soils, and which yellow-flowered *Emmenanthe* lack. In greenhouse studies, pink-flowered *Emmenanthe* were more tolerant than yellow-flowered plants to a range of serpentine soils conditions, especially to low Ca, K, and P, and to high Mg (Tadros 1957). Kruckeberg (1951, 1954) found similar results in *Streptanthus*, with serpentine races having an increased tolerance to serpentine soils compared with non-serpentine races. Mechanisms for tolerance to serpentine soil conditions (e.g., low calcium, high magnesium) have been shown to be an important adaptation in serpentine specialized taxa (Kazakou et al. 2008).

OBJECTIVES

The operational taxonomic units in *Emmenanthe* are currently treated as varieties (Hickman 1993; Baldwin et al. 2012), which may be due to an artifact of publication (Constance 1950a, 1951), and were previously treated at the rank of species to reflect morphological and ecological differences (Constance 1950a; Tadros 1957; Constance 1963; Wicklow 1966; Taylor 1968). Goals of this study were to explore relationships in *Emmenanthe*, including samples from the pink-flowered and yellow-flowered plants, using the internal transcribed spacer region (ITS-1, ITS-2, and 5.8S gene) of nuclear ribosomal DNA (nrITS) to infer an expanded nuclear phylogeny for the genus, test taxonomic concepts within a molecular phylogeny, seek support for any taxonomic rank decision, and determine the veracity of a putative case of sympatric sister-species. This study builds upon previous phylogenetic work by Ferguson (1998, 1998 [1999]), and adds to the understanding of systematics in the tribe Hydrophylleae Rchb. (Reichenbach 1830). Another goal was to provide an updated set of diagnostic characteristics for identification and recognition of taxa of *Emmenanthe*, useful in the field and herbarium, with a dichotomous key for identification. Distributions of the pink-flowered plants and the yellow-flowered plants of *Emmenanthe* were reassessed from georeferenced herbarium specimens and databased museum accession records to determine if there is elevational separation of pink-flowered and white-flowered plants and if they co-occur (exist in sympatry), and, if so, at what scale.

Materials and Methods

Taxon sampling

Samples of yellow-flowered *Emmenanthe* (=*E. penduliflora* var. *penduliflora*; *E. penduliflora* s.s.) for DNA work were included from fieldwork and herbarium specimens, and determined morphologically at the following institutions: Botanischer Garten und Botanisches Museum Berlin-Dahlem, Zentraleinrichtung der Freien Universität Berlin (B), California Academy of Sciences (CAS), Cambridge University (Larkin et al.), Kew Herbarium (K), California Polytechnic State University, San Luis Obispo (OBI), Muséum National d'Histoire Naturelle (P), San Francisco State University (SFSU), San Jose State University (SJSU), and University of California, Berkeley (UC/JEPS). One accession was downloaded from GenBank, representing yellow-flowered *Emmenanthe* (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005; Benson et al. 2013).

Specimens of pink-flowered *Emmenanthe* (=*E. penduliflora* var. *rosea*; *E. rosea*) were determined morphologically at CAS, JEPS, OBI, SFSU, and UC. Samples for DNA work were included from the Pacific Grove Museum (PGM) and the Monterey Bay chapter of the California Native Plant Society (CNPS) wildflower show from April 2010, and from herbarium specimens representing two of the three major geographic clusters (north and central). Appropriate material for DNA was not available from specimens representing the southern cluster for pink-flowered *Emmenanthe* (Mount Pinos and environs), which is also the type locality for the corresponding taxon, *E. penduliflora* var. *rosea*. There are only three collections for the southern cluster, which includes the type, all made prior in 1930. There are no other observation reports for this area from CalFlora (The Calflora Database [a non-profit organization] 2015). It is not known whether pink-flowered *Emmenanthe* still occur in the area.

When specimen metadata noted co-occurring populations of yellow-flowered and pink-flowered *Emmenanthe*, the corresponding voucher specimens of each floral morph were also sampled if destructive sampling was feasible and defensible (i.e., yellow-flowered *Bacigalupi 5653 &* pink-flowered *Bacigalupi 5654*, and yellow-flowered *Raiche 20377 &* pink-flowered *Raiche 20378*). The pink-flowered *Wicklow 154* (1963) and yellow-flowered *Wicklow 171* (1964) were collected from the same site in the first and second year following a prescribed burn in 1962 (Wicklow 1964, 1966, 1977). Herbarium accession numbers for examined for morphological determination and for georeferencing are included in Appendix 1.1 (yellow-flowered *Emmenanthe*) and Appendix 1.2 (pink-flowered *Emmenanthe*).

Additional accessions of representative genera from tribe Hydrophylleae Rchb. (*Ellisia nyctelea* Linnaeus, *Eucrypta micrantha* (Torrey) A. A. Heller, *Eucrypta chrysanthemifolia* (Bentham) Greene, *Hydrophyllum capitatum* Douglas, *Nemophila menziesii* Hooker & Arnott, and *Pholistoma auritum* (Lindley) Lilja ex Lindblom) were downloaded from GenBank, with *Draperia systyla* (A. Gray) Torrey (tribe Romanzoffieae Dumort.) as the outgroup (App. 1.3) (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005; Benson et al. 2013).

Gene region sampled

I examined the nrITS for inferring infrageneric relationships in *Emmenanthe*. nrITS is a variable, rapidly evolving region, previously used in phylogenetic studies to successfully resolve relationships at multiple taxonomic levels in the angiosperms (Baldwin et al. 1995; Álvarez and Wendel 2003; Yao et al. 2010; China Plant BOL Group et al. 2011), the Lamiidae sensu Olmstead et al. 1992 (Olmstead et al. 1992; Stevens 2001 onward; Maddison and Schulz 2007; Refulio-Rodriguez and Olmstead 2014), the Boraginales (Ferguson 1998; Moore and Jansen 2006; Weigend et al. 2009; Hasenstab-Lehman and Simpson 2012; Nazaire and Hufford 2012; Cohen 2013), and the hydrophylls (Ferguson 1996, 1997; Gilbert et al. 2005; Taylor 2012; Barr 2014). There are known issues for nrITS regarding alignment difficulties for some clades in Boraginales due to length variation resulting in indels (e.g., placement of the holoparasite family Lennoaceae Solms) (Ferguson 1998; Hilger et al. 2001; Smith 2003), and support can be weak at deeper nodes and in clades where sampling is sparse (Nazaire and Hufford 2012; Walden et al. 2014). nrITS was an appropriate set of markers for the objectives of this study, as it provides resolution for inferring infrageneric taxonomic relationships, as well as confirming membership within clades.

DNA isolation and PCR amplification

DNA Isolation. Protocol followed that of Walden et al. (2014) for nrITS. Total genomic DNA was extracted from at least 0.020 mg (up to 0.050 mg) dry weight herbarium or silica-dried leaf material following Doyle and Dickson (1987) using Qiagen DNeasy Plant kits (Qiagen, Valencia, CA, USA). Young, green leaves near tips of growing shoots were preferred for extraction, but not always available from herbarium specimens. For older herbarium specimens (i.e., anything collected before 1965), target weight herbarium leaf material was 0.040–0.050 mg dry weight to increase starting material. The protocol was modified to include tissue homogenization with acid-clean 3.2 mm chrome-steel beads or 5 mm solid soda lime #3000 glass beads using a TissueLyser II (Qiagen, Valencia, CA, USA) instead of grinding tissue with liquid nitrogen using mortar and pestle. The weighed samples were frozen at 4ºC in 2 ml microcentrifuge tubes prior to homogenization. The TissueLyser Adapters (2 × 24 Set) were also frozen for minimum 2 hours period prior to homogenization. Following the first homogenization cycle, the inner sample tubes were switched with outer sample tubes, and adapters were rotated and inverted for the second homogenization cycle. The incubation time was extended to 24 hrs for field-collected material, and to 48 hrs for herbarium material.

PCR amplification for nrITS. Total genomic DNA elutions for *Emmenanthe* were serially diluted to 1:100 in Ultra-Pure distilled H_20 (Invitrogen, Grand Island, NY, USA) for best PCR amplification (Mullis et al. 1987) of nrITS with primers ITS-I (forward) (Urbatsch et al. 2000) and ITS4 (reverse) (White et al. 1990). Primers were obtained as 300 mM stock (Elim Biopharmaceuticals, Inc. Hayward, CA, USA), and diluted first to 100 mM stock with ultralow Tris-EDTA buffer (ULTE), and then to 10 mM with Ultra-Pure H_20. PCR was conducted with a final reaction volume of 20 µL in AccuPower PCR PreMix Bioneer strip tubes (Bioneer, Inc., Alameda, CA, USA), each containing 0.75 µL of forward and 0.75 µL of reverse primer at 10mM each, and 17.0 µL 1:100 dilution genomic DNA template. The PCR thermo-cycle profile had an initial denaturation step of 1 min at 96ºC, followed by 35 cycles of 30 sec at 94ºC, 30 sec at 56ºC, and 1 min at 72ºC, and a final extension at 72ºC for 5 min, with subsequent storage at 4ºC.

To verify amplification of PCR products, a combined total of 5 µL of template PCR product and 1 µL of 6× loading dye was run on a 1.8% agarose gel (APEX agarose) in 1× TBE buffer at 100 volts, with a standard 100 bp ladder to visually size fragments. The gel was stained in an ethidium bromide bath, rinsed in deionized water, and viewed under ultra-violet light. Gel photographs were taken for reference (not shown). Sequence polymorphism in the direct sequenced PCR products was not observed; successful amplifications showed only a single band.

DNA sequencing

Cycle sequencing for nrITS. PCR products were cleaned of excess nucleotides (dNTPs) and primers from the amplification reaction using 1 µL ExoSAP-IT (USB Corp, Cleveland, Ohio, USA) per 5 µL template, with an initial 37ºC incubation for 30 min for digestion, followed by 80ºC for 10 min to inactivate the enzymes. Cycle sequencing for nrITS was conducted with the forward amplification primer ITS4 and reverse internal cycle sequencing primer ITS-5A (Downie et al. 2000) in a final reaction volume of 12 µL, containing 6.20 µL ultra-pure H_20, 0.8 µL BigDye (Applied Biosystems, Inc., Foster City, CA, USA), 2.0 µL 5× buffer, 1.0 µL primer (forward or reverse), and 2.0 µL template DNA. Reaction parameters were an initial 2 min at 94ºC denaturation step, followed by 25 cycles of 30 sec at 94ºC, 30 sec at 56ºC, and 30 sec at 72ºC, with terminal extension at 72ºC for 4 min, and storage at 4ºC.

Sequencing for nrITS. Cycle sequencing products were precipitated using EDTA/sodium acetate in ethanol protocol, and then resuspended in 15 µL Hi-Di formamide (Applied Biosystems, Inc., Foster City, CA, USA). Products were denatured for 2 min at 95ºC, followed by 5 min at 4ºC to snap chill. Samples were loaded into 96 well plates or strip tubes and spun down at low speed (700 rpm for 1 min). Sequencing was conducted using an ABI PRISM 3100 Sequencer (Applied Biosystems, Inc., Foster City, CA, USA).

Georeferencing

Databased herbarium accessions were extracted as .csv files from BajaFlora (BajaFlora 2015), Consortium of California Herbaria [CCH] (Consortium of California Herbaria [CCH] 2015), Consortium of Pacific Northwest Herbaria [CPNWH] (Consortium of Pacific Northwest Herbaria [CPNWH] 2015), and the Southwest Environmental Information Network [SEINet] (SOUTHWEST ENVIRONMENTAL INFORMATION NETWORK [SEINet] 2012–2015). Permission to access BajaFlora for research purposes was granted by Jon Rebman (Curator, San Diego Natural History Museum).

Data records with accepted names and synonyms for taxa of interest were retained from searches. Records were grouped by synonym for *E. penduliflora* and *E. rosea*, respectively (i.e., *E. penduliflora* var. *penduliflora* was grouped with *E. penduliflora*; *E. penduliflora* var. *rosea* was grouped with *E. rosea*). Records determined only to genus (i.e., *Emmenanthe* sp.) were considered the typical species (=*E. penduliflora* var. *penduliflora*, yellow-flowered *Emmenanthe*) unless contraindicated by metadata and then flagged for additional review. Data files were manually cleaned for consistency across fields and formats. Duplicate accessions of a unique collection were represented by a single placemark for georeferencing purposes, unless contraindicated by metadata. In some instances, accessions were extracted from more than one database due to overlapping geographic regions of interest by maintaining data institutions (e.g., SDSU5942 was extracted from both CCH and SEINet). These duplicate accessions were flagged during metadata processing, reviewed, and only one instance of the accession was included for georeferencing purposes.

Herbarium specimens were examined, morphologically determined, and annotated from B, CAS, CGE, JEPS, K, OBI, P, SFSU, SJSU, and UC during this study. Metadata from these specimens were used to validate fields from database extractions. Non-databased specimens were added to the study set when encountered during herbarium research. These specimens, and any databased accessions with null latitude and null longitude fields, were georeferenced using BerkeleyMapper 2.0 (Deck 2015; Google Earth Pro 2015). Duplicate collection numbers or duplicate collection localities were mapped using companion georeferenced accessions from additional search extractions in BajaFlora, California Academy of Sciences Botany Collection database (California Academy of Sciences [CAS] 2015), CCH, CPNWH, and SEINet in BerkeleyMapper 2.0 (Deck 2015) and Google Earth Pro (Google Earth Pro 2015). Where duplicate accessions were georeferenced, the single best georeferenced point that matched the combined metadata was chosen for completing fields. If all else was equal then the specimen physically examined during this study was chosen for completing null latitude and longitude fields (e.g., SBBG121262 was mapped from georeferenced duplicate UC1922641!, rather than georeferenced RSA654014 or UCR200180). Township Range Section was converted to decimal format using the TRS-data page of the Graphical Locator portal (Wefald 2003; Gustavson 2015). Universal Transverse Mercator (UTM) and other lat/long formats were converted to decimal format using the online converter from the Yellowstone Research Coordination Network (Yellowstone Research Coordination Network 2015). Conversions were validated using the LoadMapper function in BerkeleyMapper 2.0 (Deck 2015). For the records from the CCH, yellow flags from the Jepson eFlora and outlier points were resolved and communicated to the data administrator (i.e., Dick Moe and David Baxter). Some specimens were georeferenced to a general centroid for localities if metadata was sparse or otherwise limited to a location. These were mapped to the nearest populated area from available metadata. Some specimens were not georeferenced due to minimal metadata, and are noted in the list of accessions reviewed for metadata. For some historic collections, georeferencing was not appropriate with information currently available (see discussion regarding type collection in taxonomic section, and Appendix 1.4 for yellow-flowered *Emmenanthe*, and Appendix 1.5 for pink-flowered *Emmenanthe*).

kml files were generated using the online converter CSV to KML (http://www.convertcsv.com/csv-to-kml.htm, Data Design Group, Inc., Tallahassee, FL). Output was validated as .xml in Firefox 37.0.2 web browser, and as .kml files using the online web application KML Validator version 1.0 (http://www.kmlvalidator.com, Galdos Systems, Inc., Vancouver, B.C.), and using Excel to KML (https://www.earthpoint.us/ExcelToKml.aspx, Earth Point Corp., Kuna, ID). .kml files were imported to Google Earth Pro for visualization (Google Earth Pro 2015), and included as mapped (see taxonomic section, and appendices 2.4, 2.5, and 2.6). Ecoregions of North America were downloaded as shapefiles [shp] from the U.S. EPA (United States Environmental Protection Agency [U.S. EPA] 2013) and imported to Google Earth Pro (Google Earth Pro 2015). Jepson eFlora geographic subdivisions were imported as kml files (Jepson Flora Project [eds.] 2013). Geologic maps from the U.S.G.S. were imported as kml files (United States Geological Survey [U.S.G.S.] 2014). Georeferencing of herbarium specimens and databased accessions are visualized in Google Earth maps in the taxonomy section.

Data Analysis

Sequences were base-called in Sequencing Analysis Software 5.1 (Applied Biosystems, Inc., Foster City, CA, USA). Base calling was straightforward for nrITS; sequence polymorphism in the direct sequenced PCR products was not observed. Nucleotide sequences were edited and assembled using Sequencher 4.8 (Gene Codes Corporation, Inc., Ann Arbor, MI, USA) through a key license from the SFSU GTAC laboratory.

This study combined eight previously published nrITS sequences (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005) downloaded from GenBank (Benson et al. 2013) with nineteen new sequences for a total of 27 nrITS sequences. Seven new sequences were from specimens morphologically determined as pink-flowered *E. penduliflora* var. *rosea* (=*E. rosea*). Twelve new sequences were from populations and specimens determined as yellow-flowered *E. penduliflora* var. *penduliflora* (=*E. penduliflora* s.s.), combined with one previously published sequence of that taxon for a total of thirteen sequences. Six sequences were included as additional representatives of tribe Hydrophylleae, with *Draperia systyla* (tribe Romanzoffieae) as the outgroup. All sequences generated for this study will be deposited in GenBank.

Sequences were aligned in MAFFT (Katoh et al. 2002; Edgar 2004; Katoh et al. 2005; Katoh and Toh 2010) on XSEDE (Extreme Science and Engineering Discovery Environment) through the CIPRES (Cyberstructure for Phylogenetic Research) Science Gateway portal (Miller et al. 2010) using default parameters. Indels were edited manually in MacClade v.4.8 OSX (Sinauer Associates Inc., Sunderland, Massachusetts, [Maddison and Maddison 2001]).

Maximum parsimony phylogenetic analysis. The nrITS matrix was analyzed using the maximum parsimony criterion (MP) in PAUP* v.4.0b10 (Swofford 2002). MP phylogeny reconstruction was performed using a heuristic search of 10,000,000 random addition sequence replicates, with tree-bisection-reconnection (TBR) branch swapping algorithm, ACCTRAN, all characters unordered and weighted equally, gaps treated as missing data, and MAXTREES increased by 100 to a limit of 1,000,000. The maxtrees limit was hit once, while swapping on tree 30,628. Nonparametric bootstrap analyses were performed using the starting strict consensus tree obtained via stepwise addition, using a heuristic search, including 10 random addition sequence replicates with 100 bootstrap replicates (Felsenstein 1985).

DNA substitution model selection. NEXUS format of the sequence matrix was converted through the CIPRES Science Gateway portal (Miller et al. 2010) with NCLconverter version 2.1 (Lewis and Holder 2008) to a relaxed PHYLIP format on XSEDE (Extreme Science and Engineering Discovery Environment) (Stamatakis 2014). jModeltest2 version 2.1.6 on XSEDE with PHYML was used to test 88 models of evolution for best fit for the nrITS sequences (Posada and Crandall 1998; Guindon and Gascuel 2003; Posada and Buckley 2004; Posada 2008; Darriba et al. 2012).

Maximum likelihood phylogenetic analysis. Maximum likelihood (ML) analysis was initiated through the CIPRES Science Gateway portal (Miller et al. 2010) with RAxML-HPC2 version 8.1.11 analysis on XSEDE (Stamatakis 2014). The model of evolution was GTRGAMMA, with rapid bootstrapping, 1,000 bootstrap replicates, best tree search, and gaps and undetermined values treated as missing data (Stamatakis 2006; Stamatakis et al. 2008; Stamatakis 2014).

Bayesian phylogenetic analysis. Phylogenetic analyses using Bayesian inference (BI) were initiated in MrBayes 3.2.3 (Huelsenbeck and Ronquist 2001; Ronquist and Huelsenbeck 2003; Ronquist et al. 2012) using XSEDE through the CIPRES portal, with default priors, random starting trees, and two independent runs of 10,000,000 generations each (sampled every 1,000 generations), using four chains (three hot and one cold) and the general time reversible model with gamma-distributed rate variation across sites (GTR+G, nst to 6, rates to gamma). The average standard deviation of split frequencies from each run was less than 0.01, and PSRF (Potential Scale Reduction Factor) approached one (0.999) or equaled one for the 95% credibility interval. The number of trees required to reach stationarity was determined using Tracer v.1.6 (Rambaut et al. 2014). Convergence of posterior probabilities of split frequencies of runs was assessed in AWTY (Are We There Yet?) using the between run compare diagnostic function; graphical plots did not reject convergence (p near one for burn-in at 25%) (Wilgenbusch et al. 2004; Nylander et al. 2008). Burn-in samples (2,500) were discarded (samples included for analysis from each run: 7,501), and runs were combined, with posterior probabilities of nodes ≥95% considered strongly supported.

RESULTS

Model selection. Calculations via jModeltest2 using the Akaike information criterion (AIC) (Akaike 1973, 1974) indicated GTR+G (General Time Reversible model of nucleotide substitution with the gamma [Γ] model of rate heterogeneity) (Tavaré 1986) as the best-fit model of evolution (-lnL score: 2504.72843, delta = 0.0), as did use of the corrected Akaike information criterion (AICc) (-lnL score: 2504.72843, delta = 0.0). Use of the Bayesian information criterion (BIC) (Schwarz 1978; Wit et al. 2012) indicated TrNef+G (equal-frequency Tamura-Nei model of nucleotide substitution plus gamma [Γ] model of rate heterogeneity) (Tamura and Nei 1993) to be the best evolutionary model (-lnL score: 2521.67168, delta = 0.0), as did use of Decision Theory Performance-based selection (DT) (-lnL score: 2521.67168, delta = 0.0).

Phylogenetic analyses. The aligned nrITS matrix included 27 sequences and contained 2016 total characters. 1848 (91.667%) characters were constant and 83 (0.041%) variable characters were parsimony uninformative. The total number of parsimony informative characters was 85 (0.042%). The shortest MP tree length was 280 steps.

The RAxML phylogram of the single, best tree [-lnL = 2507.005750, tree length = 0.499096] with MP bootstrap values, ML bootstrap values, and BI posterior probabilities at nodes is shown in Fig. 1.1.

Emmenanthe is supported as a monophyletic clade in all analyses (MP 100/ ML 100/ BI 1). Two clades were strongly supported within the genus, corresponding to *E. penduliflora* (yellow-flowered, MP 99/ ML 81/ BI 0.97) and *E. rosea* (pink-flowered, MP 100/ ML 100/ BI 1).

Georeferencing and distribution. This study confirms and expands the distribution of yellow-flowered *Emmenanthe* (*E. penduliflora* var. *penduliflora*; *E. penduliflora* s.s.) and pink-flowered *Emmenanthe* (*E. penduliflora* var. *rosea*; *E. rosea*) from that of Taylor (see figure 1, 1968). Georeferencing of herbarium specimens and databased accessions for *Emmenanthe* resulted in range and elevation extensions for these taxa.

Yellow-flowered *Emmenanthe* were previously documented occurring from 0–2200 m (Patterson and Halse 2012); the metadata associated with specimens examined for this study extend this upper limit to 2600 m. Pink-flowered *Emmenanthe* were previously documented from an elevation range of 400–1800 m (Patterson and Halse 2012); the metadata associated with specimens examined for this study extend this lower limit to 300 m. Although Brand speculated that there might be elevational separation of the yellow-flowered and pink-flowered plants where they co-occur in the field, this was not supported by these data.

Yellow-flowered *Emmenanthe* are widespread, occurring in the United States in Arizona, California, Nevada, and Utah, and the Baja Peninsula in México (Fig. 1.2, 1.3). In California, for purposes of the Jepson eFlora (Jepson Flora Project [eds.] 2015), morphological determination of herbarium specimens and georeferencing of yellow-flowered *Emmenanthe* collections expands their distribution to add the Klamath Ranges, North Coast Ranges, and Tehachapi Mountain Area (full string KR, NCoRo, SNF, c&s SNH, Teh, SnJV, CW, SW, SNE, D) (following the bioregion name strings in the second edition of *The Jepson Manual* and online Jepson eFlora) (Baldwin et al. 2012; Jepson Flora Project [eds.] 2015).

Pink-flowered *Emmenanthe* remain limited in distribution within California (Fig. 1.4). Pink-flowered *Emmenanthe* occur throughout the southern Diablo Range (6z) (Fig. 1.5), with a separate occurrence in the Southern California Mountains. The collections in the Diablo Range (6z) occur from Mount Hamilton to Red Mountain, along Arroyo del Puerto, at Mount Oso, and south of Cedar Mountain approaching Arroyo Mocho (6r). For the northernmost geographic cluster of Mt. Hamilton and the Red Mountains, the earliest collection was 1903 (*A. D. E. Elmer 4877*). For the central cluster, there are western collections from the Gabilan Range (6y), from Pinnacles National Park (but regarding this collection; georeferencing is coarse), and along Mustang Grade in Monterey County. Additional populations occur along Sweetwater Grade and Clear Creek of San Benito Mountain, in possibly the most extreme area of severe edaphic selection in central California. For the geographic cluster around Idria, the earliest collection was from 1899 (*W. R. Dudley s.n.*). There are collections from the eastern edge of the Salinas-Cholame Hills (6al), and the western edge of the Eastern Hills (6aa).

The southern cluster of pink-flowered *Emmenanthe* occurs in the Northern Transverse Range (8g) of the San Emigdio Mountains, from Mount Pinos to Frazier Mountain, in Lockwood Valley (the southern drainage of Mount Pinos), and in Cuddy Valley and Cuddy Canyon (an eastern drainage of Mount Pinos) (Carman 1964). The area includes Ventura and Kern counties, adjacent to the Los Angeles County line. Separated by ca. 115 miles from the nearest population, the southernmost geographic cluster appears somewhat isolated geographically from the central and northern clusters, and has been collected less frequently.

In California, for purposes of the Jepson eFlora (Jepson Flora Project [eds.] 2015), morphological determination of herbarium specimens and georeferencing of collections expand the distribution of pink-flowered *Emmenanthe* to the edge of the western San Joaquin Valley for the Jepson eFlora (full string SnFrB, SCoRI, SnJV, WTR).

Pink-flowered *Emmenanthe* are wholly included within the distribution of yellow-flowered *Emmenanthe* (Fig. 1.6), and co-occur with yellow-flowered *Emmenanthe* at nearly all localities where pink-flowered plants have been documented. Pink-flowered *Emmenanthe* occur less frequently than yellow-flowered plants, and in less abundance, when considering their overall extent and only where they overlap on serpentine soils. Although collections of pink-flowered *Emmenanthe* along the western portion of the road from Red Mountain approaching Mt. Hamilton were not located in herbaria, there are reports from the literature that pink-flowered plants co-occur with yellow-flowered *Emmenanthe* throughout this area as well (Wicklow 1964; Taylor 1968).

DISCUSSION

Evolutionary and taxonomic implications of phylogenetic results. Two reciprocally monophyletic subclades are strongly supported within *Emmenanthe* in the phylogeny. Those subclades correspond precisely with the morphological distinction between pink-flowered *Emmenanthe* and yellow-flowered *Emmenanthe* seen in the field and herbarium. This supports recognition of the yellow-flowered and pink-flowered plants as separate phylogenetic species, *E. penduliflora* and *E. rosea*, using the definition of Mishler and Theriot (2000). There are several additional distinguishing factors that support delimiting these taxa at species rank: morphological characters, partial post-zygotic reproductive isolation (see Taylor 1968), and ecological restriction of *E. rosea* to serpentine, where its tolerance of low calcium (and also phosphorus and potassium) is met with a sufficient lack of pathogenic soil microbiota that infect seedlings (Tadros 1957; Wicklow 1966; Taylor 1968). This is probably a result of both intrinsic and extrinsic reproductive barriers that may provide sufficient reproductive isolation to satisfy the definition of the biological species concept (Mayr 1942, 1970). Intergradation has not been observed between *E. penduliflora* and *E. rosea* growing in adjacent settings (Tadros 1957; Wicklow 1966; Taylor 1968), which passes the "test of sympatry" of Stebbins (1966).

Distributional and edaphic considerations. Sister-species status of partially sympatric taxa is of evolutionary interest and warrants special attention to their ecological characteristics. *Emmenanthe rosea* was included as a broad serpentine endemic and strong indicator (SI) of serpentine affinity by Safford et al. (2005). Results of distributional studies reported here indicate that *E. rosea* occurs in areas associated with serpentinite, peridotite, mafics, and ultramafics. The ultramafic derived soils are serpentine, and the mafic derived soils are gabbro, which have generally been included together as 'serpentine' on labels (Walker 1954; Moody 1976; Alexander et al. 2007).

Emmenanthe penduliflora (as var. *penduliflora*) was included as a weak indicator (WI) of serpentine affinity by Safford et al. (2005). Although *E. penduliflora* sensu stricto is most commonly found in non-serpentine areas, it has been shown to tolerate areas of serpentine soils (Tadros 1957; Wicklow 1966). It is clear that in parts of its range, occurrence on serpentine is part of the ecology of yellow-flowered *E. penduliflora*. Georeferencing of herbarium accessions presented in this study is coarse, and comparison with geologic maps and soil surveys is minimally informative to associate collection localities with particular rock outcrops or soils. However, this study establishes the need for future work to characterize soils and relationships in *Emmenanthe*, as well as other soil specialists in the hydrophylls.

This updated and comprehensive distributional reassessment for *E. penduliflora* and *E. rosea* also indicates that both taxa are associated with disturbances and are abundant following fires. *Emmenanthe penduliflora* is considered a 'fire-annual' or 'fire-follower, due to the abundance in the first few years following burns of foothills and chaparral. *Emmenanthe* arose in association with polyploidization, although it is not known whether this was an autopolyploid or allopolyploid event, which needs additional research. Although nuclear and chloroplast partitions are poorly sampled and incongruent in recent studies for this clade (see Ferguson 1997, 1998 [1999], Walden et al. 2014), the closest sister taxon is *Eucrypta chrysanthemifolia* for most topologies (see Chapter 2). *Eucrypta chrysanthemifolia* is also considered a postfire specialist (Keeley et al. 2012) and fire adapted or preadapted traits may have been present in the most recent common ancestor of *Emmenanthe* and *Eucrypta* sensu stricto that proved advantageous in the consistent fire regimes and short intervals of the Californian Mediterranean-like climate.

Stebbins considered widespread and common taxa to be rich in biotypes; the genetic diversity of ecotypes providing adaptive advantages throughout heterogeneous conditions (Stebbins 1942). This characterization may be especially pertinent for *E. penduliflora* across its range. It has been considered a colonizer or a weedy taxon (Constance 1963) due to success following disturbances (Kruckeberg 1986). One hypothesis is that *Emmenanthe* was a desert-adapted plant, able to colonize newly opened spaces in habitats due to its weedy ecology, with genetic heterozygosity provided from polyploidy (Baker 1991). According to this hypothesis, *Emmenanthe* broadened its distribution through time and space, as additional land areas emerged, especially along the San Andreas Fault in California. However, the highly specific germination requirements of *E. penduliflora* are at odds with the category of colonizer. Was polyploidy a pre-adaptation to stress tolerance in *Emmenanthe* as it appears to have been in *Hesperolinon* (Rogers 1982)? There are likely edaphic races or edaphic ecotypes of *E. penduliflora* that are serpentine tolerant (or serpentine indifferent, or bodenvag); these are the populations that are common on the non-serpentine soils and can colonize serpentine soils of the Coast Range following burns (Kruckeberg 1951, 1984). These populations in particular conform to those previously described by Stebbins and Major (1965) as the *E. penduliflora* 'relict species' of the Napa-Lake area, Mt. Diablo and hills to the north, Santa Lucia Range from Cone Peak to Jolon, and the San Carlos Mountains, from Idria to Smith Mountain (Stebbins and Major 1965).

Emmenanthe rosea appears to be restricted to serpentine for much of its distribution, and these populations could be considered serpentine endemic or bodenstet (Unger 1836; Kruckeberg 1951; Safford et al. 2005). A possible scenario for the origination of *E. rosea* might be from an ecotype of *Emmenanthe* that was pre-adapted to serpentine soils and has not become much more widely distributed. The serpentine outcrops and barren slopes could be considered restricted terrestrial "islands" of appropriate habitat (Kruckeberg 1991), that fit the definition of an 'insular-species' (Stebbins 1942). If *E. rosea* speciated on serpentine, then the age of the speciation could be dated from the age of availability of habitat islands. This might also be useful if the divergence of *E. rosea* from a common ancestor with *E. penduliflora* occurred as a pre-adapted phenotype that aided fitness on serpentine when serpentine landscapes emerged.

Emmenanthe rosea has a partially discontinuous distribution, however, and the southernmost occurrence (Frazier Mountain and Lockwood Valley region) is from soils not associated with serpentine on the scale maps, and the observation of tolerance to a wider range of serpentine soils in cultivation (e.g., UCB82.1220, Wicklow 1966; Taylor 1968) perhaps better describe this taxon throughout its range as bodenhold (Nägeli 1865; Artschwager and Smiley 1925; Artschwager 1930). The confounding issue is the geology of the southern cluster and the relative association of the taxon to serpentine. For the southern cluster, there are fewer herbarium collections and limited metadata to derive conclusions. In addition, the geology of this area is distinct from that of the northernmost clusters. Generally the geology of the southern area is shaley, but the soils are shaley, clayey, and again form steep slopes. The ages of the rocks of the Mt. Pinos region are not satisfactorily dated (Carman 1964).

The current disjunction of the southern population cluster of *E. rosea* may be the result of several possible scenarios. One is that *E. rosea* evolved from an ecotype pre-adapted to serpentine soils in the north (the center of the largest population clusters), and subsequently dispersed to the south. Alternatively, this could be the opposite scenario, with a center of origin in the south and dispersal to the north. It is also possible that *E. rosea* was once more broadly distributed, and that the largest remaining populations are currently restricted to serpentine soils (depleted species), but also include the occurrence on the gypsite and shale barrens of Lockwood Valley (Stebbins 1942). Population genetics of these clusters, along with characterization of soils and pollinators would be ideal. Future work is needed to investigate genetic variation from edaphic and ecotypic areas of the range.

There is also the possibility that the explanation for the distribution of *E. rosea* may be similar to the situation noted by Kruckeberg for *Streptanthus amplexicaulis* (S. Watson) Jeps. var. *amplexicaulis* (=*Caulanthus amplexicaulis* S. Watson var. *amplexicaulis*) and *S. amplexicaulis* (S. Watson) Jeps. var. *barbarae* J. T. Howell (=*Caulanthus amplexicaulis* var. *barbarae* [J. T. Howell] Munz). *Streptanthus amplexicaulis* var. *barbarae* occurs on serpentine soils, while *S. amplexicaulis* var. *amplexicaulis* generally occurs on non-serpentine soils (granitics), except in the Lockwood Valley, where plants of *S. amplexicaulis* var. *amplexicaulis* occur on shale barrens but morphologically resemble those of *S. amplexicaulis* var. *barbarae*. Molecular studies of these plants confirmed that the Lockwood Valley populations are members of *Caulanthus amplexicaulis* var. *amplexicaulis* (Pepper and Norwood 2001). Because I was unable to include samples from the southernmost cluster of *E. rosea*, I can only offer this as a possible scenario for *Emmenanthe*. Should the plants from Mt. Pinos currently assigned to *E. rosea* be in the same clade as those of *E. penduliflora*, there would be taxonomic consequences, as the type of *E. rosea* is from this area.

Phenology, pollination, and reproductive morphology. There is no temporal separation for flowering times of pink-flowered *Emmenanthe* and yellow-flowered *Emmenanthe* where they occur together (see taxonomic treatment for additional details, and Appendices 1.4, 1.5) (Wicklow 1966; Taylor 1968; Kennedy 1971; Wicklow 1977).

Emmenanthe (pink-flowered and yellow-flowered plants) is pollinated by small solitary bees (halictids), which collect pollen and/or nectar as food sources (Taylor 1968; Kennedy 1971), but is primarily autogamous (self-fertile by means of self-pollination). The pink-flowered and yellow-flowered plants share pollinators (e.g., *Protodufourea wasbaueri* Timberlake) (Timberlake 1955; Kennedy 1971). It is not known if there are different pollinator preferences for *E. penduliflora* and *E. rosea* that might confer some degree of pre-zygotic isolation for co-occurring populations, and future studies are critically needed to investigate mechanisms maintaining variation in populations. Pollinators can be catholic for floral morphs, as in *Linanthus parryae* (Schemske and Bierzychudek 2001), or discriminate between floral morphs, as in *Raphanus sativus* L. (Stanton 1987) and in *Platystemon californicus* Benth. (Hannan 1981).

Emmenanthe has a conspicuous nectary disk subtending the ovary, which may provide reward for pollinators (Di Fulvio et al. 1999). The ovary has glandular emergences, which are unique to the genus in Hydrophyllaceae, as well as glandular trichomes, which may also contribute to a scent signal or reward for visiting pollinators (Di Fulvio and Dottori 1995; Di Fulvio et al. 1999). The scent of *Emmenanthe* has been described as "sweet, minty" (p. 35, Taylor 1968), or "chaparral" like (p. 98, Kennedy 1971), and is stronger in plants of *E. rosea* than in *E. penduliflora* (Taylor 1968). Pollinators may preferentially visit plants with different odors, as in *Polemonium viscosum* Nutt. (Galen 1985). The corolla and pollen grains of *E. penduliflora* are UV reflective, with shading of the corolla to indicate depth, but it is unknown if there are other pollinator guides or targets, or if reflectiveness changes during or post anthesis, and differs in comparison with *E. rosea* (Kennedy 1971). *Emmenanthe penduliflora* reflected visible light in yellow to yellow-green (641 nm, 578 nm, 578–424 nm) (Kennedy 1971). New methods in image calibration analysis may be effective in providing insights into the visual systems of pollinators (Troscianko and Stevens 2015).

There are additional reproductive morphological differences between *E. penduliflora* and *E. rosea* in addition to flower color. *Emmenanthe rosea* has greater distance between the pedicels of flowers along the inflorescence (7–11 mm), and fewer flowers per inflorescence (7–12). *Emmenanthe penduliflora* has a shorter distance between the pedicels of the inflorescence (5–9 mm), and more flowers per inflorescence (6–20). *Emmenanthe penduliflora* also tends to be more robust in its erect, dense habit, supporting more inflorescences per plant than the loose, open habit of *E. rosea* (Taylor 1968). *Emmenanthe rosea* has larger anthers, and Taylor (1968) reported anthers of *E. rosea* contained greater amounts of pollen compared to those of *E. penduliflora*, and this may provide greater rewards, increased visits, and perhaps insurance for pollination of the less abundant populations of *E. rosea*. The pollen of Hydrophyllaceae is tricolpate or tricolporate, exine structure tectate-perforate to semitectate, and exine ornamentation is generally reticulate (Walker 1974; Doyle 1978; Constance and Chuang 1982; Furness and Rudall 2004). *Emmenanthe penduliflora* exine sculpturing is rugulate-foveolate (Fig. 8, p. 43), while *E. rosea* is foveo-reticulate (Fig. 7, p. 43) (Constance and Chuang 1982).

Conservation Implications

Emmenanthe rosea is a California endemic, naturally restricted to areas of serpentine soils, except in the southernmost population cluster near Mt. Pinos. In cultivation, *E. rosea* exhibits two notable characteristics: it can tolerate a wider range of serpentine soils, and can sometimes lose the distinctive reddish coloring to the glandular trichomes when grown on non-parent serpentine soil (Wicklow 1966; Taylor 1968). An accession (JEPS81594) is in cultivation at the UC Berkeley Botanical Garden (UCB82.0220) in the chaparral bed. *Emmenanthe rosea* is not currently listed as a conservation concern by the California Department of Fish and Wildlife (California Department of Fish and Wildlife [CA DFG]), or by the California Native Plant Society (CNPS) (CNPS 2015). Thus, the plant is not tracked by occurrence for the state in databases CNDDB (California Department of Fish and Wildlife [CA DFG] 2015). However, the plant is included on the locally rare plant list for Ventura County (Magney 2013). *Emmenanthe rosea* was listed as Rare [R] and Indeterminate [I] in the 1997 IUCN Red list, but is no longer included in the current Red List (International Union for Conservation of Nature and Natural Resources [IUCN] 2015). It is important to understand demographics for these populations, especially with the limited information available for the southernmost population cluster of Lockwood Valley and Mt. Pinos.

The earliest collections of *E. rosea* from California are from 1896 (*Dudley and Lamb 4503* UC463133). This is also the earliest for the southernmost population cluster of Mt. Pinos and Frazier Mountain; it was next collected there in 1905 (the type), but not described until 1913. It was collected in the southernmost area again in 1930, but no other herbarium specimens have been documented since that time from the area. There are no herbarium specimens from the area collected more recently than 1930. There also are no other observation reports for this area from CalFlora (The Calflora Database [a non-profit organization] 2015). It is not known whether *E. rosea* still occurs in the area.

The Red Listed halictid bee, *Protodufourea wasbaueri* Timberlake (1955) was described from *E. rosea* flowers from Idria (San Benito Co.) (Bohart and Griswold 1996; The Xerces

Society 2015). Determination of the plants was made by H. Sharsmith (Timberlake 1955). *Emmenanthe penduliflora* and *E. rosea* occur throughout the Idria area. This halictid taxon was also collected from *E. penduliflora* during a pollinator study in the Mt. Hamilton region, with the specimens deposited at SFSU (Kennedy 1971). The distribution of *P. wasbaueri* is not well described, but it is of interest that *E. penduliflora* and *E. rosea* co-occur in the Mount Hamilton Range, and may provide suitable resources for this bee.

TAXONOMIC TREATMENT

Emmenanthe Benth., Transactions of the Linnean Society of London 17(2):281. 1835 [read 1834, issue published May 1835, entire vol. published 1837]. ---TYPE SPECIES: *Emmenanthe penduliflora* Benth., Transactions of the Linnean Society of London 17(2):281. 1835.

Plants annual herbs, minute to long hairy, minute glandular-hairy, sticky, odorous, taprooted. **Stems** erect, 2.5–85 cm, branches 0–many. **Leaves** basal and cauline, alternate, minute to long hairy, minute glandular-hairy; lower short-petioled, upper sessile, generally clasping, 1–12 cm, generally < 3 cm wide, elliptic to narrowly oblong, simple to pinnatifid, lobes ovate to lanceolate, margin entire or toothed to deep- pinnate-lobed, reduced upward; cotyledons lanceolate, base attenuate, short petiolate, early withering. **Inflorescences** terminal cyme, open, gen several to many-branched. **Pedicels** 5–15 mm, 12–25 mm in fruit, thread-like, ± ascending to erect or subspreading at anthesis, becoming recurved to pendulous in fruit. **Flowers** calyx divided to connate base or divided 2/3, marcescent, slightly imbricate in bud, gen equal, +- alike, green to red, minute to long hairy, minute glandular-hairy, scarcely accrescent lengthwise in fruit, slightly accrescent widthwise in fruit, lobes usually erect at anthesis, sometimes spreading in fruit, sinus appendages absent; aestivation imbricate quincuncial, corolla bell-shaped, white, cream, yellow, or pink at anthesis, minute to long hairy adaxially, minute glandular-hairy adaxially, persistent in age, withering, papery, enclosing fruit, scales of tube base absent, nectary gland on petal midvein absent; stamens 5, scarcely epipetalous, filament appearing free for most of length from corolla, included, (sub)equal in length, attached ± at same level at very base of corolla tube, erect, closely held next to ovary, glabrous, filament base not widened, white or yellow, anthers oblong, white or yellow, base cordate; ovary superior, sparsely minute glandular-hairy and minute to short hairy proximally, glandular emergences present, chambers 1, appearing 2 due to intrusion of narrow linear placentas, placentas parietal, membranaceous, ovules 3–8 per placenta, pendent, attached by the proximal end to margin of placentae; style 1, included, 1–4 mm, shallowly bifid to cleft 1/3, becoming recurved during anthesis, sparsely minute glandular-hairy and minute to short hairy proximally, glabrate distally, deciduous in fruit (rarely persistent), stigmas slightly capitate and papillose, hypogynous disk conspicuous, 5-lobed, lobes alternating between filaments, opposite corolla lobes. **Fruits** capsule, 7–10 mm, 2–4 mm wide, ovoid to oblong, compressed, indented along placental attachment, loculicidal, exceeded by corolla at maturity, minute to short hairy, minute glandular-hairy, glandular emergences present. **Seeds** 6–16, (1.5-) 2.5–6 mm, compressed adaxially and abaxially, wide-elliptic, brown; surface honeycombed (reticulate pitted) in irregular rows; elaiosome absent; embryo orthotropous. ***n*** = 18.

Emmenanthe can be distinguished from other genera in Hydrophyllaceae by imbricate quincucial aestivation, corolla scales or appendages absent, stamens scarcely epipetalous, glandular emergences present on the ovary and capsule, seeds compressed adaxially and abaxially, and a chromosome number of $2n = 18_{II}$. The haploid count of $n = 18$ is a synapomorphy for the genus within tribe Hydrophylleae and Hydrophyllaceae (Boraginales); biosystematic research resulted in chromosome counts of $n = 18$ for both pink-flowered *Emmenanthe* (Cave and Constance 1950) and yellow-flowered *Emmenanthe* (Constance 1963). Constance's (1963) idea that the genus originated as a polyploid duplication event (or saltational cladogenesis) remains a reasonable working hypothesis. Other haploid counts for genera included in tribe Hydrophylleae are $n = 8$ (*Hesperochiron, Howellanthus, Tricardia*), $n = 9$ (*Draperia, Hydrophyllum, Nemophila, Pholistoma*), $n = 10$ (*Ellisia*), and $n = 6, 10, 12, 20$ (*Eucrypta* in the broad sense, but see Chapter 2).

The genus name is derived from the Greek εμμένω (*emméno̲*, abide in place, stand fast, hold good), and άνθος (*ánthos*, flower or blossom), for the marcescent corollas (Liddell and Scott 1940; www.perseus.tufts.edu/hopper 2010). The otherwise unrelated genus *Emmenanthus* Hook. & Arn. (Ixonanthaceae) was described in 1841 for similar characters of persistence for the calyx and corolla (Hooker and Arnott 1841a). However, in the Supplement (Hooker and Arnott 1841b), a note was made that because the name *Emmenanthe* had priority, *Emmenanthus* was transferred to *Ixonanthe* Jack (Capt. Champion 1850).

The flowers of *Emmenanthe* exhibit heliotropism: opening in response to morning light, following the path of the sun, and closing in response in the evening or to water stress (Kennedy 1971). Corollas are open for two days, the anthers dehisce first (plants are protandrous), and the stigmas become receptive on the second day (Kennedy 1971; Lloyd and Webb 1986). *Emmenanthe* has a branched style, and these stigmatic lobes are erect on the first day, but then elongate and become recurved on the second day, bringing the receptive stigmatic surfaces closer to the anthers. The anthers continue to dehisce pollen throughout this second day, but the full length of pollen presentation is not known. This staggered timing of effective presentation of male and female parts (incomplete dichogamy/dikogamy system) is a mechanism that initially favors outcrossing but allows for eventual selfing (Lloyd and Webb 1986).

Following this two-day period, or after pollination, the corolla stays open but fades in color, becoming papery in texture, the lobes collapsing slightly between the sinuses (so that it appears much like a partially opened umbrella), and persisting around the fruiting capsule. The pedicels elongate and recurve following anthesis, so that the flower becomes pendulous. In *E. penduliflora*, the corolla fades from cream to white, or from yellow to pale yellow. In *E. rosea*, the corolla fades from white to off-white or tan, or from pink to pale pink. The inflorescences are cymes, generally branched in robust plants, with the lowest flowers developing first, and the terminal buds last. The inflorescence develops over the course of several weeks (although data on length of this full process are not well established), and monochasial cymes are asynchronous in development of flowers. Cues for germination (e.g., fire) in both *E. penduliflora* and *E. rosea* insure that open flowers are available on other plants in the cohort. Inflorescences can be branched in pairs (dichasial), with additional lateral cymes developing later. Flowers occurring at the same position along an inflorescence rachis develop approximately at similar rates for *E. penduliflora*, so that the flowers of geminate inflorescences will be open at the same time on a plant, and the geminate inflorescences can be considered hemisynchronous (Lloyd and Webb 1986).

Emmenanthe penduliflora Benth., Transactions of the Linnean Society of London 17(2):281. 1835 [read 1834, issue published May 1835, entire vol. published 1837]. ---TYPE: USA, California, *D. Douglas s.n.* (holotype: K! [this sheet with the Herbarium Benthamianum stamp of 1854 and drawings in pencil of the illustrated flower parts in the type folder at Kew]; isotypes: K! [annotated as *Emmenanthe* Benth. Hydrophylleae, and included as original material "Mr. Douglas's Californian collection" but perhaps collected from a different locality? with the Herbarium Benthamianum 1854 stamp, additional pencil drawings here as well, mounted with Sta. Barbara, *Nuttall s.n.* (K!) and det. *Emmenanthe penduliflora* Benth. with the Herbarium Hookerianum 1867 stamp], CGE!, E00288425 [D.D. fide Hooker] [E], P00648961!, NY00337106 [Torrey Herbarium] [sweetgum], M-0185227 [JStor]).

Plants 2.5–85 cm. **Stems** erect, green, glands colorless. **Petioles** proximally exceeding blade, winged, clasping at base, hairy in junctions, reduced distally, short-petiolate. **Leaves** green, pinnatifid, lobes few toothed, proximal leaves divided 1/2 to midrib, +- reduced upwards. **Inflorescences** (1-)6–19(-20) flowered; rachis green. **Pedicels** green, sometimes reddening adaxially in fruit, distance between pedicels 5–9 mm. **Flowers** calyx divided 2/3 (lobes divided 2/3), 3–7 mm, 2–4 mm wide, lance-ovate to ovate to triangular-ovate, glandular, scarcely enlarging lengthwise, slightly enlarging widthwise in fruit, midvein slightly raised, impressed in fruit so that the lobes appear auriculate proximally; corolla (6-)8–11(-15) mm, cream or yellow at anthesis, fading white or pale yellow post anthesis; filaments yellow, anthers 0.4–0.7 mm; style cleft 1/3, yellow. **Fruits** oblong. **Seeds** 8–16, (1.5-)2.5–4 mm, brown to dark brown. Figure 1.7.

The specific epithet for the type species (*penduliflora*) likely refers to the pendulous marcescent flowers of the inflorescence (from the Latin, *pendulinous*, to hang, and *flos*, flower) (Liddell and Scott 1940; www.perseus.tufts.edu/hopper 2010). At anthesis, the flowers are held upright on erect pedicels. Following anthesis, the pedicels elongate and curve downward, so that the marcescent flowers are pendulous and well spaced along the inflorescence rachis (Taylor 1968). The corolla dries to a papery texture, and in windy conditions, weighted by the developing capsules, causes a rasping sound as it moves against others corollas. Thus the common name 'whispering bells'.

Taylor (1968) collected pollinators of *E. penduliflora* from Mt. Hamilton, including *Osmia* Panzer, 1806 and *Augochlora* Eickwort, 1969 (Panzer 1806; Eickwort 1969). Kennedy (1971) recorded pollinators visiting *E. penduliflora* in the post-burn chaparral community of Mt. Hamilton, and identified *Ceratina* Latreille, 1802, *Conanthalictus seminiger* Michener, 1937, *Halictus* Latreille, 1804, *Hylaeus* Fabricius, 1793, *Lasioglossum* Curtis, 1833, *Nomadopsis fracta* Rozen, 1952, and *Protodufourea wasbaueri* Timberlake, 1955. Pollinator visitation was greatest in the morning, and decreased after noon. No insects were observed in overnight traps, consistent with the closing of the flowers (Kennedy 1971). Both Taylor (1968) and Kennedy (1971) found that self-pollinated plants (insect excluded) and open pollinated plants had similar pollination success and fertilization success based on high percent seed viability. Kennedy (1971) documented that insects increased efficiency of pollination in yellow-flowered *Emmenanthe*. Open pollinated plants of *E. penduliflora* had larger and more seeds compared to autogamous treatments (bagged and caged) (Kennedy 1971). Although morphological characters for yellow-flowered *Emmenanthe* are overall very similar across its distribution, differences between progeny from self-pollinated or open-pollinated plants may contribute to the occasional variability in morphologies observed (e.g., sizes and numbers of seeds).

Emmenanthe was collected by Douglas from California (given as 'California' in the protologue and type specimens, or sometimes 'Nova California' on type labels) (Bentham 1835 [read June 17th, 1834, issue published 1835, volume published 1837]). The protologue was read in 1834 (issue published in 1835, volume published in 1837), and some specimens include printed labels with the year 1833. Douglas traveled from Fort Vancouver [Washington] in October 1833 to the Hawaiian Islands, stopping in California, and sending correspondence dated November 1833 from San Francisco [Yerba Buena] (Douglas 1914; Jepson and Douglas 1933; Howell 1942; Douglas and Davies 1980). No collections of *Emmenanthe* from San Francisco County were located from extensive searches of herbaria collections during these studies. Douglas explored Mt. Tamalpais during the 1833 stopover (Balfour 1942b, 1942a), but no collections of *Emmenanthe* from Marin County were located. Searches of herbarium collections for these counties included synonyms, typographic and orthographic errors, undetermined specimens (determined during the process of this study), unaccessioned specimens, and folders of morphologically similar species that might host a misfiled or misidentified sheet of *Emmenanthe*. It is likely that the type collection was made during an earlier trip to California (1831–1832), perhaps from one of the stations listed by Howell (1942) or Harvey (1947). The '1833' date of type specimen labels may be the date of receipt by Bentham, or of distribution of duplicates. It is hoped that future work may identify the type locality more precisely for *E. penduliflora* and localities of many of the other important collections of David Douglas throughout California and the Pacific Northwest.

Emmenanthe rosea (Brand) Constance in Cave and Constance, University of California Publications in Botany 23:369–370, 380, fig. 43. 1950. *Emmenanthe penduliflora* Bentham var. *rosea* Brand, Pp. 134 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59). Verlag von Wilhelm Engelmann, Leipzig. 1913. ---TYPE: USA, California, Ventura County, Mount Pinos, Hillside near Stauffer P.O., piñon-belt, gravelly soil, only place, not common, (near Frazier Borax Mine), altitude 5750 feet, flowers dull white, rosy-tinted, ovules 6, 7, 8, 8, (1) June 1905, *H. M. Hall 6446* (holotype: UC126667!; isotypes: POM3684-0003779! [C. F. Baker Herbarium] [JStor], RENO10529-009888 [JStor], US614806-00110584 [JStor]).

Plants 4–20(-25) cm. **Stems** erect to spreading, red-green, glands reddish or pinkish. **Petioles** more or less equaling blade, reduced distally, winged, clasping at base. **Leaves** blue-green, pinnatisect or bipinnatifid, proximal leaves deeply divided to midrib, +- reduced upwards. **Inflorescences** 7–12 flowered; rachis red-green. **Pedicels** red-green, distance between pedicels 7–11 mm. **Flowers** calyx divided to connate base (lobes free to base), 7–11 mm, 2–3 mm wide, lanceolate, glandular, scarcely enlarging in fruit; corolla (8-)9–12(-13) mm, white or pale pink at anthesis, fading to off-white or brownish-white or pink post-anthesis; filaments white, anthers 0.6–1.1 mm; style shallowly bifid, white. **Fruits** ovoid. **Seeds** 6–12, (3.5-)4–6 mm, light brown to brown. Figure 1.8.

Jepson annotated a collection (*W. L. Jepson 12236*, JEPS1559 [sheet 1 of 2], JEPS1560 [sheet 2 of 2]) and corresponding field notebooks with the unpublished name *Emmenanthe brunnea* (Field Book Vol. 46, p. 46) (*Jepson Field Books, 1895 to 1940*). This collection was later annotated as *E. penduliflora* var. *rosea* in the same volume (Field Book Vol. 46, p. 202) (*Jepson Field Books, 1895 to 1940*) and cited as the variety (Jepson 1943). Jepson's choice for the epithet (*brunnea*, from the Latin brunneus, pure dull brown) was likely due to the coloration of the "stems, pedicels and calyces reddish-brown" (Jepson 1927; Borror 1988; Stearn 2004).

Halictid bees (not otherwise identified) were observed pollinating *E. rosea* grown outside for crossing studies at San Francisco State University (San Francisco County) (Taylor 1968).

KEY TO SPECIES OF *EMMENANTHE*

Emmenanthe penduliflora can be distinguished from *E. rosea* by the following dichotomous key.

1. Stem and inflorescence rachis green; proximal leaves divided 1/2 to midrib; calyx divided 2/3; corolla cream to yellow at anthesis.. *E. penduliflora*

1' Stem and inflorescence rachis red-green; proximal leaves deeply divided to midrib; calyx divided to connate base; corolla white to pink at anthesis...................................... *E. rosea*

NAMES NOT INCLUDED IN THE GENUS *EMMENANTHE*

Emmenanthe subg. *Miltitzia*, see *Phacelia* sect. *Miltitzia* (Halse 1979, 1981).
Emmenanthe foliosa, see *Phacelia salina*.
Emmenanthe glaberrima, see *Phacelia glaberrima.*
Emmenanthe glandulifera, see *Phacelia adenophora* J. T. Howell.
Emmenanthe lutea, see *Phacelia lutea*.
Emmenanthe parviflora, see *Phacelia inundata*.
Emmenanthe pusilla, see *Phacelia tetramera*.
Emmenanthe salina, see *Phacelia salina*.
Emmenanthe scopulina, see *Phacelia scopulina*.

Phacelia Juss. sect. *Miltitzia* (A. de Candolle) J.T.Howell, Leaflets of Western Botany 4(1): 15. 1944. *Miltitzia* A. de Candolle, Prodr. 9: 296. 1845. *Miltitzia* A. de Candolle ex de Candolle, Prodromus Systematis Naturalis Regni Vegetabilis 9:296. 1845. *Emmenanthe* Bentham subg. *Miltitzia* (A.DC.) A. Gray, War Department (U.S), Pacif. Railr. Rep. 1854-5, Volume VI, Part III, Botanical Report, No. 2:84–85. 1857. ---TYPE SPECIES: *Miltitzia lutea* (Hooker & Arnott) A. de Candolle, Prodromus Systematis Naturalis Regni Vegetabilis 9:296. 1845.

Phacelia adenophora J. T. Howell, Leaflets of Western Botany 4:15. 1944. *Emmenanthe glandulifera* Torrey ex S. Watson, Bot. U.S. Geol. Explor 40th Paral, King's Exped. 257–258. 1871. *Miltitzia glandulifera* (Torrey ex S. Watson) A. Heller, Muhlenbergia 8:20. 1912. *Phacelia lutea* (Hooker & Arnott) J. T. Howell var. *glandulifera* (Torrey ex S. Watson) A. Cronquist, Interm. Fl., 4:176. 1984. ---TYPE: USA, Nevada, Virginia Mountains, above Valley Wells, 5000 ft. elevation, July 1867, *S. Watson 885* [mounted with non-type specimen of *C. L. Anderson*, 1865] (holotype: GH00093338 [GH]; isotypes: NY00337105 [sweetgum], US00110582-00110579 [US], YU002009 [YU]).
Miltitzia glandulifera (Torrey) A. Heller var. *californica* Brand, Univ. Calif. Publications in Botany. 4:224. 1912. ---TYPE: USA, California, Lassen County, collected on Madeline Plains, June 1898, *Mrs. C. C. Bruce 2135t* (holotype: UC24031!).

Phacelia glaberrima (Torrey ex S. Watson) J. T. Howell, Leaflets of Western Botany 4(1):15. 1944. *Emmenanthe glaberrima* Torrey ex S. Watson, Bot. U.S. Geol. Explor 40th Paral, King's Exped. 257–258. 1871. *Miltitzia glaberrima* (Torrey ex S. Watson) Brand, p. 131 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59). Verlag von Wilhelm Engelmann, Leipzig. ---LECTOTYPE, designated by Halse 1981: USA, Nevada, Reese Valley, July 1868, *S. Watson 886* (hololectotype: GH00093336 [JStor]; isolectotypes: NY00337104 [sweetgum] US42142-00110579 [US]). SYNTYPE: USA, Nevada, Humboldt Mountains, Humboldt Sink, May 1868, *S. Watson 886* (GH00093337 [JStor], US42141-00110578 [US], NY01055196 not seen)

Phacelia inundata J. T. Howell, Leaflets of Western Botany 4(1):15. 1944. *Emmenanthe parviflora* A. Gray, War Department (U.S), Pacif. Railr. Rep. 1854-5, Volume VI, Part III, Botanical Report, No. 2:84-85, plate XV. 1857. *Miltitzia parviflora* (A. Gray) Brand, pp. 131–132 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59). Verlag von Wilhelm Engelmann, Leipzig. ---TYPE: USA, Oregon, Klamath Lake, *J. S. Newberry s.n.* (holotype: GH00093439 [JStor]).

Phacelia lutea (Hooker & Arnott) J. T. Howell, Leaflets of Western Botany 4:15. 1944. *Eutoca lutea* Hooker & Arnott, Bot. Beech. Voy. 373-374. 1841 [1839] [as *Eutoca ? lutea*]. *Miltitzia lutea* (Hooker & Arnott) A. de Candolle, Prodromus Systematis Naturalis Regni Vegetabilis 9:296. 1845. *Emmenanthe lutea* (Hooker & Arnott) A. Gray, Proceedings of the American Academy of Arts and Sciences 10:329. 1875. ---TYPE: USA, Idaho, Snake Fort, Snake Country, 1837, *W. F. Tolmie s.n.* (holotype: K!; isotype: E00369166 [JStor]).

Phacelia salina (A. Nelson) J. T. Howell, Leaflets of Western Botany, 4(1):16. 1944. *Emmenanthe salina* A. Nelson, Bulletin of the Torrey Botanical Club 25(7):381. 1898. *Miltitzia salina* (A. Nelson) Rydberg, Bulletin of the Torrey Botanical Club 40 (No. 9): 479. 1913. ---TYPE: USA, Wyoming, Bitter Creek Station, June 2, 1897, *Aven Nelson 3105* (holotype: RM10559-0002801 [RM]; isotypes MO2487462-011469 [TROPICOS], GH00091952 [GH], NY00337107 [JStor], CAS312479-0033426! [CAS], US00110587 [JStor])

Emmenanthe foliosa M. E. Jones, Zoë 4(3):278–279. 1893. *Miltitzia foliosa* (M.E. Jones) Brand, p. 131 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59). Verlag von Wilhelm Engelmann, Leipzig. ---LECTOTYPE, designated by Howell, 1944: USA, Utah, Tooele County, Alkaline flats, Deep Creek Valley above (i.e., south of) Furber, 8 June 1891, *M. E. Jones s.n.* (hololectotype: POM72887-0003778! [JStor]; isolectotypes: NY00337103 formerly DS [JStor], UC373321!, UC107114!, CAS154497-0033475! [JStor], US00110577 [JStor], GH00093333 [GH], MSC68498-0091662 [JStor]). See Howell 1944, p. 374, regarding variations of label metadata for Jones' collections.

Phacelia scopulina (A. Nelson) J. T. Howell, Leaflets of Western Botany 4(1):16. 1944. *Emmenanthe scopulina* A. Nelson, Bulletin of the Torrey Botanical Club 25:380381. 1898. *Miltitzia lutea* (Hooker and Arnott) A. de Candolle var. *scopulina* (A. Nelson) Brand, p. 131 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59). Verlag von Wilhelm Engelmann, Leipzig. *Miltitzia scopulina* Rydberg, Bulletin of the Torrey Botanical Club. 40:479. 1913. *Phacelia lutea* (Hooker & Arnott) J. T. Howell var. *scopulina* (A. Nelson) Cronquist, Vascular Plants of the Pacific Northwest. 4:168. 1959. LECTOTYPE, designated by Halse, 1981: USA, Wyoming, Sweetwater Co., Green River, 31 May 1897, *A. Nelson 3056* (hololectotype: RM10561-0002802 [RM];

isolectotype US00110588 [JStor], NY00337108 [JStor], GH00093461 [JStor]). SYNTYPE: USA, Wyoming, Sweetwater Co., Green River, 30 May 1897, *A. Nelson 3026* (holosyntype RM10560-0002803 [RM]; isosyntype US358897-01014290 [US]).

Phacelia tetramera J. T. Howell, Leaflets of Western Botany 4(1):16. 1944. *Emmenanthe pusilla* A. Gray, Proceedings of the American Academy 11:87-88. 1876. *Miltitzia pusilla* (A. Gray) Brand, p. 132 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59). Verlag von Wilhelm Engelmann, Leipzig. ---LECTOTYPE, designated by Halse 1981: USA, Nevada, Steamboat Springs, alt. 5,000 ft., May 1868, *S. Watson 878* in part (hololectotype: GH00093093 [GH]). SYNTYPE: USA, Nevada, northwest Nevada, May 1875, *Lemmon s.n.* [*887*] (syntype: GH00093094 [GH]; isosyntypes: UC444445!, YU001999 [YU]).

Miltitzia pusilla (A. Gray) Brand var. *flagellaris* Brand! , p. 132 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59). Verlag von Wilhelm Engelmann, Leipzig. LECTOTYPE, designated by Halse 1981: USA, Oregon, sterile alkaline soil of the Malheur River, 20 June 1898, *Wm. C. Cusick 1946* (hololectotype: US354672- 00110585 [US]; isolectotypes: GH00093453 [GH], MO2487475-694564 [JStor], ORE95944 not seen, ORE95944B not seen, WS 21853 not seen, RM31525-0002807 [JStor], NDG51465-41118 [JStor]). SYNTYPE: USA, Oregon, Union Co., [Union], dry alkaline soil, 1879, *Wm. C. Cusick 758* (GH00093092 [GH], NY not seen, US63241-00110586 [US], PH748787-00012108 [label date is 1883, handwritten 3, likely syntype material despite inconsistency on label] [JStor]).

Literature Cited

A. M. Wakelin, C. E. Lister, and A. J. Conner. 2003. Inheritance and biochemistry of pollen pigmentation in California Poppy (*Eschscholzia californica* Cham.). International Journal of Plant Sciences 164(6):867–875.

Abrams, L. R., and R. S. Ferris. 1951. An illustrated flora of the Pacific States: Washington, Oregon, and California. 4 vols. Vol. 3. Geraniaceae to Scrophulariaceae, geraniums to figworts. Stanford University Press, Stanford, California.

Akaike, H. 1973. Information theory and an extension of the maximum likelihood principle. Pp. 267–281. *In* B. N. Petrov and F. Caski (eds.), Proceedings of the Second International Symposium on Information Theory. Akademiai Kiado, Budapest. Springer-Verlag, New York, NY.

———. 1974. A new look at the statistical model identification. IEEE Transactions on Automatic Control 19(6):716–723.

Alexander, E. B., R. C. Coleman, T. Keeler-Wolfe, and S. P. Harrison. 2007. Serpentine geoecology of western North America: geology, soils, and vegetation. Oxford University Press, New York.

Álvarez, I., and J. F. Wendel. 2003. Ribosomal ITS sequences and plant phylogenetic inference. Molecular Phylogenetics and Evolution 29(3):417–434.

Artschwager, E. 1930. Dictionary of biological equivalents, German-English, by Ernst Artschwager. The Williams & Wilkins Company, Baltimore, MD.

Artschwager, E., and E. M. Smiley. 1925. Dictionary of botanical equivalents, German-English, Dutch-English, Italian-English. The Williams & Wilkins Company, Baltimore.

BajaFlora. *The Flora of Baja California. Specimen data obtained from a combined multi-herbarium specimen database called the Baja California Botanical Consortium hosted by the San Diego Natural History Museum. Herbarium specimen data provided by: San Diego Natural History Museum (SDNHM), San Diego State University (SD), Rancho Santa Ana Botanic Garden (RSA), Pomona College (POM), Centro del Investigaciones Biologicas del Noroeste, La Paz (HCIB), and Universidad Autonoma de Baja California, Ensenada (BCMEX)* 2015. Available from http://www.bajaflora.org.

Baker, H. 1991. The continuing evolution of weeds. Economic Botany 45(4):445–449.

Baldwin, B. G., D. H. Goldman, D. J. Keil, R. Patterson, T. J. Rosatti, and D. H. Wilken, eds. 2012. *The Jepson Manual: vascular plants of California*, Second Edition. University of California Press, Berkeley, California.

Baldwin, B. G., R. E. Preston, B. L. Wessa, and M. Wetherwax. 2001. A biosystematic and phylogenetic assessment of sympatric taxa in *Blepharizonia* (Compositae-Madiinae). Systematic Botany 26(1):184–194.

Baldwin, B. G., M. J. Sanderson, J. M. Porter, M. F. Wojciechowski, C. S. Campbell, and M. J. Donoghue. 1995. The ITS region of nuclear ribosomal DNA: a valuable source of evidence on angiosperm phylogeny. Annals of the Missouri Botanical Garden 82(2):247–277.

Balfour, F. R. S. 1942a. David Douglas. Journal of the Royal Horticultural Society 67(5):153–162.

———. 1942b. David Douglas. Journal of the Royal Horticultural Society 67(4):121–128.

Barr, C. M. 2014. Phylogenetic relationships and crossing data reveal a new species of *Nemophila* (Boraginaceae). Madroño 61(3):308–315.

BARRY, T. 2013. Local adaptation of two cryptic species, *Lasthenia californica and Lasthenia gracilis*, to distinct regions within a serpentine outcrop. M.S. Thesis, San Jose State University, San Jose, CA.

BENSON, D. A., M. CAVANAUGH, K. CLARK, I. KARSCH-MIZRACHI, D. J. LIPMAN, J. OSTELL, AND E. W. SAYERS. 2013. GenBank. Nucleic Acids Res 41(Database issue):D36–42.

BENTHAM, G. 1835 [read June 17th, 1834, issue published 1835, volume published 1837]. Review of the order of Hydrophylleae. Transactions of the Linnean Society 17:267–282.

BOHART, G. E., AND T. GRISWOLD. 1996. A revision of the Rophitine genus *Protodufourea* (Hymenoptera: Halictidae). Journal of the Kansas Entomological Society 69(4):177–184.

BORROR, D. J. 1988. Dictionary of word roots and combining forms compiled from the Greek, Latin, and other languages, with special reference to biological terms and scientific names. Mayfield Pub. Co., Mountain View, CA.

BOYD, R. S., M. A. WALL, S. R. SANTOS, AND M. A. DAVIS. 2009. Variation of Morphology and Elemental Concentrations in the California Nickel Hyperaccumulator Streptanthus polygaloides (Brassicaceae). Northeastern Naturalist 16(sp5):21–38.

BRAND, A. 1913. Hydrophyllaceae. Pp 1-210 *In* Das Pflanzenreich IV, Vol. 251 (Heft 59), Adolf Engler (ed.). Verlag von Wilhelm Engelmann, Leipzig [in German, translation by GKW].

CALIFORNIA ACADEMY OF SCIENCES [CAS]. 2015. Institute for Biodiversity Science and Sustainability, CAS Botany Collection Database. Website http://researcharchive.calacademy.org/research/botany/coll_db/index.asp.

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE [CA DFG]. *California Natural Diversity Database (CNDDB) Quickview Tool in BIOS 5* 2015. Available from https://map.dfg.ca.gov/bios/?tool=cnddbQuick.

CAPT. CHAMPION. 1850. On the ternstroemiaceous plants of Hong Kong. Proceedings of the Linnean Society of London 2:98–100.

CARMAN, M. F. 1964. Geology of the Lockwood Valley area, Kern and Ventura counties, California. Special Report 81. California Division of Mines and Geology, San Francisco, California.

CAVE, M. S., AND L. CONSTANCE. 1942. Chromosome numbers in the Hydrophyllaceae. University of California Publications in Botany 18:205–216.

———. 1944. Chromosome numbers in the Hydrophyllaceae, II. University of California Publications in Botany 18:293–298.

———. 1947. Chromosome numbers in the Hydrophyllaceae, III. University of California Publications in Botany 18:449–465.

———. 1950. Chromosome numbers in the Hydrophyllaceae, IV. University of California Publications in Botany 23:363–382.

———. 1959. Chromosome numbers in the Hydrophyllaceae, V. University of California Publications in Botany 30:233–258.

CHAN, R., B. G. BALDWIN, AND R. ORNDUFF. 2001. Goldfields revisited: A molecular phylogenetic perspective on the evolution of Lasthenia (Compositae : Heliantheae sensu lato). International Journal of Plant Sciences 162(6):1347–1360.

———. 2002. Cryptic goldfields: a molecular phylogenetic reinvestigation of Lasthenia californica sensu lato and close relatives (Compositae: Heliantheae sensu lato). American Journal of Botany 89(7):1103–1112.

CHINA PLANT BOL GROUP, D.-Z. LI, L.-M. GAO, H.-T. LI, H. WANG, X.-J. GE, J.-Q. LIU, Z.-D. CHEN, S.-L. ZHOU, S.-L. CHEN, J.-B. YANG, C.-X. FU, C.-X. ZENG, H.-F. YAN, Y.-J. ZHU, Y.-S. Sun, S.-Y. Chen, L. Zhao, K. Wang, T. Yang, and G.-W. Duan. 2011. Comparative analysis of a large dataset indicates that internal transcribed spacer (ITS) should be incorporated into the core barcode for seed plants. Proceedings of the National Academy of Sciences 108(49):19641–19646.

California Native Plant Society (CNPS), Inventory of Rare and Endangered Plants. 2015. http://www.cnps.org/inventory.

Cohen, J. I. 2013. A phylogenetic analysis of morphological and molecular characters of Boraginaceae: evolutionary relationships, taxonomy, and patterns of character evolution. Cladistics Online edition, DOI: 10.1111/cla.12036 (accessed 12 July 2013):1–31.

Consortium of California Herbaria [CCH]. *Data provided by the participants of the Consortium of California Herbaria [CCH]*. Regents of the University of California 2015. Available from <http://ucjeps.berkeley.edu/consortium/.

Consortium of Pacific Northwest Herbaria [CPNWH]. *Herbarium specimen data provided by: B. A. Bennett Herbarium, Yukon Government (BABY), Boise District Bureau of Land Management (BBLM), Boise State University, Snake River Plains Herbarium (SRP), Bureau of Land Management, Medford District (BLMMD), College of Idaho, Harold M. Tucker Herbarium (CIC), Eastern Washington University (EWU), Evergreen State College (EVE), Friday Harbor Laboratories (FHL), H.J. Andrews Experimental Forest (HJAEF), Humboldt State University (HSC), Idaho State University, Ray J. Davis Herbarium (IDS), Linfield College (LINF), Milner Gardens and Woodland, Vancouver Island University (VIU), Montana State University (MONT), Oregon State University (OSC), Pacific Lutheran University (PLU), Pacific Northwest Herbarium, Western Washington University (WWB), Portland State University (HPSU), Reed College (REED), Royal British Columbia Museum (V), Southern Oregon University (SOC), The New York Botanical Garden (NY), University of Alaska, Anchorage (UAAH), University of Alaska, Fairbanks - Museum of the North (ALA), University of British Columbia (UBC), University of Idaho, Stillinger Herbarium (ID), University of Lethbridge (LEA), University of Montana (MONTU), University of Puget Sound (PSM), University of Washington (WTU), University of Wyoming, Rocky Mountain Herbarium (RM), Washington State University, Marion Ownbey Herbarium (WS), Whitman College (WCW). Accessed through the Consortium of Pacific Northwest Herbaria web site* 2015. Available from www.pnwherbaria.org.

Constance, L. 1938. The genus *Eucrypta* Nuttall. Lloydia 1:143–152.

———. 1939a. The genera of the tribe Hydrophylleae of the Hydrophyllaceae. Madroño 5:28–33.

———. 1939b. The genus *Pholistoma* Lilja. Bulletin of the Torrey Botanical Club 66:341–352.

———. 1940. The genus *Ellisia*. Rhodora 42(494):33–39.

———. 1941. The genus *Nemophila* (Nuttall). University of California Publications in Botany 19:341–398.

———. 1942. The genus *Hydrophyllum* L. American Midland Naturalist 27:710–731.

———. 1943. A new species of *Phacelia* from Saline Valley, California. Madroño 7(2):56–59.

———. 1948. A new species of *Phacelia* from Sonora, México. Madroño 9(8):255–256.

———. 1949. A revision of *Phacelia* subgenus *Cosmanthus* (Hydrophyllaceae). Contributions to the Gray Herbarium 168:1–48.

———. 1950a. *Emmenanthe rosea* (Brand) Constance, P. 369-370, 380, fig. 43. *In* M. S. Cave and L. Constance, Chromosome numbers in the Hydrophyllaceae, IV. University of California Publications in Botany 23:363-382.

———. 1950b. Some interspecific relationships in *Phacelia* subgenus *Cosmanthus*. Proceedings of the American Academy of the Arts 78:135–147.

———. 1951. Hydrophyllaceae, Pp. 476–532. Illustrations by J. R. Janish. *In* L. R. Abrams and R. S. Ferris, (eds.), Illustrated Flora of the Pacific States. 4 vols. Vol. 3. Geraniaceae to Scrophulariaceae, geraniums to figworts. Stanford University Press, Stanford, California.

———. 1953. *Howellanthus*, a new subgenus of *Phacelia*. Madroño 11(5):198–203.

———. 1963. Chromosome number and classification in Hydrophyllaceae. Brittonia 15:273–285.

CONSTANCE, L., AND T.-I. CHUANG. 1982. SEM survey of pollen morphology and classification in Hydrophyllaceae (Waterleaf Family). American Journal of Botany 69:40–53.

COOK, S. A. 1962. Genetic system, variation, and adaptation in *Eschscholzia californica*. Evolution 16(3):278–299.

DALLA TORRE, K. W. V., AND H. A. T. HARMS. 1904. Genera siphonogamarum ad systema Englerianum conscripta. Verlag con Wilhelm Engelmann, Leipzig.

DARRIBA, D., G. L. TABOADA, R. DOALLO, AND D. POSADA. 2012. jModelTest 2: more models, new heuristics and parallel computing. Nature methods 9(8):772–772.

DE CANDOLLE, A. 1845. Hydrophyllaceae. Pp. 287-301. *In* Augustin Pyramus de Candolle (ed.), Prodromus Systematis Naturalis Regni Vegetabilis, Fortin, Masson and Company, Paris, France.

DECK, J. *Berkeley Mapper 2.0, http://berkeleymapper.berkeley.edu. Available at https://github.com/BNHM/berkeleymapper* 2015.

DEL PILAR RODRÍGUEZ-ROJO, M., D. SÁNCHEZ-MATA, S. RIVAS-MARTÍNEZ, AND M. G. BARBOUR. 2001. Syntaxonomical approach for classification of the Californian serpentine annual grasslands. Lazaroa 22:83–94.

DEMPCY, J. M. 1996. Phylogenetic relationships in *Phacelia* section *Euglypta* (Hydrophyllaceae). M.S. Thesis, Biology, San Francisco State University, San Francisco.

DI FULVIO, T. E., M. T. COSA, AND N. DOTTORI. 1999. Morfología y vascularización floral de *Draperia, Emmenanthe, Hesperochiron, Romanzoffia,* y *Tricardia* (Phacelieae, Hydrophyllaceae). Kurtziana 27(1):187–209. [in Spanish, translation by GKW].

DI FULVIO, T. E., AND N. DOTTORI. 1995. Contribución al conocimiento de tricomas y emergencias en Hydrophyllaceae. Clasificación y consideraceones taxonómicas. Kurtziana 24:19–24.

DOBZHANSKY, T. 1943. Genetics of natural populations IX. Temporal changes in the composition of populations of *Drosophila pseudoobscura*. Genetics 28(2):162.

DOUGLAS, D. 1914. Journal kept by David Douglas during his travels in North America 1823-1827 together with a particular description of thirty-three species of American oaks and eighteen species of *Pinus*, with appendices containing a list of the plants introduced by Douglas and an account of his death in 1834. Published under the direction of the Royal Horticultural Society by W. Wesley & Son, London. Website http://www.archive.org/details/journalkeptbydav00dougiala (accessed 18 January 2014).

DOUGLAS, D., AND J. DAVIES. 1980. Douglas of the forests : the North American journals of David Douglas. University of Washington Press, Seattle.

DOWNIE, S. R., D. S. KATZ-DOWNIE, AND M. F. WATSON. 2000. A phylogeny of the flowering plant family Apiaceae based on chloroplast DNA *rpl16* and *rpoc1* intron sequences: towards a suprageneric classification of subfamily Apioideae. American Journal of Botany 87:273–292.

DOYLE, J. A. 1978. Origin of Angiosperms. Annual Review of Ecology and Systematics 9:365–392.

DOYLE, J. J., AND E. E. DICKSON. 1987. Preservation of plant samples for DNA restriction endonuclease analysis. Taxon 36:715–722.

EDGAR, R. C. 2004. MUSCLE: multiple sequence alignment with high accuracy and high throughput. Nucleic Acids Research 32(5):1792–1797.

EGERTON-WARBURTON, L. M., AND E. L. GHISALBERTI. 2001. Isolation and Structural Identification of a Germination Inhibitor in Fire-Recruiters from the California Chaparral. Journal of Chemical Ecology 27(2):371–382.

EICKWORT, G. C. 1969. A comparative morphological study and generic revision of the augochlorine bees (Hymenoptera: Halictidae). Estudio morfológico comparativo y revisión genérica de las abejas augochlorinas (Hymenoptera: Halictidae). The University of Kansas Science Bulletin. 48(13):325–524.

EPLING, C., AND T. DOBZHANSKY. 1942. Genetics of natural populations. VI. Microgeographic races in Linanthus parryae. Genetics 27(3):0317–0332.

ERDTMAN, G. 1966. Pollen morphology and plant taxonomy: angiosperms. Hafner, New York, NY.

FERGUSON, D. M. 1996. Phylogenetic analysis of Hydrophyllaceae and a preliminary study of biogeographic patterns and life history evolution. American Journal of Botany (supplement) 83:155–156.

———. 1997. Phylogenetics systematics in Hydrophyllaceae as inferred from the chloroplast gene *ndhF* and the nuclear rDNA *ITS* region. American Journal of Botany (supplement) 84:557.

———. 1998. Phylogenetic systematics of Hydrophyllaceae. Ph.D. Dissertation, Biology, Harvard, Cambridge.

———. 1998 [1999]. Phylogenetic analysis and relationships in Hydrophyllaceae based on *ndh*F sequence data. Systematic Botany 23(3):253–268.

FURNESS, C. A., AND P. J. RUDALL. 2004. Pollen aperture evolution–a crucial factor for eudicot success? Trends in plant science 9(3):154–158.

GALEN, C. 1985. Regulation of seed-set in *Polemonium viscosum*: floral scents, pollination, and resources. Ecology 66(3):792–797.

GANONG, C. K. 2002. Phylogenetic analysis of *Phacelia* section *Miltitzia*. M.S. Thesis, Biology, San Francisco State University, San Francisco.

GILBERT, C., J. M. DEMPCY, C. K. GANONG, R. PATTERSON, AND G. S. SPICER. 2005. Phylogenetic relationships within *Phacelia* subgenus *Phacelia* (Hydrophyllaceae) inferred from nuclear rDNA ITS sequence data. Systematic Botany 30:627–634.

GODOY, R., P. ITURRA, S. KOREF-SANTIBÁÑEZ, J. NAVARRO, N. PACHECO, AND G. STEBBINS. 1975. Polymorphism and geographic variation of flower color in chilean populations of *Eschscholzia californica*. Plant systematics and evolution 123(3):185–198.

GOOGLE EARTH PRO. *version 7.1*. Google, Inc. Mountain View, CA 2015. Available from http://www.google.com/enterprise/earthmaps/earth_pro.html.

GRANT, V. 1971. Plant speciation. Columbia University Press, New York, NY.

GRAY, A. 1875. A Conspectus of the North American Hydrophyllaceae. Proceedings of the American Academy of Arts and Sciences 10:312–332.

GUINDON, S., AND O. GASCUEL. 2003. A simple, fast, and accurate algorithm to estimate large phylogenies by maximum likelihood. Systematic Biology 52(696-704).

GUSTAVSON, D. L. *Graphical Locator* 2015. Available from http://www.esg.montana.edu/gl/index.html [accessed 2010–2015].

HALSE, R. R. 1979. Taxonomy of *Phacelia* section *Miltitzia* (Hydrophyllaceae). Dissertation, Biology, Oregon State University, Corvallis.

———. 1981. Taxonomy of *Phacelia* section *Miltitzia* (Hydrophyllaceae). Madroño 28(3):121–132.

HALSE, R. R., D. WILKEN, AND R. PATTERSON. 1993. Hydrophyllaceae. *In* The Jepson Manual: Higher plants of California, J. C. Hickman (ed. University of California Press, Berkeley.

HANNAN, G. L. 1981. Flower color polymorphism and pollination biology of *Platystemon californicus* Benth. (Papaveraceae). American Journal of Botany 68(2):233–243.

HANSEN, D. R., G. S. SPICER, AND R. PATTERSON. 2009. Phylogenetic relationships between and within *Phacelia* sections *Whitlavia* and *Gymnobythus* (Boraginaceae). Systematic Botany 34(4):737–746.

HARVEY, A. G. 1947. Douglas of the Fir: a biography of David Douglas, botanist. Harvard University press, Cambridge, MA.

HASENSTAB-LEHMAN, K. E., AND M. G. SIMPSON. 2012. Cat's eyes and popcorn flowers: phylogenetic systematics of the genus *Cryptantha* s.l. (Boraginaceae). Systematic Botany 37(3):738–757.

HICKMAN, J. C., ed. 1993. The Jepson Manual: Higher plants of California. University of California Press, Berkeley.

HILGER, H. H., M. WOLF, AND N. DIANE. 2001. Secondary structure of the ITS1 transcript and its application in a reconstruction of the phylogeny of Boraginales. Plant Biology 3:629–636.

HOOKER, W. J., AND G. A. W. ARNOTT. 1841a. The botany of Captain Beechey's voyage; comprising an acount of the plants collected by Messrs. Lay and Collie, and other officers of the expedition, during the voyage to the Pacific and Behring's Strait, performed in His Majesty's ship Blossom, under the command of Captain F. W. Beechey ... in the years 1825, 26, 27, and 28. H. G. Bohn, London.

———. 1841b. Supplement to the *Californian Collection*, *in* The botany of Captain Beechey's voyage. H. G. Bohn, London.

HOWELL, J. T. 1942. Concerning David Douglas. Leaflets of Western Botany 3:160–162.

———. 1944a. A reconsideration of the genus *Miltitzia*. Leaflets of Western Botany 4(1):12–16.

———. 1944b. A revision of *Phacelia* section *Miltitzia*. Proceedings of the California Academy of Sciences 4th series, volume 25:357–376.

HUELSENBECK, J. P., AND F. RONQUIST. 2001. MRBAYES: Bayesian inference of phylogeny. Bioinformatics 17:754–755.

INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES [IUCN]. *The IUCN Red List of Threatened Species. Version 2014.3* 2015. Available from http://www.iucnredlist.org.

J. S. NEWBERRY. 1855. Part III, Botanical Report, No. 2, General catalogue of the plants collected on the expedition. With A. Gray and J. Torrey. Pp. 65–94. *In* Report of Lieutenant Henry J. Abbot, Corps of Topographical Engineers, upon Explorations for a

Railroad Route from The Sacramento Valley to the Columbia River, made by Lieutenant R. S. Williamson Washington, D.C.

Jepson Field Books, 1895 to 1940. The University and Jepson Herbaria, University of California, Berkeley. Available from http://ucjeps.berkeley.edu/images/fieldbooks/jepson_fieldbooks.html.

JEPSON FLORA PROJECT [EDS.]. 2013. Jepson eFlora: Geographic subdivisions [kml].

———. *Jepson eFlora* 2015. Available from http://ucjeps.berkeley.edu/IJM.html [accessed from 2010–2015].

JEPSON, W. L. *Emmenanthe brunnea* Jepson n. sp. manuscript (*nomen in. herb.*). Jepson Herbarium. mss. in envelope of specimen *Jepson 12236* (JEPS1559). University & Jepson Herbaria, University of California, Berkeley.

———. 1943. Flora of California. Vol. 3. Associated Students Store, University of California Berkeley, Berkeley.

JEPSON, W. L., AND D. DOUGLAS. 1933. David Douglas in California. Madroño 2(12):97–100.

JONES, C. S., AND W. H. SCHLESINGER. 1980. *Emmenanthe penduliflora* (Hydrophyllaceae: Further consideration of germination response. Madroño 27(3):122–125.

KATOH, K., K.-I. KUMA, H. TOH, AND T. MIYATA. 2005. MAFFT version 5: improvement in accuracy of multiple sequence alignment. Nucleic acids research 33(2):511–518.

KATOH, K., K. MISAWA, K. I. KUMA, AND T. MIYATA. 2002. MAFFT: a novel method for rapid multiple sequence alignment based on fast Fourier transform. Nucleic acids research 30(14):3059–3066.

KATOH, K., AND H. TOH. 2010. Parallelization of the MAFFT multiple sequence alignment program. Bioinformatics 26(15):1899–1900.

KAZAKOU, E., P. G. DIMITRAKOPOULOS, A. J. M. BAKER, R. D. REEVES, AND A. Y. TROUMBIS. 2008. Hypotheses, mechanisms and trade-offs of tolerance and adaptation to serpentine soils: from species to ecosystem level. Biological Reviews 83(4):495–508.

KEELEY, J. E., W. BOND, R. BRADSTOCK, J. PAUSAS, AND P. RUNDEL. 2012. Fire in Mediterranean ecosystems: ecology, evolution and management. Cambridge University Press, New York, NY.

KENNEDY, P. L. 1971. Pollination studies and the ecology of *Emmenanthe penduliflora* Benth. and *Dicentra chrysantha* (H. & A.) Walp. M.A. Thesis, San Francisco State College, San Francisco, CA.

KRUCKEBERG, A. R. 1951. Intraspecific variability in the response of certain native plant species to serpentine soil. American Journal of Botany 38(6):408–419.

———. 1954. The ecology of serpentine soils: A symposium. III. Plant species in relation to serpentine soils. Ecology 35:267.

———. 1957. Variation in fertility of hybrids between isolated populations of the serpentine species, *Streptanthus glandulosus* Hook. Evolution:185–211.

———. 1984. California serpentines: flora, vegetation, geology, soils, and management problems. University of California Publications in Botany 78:1–180.

———. 1986. An essay: the stimulus of unusual geologies for plant speciation. Syst. Bot. 11:455.

———. 1991. An essay: geoedaphics and island biogeography for vascular plants. Aliso 13(1):225–238.

LARKIN, M. A., G. BLACKSHIELDS, N. P. BROWN, R. CHENNA, P. A. MCGETTIGAN, H. MCWILLIAM, F. VALENTIN, I. M. WALLACE, A. WILM, R. LOPEZ, J. D. THOMPSON, T. J.

GIBSON, AND D. G. HIGGINS. 2007. Clustal W and Clustal X version 2.0. Bioinformatics 23(21):2947–2948.

LEWIS, P. O., AND M. T. HOLDER. 2008. NEXUS Class Library (version 2.1), http://sourceforge.net/projects/ncl/.

LIDDELL, H. G., AND R. SCOTT. 1940. A Greek-English Lexicon. revised and augmented throughout by Sir Henry Stuart Jones. with the assistance of Roderick McKenzie. Clarendon Press, Oxford.

LLOYD, D. G., AND C. WEBB. 1986. The avoidance of interference between the presentation of pollen and stigmas in angiosperms I. Dichogamy. New Zealand journal of botany 24(1):135–162.

MADDISON, D. R., AND K.-S. SCHULZ, eds. 2007. The Tree of Life Web Project. Website http://tolweb.org.

MAGNEY, D. 2013. Checklist of Ventura County Rare Plants (Twentieth Edition), updated 3 October 2013. California Native Plant Society, Channel Islands Chapter, Ojai, California.

MAYER, M. S., AND L. BESEDA. 2010. Reconciling Taxonomy And Phylogeny in the Streptanthus glandulosus Complex (Brassicaceae)1. Annals of the Missouri Botanical Garden 97(1):106–116.

MAYER, M. S., AND P. S. SOLTIS. 1999. Intraspecific phylogeny analysis using ITS sequences: insights from studies of the *Streptanthus glandulosus* complex (Cruciferae). Systematic Botany:47–61.

MAYR, E. 1942. Systematics and the origin of species. Columbia University Press, New York.

———. 1970. Populations, species, and evolution: an abridgment of animal species and evolution. Harvard University Press, Cambridge, MA.

MILLER, M. A., W. PFEIFFER, AND T. SCHWARTZ. 2010. Creating the CIPRES Science Gateway for inference of large phylogenetic trees. Paper read at Proceedings of the Gateway Computing Environments Workshop (GCE), 14 Nov. 2010, at New Orleans, LA.

MISHLER, B. D., AND E. C. THERIOT. 2000. The phylogenetic species concept (sensu Mishler and Theriot): monophyly, apomorphy, and phylogenetic species concepts. Pp. 119-132. *In* Wheeler, Q. D., and R. Meier. 2000. Species concepts and phylogenetic theory: a debate. Columbia University Press, New York, NY.

MOODY, J. B. 1976. Serpentinization: a review. Lithos 9(2):125–138.

MOORE, M. J., AND R. K. JANSEN. 2006. Molecular evidence for the age, origin, and evolutionary history of the American desert plant genus *Tiquilia* (Boraginaceae). Molecular Phylogenetics and Evolution 39(3):668–687.

MULLIS, K. B., F. FALOONA, S. SCHARF, R. SAIKI, G. HORN, AND H. A. ERLICH. 1987. Specific enzymatic amplification of DNA in vitro: the polymerase chain reaction. Cold Spring Harbor Symposia on Quantitative Biology 51:263–273.

MUNZ, P. A. 1935. A manual of southern California botany Claremont.

NÄGELI, C. 1865. Über die Bedingungen des Vorkommens von Arten und Varietäten innerhalb ihres Verbreitungsbezirkes. Königlich Bayerische Akademie der Wissenschaften zu Munchen:367–395.

NAZAIRE, M., AND L. HUFFORD. 2012. A broad phylogenetic analysis of Boraginaceae: implications for the relationships of *Mertensia*. Systematic Botany 37(3):758–783.

OLMSTEAD, R. G., H. J. MICHAELS, K. M. SCOTT, AND J. D. PALMER. 1992. Monophyly of the Asteridae and Identification of Their Major Lineages Inferred From DNA Sequences of rbcL. Annals of the Missouri Botanical Garden 79(2):249–265.

PANZER, G. W. F. 1806. Kritische Revision der Insekten Fauna Deutschlands. Vol. 2 Nürnberg.
PATTERSON, R., AND R. HALSE. 2012. *Emmenanthe,* Pp. 683-684. *In* The Jepson Manual: Vascular plants of California, Second Edition, Bruce G. Baldwin, Douglas H. Goldman, David J. Keil, Robert Patterson, Thomas J. Rosatti and Dieter H. Wilken eds.). University of California Press, Berkeley, California.
PEPPER, A. E., AND L. E. NORWOOD. 2001. Evolution of *Caulanthus amplexicaulis* var. *barbarae* (Brassicaceae), a rare serpentine endemic plant: a molecular phylogenetic perspective. American Journal of Botany 88(8):1479–1489.
POPE, N., M. FONG, R. S. BOYD, AND N. RAJAKARUNA. 2014. The role of elevation and soil chemistry in the distribution and ion accumulation of floral morphs of Streptanthus polygaloides Gray (Brassicaceae), a Californian nickel hyperaccumulator. Plant ecology & diversity 7(3):421–432.
POSADA, D. 2008. jModelTest: Phylogenetic model averaging. Molecular Biology and Evolution 25(1253-1256).
POSADA, D., AND T. R. BUCKLEY. 2004. Model selection and model averaging in phylogenetics: advantages of the AIC and Bayesian approaches over likelihood ratio tests. Systematic Biology 53(793-808).
POSADA, D., AND K. A. CRANDALL. 1998. Modeltest: testing the model of DNA substitution. Modeltest 3.7. Bioinformatics 14(9):817–818.
RAJAKARUNA, N. 2003. Edaphic differentiation in the Lasthenia: A model for studies in evolutionary ecology. Madroño 50:34.
RAJAKARUNA, N., B. G. BALDWIN, R. CHAN, A. M. DESROCHERS, B. A. BOHM, AND J. WHITTON. 2003. Edaphic races and phylogenetic taxa in the Lasthenia californica complex (Asteraceae : Heliantheae): an hypothesis of parallel evolution. Molecular Ecology 12(6):1675–1679.
RAJAKARUNA, N., AND B. BOHM. 1999. The edaphic factor and patterns of variation in Lasthenia californica (Asteraceae). Am. J. Bot. 86:1576.
RAJAKARUNA, N., G. BRADFIELD, B. BOHM, AND J. WHITTON. 2003. Adaptive differentiation in response to water stress by edaphic races of Lasthenia californica (Asteraceae). Int. J. Plant Sci. 164:371.
RAJAKARUNA, N., M. SIDDIQI, J. WHITTON, B. BOHM, AND A. GLASS. 2003. Differential responses to Na+/K+ and Ca2+/Mg2+ in two edaphic races of the *Lasthenia californica* (Asteraceae) complex: A case for parallel evolution on physiological traits. New Phytol. 157:93.
RAMBAUT, A., M. SUCHARD, D. XIE, AND A. DRUMMOND. 2014. Tracer v.1.6.0 Available at http://beast.bio.ed.ac.uk/Tracer.
RAVEN, P. H., AND D. AXELROD. 1978. Origin and relationships of the California flora. University of California Publications in Botany 72:1–134.
REFULIO-RODRIGUEZ, N. F., AND R. G. OLMSTEAD. 2014. Phylogeny of Lamiidae. American Journal of Botany 101(2):287–299.
REICHENBACH, H. G. L. 1830. Flora germanica excursoria ex affinitate regni vegetabilis naturali disposita, sive principia synopseos plantarum in Germania terrisque in Europa media adjacentibus sponte nascentium cultarumque frequentius. 2 vols. Vol. 1 (1830–1832). Carolum Cnobloch, Lipsiae.
ROGERS, C. 1982. The systematics of *Linum* sect. *Linopsis* (Linaceae). Plant Systematics and Evolution 140(2-3):225–234.

RONQUIST, F., AND J. P. HUELSENBECK. 2003. MrBayes 3: Bayesian phylogenetic inference under mixed models. Bioinformatics (Oxford) 19(12):1572–1574.

RONQUIST, F., M. TESLENKO, P. VAN DER MARK, D. L. AYRES, A. DARLING, S. HÖHNA, B. LARGET, L. LIU, M. A. SUCHARD, AND J. P. HUELSENBECK. 2012. MrBayes 3.2: Efficient Bayesian Phylogenetic Inference and Model Choice Across a Large Model Space. Systematic Biology 61(3):539–542.

RYDBERG, P. A. 1913. Studies on the Rocky Mountain Flora-XXIX. Bulletin of the Torrey Botanical Club 40(9):461–485.

SAFFORD, H. D., J. H. VIERS, AND S. P. HARRISON. 2005. Serpentine endemism in the California flora: a database of serpentine affinity. Madroño 52(4):222–257.

SCHECHTER, S. P., AND T. D. BRUNS. 2008. Serpentine and non-serpentine ecotypes of *Collinsia sparsiflora* associate with distinct arbuscular mycorrhizal fungal assemblages. Molecular Ecology 17(13):3198–3210.

SCHEMSKE, D. W., AND P. BIERZYCHUDEK. 2001. Perspective: Evolution of flower color in the desert annual *Linanthus parryae*: Wright revisited. Evolution 55(7):1269–1282.

———. 2007. Spatial differentiation for flower color in the desert annual *Linanthus parryae*: Was Wright right? Evolution 61(11):2528–2543.

SCHWARZ, G. 1978. Estimating the dimension of a model. The Annals of Statistics 6(2):461–464.

SHARSMITH, H. K. 1945. Flora of the Mount Hamilton range of California (a taxonomic study and floristic analysis of the vascular plants). American Midland Naturalist 34(2):289–367.

SMITH, R. A. 2003. The systematics and molecular evolution of Lennoaceae. Ph.D. Dissertation, Biology, Vanderbilt University.

SOUTHWEST ENVIRONMENTAL INFORMATION NETWORK [SEINET]. 2012–2015. Available from http//:swbiodiversity.org/seinet/index.php.

SPRINGER, Y. P. 2009. Do extreme environments provide a refuge from pathogens? A phylogenetic test using serpentine flax. American journal of botany 96(11):2010–2021.

STAMATAKIS, A. 2006. RAxML-VI-HPC: Maximum likelihood-based phylogenetic analyses with thousands of taxa and mixed models. Bioinformatics 22(21):2688–2690.

———. 2014. RAxML Version 8: A tool for Phylogenetic Analysis and Post-Analysis of Large Phylogenies. Bioinformatics 10.1093/bioinformatics/btu033 http://bioinformatics.oxfordjournals.org/content/early/2014/01/21/bioinformatics.btu033.abstract

STAMATAKIS, A., P. HOOVER, AND J. ROUGEMONT. 2008. A fast bootstrapping algorithm for the RAxML web-servers. Systematic Biology 57(5):758–771.

STANTON, M. L. 1987. Reproductive biology of petal color variants in wild populations of *Raphanus sativus*: I. Pollinator response to color morphs. American Journal of Botany 74(2):178–187.

STEARN, W. T. 2004. Botanical Latin. 4 ed. Timber Press, Portland.

STEBBINS, G. L., JR. 1942. The genetic approach to problems of rare and endemic species. Madroño 6(8):241–258.

———. 1966. Processes of organic evolution. Prentice-Hall, Englewood Cliffs, N.J.

STEBBINS, G. L., JR., AND J. MAJOR. 1965. Endemism and speciation in the California Flora. Ecological Monographs 35(1):1–35.

STEVENS, P. F. 2001 onward. Angiosperm Phylogeny Website, version 13, June 2015 [and more or less continuously updated since] Website http://www.mobot.org/MOBOT/research/APweb/.

SWEENEY, J. R. 1956. Responses of vegetation to fire: a study of the herbaceous vegetation following chaparral fires. University of California Publications in Botany 28(4):143–250.

PAUP* Phylogenetic analysis using parsimony (*and other methods), version 4.0 beta 10. Sinauer Associates Inc. , Sunderland, Massachusetts.

TADROS, T. M. 1957. Evidence of the Presence of an Edapho-Biotic Factor in the Problem of Serpentine Tolerance. Ecology 38(1):14–23.

TAMURA, K., AND M. NEI. 1993. Estimation of the number of nucleotide substitutions in the control region of mitochondrial DNA in humans and chimpanzees. Molecular Biology and Evolution 10(3):512–526.

TAVARÉ, S. 1986. Some probabilistic and statistical problems in the analysis of DNA sequences. Lectures on Mathematics in the Life Sciences 17:57–86.

TAYLOR, K. F. 1968. The ecology of Emmenanthe Benth. (Hydrophyllaceae). M.A. Thesis, San Francisco State College, San Francisco, CA.

TAYLOR, S. 2012. Molecular systematics and the origin of gypsophily in *Nama* L. (Boraginaceae). Ph.D. Dissertation, Plant Biology, University of Texas at Austin, Austin, Texas.

THE CALFLORA DATABASE [A NON-PROFIT ORGANIZATION]. *Calflora: Information on California plants for education, research and conservation, with data contributed by public and private institutions and individuals, including the Consortium of California Herbaria [web application]* 2015 [cited 2014-2015. Available from http://www.calflora.org.

THE XERCES SOCIETY. 2015. Red List of Bees: Native Bees in Decline. Available at http://www.xerces.org/pollinator-redlist/.

TIMBERLAKE, P. H. 1955. A new genus for two new species dufoureine bees from California (Hymenoptera: Apoidea). Pan-Pacific Entomologist 31:105–108.

TORREY, J. 1871. Hydrophyllaceae. Pp. 248–259. *In* S.Watson (ed.), United States Geological Expolration [sic] of the Fortieth Parallel, Botany, Volume 5. Washington, D.C.

TROSCIANKO, J., AND M. STEVENS. 2015. Image calibration and analysis toolbox – a free software suite for objectively measuring reflectance, colour and pattern. Methods in Ecology and Evolution early view:doi: 10.1111/2041–210X.12439.

TURESSON, G. 1922. The genotypical response of the plant species to the habitat. Hereditas 3(3):211–350.

UNGER, F. 1836. Über den Einfluß des Bodens auf die Vertheilung der Gewächse, nachgewiesen in der Vegetation des nordöstlichen Tirol's. Bei Rohrmann und Schweigerd, Wien, Germany.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY [U.S. EPA]. 2013. Ecoregions of North America, . Western Ecology Division, National Health and Environmental Effects Research Laboratory, Corvallis, Oregon. Available from http://www.epa.gov/wed/pages/ecoregions/na_eco.htm.

UNITED STATES GEOLOGICAL SURVEY [U.S.G.S.]. 2014. Geologic maps of US states. Mineral Resources On-Line Spatial Data, U.S. Department of the Interior. Available from http://mrdata.usgs.gov/geology/state/.

URBATSCH, L. E., B. G. BALDWIN, AND M. J. DONOGHUE. 2000. Phylogeny of the coneflowers and relatives (Heliantheae: Asteraceae) based on nuclear rDNA internal transcribed spacer (ITS) sequences and chlorplast DNA restriction site data. Systematic Botany 25(3):539–565.

WALDEN, G. K. 2010. Phylogeny of infrageneric relationships within *Phacelia* (Boraginaceae) inferred from chloroplast sequence data. M.S. Thesis, Biology, San Francisco State University, San Francisco.

WALDEN, G. K., L. M. GARRISON, F. W. CIPRIANO, G. S. SPICER, AND R. PATTERSON. 2014. Phylogenies and chromosome evolution of *Phacelia* (Boraginaceae: Hydrophylloideae) inferred from nuclear ribosomal and chloroplast sequence data. Madroño 61(1):16–47.

WALDEN, G. K., AND R. PATTERSON. 2012. Nomenclature of subdivisions in *Phacelia* (Boraginaceae). Madroño 59(4):211–222.

WALKER, J. W. 1974. Evolution of Exine Structure in the Pollen of Primitive Angiosperms. American Journal of Botany 61(8):891–902.

WALKER, R. 1954. The ecology of serpentine soils: A symposium. II. Factors affecting plant growth on serpentine soils. Ecology 35:259.

WEFALD, M. *trs2ll program* 2003. Available from http://www.esg.montana.edu/gl/trs-data.html [accessed 2010–2015].

WEIGEND, M., M. GOTTSCHLING, F. SELVI, AND H. H. HILGER. 2009. Marbleseeds are gromwells - Systematics and evolution of *Lithospermum* and allies (Boraginaceae tribe Lithospermeae) based on molecular and morphological data. Molecular Phylogenetics and Evolution 52(3):755–768.

WHITE, T. J., T. BRUNS, AND J. TAYLOR. 1990. Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. *In* M. A. Innis, D. H. Gelfand, J. J. Sinisky, and T. J. White (eds.), PCR protocols: a guide to methods and applications. Academic Press, Inc., New York.

WICKLOW, D. T. 1964. A biotic factor in serpentine endemism. M.S. Thesis, San Francisco State College, San Francisco, CA.

———. 1966. Further observations on serpentine response in *Emmenanthe*. Ecology 47(5):864–865.

———. 1977. Germination response in *Emmenanthe penduliflora* (Hydrophyllaceae) Ecology 58(1):201–205.

WIT, E., E. V. D. HEUVEL, AND J. W. ROMEIJN. 2012. 'All models are wrong...': an introduction to model uncertainty. Statistica Neerlandica 66(3):217–236.

WRIGHT, S. 1943. An analysis of local variability of flower color in *Linanthus parryae*. Genetics 28(2):139–156.

Perseus Digital Library. 2010. http://www.perseus.tufts.edu/hopper/.

YAO, H., J. Y. SONG, C. LIU, K. LUO, J. P. HAN, Y. LI, X. H. PANG, H. X. XU, Y. J. ZHU, P. G. XIAO, AND S. L. CHEN. 2010. Use of ITS2 Region as the Universal DNA Barcode for Plants and Animals. PLoS ONE 5(10).

YELLOWSTONE RESEARCH COORDINATION NETWORK. *Lat/Long and UTM Conversion* 2015. Available from http://www.rcn.montana.edu/Resources/Converter.aspx [accessed 2010–2015].

YOST, J. M., T. BARRY, K. M. KAY, AND N. RAJAKARUNA. 2012. Edaphic adaptation maintains the coexistence of two cryptic species on serpentine soils. American Journal of Botany 99(5):890–897.

APPENDIX 1.1. SPECIMENS EXAMINED FOR MOLECULAR STUDY - *EMMENANTHE PENDULIFLORA*

Emmenanthe penduliflora Bentham, *Ferguson 47*, GH (n.v.), AF091158 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005), not georeferenced; San Diego Co., Indian Gorge, 22 March 2008, *G. K. Walden 10* (SFSU!); San Diego Co., Indian Gorge, 27 March 2010, *G. K. Walden 271* (SFSU!); Monterey Co., Ventana Wilderness, 3 June 2009, *G. K. Walden 162* (SFSU!); Inyo Co., 11 June 2009, *G. K. Walden 181* (SFSU!); San Diego Co., Anza Borrego Palm Canyon, 7 April 2011, *G. K. Walden 344* (SFSU!); San Benito Co., 25 May 1956, *Bacigalupi 5633* (JEPS18170!); San Benito Co., 8 June 1964, *D. T. Wicklow 171* (SFSU08059!); Santa Barbara Co., 6 May 1994, *S. R. Hubbard 42* (SFSU!); Santa Barbara Co., 11 April 1965, *J. Ammirati 102* (SFSU08064!); Santa Clara Co., 25 May 1969, *P. Kennedy 200* (SFSU08062!); Alameda Co., Red Mtn. area Red Mtn. (along Mines Rd), 22 May 1982, *R. Raiche 20377* (JEPS81593!); Los Angeles Co., 23 April 1950, *S. Carlquist 61* (SFSU08067!).

APPENDIX 1.2. SPECIMENS EXAMINED FOR MOLECULAR STUDY - *EMMENANTHE ROSEA*

Emmenanthe rosea (Brand) Constance, likely Monterey Co., 27 April 2010, *G. K. Walden 296* (SFSU!) not georeferenced; San Benito Co., 20 June 1960, *M. P. Johnson 2* (SFSU08077!); San Benito Co., 10 June 1952, *J. R. Sweeney 948* (SFSU08076!); San Benito Co., 25 May 1956, *Bacigalupi 5654* (JEPS18152!); San Benito Co., 2 June 1962, *V. F. Hesse 3130* (JEPS28869!); San Benito., approximately 1 mile northeast of the junction of Clear Creek road and Clear Creek, the collection was made on a 1 year serpentine chaparral burn, burning done in 1962, 10 June 1963, *D. T. Wicklow 154* (SFSU08075!); Alameda Co., Red Mtn. area Red Mtn. (along Mines Rd), 22 May 1982, *R. Raiche 20378* (JEPS81594! also in cultivation as UCB82.0220).

APPENDIX 1.3. GENBANK ACCESSIONS. List of taxa sampled in this study: *named taxon* (presented in alphabetical order, with bolded type and botanical authority given for first instance of taxon), name of collector(s) and collection number, acronym of herbarium where voucher specimen is deposited and herbarium accession number (if available), and GenBank accession numbers for nrITS. Taxa names* follow recent treatments in the second edition of *The Jepson Manual* (Baldwin et al. 2012) and treatments in preparation for FNANM, botanical authorities follow *Authors of Plant Names* edited by R.K. Brummitt and C.E. Powell (1992), and herbarium acronyms follow Index Herbariorum (http://sweetgum.nybg.org/ih/). *The accession AF091166 retains the GenBank identifier here, but see Chapter 2 on the non-monophyly of *Eucrypta* and proposed replacement name.

Draperia systyla (A. Gray) Torr., Tulare Co., *R. Thorne 53719* (RSA341263, n.v.), AF091155 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005); ***Ellisia nyctelea*** Linnaeus, *R. Olmstead 95-16*, WTU (n.v.), AF091157 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005); ***Eucrypta micrantha*** (Torrey) A. A. Heller [GenBank taxonomy identifier], *Chambers 5832*, GH (n.v.), *AF091166 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005); ***Eucrypta chrysanthemifolia*** (Bentham) Greene, *Ferguson 48*, GH (n.v.), AF091165 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005); ***Hydrophyllum capitatum*** Douglas, *Ferguson 116*, GH (n.v.), AF091169 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005); ***Nemophila menziesii*** Hooker & Arnott, *Ferguson 53,* GH (n.v.), AF091183 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005); ***Pholistoma auritum*** (Lindley) Lilja ex Lindblom, USA, *Ferguson 41,* GH (n.v.), AF091204 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005).

APPENDIX 1.4. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR YELLOW-FLOWERED *EMMENANTHE PENDULIFLORA*.

MEXICO. BAJA CALIFORNIA: (HCIB9430), (SD182730), (SD119482), (UC11174465!), (SD113467), (UC107109!), (UC1785725!), (UC1552036!), (ASU0031445-116025), (ASU0031441-208200, BCMEX5964, SD137131), (SD119246), (RSA575950), (SD48338, UC11083874!), (SD48644, UC11183052!), (SD47017), (UC1755079!, UC1755080!), (SD60590, UC11297915!), (ASU0031444-41562), (DES00004240), (ASU0031443-79449, DES00009261, SD86503), (SD53847, UC11247510!), (UC11251637!), (SD59976), (UC11087202!), (SD64890, UC1345903!), (ASU0031442-150717), (SD72340), (SD75373), (SD75457), (SD74957), (DES00013254, SD92482), (SD92353), (SD87261), (SD87259), (SD87079), (SD83871), (SD96923), (SD102627), (SD105107), (SD108488), (SD110883), (SD111328), (RSA310602, SD124114), (BCMEX3903), (ARIZ 408898, SD218148, UCR-226029), (SD230853), (SD230852, UCR-249384), (SD235618), (UC11283198!), (UC107107!), (UC107108!), (UC107111!), (UCR21083).

UNITED STATES. ARIZONA. GILA CO. : (DES00011496), (JEPS1566!), (ASU-270030), (ASU-281142), (RM 147306), (DES00031941), (DES00034141), (CAS167157!), (UC11302762!), (ASU-48536, DES00002221, OBI042583!), (ASU-32020), (ASU-32021), (ARIZ 356346), (ASC 57015), (ARIZ-ID5548696), (ARIZ 376994), (ASU-24969); **GILA/MARICOPA CO. :** (ARIZ-ID5548693); **LA PAZ CO. :** (ID117591 ID108849), (ASU-200528); **MARICOPA**: (DES00074649), (DES-ID3385866), (ASU-243964), (ASU0061144-56446), (ASU-187532), (ASU-167078), (ASU-187163), (ASU-ID659440), (ASU-ID659441), (ASU-49381, DES00008107, ID59428 ID108850), (ASU-35770), (ASU-250072), (ASU-32016), (ASU-87060), (ASU-87061), (DES00008216), (ASU-246690), (ASU-277037), (ASU-283300), (ASU-23563), (ASU-22309), (ASU-287932, UCR-246801), (DS220830!, UC489528!), (ASU-25684), (ASU-100152), (ASU-158577), (ASU-59425), (DS213332!), (ASU-49930), (ASU-49417), (ASU-49415, ID59422 ID108851), (ASU-51036), (ASU-49836), (ASU-144816), (ASU-32014), (DS743538!), (ASU-ID758357), (ASU-262933), (DES00001747), (DES00023209), (ASU-35771), (ASU0061143-56482), (DES00017676), (DES00019150), (ARIZ 417248, DES00072653), (ASC 51392), (ARIZ-ID5548695), (DES00059745), (TEUI-ID273624), (ARIZ-ID5548676), (ARIZ-ID5548675), (DES00048167), (DES00048557), (DES00050236), (DES00008995), (ARIZ-ID5548682), (DES00065350), (DES00054245), (DES00054339), (DES00056584), (ASU-275756), (ASU-ID777206); **MOHAVE CO. :** (DES00014817), (DES00029231, UCR-42190), (DES00020268), (DES00020262), (RENO 32925, RM 785605, UCR-167155), (ARIZ-ID5548677, ASC 4832, CAS154468!, RM 49574, UC708841!), (UC11302763!), (UC131711!), (ASC 82615), (ASC 96479), (ASC 82688), (ASC 73485), (ASC 82679), (ASC 94651), (ASC-ID1070886), (ASC 17551, ASU-28804), (ASC 89093), (ASC 96651), (ASC 79259), (DES00014790), (ARIZ-ID5548686), (ARIZ-ID5548670), (ASU-115145), (ASU-133842), (ASU-133829), (ASU-149474), (ASU-32015), (ASC 73425), (ARIZ-ID5548689), (ARIZ-ID5548673), (ASC 62951, ASU-218830), (ASC 63543), (ASC 63544), (ASU-89325), (MNA B.35807); **PIMA CO. :** (ASU-221651), (UCR-86145), (RM 147307), (BGBM! not georeferenced), (DES00031206), (DES00032385, UC945532!), (CAS373170!), (CAS35669!), (UC880685!), (UC732355!), (USON 20751), (ASU-70193, UC708842!), (CAS341906!), (DS311397!), (DS89946!), (ARIZ 391431), (ARIZ-ID5548694), (ARIZ-ID5548674), (ARIZ

386431), (ARIZ 387970), (ARIZ 388198), (ARIZ-ID5548671), (ARIZ 326674-SAGU 6734), (ASC 25933), (ASU-24401), (ARIZ-ID5548681), (ARIZ-ID5548690), (ASU-50936), (ARIZ-ID5548669, ASC 6145), (ARIZ-ID5548672), (ARIZ-ID5548678), (ARIZ-ID5548680), (ARIZ-ID5548683), (ARIZ-ID5548685, ARIZ-ID5548687, ASU-216135), (ARIZ-ID5548692), (ARIZ 377299), (ASU-46302), (MNA B.5859); **PINAL CO. :** (CAS348987!), (DES00008079), (UCR-201350), (DS217518!), (UC708820!), (ARIZ 76645-CAGR 6574), (ASC 74367), (ARIZ-ID5548688), (ASU-191445), (ARIZ-ID5548679), (ASU-188130), (ASU-161945), (ASU-32017), (TEUI-ID274707), (ARIZ-ID5553245, ARIZ-ID5574558), (ARIZ 373719), (DES00046721), (DES00046702), (DES00045637), (DES00053776), (DES00048665), (ASU-64275), (DES00076274), (DES00018264), (ASU-105154), (ARIZ-ID5548697), (ARIZ-ID5583351); **YAVAPAI CO. :** (DES00011402), (DES00035227), (SEINET-ID6166223), (SJNM 54848), (SJNM 53800), (MNA B.21589), (CS 78840), (CS 78841), (ASU-128301), (DES00054390), (DES00057823), (ASU-116311), (ASU-117907), (ARIZ-ID5548684, ASU-125429), (ASU-61333), (DES00052966), (DES00052897), (ASU-278232, DES00052643), (DES00071798), (DES00052935), (ASC 32658), (MNA B.26494), (ASU-200478), (ARIZ-ID5548691), (ASC 24012), (ASC 24156), (ASC 51868), (MNA B.9024);

CALIFORNIA: ALAMEDA CO. : (UC1614116!), (UC24033!), (JEPS81593!), (CAS35648!); **AMADOR CO. :** (JEPS35242!); **CALAVERAS CO. :** (UC1124251!), (UC24037!), (JEPS1571!, POM161644), (JEPS1570!), (JEPS1583!); **COLUSA CO. :** (CHSC90779), (CHSC79516), (UCD63620), (UCD82384), (JEPS16205!, UC1053475!), (HSC48169), (UC1051707!), (CHSC60744, UC1609171!); **CONTRA COSTA CO. :** (JEPS108314!), (JEPS1599!, UC691699!), (RSA128915), (UC672376!), (DS124986!), (JEPS1564!), (JEPS1582!); **FRESNO CO. :** (CHSC47109), (CHSC47036), (CAS1119717!), (POM225956), (JEPS77702!), (RSA750177), (CAS139473!), (CHSC69767), (DS126469!); **GLENN CO. :** (CHSC56546), (CHSC50327, UC1562460!), (UC880689!), (DS49319!, DS79889!), (UCD119199), (UCD119200), (UCD119222); **IMPERIAL CO. :** (SD157671), (SD73523), (RSA785612), (RSA401462A), (SD144373, UCR-245064), (RSA683873, SD158981, UC1787532!, UCR-153082), (RSA803911), (SD10792), (SD4051); **INYO CO. :** (UCR901), (RSA517647), *S. E. Lambert 34* (SFSU!), *C. Condos 63* (SFSU!), (RSA296641), *G. K. Walden 181* (SFSU!), (SD26079), (DS738304!), (CAS745691!), (DS190797!, POM194068, UC423477!), (RSA35227), (BGBM!, CAS185393!, DS205975!, NY1082227, P03861628!, RSA4092, UCD119204, UC439823!, SEINET3225042, UTC00010788), (DS8106!, K!, NY1082217), (DS738305!), (UC696090!), (UCSB31820), (CAS627609!), (RSA615618), (NY1082221), (UC1299980!), (NY1082224, UC1299941!), (RSA616765), (UCR88774), (NY1082222, UC1535098!, NY1082224), *H. H. Hilger and M. Hofmann 354/97* (BGBM!), (RSA387707), (RSA387488), (POM289360), (JEPS100937!), (JEPS100938!), (NY1082225), (POM147939), (CAS35654!, DS8101!, NY1082226), (CAS290480!), (RSA767989), (UCR216572), (UCR221960), (POM255153), (OBI33175!), (UCR235165), (RSA291978), (JEPS1592!), (JEPS1578!), (USON 10917), (NY 1082221), (DS156530!, POM72986, SEINET3225044, UTC00010789), (DS253407!), (JEPS1596!), (RSA274227), (RSA401463A), (RSA43633, SBBG65075), (RSA678839), (RSA678840), (SD4047), (SD40497), (SJSU11096!), (UCR22203); **KERN CO. :** (RSA613059), (UCSB5261), (RSA720163), (UCSB10447), (RSA563223), (UC532266!), (UCD109533), (JEPS3101!), (SJSU4805!), (UC1073339!), (RSA778695), (RSA776833), (RSA720952), (RSA401466A), (CAS1121886!), (CHSC108394, RSA727549, UCR196662), (SBBG11653), (UC1124255!), (UC24041!), (UCR120389), (RSA707773), (POM289361),

(POM289362), (RSA401465A), (RSA749402), (JEPS76454!), (RSA761525), (RSA761557), (RSA563096), (RSA552556), (RSA562908), (UCR82120), (UC69143), (POM277115), (RSA746942), (LSU00087308-38575, SD95165, UCD119223), (NY1082228), (CAS1126667!, RSA788522, RSA789968), (CAS1170579!, RSA788498, RSA791319), (SBBG23904), (RSA730962, UCR200223), (SBBG26155), (UCR234713), (UCR98360), (OBI52946!), (RSA171989), (UCR184026), (UCR183882), (UCR-79435), (SBBG20954, UCR79435), (JEPS1574!), (POM289365), (RSA401464A), (SFV13156), (SFV9387), (UCD119207), (UCR-186071), (UCR-96436), (UCR186071), (UCR96436); **LAKE CO. :** (UCD81084), (CAS696654!, CAS696655!), (HSC67108), (POM296091), (CHSC90538), (JEPS21088!, UC573590!), (SFSU08070!), (CHSC91155), (SFSU08072!), (POM289364), (JEPS3235!), (SFSU08078!), (UC1282747!), (SBBG6076), (SFSU08069!), (POM289363), (UCD38475), (UC511342!), (CHSC63737), (CHSC68547), (CHSC70982, JEPS94207!), (CHSC71429), (UC1178980!), (JEPS1597!), (JEPS1561!), (RENO 32938-NESH 57644, UTC00198449), (RSA339158), (DS8095!), (RSA2670), (SD4050, SD4054), (SEINET232464); **LOS ANGELES CO. :** (RSA652208), (SFV15597), (RSA653775), (SEINET3306035), (UNM 23372), (UCD119203), (OBI69406!), (RSA658401), (SBBG53209), (RSA201836), (RSA608530), (RSA401555), (UCSB45418), (UCR197769), (SFSU08067!), (OBI69330!), (POM3681), (LA1489), (CHSC12146), (UCR48582), (SFV11224), (JEPS1590!, RSA77256), (SFV13263), (UC1124262!), (UC24038!), (RSA587391), (LA81944), (RSA401470A), (NMC 21629, RENO 32939-NESH 59524, SEINET3156054), (RSA660079), (RSA784336), (UC1124253!), (RSA660093), (RSA226246), (POM305408), (RSA654081), (RSA653850, SFV22138, UCR200136), (UCSC886!), (RSA654014, SBBG121262, UC1922641!, UCR200180), (SRP3234), (SFV2954), (SRP3235), (RSA682712), (SFV2955, UCD119224), (SRP3236), (RSA678205, SBBG119346), (UC697629!), (RSA708772, UC1922863!, UCR200036), (RSA401550), (RSA709677), (DES00032265, RSA401564A, SEINET3091504), (RSA710830), (POM3679), (RSA401544), (UC24039!), (UCR96144), (UC672377!), (UCR88663), (RSA401547), (RSA401565), (JEPS1580!), (RSA597013), (JEPS8609!), (RSA498201), (RSA401558A), (RSA11626), (RSA401557A), (K!, P03861623!, POM199694, UC880683!, UCR124617), (RSA533467, UC1587643!), (LA200515), (UC880686!), (RSA585356), (RSA9613), (RSA589176), (UC1871131!), (UC1211102!), (RSA401554A, UCR124553), (SBBG13348), (BGBM!, POM3733, UC147929!), (RSA77255), (RSA756080, UCR182112), (RSA549601, UC1595438!), (RSA734976, UCR190898), (RSA663499), (RSA550383), (RSA547456), (UC284838!), (UCSB10409), (RSA584984), (RSA213388, SBBG37806), (RSA596832), (RSA595453), (RSA746955, UCR205230), (OBI70934!, RSA599582), (RSA599820), (RSA592174, UCR95449), (RSA82725), (RSA599707), (RSA599674), (RSA598582), (RSA599833), (UCR219428), (SEINET3095961, UCR220157), (UCR220206), (UCR223032), (LA32283, P03864847!, RSA126731), (JEPS1573!), (RSA151294), (RSA655989, UCR146344), (RSA115039), (UCR129425), (UCR126723), (UCR127892), (IRVC29113, RSA733358, SD234884, UCR127169), (SEINET1906671, UCR165421), (SBBG119226, UCR155603), (UCR155380), (RSA171988), (RSA171987), (RSA177775, SD69613, UC1349036!), (RSA137875), (RSA191092), *L. S. Rose 46233* (BGBM!), (RSA316348), (SBBG44744), (SD38512), (RSA725104), (SRP21361), (UC450801!), (HPSU7948), (HSC13509), (HSC13510), (JEPS1603!), (LA200516), (LA200517), (LA200518), (LA38485), (LA38486), (LA38487), (LA38488), (BGBM!, K!, LA38489, P03861624!), (PASA2102), (POM83852), (RSA401542), (RSA401545), (RSA401546), (RSA401548), (RSA401551), (RSA401552), (RSA401553), (RSA401560A), (RSA401561A), (RSA401569A), (RSA598957), (RSA608897), (RSA652206),

(RSA652207), (RSA652210), (RSA652211), (SBBG125138), (SBBG31323), (SBBG65070), (SBBG65078), (SFV16773), (SFV2956), (SFV6496), (UC457216), (UC56710), (UC57039), (UC880688!), (UCD119210), (UCD119217), (UCR193512), (RSA401549), (RSA401541), (DES00068734), (ARIZ 395728); **LOS ANGELES/VENTURA CO. :** (UNM 100451); **MARIPOSA CO. :** (UCD38078), (UC1585926!), (JEPS1593!); **MENDOCINO CO. :** (UCR250222), (JEPS1567!), (UC519013!); **MERCED CO. :** (UC1137258!), (CHSC55120); **MONO CO. :** (UC698041!), (HSC85236, UC1534855!, UCR47451), (HSC86076, NY1082223, UC1545600!, UCR60048), (RSA167582); **MONTEREY CO. :** (OBI13939!), (UC221727!), *G. K. Walden 162* (SFSU!); (PGM5915), (UC24032!), (UCSB15715), (JEPS74106!), (SD38514), (UBCV191085), (SBBG107542), (CHSC39859), (CDA14963), (SBBG109270), (CAS440475!), (JEPS98166!, OBI70374!, SBBG51816), (SBBG113305), (CHSC688), (PGM0264), (PGM3102), (PGM5916), (SBBG39554), (UC24035!), (UC596677!), (UCSC1725), (NY337106), *GKW 295* (SFSU! not georeferenced). **NAPA CO. :** (UCD54561), (UCD48052), (UCD48053), (SFSU08066!), (JEPS110832!), (HSC43935), (JEPS110831!), (UCD119205, not georeferenced); **ORANGE CO. :** (RSA610), (RSA539404), (RSA539385), (RSA552942), (RSA594897), (UCR209332), (RSA731987, UCR191425), (UCR191237), (RSA734990, UCR192079), (VVC254); **RIVERSIDE CO. :** (UCR2854), (WCW13199), *R. Peters 005* (SFSU!), (UCR231806), (UCR906A), (UCR176189), *K. Whitney 17* (SFSU!), (SFV12248), (UCR22481), (RSA662568), (OBI13946!), (UCR216359), (OBI32762!), (RSA648274), (POM126305), (RSA401444A), (UC1537546!), (UCR215515), (UCR216026), (UCSB5259!), (RSA697749), (UCR-41358), (UCR35122), (POM10398), (UCSB9699), (RSA701471), (POM128370), (RSA586310, SD137736), (UCR22033), (RSA503145), (UCSB16206), (UCSB5251), (RSA679112), (JOTR30211), (RSA585814), (POM8455), (UCR241193), (UCR35121), (JEPS1577!), (SD119899), (RSA765232, RSA787984), (SFSU08060!), (OBI2172!), (RSA401446B), (OBI29870!), (JEPS86533!), (UCSC885), (UCR157769), (UCR133969), (RSA594781), (RSA401449A), (RSA33518), (UCR120307), (SEINET270931, UTC00222530), (CCH 56, RSA33584, SEINET156521), (JEPS1595!), (NY 43125), (NY43125, SD216486), (RSA613640, UCR137693), (UC666588!), (JOTR30135), (RSA401451A), (RSA401453A), (RSA785609), (POM3680), (JOTR30979), (UCR84597), (RSA618394), (JOTR31047), (SBBG29830), (UC667294!), (JOTR31958), (JOTR32036), (JOTR32151), (HSC25791), (UCR91411), (JOTR34010), (JOTR34048), (UCR107412), (P03861627!, POM9612), (UCR103920), (UCD119202), (RSA784785), (RSA401450A), (UC700958!, UC724322!), (UCR122750), (RSA182346), (RSA500219), (UCR103256), (UCR114116), (RSA500540), (RENO 32933-NESH 4208), (RSA524425), (RSA444571), (RSA757796), (RSA770311), (RSA516412), (RSA774722), (RSA525694), (RSA525223), (RSA772413), (RSA771665), (POM14089, UC217917!), (RSA772573), (RSA772583), (UCR138759), (POM13111), (UCR25801), (RSA180275), (RSA25342, UC880684!), (UC68775!), (UCR41850), (RSA221007), (RSA543174, SBBG101705), (UC1124258!), (SD38509), (JEPS1572!, POM250358, UC880682!), (POM17934), (RSA16506), (RSA562451), (RSA559344, SD136826), (RSA676262), (RSA676092), (RSA682848), (SBBG6075), (RSA28062, UC665883), (POM97137), (RSA401445A), (SD187424), (UCR199561), (CHSC101910, RSA678348, SD232263, UC1929975!), (SRP34123), (JEPS1565!), (RSA747732), (UC1088551!), (RSA49178, UC809725!), (UCR87618), (UCR226583), (UCR85172), (UC2015541!, UCR85315), (UCR227009), (UCR233169A), (RSA80986), (RSA401467A), (UCR104918, VVC253), (JOTR34387, UCR244419), (UCR116828), (HSC13507), (RSA667004, UCR116927), (SFSU08059!), (UCR140321), (UCR165405), (UCR158327), (UCR154453),

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(SBBG121468), (JEPS57324!), (RSA1719), (P03864843!, UC967383!), (RSA401479A), (SBBG23255), (RSA723060), (SBBG43245), (RSA401478A), (SD98978, SDSU6075), (LA201843), (LA40156), (LA40155), (SD38508), (P03864841!, POM230832, UC880681!, UCR133612), (RSA727219, UCR200755), (RSA701679, SBBG119003, UCD119225, UCR160027), (RSA60304), (RSA59139), (NMC 74613, RSA60371, SEINET3156053), (UCR158071), (IRVC26252, UCR127284), (UCSB53503), (RSA401476B), (RSA401477A, SBBG65071), (RSA652209), (SBBG15156), (SBBG30040), (SBBG30447), (SBBG39318), (SBBG65072), (SBBG65074), (UC1021915!), (UC527207!), (UCR-64801), (UCR64801);

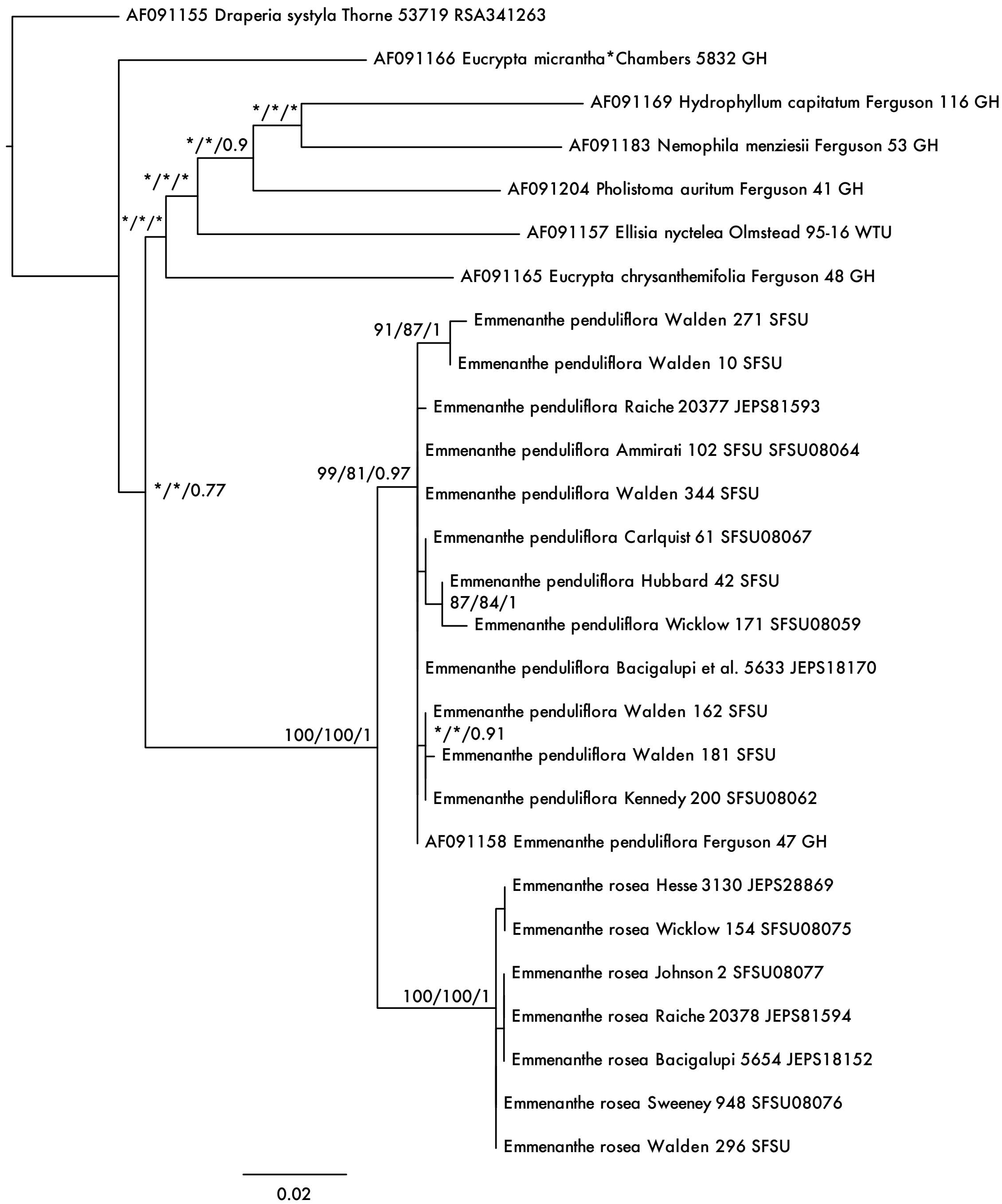
NEVADA. CLARK CO. : (RENO 32931-RENO 6009), (RENO 32930-RENO 6010, UC990317), (ASC 103626), (RENO 32928), (CAS307940!, DS270444!, JEPS1581!, UC900318!), (DS278283!, K!, P03864844!, P03864846!, RENO 32936-RENO 6973, UC900316!, UCR-128709), (RENO 32935-NESH 14412); **ESMERALDA CO. :** (ID137107 ID108848), (CAS1065888!, CIC41257, RENO 32923, SRP29515, UC1875091!, UTC00247328), (DS312155!, NY 1082220, UC701708!); **LINCOLN CO. :** (ENLC00952, UTC00264886), (ENLC01896), (ENLC00953), (SJNM 30124); **MINERAL CO. :** (CAS805461!, NY 1082219, RENO 32927-NESH 66052); **NYE CO. :** (NTS 18417), (NTS 16205), (RENO 32926, UCR-235976), (NTS 17991), (DS625991!, RENO 32929-RENO 25241), (DS835868!, RENO 32932-RENO 31587);

UTAH. WASHINGTON CO. : (NY 1082216), (MNA B.17513, UTC00110872), (NY 1082215), (NY 1082218), (NY 1082214, RENO 32924), (BRY 614202, SRP44949);

APPENDIX 1.5. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR PINK-FLOWERED *EMMENANTHE ROSEA*.

UNITED STATES, CALIFORNIA: ALAMEDA CO. : (JEPS81594!), (UC809800! not georeferenced); **FRESNO CO. :** (UC1124269!), (CHSC41331), (CHSC41330), (JEPS77703!), (CAS256904!), (JEPS1568!), (CIC45573), (CHSC69881), (CHSC70129); **KERN CO. :** (UC463133!); **MERCED CO. :** (CHSC53586); **MONTEREY CO. :** (CAS439520!, CAS498262!), (POM97460), (CAS514150!, CAS994339!, SBBG107542), (CAS514661!, P03864848!, SBBG39554), (PGM2414, PGM2419, PGM2420), *GKW 296* (SFSU! not georeferenced), (UC454115!); **SAN BENITO CO. :** (CAS574158!, SFSU08077!), (SFSU08075!), (UC1137257!, UC661032!), (JEPS5415!, SFSU08076!, UC1282749!), (UC1299124!), (CAS234878!, UC583354!), (UC1181797!), (JEPS74105), (JEPS28869), (OBI13940, RSA313408B, UC1237901), (JEPS18152, RSA181885), (CAS431244!, DS380127!, RSA181287), (JEPS100939!), (JEPS1559!, JEPS1560!), (CAS516318!, CAS626831!), (CAS516409!, CAS626696!), (JEPS105115!, JEPS105440!, RSA695545), (CAS994339!), (DS79659!, POM135797), (PGM3885), (SJSU12288!), (UC1004321!), (CAS251999!); **SANTA CLARA CO. :** (CAS35664!, DS68732!, POM65451, UC306569!); **STANISLAUS CO. :** (UC1745656!), (CAS257168!, UC571731!), (UC794424!), (CAS35661!, K!, P03864840!, RENO 32940-RENO 19657, SFV2957, UC794384!), (UC571730!), (SJSU1616!), (SJSU1645!), (UC1039627!), (CAS406754!); **VENTURA CO. :** (POM3684-0003779 isotype, RENO10529-009888 isotype, UC126667! holotype, US614806-00110584 isotype), (SBBG65074).

Fig. 1.1. RAxML phylogram of the single, best tree [-lnL = 2507.005750, tree length = 0.499096]. Support values are at nodes for MP bootstrap values / maximum likelihood (ML) bootstrap values / Bayesian posterior probabilities for nodes supported at ≥95% posterior probability. An asterisk (*) indicates clade with <75% support in the 0.5 majority-rule MP bootstrap tree or in the 0.5 majority-rule ML bootstrap tree. (scale bar = mean number of nucleotide substitutions per site). The accession AF091166 retains the GenBank identifier here, but see chapter on the paraphyly of *Eucrypta* and proposed replacement name.


AF091155 Draperia systyla Thorne 53719 RSA341263
AF091166 Eucrypta micrantha*Chambers 5832 GH
AF091169 Hydrophyllum capitatum Ferguson 116 GH
AF091183 Nemophila menziesii Ferguson 53 GH
AF091204 Pholistoma auritum Ferguson 41 GH
AF091157 Ellisia nyctelea Olmstead 95-16 WTU
AF091165 Eucrypta chrysanthemifolia Ferguson 48 GH
//*
//0.9
//*
//*
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Emmenanthe penduliflora Walden 10 SFSU
Emmenanthe penduliflora Raiche 20377 JEPS81593
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99/81/0.97
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Emmenanthe penduliflora Carlquist 61 SFSU08067
Emmenanthe penduliflora Hubbard 42 SFSU
87/84/1
Emmenanthe penduliflora Wicklow 171 SFSU08059
Emmenanthe penduliflora Bacigalupi et al. 5633 JEPS18170
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Emmenanthe penduliflora Kennedy 200 SFSU08062
AF091158 Emmenanthe penduliflora Ferguson 47 GH
Emmenanthe rosea Hesse 3130 JEPS28869
Emmenanthe rosea Wicklow 154 SFSU08075
Emmenanthe rosea Johnson 2 SFSU08077
100/100/1
Emmenanthe rosea Raiche 20378 JEPS81594
Emmenanthe rosea Bacigalupi 5654 JEPS18152
Emmenanthe rosea Sweeney 948 SFSU08076
Emmenanthe rosea Walden 296 SFSU
0.02

Fig. 1.2. Distribution of georeferenced yellow-flowered *Emmenanthe penduliflora* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 400 miles.

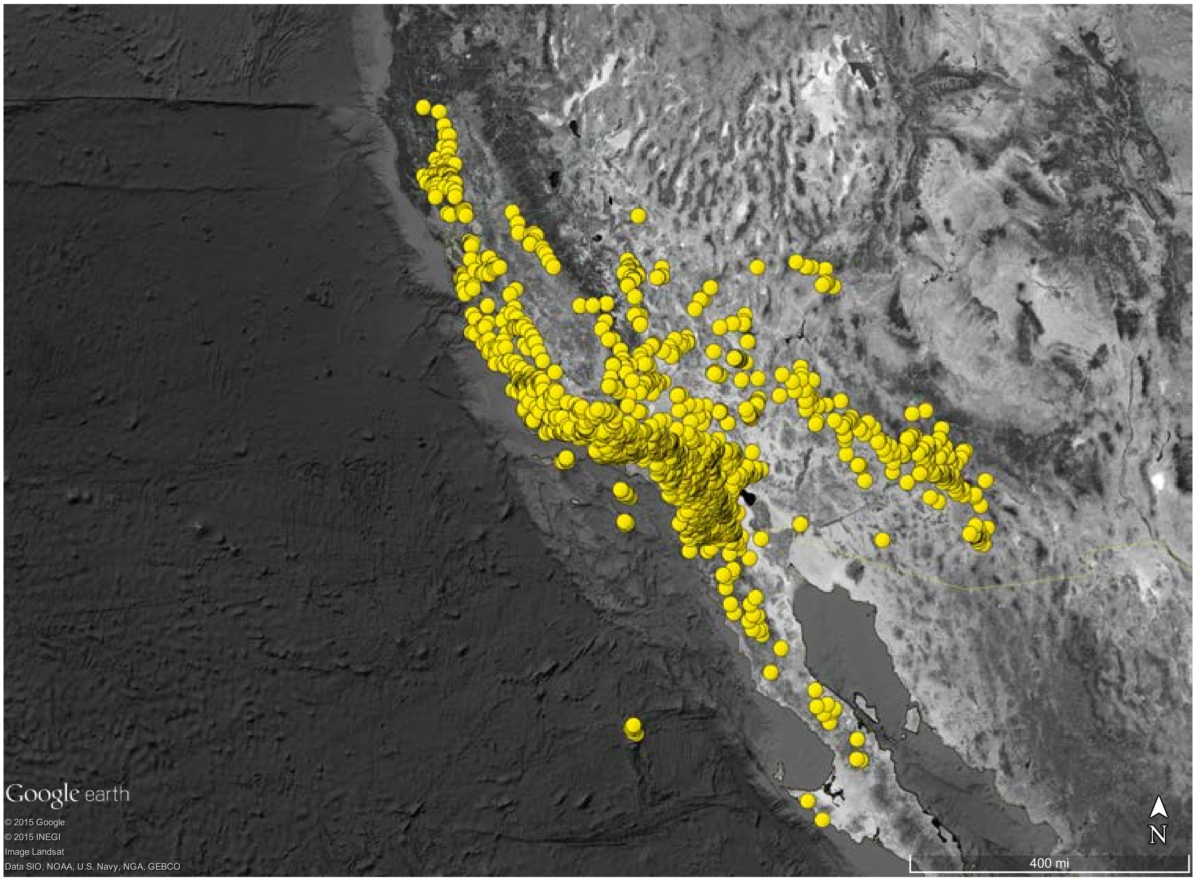
Google earth
© 2015 Google
© 2015 INEGI
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
400 mi
N

Fig. 1.3. Distribution of georeferenced yellow-flowered *Emmenanthe penduliflora* in the ecoregions (U.S. EPA III) of the Baja Californian Deserts (10.2.3, Baja California and Baja California Sur), the California Coastal Sage, Chaparral, and Oak Woodlands (11.1.1, Isla Guadalupe and Baja California, California Channel Islands and California), the edges of the Sonoran Desert (10.2.2, Baja California, California, and Arizona), the Southern and Baja California Pine-Oak Mountains (11.1.3, Baja California and California), throughout the Mojave Basin and Range (10.2.1, California, Nevada, Utah, and Arizona), the Arizona/New Mexico Mountains (13.1.1, Arizona), the western Madrean Archipelago near Tucson (12.1.1), the Central Basin and Range (10.1.5, California, Nevada, and Utah), Sierra Nevada (6.2.12, California), Klamath Mountains (6.2.1, California), the Central California Valley (11.1.2), and the Coast Range (7.1.8) (United States Environmental Protection Agency [U.S. EPA] 2013b). Ecoregions of North America (Levels III, IV) were downloaded as shapefiles [shp] from the U.S. EPA (United States Environmental Protection Agency [U.S. EPA] 2013a) and imported to Google Earth Pro for visualization (Google Earth Pro 2015). Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 500 miles.

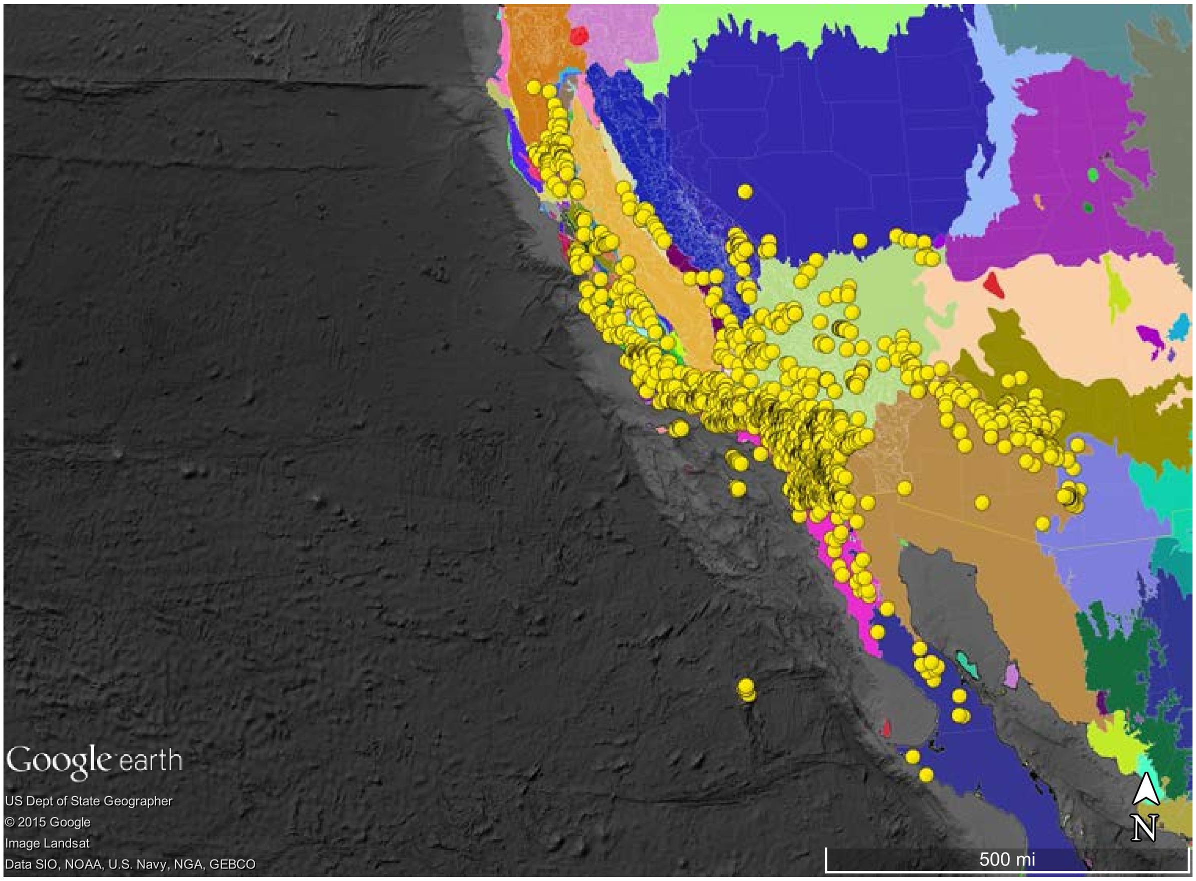
Google earth
US Dept of State Geographer
© 2015 Google
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
500 mi
N

Fig. 1.4. Distribution of georeferenced pink-flowered *Emmenanthe rosea* specimens in California. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 100 miles.

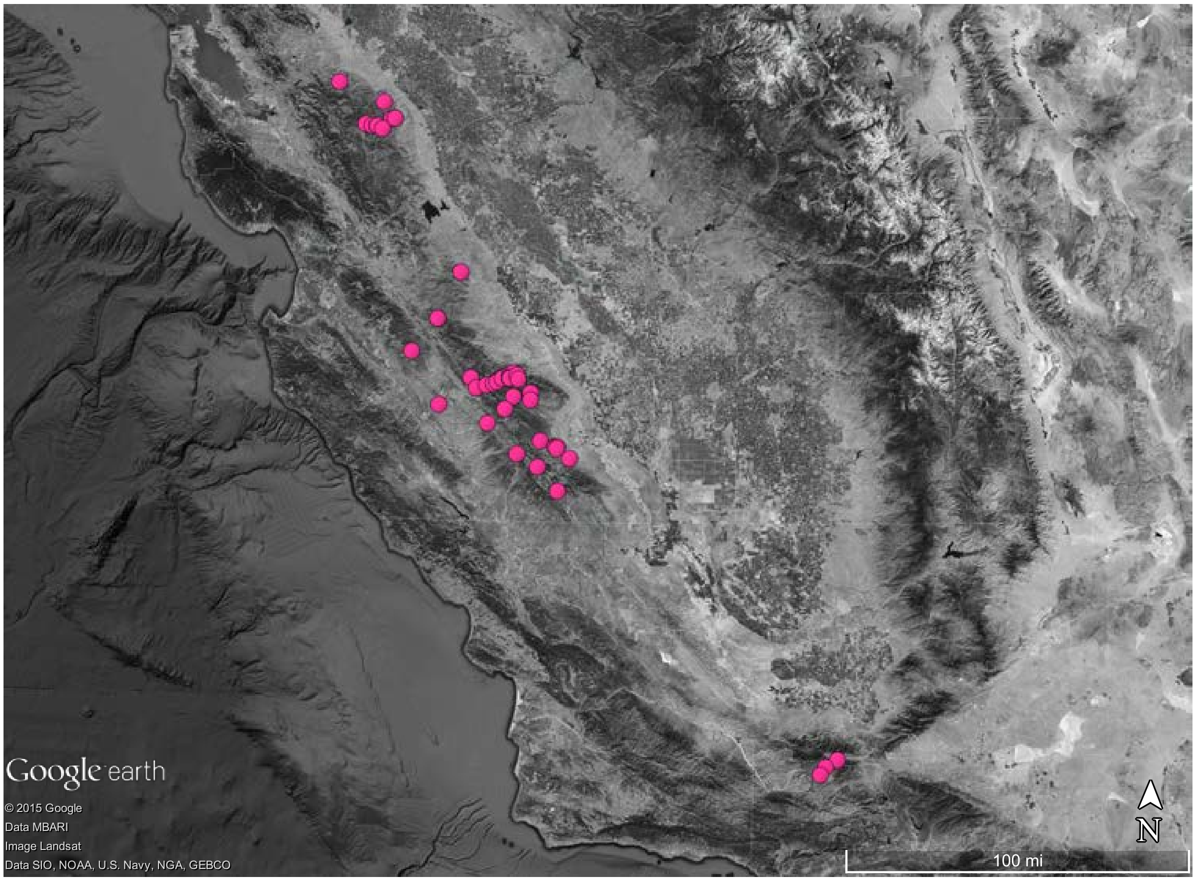
Google earth
© 2015 Google
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Fig. 1.5. Distribution of georeferenced pink-flowered *Emmenanthe rosea* specimens in California, occurring in the Level III ecoregions of the California Coastal Sage, Chaparral, and Oak Woodlands (11.1.1) (United States Environmental Protection Agency [U.S. EPA] 2013b). Ecoregions of North America (III, IV) were downloaded as shapefiles [shp] from the U.S. EPA (United States Environmental Protection Agency [U.S. EPA] 2013a) and imported to Google Earth Pro for visualization (Google Earth Pro 2015). Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 100 miles.

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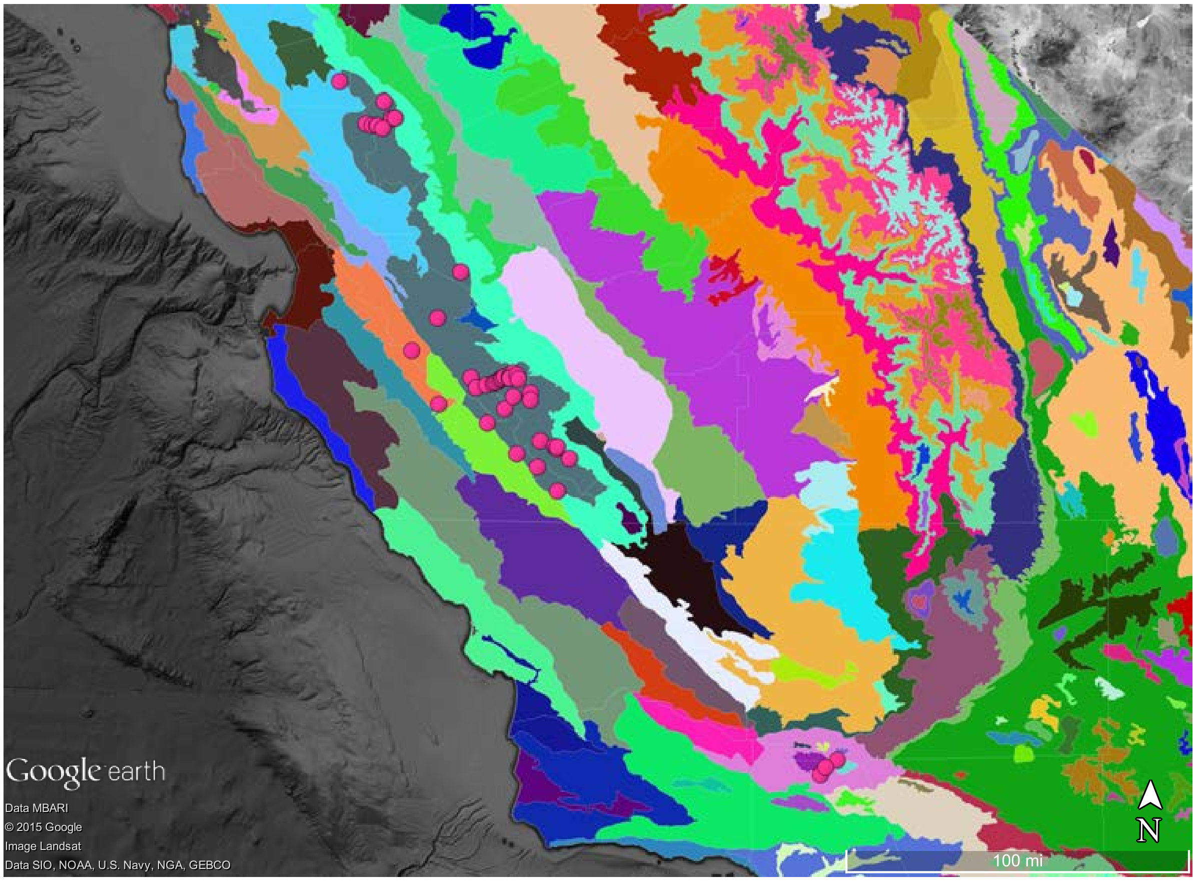
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Fig. 1.6. Distribution of georeferenced yellow-flowered *Emmenanthe penduliflora* and pink-flowered *Emmenanthe rosea* specimens co-occurring in California counties, showing full distribution of pink-flowered *Emmenanthe rosea* in the Diablo Range and Southern California Mountains. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 100 miles.

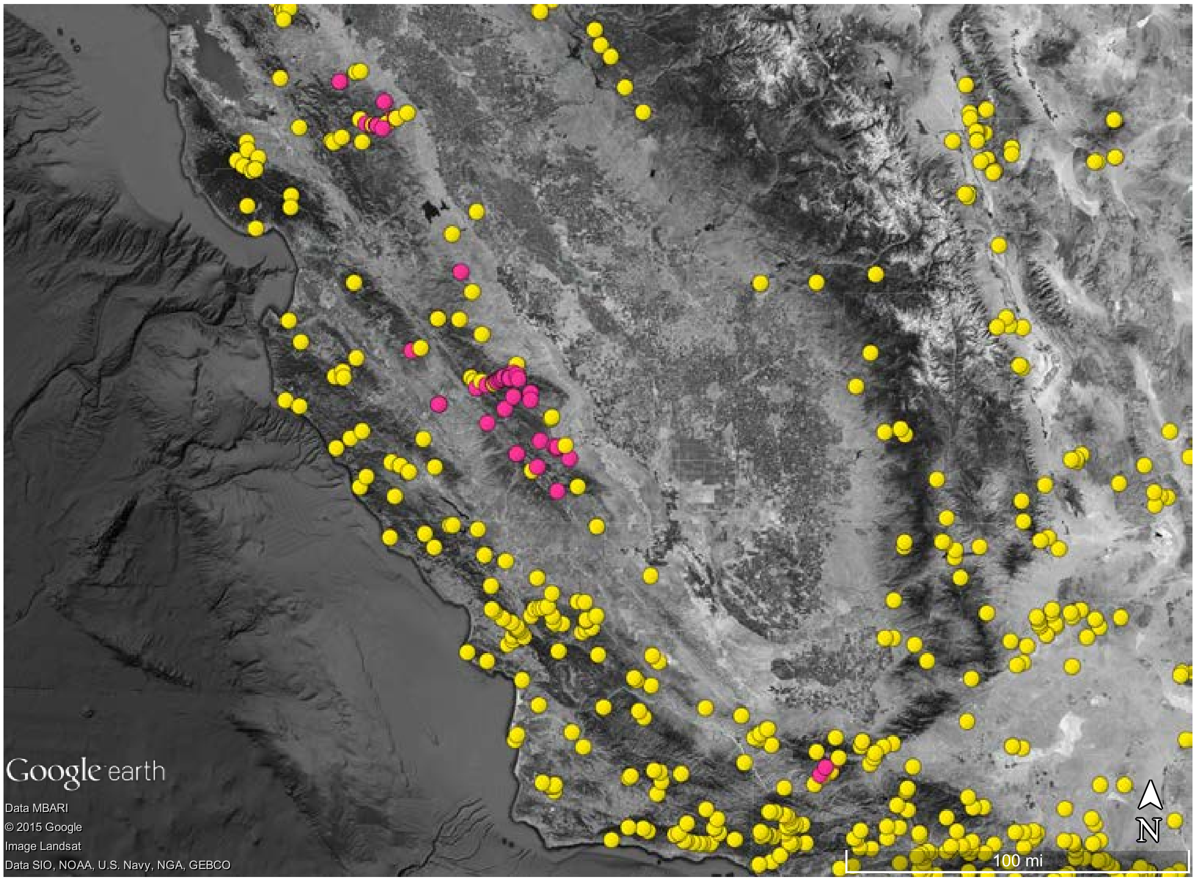
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Fig. 1.7. Representative voucher specimen of yellow-flowered *Emmenanthe penduliflora* (*Lowell Ahart 8807* [JEPS102429]). Image and permission provided by The University & Jepson Herbaria, University of California, Berkeley. See also plate XIII, *Emmenanthe penduliflora*, Taylor 1968.


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THE UNIVERSITY AND JEPSON HERBARIA
OF THE UNIVERSITY OF CALIFORNIA, BERKELEY
Emmenanthe penduliflora Bentham
Transactions of the Linnean Society of London 17(2):281. 1835 [read 1834, issue published May 1835, entire vol. published 1837]
Specimen examined during dissertation study of Hydrophylloideae systematics
det. Genevieve K. Walden
2 November 2014
Plants of California
Tehama County
Emmenanthe penduliflora Benth. var. *penduliflora*
Hydrophyllaceae
T24N, R7W, near center, west border, Section 34.
Normal size plants, on dry rocky serpentine soil, burned area on the west side of road M2, about 9 miles west of Paskenta. Very common, scattered in areas where the fire was very hot, some plants very large. Flowers pale yellow. Chaparral. Elevation 2600 feet.
Lowell Ahart 8807. 08 June, 2001.
Herbarium of California State University, Chico
JEPSON HERBARIUM
JEPS
UNIVERSITY OF CALIFORNIA
Annotations for the duplicate of this specimen in the Jepson Reference Collection are appreciated.

Fig. 1.8. Representative voucher specimen of pink-flowered *Emmenanthe rosea* (*Dean Wm. Taylor 14792A* [JEPS105115]). Image and permission provided by The University & Jepson Herbaria, University of California, Berkeley. See also plate XIV, *Emmenanthe rosea,* Taylor 1968.


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THE UNIVERSITY AND JEPSON HERBARIA
OF THE UNIVERSITY OF CALIFORNIA, BERKELEY
Emmenanthe rosea (Brand) Constance
University of California Publications in Botany 23:369-370, 380, fig. 43. 1950.
Specimen examined during dissertation study of Hydrophylloideae systematics
det. Genevieve K. Walden
2 November 2014
PLANTS OF CALIFORNIA
INNER SOUTH COAST RANGE REGION (SCoRI)
PLANTS OF THE DIABLO RANGES
Emmenanthe penduliflora Benth.
var. rosea Brand
SAN BENITO COUNTY: Call Mountains, open slopes near fire lookout tower on summit hill 3888 (tributary to Tres Pinos Creek); T15S R8E, NW1/4 of NE1/4 Section 23, San Benito 7½' USGS quadrangle, 1971 edition); 3800 feet elevation. Habitat: recently burned and cleared chaparral Adenostoma; fully intermixed with var. penduliflora (DWT #14792B) at this site without apparent intermediates.
Dean Wm. Taylor #14792A
3 April 1995
University and Jepson Herbaria, Univ. of California, Berkeley
Family: HYDROPHYLLACEAE - 251
JEPSON HERBARIUM
JEPS
UNIVERSITY OF CALIFORNIA
Annotations for the duplicate of this specimen in the Jepson Reference Collection are appreciated.

CHAPTER TWO

EUCRYPTA (HYDROPHYLLACEAE; BORAGINALES) IS NOT MONOPHYLETIC

ABSTRACT

Phylogenetic analyses of sequences from populations and specimens determined as *Eucrypta chrysanthemifolia* and *E. micrantha*, together with sequences representing major clades of tribe Hydrophylleae demonstrate that the two species in *Eucrypta* are not each other's closest relatives and represent disparate lineages in Hydrophyllaceae, confirming previous molecular studies. These results require recognition of a narrowed circumscription of *Eucrypta* sensu stricto (equivalent to *E. chrysanthemifolia* and varieties), a new genus, **Vermisperma**, and a new combination, **Vermisperma micranthum**, for *E. micrantha*. Although sampling was not adequate to address the molecular support for varieties of *E. chrysanthemifolia* (var. *chrysanthemifolia* and var. *bipinnatifida*), there is a clear geographic separation of the varieties. This, in addition to differences between them in morphological characters and chromosome numbers, supports my decision to retain these varieties as taxonomic entities here. Although placement of *Eucrypta* sensu stricto and *V. micranthum* in Hydrophyllaceae is well supported, reconciliation of previous infrafamilial classifications is extremely complicated, requiring substantial family level sampling and falling outside the scope of this study.

Key Words: *Eucrypta chrysanthemifolia, Eucrypta micrantha,* Hydrophyllaceae, Boraginales, polyphyly

INTRODUCTION AND BACKGROUND

Eucrypta Nuttall was first published as a genus with two species, *E. foliosa* Nuttall and *E. paniculata* Nuttall, both from collections made by Gambel from California (Nuttall 1848a, 1848b; Reveal and Spevak 1967). Bentham had previously published a similar collection of Douglas, also from California, in *Ellisia* Linnaeus (as *Ellisia chrysanthemifolia* Bentham), in his treatment of Hydrophyllaceae R. Br. (Edwards and Ridgeway 1817; Bentham 1835 [read June 17th, 1834, issue published 1835, volume published 1837]). Greene separated *Eucrypta* from *Ellisia* Linnaeus, recognizing Nuttall's *Eucrypta paniculata*, and made a new combination for Bentham's species, as *Eucrypta chrysanthemifolia* (Bentham) Greene (Greene 1886 [1885]). Constance lectotypified *Eucrypta* with the first published taxon of Nuttall (*Eucrypta paniculata* Nuttall), which along with *Eucrypta foliosa*, have been treated as synonyms of *Eucrypta chrysanthemifolia* (Constance 1938). Another species, *Eucrypta micrantha* (Torrey) A. Heller, was originally treated in *Phacelia* Jussieu (as *P. micrantha* Torrey).

Substantial disagreement has existed regarding the taxonomy of the two widely recognized species placed within *Eucrypta*, *E. chrysanthemifolia* and *E. micrantha*, and relationships of those species to each other and to other members of Hydrophyllaceae. Some of this disagreement is understandable as a natural progression in the refinement of understanding of biodiversity with increased technical and analytical advancements. Earlier placement of both species in different genera is evidence of the exploration of proposed relationships in Hydrophyllaceae, as together these taxa did not align easily into any particular classification or revision of an author (Gray 1875; Greene 1886 [1885]; Brand 1913). Following the family treatment of Hydrophyllaceae by Brand (1913), the revision of *Eucrypta* by Constance (1938) remains the most comprehensive treatment of *Eucrypta*, and emphasizes the difficulty with the circumscriptions of the genus and taxa therein. Constance included five genera within tribe Hydrophylleae Reichenbach (*Hydrophyllum* Linnaeus, *Ellisia*, *Nemophila* Nuttall, *Pholistoma* Lilja, and *Eucrypta*) and published substantial revisions for the genera and tribe (Reichenbach 1830; Constance 1938, 1939a, 1939b, 1940, 1941, 1942; Constance and Chuang 1982; Chuang and Constance 1992). Additional work with chromosome numbers identified polyploid races in each of the species of *Eucrypta* (*E. chrysanthemifolia* [n=10], *E. chrysanthemifolia* var. *bipinnatifida* [n =10, 20], and *E. micrantha* [n =6, 12]) (Cave and Constance 1944, 1959; Constance 1963; Ward 1984). Publication of a haploid count of n = 9 for *E. micrantha* was an error (Cave and Constance 1942), corrected as n = 6, from a possibly mixed collection including *Nemophila* (Cave and Constance 1950, 1959). Constance suggested after these studies, in reference to *Eucrypta*, that "the genus might not be a natural one" (p. 276) (Constance 1963), and suggested that there were four groupings within Hydrophyllaceae that did not necessarily align with the previous tribal memberships of Brand (Brand 1913; Constance 1963; Constance and Chuang 1982; Chuang and Constance 1992).

Di Fulvio (1995) examined the trichomes of Hydrophyllaceae, identifying distinct glandular trichomes possessed each by *E. chrysanthemifolia* and by *E. micrantha*, concluding that *Eucrypta* was a "heterogeneous" genus, with *E. chrysanthemifolia* well-placed in tribe Hydrophylleae with unicellular capitate glandular trichomes (along with the other genera of *Ellisia, Emmenanthe, Pholistoma, Nemophila,* and *Hydrophyllum*), and *E. micrantha* possibly placed with tribe Phacelieae with a unique type of multicellular capitate glandular trichomes (Di Fulvio and Dottori 1995).

The development of ovules on both sides of the placentae has been the strongest morphological character uniting the two species, and the origin for the common name 'hide-seed' for *Eucrypta*. Ovules develop on both sides of the placenta, and 1–2 seeds are retained behind large parietal placenta in *E. chrysanthemifolia* and in *E. micrantha* (Di Fulvio 1987). This similarity has been a strong argument to retain the relationship between the two taxa (Constance 1938). However, the (6-)8 seeds of *E. chrysanthemifolia* are heteromorphic (dimorphic), where the internal seeds retained in the capsule and behind the placenta are oval and flattened, seed surface irregularly reticulate pitted, and the external seeds are terete and corrugated (Constance 1938; Chuang and Constance 1992). In *E. micrantha*, the (6-)7–15(-16) seeds are homomorphic (unimorphic), and both the internal and external seeds are oblong, and at maturity become incurved and corrugated (Constance 1938; Chuang and Constance 1992). *Eucrypta chrysanthemifolia* also has corolla scales, although small and reduced at the base of filaments, while *E. micrantha* lacks corolla scales, but has unique v-shaped folds on the midvein of the corolla lobe (Constance 1938).

Ferguson included a broad sampling of genera across Hydrophyllaceae, establishing the foundation of phylogenetic relationships in Hydrophyllaceae, and providing the basis for subsequent molecular systematic investigations (Ferguson 1998, 1998 [1999]). In those studies, two samples of *Eucrypta* were included, one of *E. chrysanthemifolia* and one of *E. micrantha*, which were not resolved as each other's closest relatives in either the nuclear, chloroplast, or combined nuclear and chloroplast trees (Ferguson 1998). Ferguson noted that *E. chrysanthemifolia* and *E. micrantha* were distinct lineages in Hydrophyllaceae, and that additional investigation was needed to confirm paraphyly of *Eucrypta* sensu lato. The clades containing each of the two species had low support, and while *E. chrysanthemifolia* was placed with other members of tribe Hydrophylleae, placement of *E. micrantha* was not resolved (Ferguson 1998, 1998 [1999]).

Objectives

The goals of this study are to assess the monophyly of *Eucrypta*, with inclusion of additional samples from the two widely recognized species (i.e., *E. chrysanthemifolia* and *E. micrantha*) in the context of a phylogenetic analysis of tribe Hydrophylleae, and to revise the taxonomy as necessary to allow for recognition of monophyletic genera.

Materials and Methods

Taxon sampling

Samples for DNA work targeting the species of *Eucrypta* sensu lato were included from fieldwork and herbarium specimens. Samples from herbarium specimens were included if destructive sampling was feasible and defensible. Material included for DNA work for *Eucrypta* sensu lato and downloaded from GenBank is detailed in the appendices (*E. chrysanthemifolia* Appendix 2.1, *E. micrantha* Appendix 2.2). Material was included from both varieties of *E. chrysanthemifolia* (var. *chrysanthemifolia* and var. *bipinnatifida*) (Appendix 2.1), but not at the sampling depth needed to evaluate molecular support for taxa at the varietal rank in this study.

Additional accessions of representative genera from Hydrophyllaceae (tribes Hydrophylleae and tribe Romanzoffieae Dumortier, Boraginaceae sensu APG 1998 or

Boraginales sensu Boraginales Working Group 2015) were downloaded from GenBank to compare with the previously published trees of Ferguson and others (*Ellisia* Linnaeus*, Emmenanthe* Bentham, *Draperia* Torrey, *Hydrophyllum* Linnaeus, *Nemophila* Nuttall, and *Pholistoma* Lilja) (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005; Hansen et al. 2009; Benson et al. 2013; Walden et al. 2014). Additional samples were included from fieldwork and herbarium specimens for these taxa to enhance clade sampling. Sequences generated for Chapter 1 (*Emmenanthe*) were also included here in this study. Details for these materials included for molecular studies are included in Appendix 2.3.

Regarding the ingroup, the taxa treated here in Hydrophyllaceae were included within Boraginaceae sensu lato by the Angiosperm Phylogeny Group (APG) and recognized as a subfamily, Hydrophylloideae (Bremer et al. 1998; APG II 2003; APG III 2009). Placement of Hydrophyllaceae in regards to various clades of Boraginales is somewhat unresolved (Nazaire and Hufford 2012; Weigend, Luebert, Gottschling, et al. 2013; Weigend, Luebert, Selvi, et al. 2013; Refulio-Rodriguez and Olmstead 2014), although Codonaceae is likely sister to the rest of Boraginales (Weigend and Hilger 2010; Weigend, Luebert, Gottschling, et al. 2013) and recent efforts have established that Codonaceae, Hydrophyllaceae, and other distinct lineages are best recognized at the rank of family in Boraginales (Stevens 2001 onward; Luebert et al. 2015 *in revision*).

The outgroup for the molecular study was *Hydrolea spinosa* L. (AF091168) (Davenport 1988; Di Fulvio 1997; Ferguson 1998, 1998 [1999]; Olmstead and Ferguson 2001; Erbar et al. 2005). An outgroup outside of Boraginales was preferred to avoid issues related to within-order relationships, and chosen because this taxon had previously been used to root Ferguson's study (Ferguson 1998, 1998 [1999]), and was the same for other chapters of the dissertation (see Chapter 1, Chapter 3). Additional samples of *Borago officinalis* L. were included from Boraginaceae sensu stricto (AF091151; FJ763248) (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005; Weigend et al. 2009).

For typification and nomenclatorial purposes, specimens were determined morphologically at B, CAS, CGE, DAV, JEPS, K, OBI, P, SFSU, SJSU, and UC.

Georeferencing

This study confirms and expands the documented distribution of taxa of *Eucrypta* sensu lato. Georeferencing of herbarium specimens and databased accessions are visualized in Google Earth maps in the taxonomy section. Databased herbarium accessions were extracted as .csv files from BajaFlora (BajaFlora 2015), Consortium of California Herbaria [CCH] (Consortium of California Herbaria [CCH] 2015), Consortium of Pacific Northwest Herbaria [CPNWH] (Consortium of Pacific Northwest Herbaria [CPNWH] 2015), La Red Mundial de Información sobre Biodiversidad [REMIB] (La Red Mundial de Información sobre Biodiversidad [REMIB] 2015), and the Southwest Environmental Information Network [SEINet] (SOUTHWEST ENVIRONMENTAL INFORMATION NETWORK [SEINet] 2012–2015). For additional details regarding methods see the georeferencing section in Chapter 1 (*Emmenanthe*). Herbarium accession numbers examined for georeferencing are included as appendices (see taxonomic section).

Gene region sampled

I examined the internal transcribed spacer region (ITS-1, ITS-2, and 5.8S gene) of 18S-26S nuclear ribosomal DNA sequences (nrITS) for inferring interspecific relationships in

Eucrypta sensu lato. ITS-1 and ITS-2 of the nrITS region are variable, rapidly evolving spacers, previously used in phylogenetic studies to successfully resolve relationships at multiple taxonomic levels in the angiosperms (Baldwin et al. 1995; Álvarez and Wendel 2003; Yao et al. 2010; China Plant BOL Group et al. 2011), the Lamiidae sensu Olmstead et al. 1992 (Olmstead et al. 1992; Stevens 2001 onward; Maddison and Schulz 2007; Refulio-Rodriguez and Olmstead 2014), the Boraginales (Ferguson 1998; Moore and Jansen 2006; Weigend et al. 2009; Hasenstab-Lehman and Simpson 2012; Nazaire and Hufford 2012; Cohen 2013), and the hydrophylls (Ferguson 1996, 1997; Gilbert et al. 2005; Taylor 2012; Barr 2014). There are known issues for nrITS regarding alignment difficulties for some clades in Boraginales (e.g., placement of the holoparasite family Lennoaceae, polyploid taxa), and support can be weak at deeper nodes and where sampling is sparse (Walden et al. 2014). nrITS was an appropriate set of markers for the objectives of this study, as it provides resolution for inferring interspecific taxonomic relationships, as well as confirming membership within clades.

DNA isolation and PCR amplification

DNA Isolation. Protocol followed that of Walden et al. (2014) for nrITS and for methods detailed in Chapter 1 (*Emmenanthe*). Total genomic DNA was extracted from at least 0.020 mg (up to 0.050 mg) dry weight herbarium or silica-dried leaf material following Doyle and Dickson (Doyle and Dickson 1987) using Qiagen DNeasy Plant kits (Qiagen, Valencia, CA, USA). Young, green leaves near tips of growing shoots were preferred for extraction, but not always available from herbarium specimens. For older herbarium specimens (i.e., anything collected before 1965), target weight herbarium leaf material was 0.040–0.050 mg dry weight to increase starting material. The protocol was modified to include tissue homogenization with acid-clean 3.2 mm chrome-steel beads or 5 mm solid soda lime #3000 glass beads using a TissueLyser II (Qiagen, Valencia, CA, USA) instead of grinding tissue with liquid nitrogen using mortar and pestle. The weighed samples were frozen at 4ºC in 2 ml microcentrifuge tubes prior to homogenization. The TissueLyser Adapters (2 × 24 Set) were also frozen for minimum 2 hours period prior to homogenization. Following the first homogenization cycle, the inner sample tubes were switched with outer sample tubes, and adapters were rotated and inverted for the second homogenization cycle. The incubation time was extended to 24 hrs for field-collected material, and to 48 hrs for herbarium material. For especially glandular material and very old herbarium material to increase PCR signal, 20 µL genomic DNA was added to 200 µL of 5% Chelex® 100 Chelating Resin (Bio-Rad Laboratories, Inc., Hercules, CA) and boiled for 20 minutes (Singer-Sam et al. 1989; Walsh et al. 1991).

PCR amplification for nrITS. Total genomic DNA elutions and supernatant from Chelex® reactions were serially diluted to 1:100 in Ultra-Pure distilled H_20 (Invitrogen, Grand Island, NY, USA) for best PCR amplification (Mullis et al. 1987) of nrITS with primers ITS-I (forward) (Urbatsch et al. 2000) and ITS4 (reverse) (White et al. 1990). Primers were obtained as 300 mM stock (Elim Biopharmaceuticals, Inc. Hayward, CA, USA), and diluted first to 100 mM stock with ultralow Tris-EDTA buffer (ULTE), and then to 10 mM with Ultra-Pure H_20. PCR was conducted with a final reaction volume of 20 µL in AccuPower PCR PreMix Bioneer strip tubes (Bioneer, Inc., Alameda, CA, USA), each containing 0.75 µL of forward and 0.75 µL of reverse primer at 10mM each, and 17.0 µL 1:100 dilution genomic DNA template. The PCR thermo-cycle profile had an initial denaturation step of 1 min at 96ºC, followed by 35 cycles of

30 sec at 94ºC, 30 sec at 56ºC, and 1 min at 72ºC, and a final extension at 72ºC for 5 min, with subsequent storage at 4ºC.

To verify amplification of PCR products, a combined total of 5 µL of template PCR product and 1 µL of 6× loading dye was run on a 1.8% agarose gel (APEX agarose) in 1× TBE buffer at 100 volts, with a standard 100 bp ladder to visually size fragments. The gel was stained in an ethidium bromide bath, rinsed in deionized water, and viewed under ultra-violet light. Gel photographs were taken for reference (not shown). Sequence polymorphism in the direct sequenced PCR products was not observed; successful amplifications showed only a single band.

DNA sequencing

Cycle sequencing for nrITS. PCR products were cleaned of excess nucleotides (dNTPs) and primers from the amplification reaction using 1 µL ExoSAP-IT (USB Corp, Cleveland, Ohio, USA) per 5 µL template, with an initial 37ºC incubation for 30 min for digestion, followed by 80ºC for 10 min to inactivate the enzymes. Cycle sequencing for nrITS was conducted with the forward amplification primer ITS4 and reverse internal cycle sequencing primer ITS-5A (Downie et al. 2000) in a final reaction volume of 12 µL, containing 6.20 µL ultra-pure H_20, 0.8 µL BigDye (Applied Biosystems, Inc., Foster City, CA, USA), 2.0 µL 5× buffer, 1.0 µL primer (forward or reverse), and 2.0 µL template DNA. Reaction parameters were an initial 2 min at 94ºC denaturation step, followed by 25 cycles of 30 sec at 94ºC, 30 sec at 56ºC, and 30 sec at 72ºC, with terminal extension at 72ºC for 4 min, and storage at 4ºC.

Sequencing for nrITS. Cycle sequencing products were precipitated using EDTA/sodium acetate in ethanol protocol, and then resuspended in 15 µL Hi-Di formamide (Applied Biosystems, Inc., Foster City, CA, USA). Products were denatured for 2 min at 95ºC, followed by 5 min at 4ºC to snap chill. Samples were loaded into 96 well plates or strip tubes and spun down at low speed (700 rpm for 1 min). Sequencing was conducted using an ABI PRISM 3100 Sequencer (Applied Biosystems, Inc., Foster City, CA, USA). All molecular work and data analysis was conducted in the San Francisco State University Department of Biology Genomics/Transcriptomics Analysis Core (GTAC).

Data Analysis

Sequences were base-called in Sequencing Analysis Software 5.1 (Applied Biosystems, Inc., Foster City, CA, USA). Base calling was straightforward for nrITS; sequence polymorphism in the direct sequenced PCR products was not observed. Nucleotide sequences were edited and assembled using Sequencher 4.8 (Gene Codes Corporation, Inc., Ann Arbor, MI, USA).

This study combined sixteen previously published nrITS sequences downloaded from GenBank, 20 sequences generated for Chapter 1 (*Emmenanthe*) with 25 additional sequences for this chapter, for a total of 61 sequences. One for the outgroup (*Hydrolea spinosa* L., Hydroleaceae), and two for Boraginaceae s.s. (*Borago officinalis* L.) were included from GenBank. For *Eucrypta chrysanthemifolia*, one sequence was downloaded from GenBank and six new sequences were generated for this study. For *E. micrantha*, one sequence was downloaded from GenBank, and four new sequences were generated for this study. For the other genera representing the tribes of the hydrophylls, included sequences are as follows. Two sequences from GenBank and one new sequence were included for *Hydrophyllum*. Two sequences of *Nemophila* from GenBank and two new sequences were included. One sequence of *Pholistoma* was downloaded from GenBank and five new sequences were included. One sequence from GenBank was included for *Ellisia*. Twenty-one sequences of *Emmenanthe* were included, one from GenBank and twenty generated for Chapter 1 (see details in chapter 1). Four sequences of *Draperia* were downloaded from GenBank and seven new sequences were included. All sequences generated for this study will be deposited in GenBank.

Sequences were aligned in MAFFT (Katoh et al. 2002; Edgar 2004; Katoh et al. 2005; Katoh and Toh 2010) on XSEDE (Extreme Science and Engineering Discovery Environment) through the CIPRES (Cyberstructure for Phylogenetic Research) Science Gateway portal (Miller et al. 2010) using default parameters. Indels were edited manually in MacClade v.4.8 OSX (Sinauer Associates Inc., Sunderland, Massachusetts, [Maddison and Maddison 2001]).

Maximum parsimony phylogenetic analysis. The nrITS matrix was analyzed using the maximum parsimony criterion (MP) in PAUP* v.4.0b10 (Swofford 2002). MP phylogeny reconstruction was performed using a heuristic search of 1,000 random addition sequence replicates, with tree-bisection-reconnection (TBR) branch swapping algorithm, ACCTRAN, all characters unordered and weighted equally, gaps treated as missing data, and MAXTREES increased by 100 to a limit of 10,000,000. The maxtrees limit was not hit. Nonparametric bootstrap analyses were performed using the starting strict consensus tree obtained via stepwise addition, using a heuristic search, including 10 random addition sequence replicates with 100 bootstrap replicates (Felsenstein 1985).

DNA substitution model selection. NEXUS format of the sequence matrix was converted through the CIPRES Science Gateway portal (Miller et al. 2010) with NCLconverter version 2.1 (Lewis and Holder 2008) to a relaxed PHYLIP format on XSEDE (Extreme Science and Engineering Discovery Environment) (Stamatakis 2014). jModeltest2 version 2.1.6 on XSEDE with PHYML was used to test 88 models of evolution for best fit for the nrITS sequences (Posada and Crandall 1998; Guindon and Gascuel 2003; Posada and Buckley 2004; Posada 2008; Darriba et al. 2012).

Maximum likelihood phylogenetic analysis. Maximum likelihood (ML) analysis was initiated through the CIPRES Science Gateway portal (Miller et al. 2010) with RAxML-HPC2 version 8.1.11 analysis on XSEDE (Stamatakis 2014). The model of evolution was GTRGAMMA, with rapid bootstrapping, 1,000 bootstrap replicates, best tree search, and gaps and undetermined values treated as missing data (Stamatakis 2006; Stamatakis et al. 2008; Stamatakis 2014).

Bayesian phylogenetic analysis. Bayesian inference (BI) phylogenetic analyses were initiated in MrBayes 3.2.3 (Huelsenbeck and Ronquist 2001; Ronquist and Huelsenbeck 2003; Ronquist et al. 2012) using XSEDE through the CIPRES portal, with default priors, random starting trees, and two independent runs of 10,000,000 generations each (sampled every 1,000 generations), using four chains (three hot and one cold) and the general time reversible model with gamma-distributed rate variation across sites (GTR+G, nst to 6, rates to gamma). The average standard deviation of split frequencies from each run was less than 0.01, and PSRF (Potential Scale Reduction Factor) approached one (0.999) or equaled one for the 95% credibility interval. The number of trees required to reach stationarity was determined using Tracer v.1.6 (Rambaut et al. 2014). Convergence of posterior probabilities of split frequencies of runs was assessed in AWTY (Are We There Yet?) using the between run compare diagnostic function; graphical plots did not reject convergence (p near one for burn-in at 25%) (Wilgenbusch et al. 2004; Nylander et al. 2008). Burn-in samples (2,500) were discarded (samples included for analysis from each run: 7,501), and runs were combined, with posterior probabilities of nodes ≥95% considered strongly supported.

RESULTS AND DISCUSSION

Model selection. Calculations via jModeltest2 using the Akaike information criterion (AIC) (Akaike 1973, 1974) indicated GTR+G (General Time Reversible model of nucleotide substitution with the gamma [Γ] model of rate heterogeneity) (Tavaré 1986) as the best-fit model of evolution (-lnL score: 4634.00309, delta = 0.0), as did use of the corrected Akaike information criterion (AICc) (-lnL score: 4634.00309, delta = 0.0). Use of the Bayesian information criterion (BIC) (Schwarz 1978; Wit et al. 2012) indicated TIM1ef+G (TIM [transition model] with equal base frequencies model of nucleotide substitution plus gamma [Γ] model of rate heterogeneity) (Rodríguez et al. 1990; Posada 2003) to be the best evolutionary model (-lnL score: 4648.61243, delta = 0.0), as did use of Decision Theory Performance-based selection (DT) (-lnL score: 4648.6124, delta = 0.0).

Phylogenetic analysis. The aligned nrITS matrix included 61 sequences and contained 2016 total characters. 1673 (82.986%) characters were constant and 105 (5.2%) variable characters were parsimony uninformative. The total number of parsimony informative characters was 238 (11.8%). The shortest MP tree length was 670 steps; the strict consensus of 95900 best MP trees with MP bootstrap values, ML bootstrap values, and BI posterior probabilities at nodes is shown in Fig. 2.1. The RAxML phylogram of the single, best tree RAxML phylogram of the single, best tree [-lnL = 4639.165896, tree length = 1.699999] with ML bootstrap values is shown in Fig. 2.2.

A large clade of *Eucrypta chrysanthemifolia, Pholistoma, Nemophila*, and *Hydrophyllum* was resolved as part of a larger clade with their sister group, *Ellisia*; in turn, representatives of those five genera were resolved as part of a still-larger clade including their sister group, *Emmenanthe*. This clade of *Emmenanthe, Ellisia, E. chrysanthemifolia, Pholistoma, Nemophila,* and *Hydrophyllum* comprises tribe Hydrophylleae, and places *E. chrysanthemifolia* and *Emmenanthe* within this group. Representatives of *Eucrypta micrantha* were resolved as a clade outside and sister to the clade encompassing representatives of *Eucrypta chrysanthemifolia*, *Pholistoma*, *Nemophila*, *Hydrophyllum*, *Ellisia*, and *Emmenanthe*. Additional investigation is needed to resolve placement of *E. micrantha* in tribe Hydrophylleae with additional evidence and statistical tests. The clade was part of a larger clade including representatives of their sister group, *Draperia*. *Draperia* is currently included within tribe Romanzoffieae.

Eucrypta sensu lato is polyphyletic, confirming the results of Ferguson (Ferguson 1998, 1998 [1999]). Some clade support values are low, raising the possibility that the reason that they are not forming a clade may be attributable to homoplasy. These results are also based only on nrITS phylogeny, although the previous results of Ferguson found similar results for nrITS and cpDNA phylogenies (Ferguson 1998, 1998 [1999]).

Sequences from populations and specimens determined as *Eucrypta chrysanthemifolia* were supported as a distinct clade, including specimens from *E. chrysanthemifolia* var. *chrysanthemifolia* and *E. chrysanthemifolia* var. *bipinnatifida*. A sample from Baja California of a population identified as *E. chrysanthemifolia* var. *bipinnatifida* (*G. K. Walden 115*) was supported as sister to the clade comprising the remainder of *E. chrysanthemifolia* var. *chrysanthemifolia*. Sampling was not broad or deep enough to evaluate the varieties of *E. chrysanthemifolia*, and future work is needed to investigate these taxa. Sequences from populations and specimens determined as *E. micrantha* were supported as a separate clade.

As in Chapter 1, *Emmenanthe* is supported as monophyletic in all analyses (MP 100/ ML 100/ BI 1). Two clades were strongly supported within the genus, corresponding to *E. penduliflora* (yellow-flowered, MP 99/ ML 81/ BI 0.97) and *E. rosea* (pink-flowered, MP 100/ ML 100/ BI 1).

Ellisia was inadequately sampled in this study for robust support at the clade level, but the topologies of all analyses confirmed the results of previous studies (Ferguson 1998, 1998 [1999]).

Draperia was supported as a clade in all analyses, sister to the rest of sampled hydrophyll genera. That clade included a sample of a specimen from the type locality of *D. systyla* var. *minor* Brand [Trinity Co., Coffee Creek, *H. D. Thiers 33857*]. The protologue of Brand described characteristics of diminutive plants that are also commonly found on cliff faces or areas with shallow soil profiles of the Sierra Nevada [especially in the vicinity of Yosemite] (Brand 1912). These plants of the Sierra Nevada were supported in a large clade, regardless of habit. The type specimen of var. *minor* and other draperias collected in the area [Trinity Co., Shasta Co., Siskiyou Co.] have distinctive corollas [and perhaps other morphological characteristics], are geographically disjunct from the populations in the Sierra Nevada, and are often found on granitic substrates. Although poorly resolved at this level of sampling, these data preliminarily indicate that there may be a distinct lineage from the Cascade/Klamath worthy of future investigation and taxonomic recognition within *Draperia*, as also suggested by US Forest Service botanist Julie Kierstead-Nelson (personal communication).

Geographic Distribution and Ecology

This study confirms and expands the distribution for *Eucrypta chrysanthemifolia* and *E. micrantha* documented by Constance [see especially map, p. 151] (Constance 1938). Specimens identified and georeferenced as *E. chrysanthemifolia* var. *chrysanthemifolia* are largely plants west of the Sierra Nevada, and plants of *E. chrysanthemifolia* var. *bipinnatifida* are largely those east of the range, of the Desert and Great Basin provinces. The populations and specimens determined as *E. chrysanthemifolia* var. *bipinnatifida* and *E. micrantha* were georeferenced as closely co-occurring across the distribution. Samples from specimens collected from the Providence Mountains (Inyo Co.) were from the same mountain at two slightly separate elevations, with *E. chrysanthemifolia* var. *bipinnatifida* (*B. Trowbridge 3151*) occurring at 4000 ft. and *E. micrantha* (*B. Trowbridge 3172*) occurring at 5000 ft elevation. Both taxa occur across a range of elevations.

If *E. chrysanthemifolia* var. *bipinnatifida* and *E. micrantha* were closely related (congeneric) and competing for the same resources, the principle of competitive exclusion would predict that one species would outcompete the other for resources (Gause 1934; Levin 1970). In Chapter 1, the two closely related sister-species of *Emmenanthe* are sufficiently ecologically divergent that these taxa co-occur in the same space and time on serpentine areas in California. However, if the two species are distantly related (as the phylogenetic evidence demonstrates here), there is no expectation that ecological needs will overlap and force competition, and that both taxa (i.e., *E. chrysanthemifolia* var. *bipinnatifida* and *E. micrantha*) can be found in similar habitats.

Two corolla colors for *Eucrypta micrantha* are commonly encountered, magenta-pink lobes with a yellow tube, or white lobes with a yellow tube. The color forms can sometimes be found in the same populations (see, for example CalPhoto ID: 0000 0000 0510 1088 [2010-05-13]). Representatives of the two corolla forms from fieldwork were included from populations along Kelbaker Road (San Bernardino Co., California). Individuals sampled were from single color-form populations [although mixed color-form populations were interspersed in the area], with a white-lobed corolla form (*G. K. Walden 283*) from a limestone outcropping and a pink-lobed corolla form (*G. K. Walden 289*) from a volcanic outcropping. The distribution of corolla color-forms is not well understood throughout the range of the taxon, and the relationship, if any, of floral color-form to chromosome number, edaphic affinity and substrate, or pollinators are not reported in the literature.

CONCLUSIONS

Phylogenetic analysis of sequences of Hydrophyllaceae including samples from populations and specimens determined as *Eucrypta chrysanthemifolia* and *E. micrantha* demonstrate that these species represent distinct lineages, confirming results of Ferguson (Ferguson 1998, 1998 [1999]) and Walden (Walden 2010) that *Eucrypta* is not monophyletic. These results warrant recognition of a narrowed circumscription of *Eucrypta*, equivalent to *E. chrysanthemifolia* and varieties (*Eucrypta* sensu stricto), and support for a separate taxon at the rank of genus, *Vermisperma*, for *E. micrantha*, now treated as *Vermisperma micranthum*. Sampling was not adequate to address the support for varieties of *E. chrysanthemifolia* (var. *chrysanthemifolia* and var. *bipinnatifida*), but there is a clear distributional separation of the varieties. This, in addition to differences in morphological characters and chromosome numbers supports my decision to provisionally retain these varieties as taxonomic entities here. *Eucrypta chrysanthemifolia* var. *chrysanthemifolia* (n = 10) can be distinguished from *E. chrysanthemifolia* var. *bipinnatifida* (n = 10, 20) by having 2–3-pinnatifid proximal leaves (compared to 1–2 pinnatifid leaves in var. *bipinnatifida*), corollas conspicuously exceeding the calyx (equaling the calyx in var. *bipinnatifida*), white or blue with purple venation (compared with corollas white to yellowish-white in var. *bipinnatifida*), and the more floriferous nature of each inflorescence (8–15 flowers per rachis in var. *chrysanthemifolia* versus 4–8 flowers per rachis in var. *bipinnatifida*). Clarification is needed to understand the chromosome counts of populations and morphological characters throughout the range for both described taxonomic entity. Although the placement of *Eucrypta* sensu stricto and the newly named *Vermisperma* are supported within this study, reconciliation of previous infrafamilial classifications is extremely complicated, requiring substantial familial level sampling (both Hydrophyllaceae and "Namaceae") and are outside the scope of this study (Luebert et al. 2015 *in revision*).

TAXONOMIC TREATMENT

Results from this study require re-circumscription of *Eucrypta* sensu stricto to include only *E. chrysanthemifolia* and subordinate taxa, and recognition of a new genus for *E. micrantha*. Full taxonomic details are provided below.

Eucrypta Nuttall, Proceedings of the Academy of Natural Sciences of Philadelphia 4(1):12–13. 1848 (Mar.–Apr. 1848); et Journal of the Academy of Natural Sciences of Philadelphia series II, 1:158–159. 1848; vide Reveal & Spevak in Taxon 16. 410. 1967. *Ellisia* Linnaeus subg. *Eucrypta* (Nuttall) A. Gray, Proceedings of the American Academy of Arts and Sciences 10:316. 1875 (as § 2. EUCRYPTA). *Ellisia* Linnaeus sect. *Eucrypta* (Nuttall) Bentham & Hooker f., Genera Plantarum 2, part 2:827. 1876. ---LECTOTYPE SPECIES designated by Constance, Lloydia 1:145. 1938: *Eucrypta paniculata* Nuttall, Proceedings of the Academy of Natural Sciences of Philadelphia 4(Mar.--Apr.):13. 1848; et Journal of the Academy of Natural Sciences of Philadelphia series II, 1:159. 1848; vide Reveal & Spevak in Taxon 16. 410. 1967.

The taxonomy of *Eucrypta* sensu lato, like that of most infratribal taxa of the hydrophylls [see synopsis of *Phacelia* by Walden and Patterson 2012] was complicated when authors inadvertently made new combinations by citing the subgenera of Gray (1875) but mistakenly translated [§] as sectional status, considered a bibliographic error of citation, but a valid publication of new combinations if published before 1953. Thus, the section of Bentham and Hooker has priority over the later isonym of Gray (Bentham and Hooker 1876; Gray 1878; McNeill et al. 2012). I correct the sectional nomenclature of *Eucrypta* here in the list of synonyms. For dates of publications for the names of Nuttall, refer to Reveal and Spevak (1967).

Invalid and illegitimate names:
Ellisia section *Eucrypta* (Nuttall) A. Gray, Synoptical Flora of North America 2(1):157–158. 1878 (as § 2. EUCRYPTA), a later isonym and of no nomenclatural standing (Gray 1878; McNeill et al. 2012).

Eucrypta chrysanthemifolia (Bentham) Greene, Bulletin of the California Academy of Sciences 1(4A):200. 1886[1885]. *Ellisia chrysanthemifolia* Bentham, Transactions of the Linnean Society of London 17(2):274. 1835 [read 1834, issue published May 1835, entire vol. published 1837]. *Macrocalyx chrysanthemifolius* (Bentham) O. Kuntze, Revisio generum plantarum: vascularium omnium atque cellularium multarum secundum leges nomenclaturae internationales cum enumeratione plantarum exoticarum in itinere mundi collectarum 2:434. 1891. ---TYPE: USA, California, "From California", 1833, *D. Douglas s.n.* (holotype: K! [type material is restricted to the lower right hand plant on sheet of Douglas, excluding material of *Eucrypta foliosa*, *Nuttall 487*; *Eucrypta foliosa*, U[pper] California, S[an] Diego, *Nuttall s.n.*; California, *Coulter s.n.*]; isotypes: GH00091955 [excluding plant on left of *Eucrypta paniculata,* Angeles, *Nuttall s.n.* [collector likely Gambel] [kiki, JStor], NY00337097 [sweetgum, JStor], E00288431 [E, JStor], P [coldbr, JStor]).

Eucrypta paniculata Nuttall, Proceedings of the Academy of Natural Sciences of Philadelphia 4(Mar.--Apr.):13. 1848; et Journal of the Academy of Natural Sciences of Philadelphia series II, 1:159. 1848; vide Reveal & Spevak in Taxon 16. 410. 1967. ---TYPE: USA, California, Angeles, *Gambel s.n.* [and printed label with coll. Nuttall] (holotype: GH00091955 [mixed collection, excluding plant on right of *Eucrypta chrysanthemifolia, Douglas s.n.*] [kiki, JStor]; isotype GH00091956 [kiki, JStor]).

The protologue gives "[n]ear Santa Barbara, Upper California. Flowering in April and May." for *Eucrypta paniculata* (Nuttall 1848a, 1848b), but see comments on type specimens (Constance 1938) and dates of publications (Reveal and Spevak 1967). The mixed collection of PH00019232 [JStor] is excluded from synonymy, although a label in Nuttall's hand has *Eucrypta paniculata* Nutt.; none of the specimens were determined as that taxon by Constance (Constance 1938, 1941).

Eucrypta foliosa Nuttall, Proceedings of the Academy of Natural Sciences of Philadelphia 4(Mar.–Apr.):13. 1848. ---TYPE: USA, California, Los Angeles County, "With the above

[*E. paniculata*, the first listed name], which it much resembles, but a lower, less viscid plant, with rather smaller flowers and capsules", U[pper] Cal[ifornia, [Santa] Catalina Island, [*Gambel*] *s.n.* [no collector given on sheet] (holotype: K! [type material is restricted to the left hand plant, excluding right hand plant material of *Eucrypta foliosa*, U[pper] California, S[an] Diego, *Nuttall s.n* [likely collected also by Gambel])

No locality was cited in the protologue for *Eucrypta foliosa* (Nuttall 1848a, 1848b), but Constance restricted the type to that of Catalina Island (Constance 1938). There are additional specimens with epithets of '*foliosa*' or '*foliosum'* variously ascribed to Nuttall as the collector at Kew, PH, and likely elsewhere. These are possible isotypes examined and distributed by Nuttall, but Constance excluded these from the original material in revision and determinations. I follow his circumscription here.

Ellisia torreyi A. Gray var. *orcuttii* A. Gray in A. Gray et al., Synoptical Flora of North America ed. 2, 2(1):413. 1886. *Eucrypta paniculata* Nuttall sensu Greene, Bulletin of the California Academy of Sciences 1(4A):200. 1886[1885], as to specimens only. ---TYPE: MÉXICO, Baja California, Northern Lower California, 11 July 1885, *C. R. Orcutt s.n.* (holotype: GH0091951 [kiki, JStor]; isotypes: MO147844-486184 [TROPICOS], UC).

Greene considered *Eucrypta paniculata* to be a plant limited in distribution to Baja California based on specimens available at Berkeley, especially those of C. R. Orcutt (Greene, 1885 #163). Citations of *Eucrypta paniculata* Nuttall are sometimes given as sensu Greene (Constance 1938) [or better, *Eucrypta paniculata* Nuttall sensu Greene, Bulletin of the California Academy of Sciences 1(4A):200. 1886[1885], as to specimens only].

Gray based 'var. orcuttii' on Greene's circumscription of *Ellisia paniculata* Nuttall, citing only Greene as the author of the basionym (Gray 1886a). This variety lacked inclusion of Nuttall's authority and basionym, which is a correctable error, but also explicitly excludes the type element for *Ellisia paniculata* Nuttall as Gray placed both of the Gambel collections [for *E. paniculata* and *E. foliosa*, respectively] in synonymy with *Ellisia chrysanthemifolia* Bentham (Gray 1886a, 1886b). This is a tenuously valid publication of the name, and is included here for thoroughness.

Brand followed Gray's synonymy in the treatment of eucryptas, basing *Ellisia torreyi* 'var. paniculata', on Greene's circumscription of *Eucrypta paniculata* Nuttall sensu Greene, with *Ellisia torreyi* A. Gray var. *orcuttii* A. Gray in synonymy (Brand 1913). Brand also explicitly excluded the type of *Ellisia paniculata* Nuttall from *Ellisia torreyi* A. Gray, again placing it in the synonymy of *Ellisia chrysanthemifolia* Bentham. Thus, Brand's new variety 'paniculata' did not include the type of *Ellisia paniculata* Nuttall, and is not a valid publication. Brand's name is, at best, considered superfluous, because it should have adopted the epithet [orcuttii] of the included basionym and type of Gray's name, and not that of the excluded *Ellisia paniculata* Nuttall.

superfluous name:

Ellisia torreyi A. Gray var. *paniculata* (Nuttall sensu Greene) Brand, p. 41–42 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59). Verlag von Wilhelm Engelmann, Leipzig. 1913. *Eucrypta paniculata* Nuttall sensu Greene, Bulletin of the California Academy of Sciences 1(4A):200. 1886[1885], as to specimens only. "Niederkalifornien: An der Nordgrenze (Orcutt, nach Gray). Nicht gesehen" [Baja California: At the northern border (Orcutt, according to Gray). Not seen.]

Eucrypta chrysanthemifolia (Bentham) Greene var. ***bipinnatifida*** (Torrey) Constance, Lloydia 1:147. 1938. *Phacelia micrantha* var. *bipinnatifida* Torrey, Report on the Colorado River 4:21. 1861, as *Phacelia* (Eutoca) *micrantha* var. ? *bipinnatifida*. *Macrocalyx bipinnatifidus* (Torrey) Coville, Contributions from the United States National Herbarium 4:157. 1893. *Ellisia torreyi* A. Gray var. *bipinnatifida* (Coville) Brand, p. 42 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59). Verlag von Wilhelm Engelmann, Leipzig. 1913. ---TYPE: USA, Arizona, Mohave Co., "Camp 61. Yampai Valley.", 25 March 1858, *J. S. Newberry s.n.* (holotype: NY83899-00083899 [sweetgum, JStor]: GH00093418 [kiki, JStor]).

Brand cited Coville as the basionym in the combination at varietal rank, and the basionym and type of Torrey under the synonymy of species (United States Army Corps of Engineers et al. 1861; Coville 1893; Brand 1913). This is an implicit citation of the type element, and so this is a valid publication at the rank of variety in the genus *Ellisia*. I correct the authority here in the synonymy, and note that if Gray had adopted the correct epithet in *Ellisia*, this could have been an invalid name and replaced by an autonym.

Superfluous names:

Ellisia torreyi A. Gray, Proceedings of the American Academy of Arts and Sciences 20:302. 1885, as *Ellisia* (Eucrypta) *Torreyi*. *Eucrypta torreyi* (A. Gray) A. Heller, Catalogue of North American plants of Mexico, exclusive of the lower cryptogams 7. 1898. *Nyctelea torreyi* (A. Gray) Tidestrom, Proceedings of the Biological Society of Washington 48(No. 9):42. 1935.

Ellisia torreyi A. Gray is superfluous, because Gray should have adopted the epithet of the basionym [bipinnatifida]. Gray obviously considered the plant described by Torrey to be worthy of recognition, including the type specimen, but that it was either not a valid publication due to inclusion of the question mark following the rank [and so thus Torrey as the author was not cited parenthetically] or anticipated that it could be blocked by the previous publication of *Phacelia bipinnatifida* Michaux if included in future works within the genus *Phacelia* (Michaux 1803; Gray 1885). Torrey's name was validly published, however, and the epithet of the basionym was available for the nomenclatural combination by Gray [and others] outside of the genus *Phacelia*. However, Gray disregarded the correct epithet (bipinnatifida) and chose a new name at rank species in honor of Torrey. Gray's name is therefore superfluous and is rejected. Names based on this superfluous name are also rejected, as the epithet (bipinnatifida) of the basionym should also have been adopted in each instance.

Vermisperma Walden, **gen. nov.** *Phacelia* Jussieu sect. *Helminthospermum* Torrey [in herbario] ex A. Gray, Proceedings of the American Academy 10:327. 1875 (as * HELMINTHOSPERMUM). *Phacelia* Jussieu subsect. *Helminthospermum* (Torrey [in herbario] ex A. Gray) Constance, Lloydia 1:145. 1938. ---TYPE SPECIES: *Vermisperma micranthum* (Torrey) Walden, **comb nov.** (≡*Phacelia micrantha* Torrey, Report on the United States and Mexican Boundary . . . Botany 2(1):144–145. 1859).

Torrey noted on the sheet mounted with accessions GH00269312, GH269313, and GH269311 the following "New genus - near *Nemophila* - but no appendages of calyx. Numerous vermiform-annular seeds. I had called it *Helminthospermum*, but I fear that name has been taken up. - J. T." This did not prevent Gray from basing the section upon Torrey's name (Gray 1875). *Phacelia* sect. *Helminthospermum* was validly published at rank section by Gray, and *Phacelia* subsect. *Helminthospermum* at rank subsection by Constance (Gray 1875; Constance 1938; Brizicky 1968, 1969; Moore 2001; McNeill et al. 2006). Although recombining the epithet [helminthospermum] at the rank of genus would be appropriately descriptive of the worm-shaped seeds of the capsule, it is blocked by *Helminthospermum* Thwaites (Cannabaceae) (Thwaites 1854). There is no other available name at infrageneric rank, nor other names at the rank of genus for this group. Therefore, a new name is needed as well as a new combination for the species.

The epithet 'helminthospermum' is a compound, based on the Greek, *ἕλμινς*, the worm [generally describing an intestinal worm], and *σπέρμα*, seed (Laertius ; LSJ contributors ; Liddell and Scott 1940; Stearn 2004). There are a number of other names broadly used in taxonomy at rank genus that use the root *hélmins*. The new name at genus rank, *Vermisperma*, was chosen to keep a similar meaning, as follows: Latinized, this is *vermis* (*m*), worm, and with the Greek *sperma* (*n*), seed. The suggested common name is vermicious knidseed (Dahl 1964, 1972). The basionym epithet for the species [micrantha] is also a compound, from the Greek *μικρός* small, little [size], and *ἄνθος* (*n,* in compounds *m*) flowered, and must be transferred with appropriate gender to the new genus. The suggested common name is Small-flowered vermicious knidseed.

Vermisperma micranthum (Torrey) Walden, **comb nov.** *Phacelia micrantha* Torrey, Report on the United States and Mexican Boundary . . . Botany 2(1):144–145. 1859. *Macrocalyx micranthus* (Torrey) Coville, Contributions from the United States National Herbarium 4:157. 1893. *Eucrypta micrantha* (Torrey) A. Heller, Muhlenbergia, a journal of Botany 2(1C):163. 1906. *Ellisia micrantha* (Torrey) Brand, p. 42 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59), Verlag von Wilhelm Engelmann, Leipzig. 1913. *Nyctelea micrantha* (Torrey) Wooton & Standley, Contributions from the United States National Herbarium 19:535. 1915. ---LECTOTYPE designated by Constance, Lloydia 1:149, 150. 1938: USA, Texas, El Paso County, El Paso, Stony Hills near El Paso, March, *Bigelow s.n* [label of the Whipple expedition, Valley of the Rio Grande, below Doñana, C.C. Parry, with J. M. Bigelow, C. Wright, and A. Schott] (holotype: NY0083900 [excluding *Newberry s.n.* NY83906] [sweetgum, JStor]). SYNTYPE: USA, Arizona, Santa Cruz Co., near Tubac, 1852, *C. C. Parry s.n.* (GH00269312 [excluding syntype GH269313 and non-type GH269311] [kiki, JStor]); SYNTYPE: USA, NEW MÉXICO, without locality, 1851–1852, *C. Wright 1582* (syntype GH00269313 [excluding syntype GH00269312 and non-type GH269311] [kiki, JStor]; isosyntypes: GH00269314 [kiki, JStor], GH00269315 [kiki, JStor], MOBOT not seen, NY, P00640042! [coldbr, JStor], PH01087072-0028265 [JStor]).

Torrey first listed the collection of Bigelow, and noted that this was made on the Whipple Expedition but was left out of publication in the previous Botanical Report (Torrey 1856). The additional collections are syntypes [*Parry, Wright*]. Almost all subsequent authors have agreed that Bigelow's collection represents the type locality, but Constance's revision of the genus *Eucrypta* was the place of publication for lectotypification by providing a corresponding herbarium for the type specimen (Constance 1938). The specimen designated by Constance at NY includes a printed label from the Whipple Expedition.

When Heller published the recombination in the genus *Eucrypta* (Heller 1906), his specimen cited was in comparison to the type [El Paso, presumably of *Bigelow*]. Jepson, in a rare editorial omission, later cited Heller as the sole author of the recombination (p. 239) (Jepson 1943), but Heller cited the basionym of Torrey and the type collection for a valid publication. Constance indicated that Heller's collection number [*Heller 7682*] represented a mixed collection, with both *Eucrypta micrantha* and *Eucrypta chrysanthemifolia* var. *bipinnatifida* mounted on the sheets (Constance 1938). (USA, California, Kern Co., on hills near Randsburg, 14 April 1905, *A. A. Heller 7682* (F [in part] not seen, GH [in part] not seen, NY [in part] not seen, P [in part] S [in part] UC144185 [in part]!, POM126793 [in part] not seen).

This species has nothing to do with *Nemophila micrantha* Eastwood (Eastwood 1901), nor the *Nemophila micrantha* Lindley in herbario [CGE, on a collection USA, 14 May 1827, D. Douglas].

Phacelia pinetorum M. E. Jones, Zoë 4(3):279. 1893. *Eucrypta pinetorum* (M. E. Jones) Rydberg, Flora of the Rocky Mountains 701, 1066. 1917. *Nyctelea pinetorum* (M. E. Jones) Tidestrom, Contributions from the United States National Herbarium 25:442. 1925. ---TYPE: USA, Utah, Tooele Co., Gold Hill, [12–13] June 1891, *M. E. Jones s.n.* (holotype POM73649-RSA0003867 [JStor]; isotypes: US not seen, UC605038!, DS698146-CAS0006827 [ex POM73666] [CAS, JStor]).

The protologue gives the collection date as "June 12, 1891", but all of the label metadata gives the collection date as 13 June 1891. Both of these dates are considered part of the original material. An additional collection from Dutch Hill was annotated by Brand as a duplicate of the type (Brand 1913), but this is not part of the original material; see Constance's revision (Constance 1938) [USA, Utah, Tooele Co., Dutch Mountain, 13 June 1891, *M. E. Jones s.n.* [UC107447!, GH not seen, POM73669-RSA0003866 [JStor], US not seen]).

LITERATURE CITED

AKAIKE, H. 1973. Information theory and an extension of the maximum likelihood principle. Pp. 267-281. *In* B. N. Petrov and F. Caski (eds.), Proceedings of the Second International Symposium on Information Theory. Akademiai Kiado, Budapest. Springer-Verlag, New York, NY.

———. 1974. A new look at the statistical model identification. IEEE Transactions on Automatic Control 19(6):716-723.

ÁLVAREZ, I., AND J. F. WENDEL. 2003. Ribosomal ITS sequences and plant phylogenetic inference. Molecular Phylogenetics and Evolution 29(3):417-434.

APG II. 2003. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG II. Botanical Journal of the Linnean Society 141:399-436.

APG III. 2009. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants. Botanical Journal of the Linnean Society 161(2):105-121.

BAJAFLORA. *The Flora of Baja California. Specimen data obtained from a combined multi-herbarium specimen database called the Baja California Botanical Consortium hosted by the San Diego Natural History Museum. Herbarium specimen data provided by: San Diego Natural History Museum (SDNHM), San Diego State University (SD), Rancho Santa Ana Botanic Garden (RSA), Pomona College (POM), Centro del Investigaciones Biologicas del Noroeste, La Paz (HCIB), and Universidad Autonoma de Baja California, Ensenada (BCMEX)* 2015. Available from http://www.bajaflora.org.

BALDWIN, B. G., M. J. SANDERSON, J. M. PORTER, M. F. WOJCIECHOWSKI, C. S. CAMPBELL, AND M. J. DONOGHUE. 1995. The ITS region of nuclear ribosomal DNA: a valuable source of evidence on angiosperm phylogeny. Annals of the Missouri Botanical Garden 82(2):247-277.

BARR, C. M. 2014. Phylogenetic relationships and crossing data reveal a new species of *Nemophila* (Boraginaceae). Madroño 61(3):308-315.

BENSON, D. A., M. CAVANAUGH, K. CLARK, I. KARSCH-MIZRACHI, D. J. LIPMAN, J. OSTELL, AND E. W. SAYERS. 2013. GenBank. Nucleic Acids Res 41(Database issue):D36-42.

BENTHAM, G. 1835 [read June 17th, 1834, issue published 1835, volume published 1837]. Review of the order of Hydrophylleae. Transactions of the Linnean Society 17:267-282.

BENTHAM, G., AND J. D. HOOKER. 1876. Genera Plantarum: ad exemplaria imprimis in Herberiis Kewensibus servata definita /auctoribus G. Bentham et J.D. Hooker. Sistens dicotyledonum gamopetalarum ordines xxxix, Stylidieas-Plantagineas. 3 vols. Vol. 2, part 2. Reeve and Company, London.

BRAND, A. 1912. Die Hydrophyllaceen der Sierra Nevada. University of California Publications in Botany 4(13):209-227.

———. 1913. Hydrophyllaceae. Pp 1-210 *In* Das Pflanzenreich IV, Vol. 251 (Heft 59), Adolf Engler (ed.). Verlag von Wilhelm Engelmann, Leipzig [in German, translation by GKW].

BREMER, K., M. W. CHASE, P. F. STEVENS, A. A. ANDERBERG, A. BACKLUND, B. BREMER, B. BRIGGS, P. K. ENDRESS, M. F. FAY, P. GOLDBLATT, M. H. G. GUSTAFSSON, S. B. HOOT, W. S. JUDD, M. KALLERSJÖ, E. A. KELLOGG, K. A. KRON, D. H. LES, C. M. MORTON, D. L. NICKRENT, R. G. OLMSTEAD, R. PRICE, C. J. QUINN, AND J. E. RODMAN. 1998. An ordinal classification for the families of flowering plants. Annals of the Missouri Botanical Garden 85(4):531-553.

BRIZICKY, G. K. 1968. 1805, A Proposed Starting Point for the Nomenclature of Subgeneric Taxa of Vascular Plants. Taxon 17(6):659-660.

———. 1969. Subgeneric and Sectional Names: Their Starting Points and Early Sources. Taxon 18(6):643-660.

CAVE, M. S., AND L. CONSTANCE. 1942. Chromosome numbers in the Hydrophyllaceae. University of California Publications in Botany 18:205-216.

———. 1944. Chromosome numbers in the Hydrophyllaceae, II. University of California Publications in Botany 18:293-298.

———. 1950. Chromosome numbers in the Hydrophyllaceae, IV. University of California Publications in Botany 23:363-382.

———. 1959. Chromosome numbers in the Hydrophyllaceae, V. University of California Publications in Botany 30:233-258.

CHINA PLANT BOL GROUP, D.-Z. LI, L.-M. GAO, H.-T. LI, H. WANG, X.-J. GE, J.-Q. LIU, Z.-D. CHEN, S.-L. ZHOU, S.-L. CHEN, J.-B. YANG, C.-X. FU, C.-X. ZENG, H.-F. YAN, Y.-J. ZHU, Y.-S. SUN, S.-Y. CHEN, L. ZHAO, K. WANG, T. YANG, AND G.-W. DUAN. 2011. Comparative analysis of a large dataset indicates that internal transcribed spacer (ITS) should be incorporated into the core barcode for seed plants. Proceedings of the National Academy of Sciences 108(49):19641-19646.

CHUANG, T.-I., AND L. CONSTANCE. 1992. Seeds and systematics in Hydrophyllaceae: Tribe Hydrophylleae. American Journal of Botany 79:257-264.

COHEN, J. I. 2013. A phylogenetic analysis of morphological and molecular characters of Boraginaceae: evolutionary relationships, taxonomy, and patterns of character evolution. Cladistics Online edition, DOI: 10.1111/cla.12036 (accessed 12 July 2013):1–31.

CONSORTIUM OF CALIFORNIA HERBARIA [CCH]. *Data provided by the participants of the Consortium of California Herbaria [CCH]*. Regents of the University of California 2015. Available from <http://ucjeps.berkeley.edu/consortium/.

CONSORTIUM OF PACIFIC NORTHWEST HERBARIA [CPNWH]. *Herbarium specimen data provided by: B. A. Bennett Herbarium, Yukon Government (BABY), Boise District Bureau of Land Management (BBLM), Boise State University, Snake River Plains Herbarium (SRP), Bureau of Land Management, Medford District (BLMMD), College of Idaho, Harold M. Tucker Herbarium (CIC), Eastern Washington University (EWU), Evergreen State College (EVE), Friday Harbor Laboratories (FHL), H.J. Andrews Experimental Forest (HJAEF), Humboldt State University (HSC), Idaho State University, Ray J. Davis Herbarium (IDS), Linfield College (LINF), Milner Gardens and Woodland, Vancouver Island University (VIU), Montana State University (MONT), Oregon State University (OSC), Pacific Lutheran University (PLU), Pacific Northwest Herbarium, Western Washington University (WWB), Portland State University (HPSU), Reed College (REED), Royal British Columbia Museum (V), Southern Oregon University (SOC), The New York Botanical Garden (NY), University of Alaska, Anchorage (UAAH), University of Alaska, Fairbanks - Museum of the North (ALA), University of British Columbia (UBC), University of Idaho, Stillinger Herbarium (ID), University of Lethbridge (LEA), University of Montana (MONTU), University of Puget Sound (PSM), University of Washington (WTU), University of Wyoming, Rocky Mountain Herbarium (RM), Washington State University, Marion Ownbey Herbarium (WS), Whitman College (WCW). Accessed through the Consortium of Pacific Northwest Herbaria web site* 2015. Available from www.pnwherbaria.org.

CONSTANCE, L. 1938. The genus *Eucrypta* Nuttall. Lloydia 1:143-152.

———. 1939a. The genera of the tribe Hydrophylleae of the Hydrophyllaceae. Madroño 5:28-33.

———. 1939b. The genus *Pholistoma* Lilja. Bulletin of the Torrey Botanical Club 66:341-352.

———. 1940. The genus *Ellisia*. Rhodora 42(494):33-39.

———. 1941. The genus *Nemophila* (Nuttall). University of California Publications in Botany 19:341-398.

———. 1942. The genus *Hydrophyllum* L. American Midland Naturalist 27:710-731.

———. 1963. Chromosome number and classification in Hydrophyllaceae. Brittonia 15:273-285.

CONSTANCE, L., AND T.-I. CHUANG. 1982. SEM survey of pollen morphology and classification in Hydrophyllaceae (Waterleaf Family). American Journal of Botany 69:40-53.

COVILLE, F. V. 1893. Botany of the Death Valley Expedition. Contributions U.S. National Herbarium 4:1-318.

DAHL, R. 1964. Charlie and the chocolate factory. Illustrated by J. Schindelman. Knopf, New York, N.Y.

———. 1972. Charlie and the great glass elevator: the further adventures of Charlie Bucket and Willy Wonka, chocolate-maker extraordinary. Illustrated by J. Schindelman. Knopf, New York, N.Y.

DARRIBA, D., G. L. TABOADA, R. DOALLO, AND D. POSADA. 2012. jModelTest 2: more models, new heuristics and parallel computing. Nature methods 9(8):772-772.

DAVENPORT, L. J. 1988. A monograph of Hydrolea (Hydrophyllaceae). Rhodora 90:169-208.

DI FULVIO, T. E. 1987. La endospermogenesis en Hydrophylleae (Hydrophyllaceae) con relacion a la taxonomia. Kurtziana 19:13-34.

———. 1997. Morfología y vascularización floral en Hydroleae e Hydrophylleae (Hydrophyllaceae). Kurtziana 25:7-34.

DI FULVIO, T. E., AND N. DOTTORI. 1995. Contribución al conocimiento de tricomas y emergencias en Hydrophyllaceae. Clasificación y consideraceones taxonómicas. Kurtziana 24:19-24.

DOWNIE, S. R., D. S. KATZ-DOWNIE, AND M. F. WATSON. 2000. A phylogeny of the flowering plant family Apiaceae based on chloroplast DNA *rpl16* and *rpoc1* intron sequences: towards a suprageneric classification of subfamily Apioideae. American Journal of Botany 87:273-292.

DOYLE, J. J., AND E. E. DICKSON. 1987. Preservation of plant samples for DNA restriction endonuclease analysis. Taxon 36:715-722.

EASTWOOD, A. 1901. Some small-flowered species of *Nemophila* from the Pacific coast. Bulletin of the Torrey Botanical Club 28(3):137-160.

EDGAR, R. C. 2004. MUSCLE: multiple sequence alignment with high accuracy and high throughput. Nucleic Acids Research 32(5):1792-1797.

EDWARDS, S., AND J. RIDGEWAY. 1817. Hydrophylleae [Hydrophyllaceae]. *In* Botanical Register, consisting of coloured figures of exotic plants cultivated in British gardens; with their history and mode of treatment, S. Edwards (ed. Printed for James Ridgway, London.

ERBAR, C., S. POREMBSKI, AND P. LEINS. 2005. Contributions to the systematic position of Hydrolea (Hydroleaceae) based on floral development. Plant Systematics and Evolution 252(1):71-83.

FERGUSON, D. M. 1996. Phylogenetic analysis of Hydrophyllaceae and a preliminary study of biogeographic patterns and life history evolution. American Journal of Botany (supplement) 83:155-156.

———. 1997. Phylogenetics systematics in Hydrophyllaceae as inferred from the chloroplast gene *ndhF* and the nuclear rDNA *ITS* region. American Journal of Botany (supplement) 84:557.

———. 1998. Phylogenetic systematics of Hydrophyllaceae. Ph.D. Dissertation, Biology, Harvard, Cambridge.

———. 1998 [1999]. Phylogenetic analysis and relationships in Hydrophyllaceae based on *ndh*F sequence data. Systematic Botany 23(3):253-268.

GAUSE, G. F. 1934. Experimental analysis of Vito Volterra's mathematical theory of the struggle for existence. Science 79(2036):16-17.

GILBERT, C., J. M. DEMPCY, C. K. GANONG, R. PATTERSON, AND G. S. SPICER. 2005. Phylogenetic relationships within *Phacelia* subgenus *Phacelia* (Hydrophyllaceae) inferred from nuclear rDNA ITS sequence data. Systematic Botany 30:627-634.

GRAY, A. 1875. A Conspectus of the North American Hydrophyllaceae. Proceedings of the American Academy of Arts and Sciences 10:312-332.

———. 1878. Synoptical Flora of North America. Vol. II, part I. Smithsonian Institute, Washington, D.C.

———. 1885. Contributions to the Botany of North America. Proceedings of the American Academy of Arts and Sciences 20:257-310.

———. 1886a. Supplement to Vol. II., Part I., additions and corrections. Pp. 394-494, 413-418. *In* A. Gray, Synoptical flora of North America. Ivison, Blakeman, Taylor and Co., New York, NY.

———. 1886b. Synoptical flora of North America. The Gamopetalae, being a 2d edition of vol. II, part I., collected. Ivison, Blakeman, Taylor and Co., New York.

GREENE, E. L. 1886 [1885]. Studies in the botany of California and parts adjacent, II. Bulletin of the California Academy of Sciences 1(4):179-228.

GUINDON, S., AND O. GASCUEL. 2003. A simple, fast, and accurate algorithm to estimate large phylogenies by maximum likelihood. Systematic Biology 52(696-704).

HANSEN, D. R., G. S. SPICER, AND R. PATTERSON. 2009. Phylogenetic relationships between and within *Phacelia* sections *Whitlavia* and *Gymnobythus* (Boraginaceae). Systematic Botany 34(4):737-746.

HASENSTAB-LEHMAN, K. E., AND M. G. SIMPSON. 2012. Cat's eyes and popcorn flowers: phylogenetic systematics of the genus *Cryptantha* s.l. (Boraginaceae). Systematic Botany 37(3):738-757.

HELLER, A. A. 1906. Addenda. Muhlenbergia 2(1):161-163.

HUELSENBECK, J. P., AND F. RONQUIST. 2001. MRBAYES: Bayesian inference of phylogeny. Bioinformatics 17:754-755.

JEPSON, W. L. 1943. Flora of California. Vol. 3. Associated Students Store, University of California Berkeley, Berkeley.

KATOH, K., K.-I. KUMA, H. TOH, AND T. MIYATA. 2005. MAFFT version 5: improvement in accuracy of multiple sequence alignment. Nucleic acids research 33(2):511-518.

KATOH, K., K. MISAWA, K. I. KUMA, AND T. MIYATA. 2002. MAFFT: a novel method for rapid multiple sequence alignment based on fast Fourier transform. Nucleic acids research 30(14):3059-3066.

KATOH, K., AND H. TOH. 2010. Parallelization of the MAFFT multiple sequence alignment program. Bioinformatics 26(15):1899-1900.

LA RED MUNDIAL DE INFORMACIÓN SOBRE BIODIVERSIDAD [REMIB]. 2015. Datos provenientes de las siguientes instituciones: The Herbarium XAL of the Institute of Ecology, A.C., Mexico (IE-XAL); The Herbarium of the National School of Biological Sciences, Mexico (ENCB, IPN); National Vegetable Germplasm Bank, Mexico (BANGEV, UACH); The Herbarium of the University of Texas - Austin, USA (LL, TEX); The Herbarium IEB of the Institute of Ecology, A.C., Mexico (IE-BAJIO) (NOTE); The Herbarium of the University of Sonora, Mexico (USON); Collection of Mexican Monocotyledons (UAM-I); Pines from the Northeast of Mexico (UANL); Columnar Cacti from Mexico (IE-MORELIA, UNAM); Native Trees and Shrubs for Restoration and Reforestation of Mexico (IE-DF, UNAM); Trees from the Yucatan Peninsula, Flora from Tehuantepec, Oaxaca and Asteraceae Family in Mexico (IBUNAM); w3TROPICOS, Missouri Botanical Garden (MO); Herbarium of the CIBNOR; The Herbarium Weberbauer of the La Molina Agrarian National University (MOL); Cacti from the Peninsula of Baja California, Mexico (UABC); Vascular Flora from the Sierra of San Pedro Martir, Baja California, Mexico (UABC); Actual Status and Phytogeography of the Species of the Endemic Family Cucurbitaceae of Mexico (FES-I, UNAM); Flora from the Valley of Tehuacan-Cuicatlan, Mexico (FES-I, UNAM); Taxonomic Study of the Genus Quercus (Fagaceae) from the State of Mexico, Mexico (FES-I, UNAM); Herbarium of the Autonomous University of Baja California, Mexico (UABC); Herbarium of the University of Arizona, USA (ARIZ); Herbarium of the Yucatan Scientific Research Center, Mexico (CICY); Bioactive Agents from Dryland Biodiversity of Latin America (ICBG); Herbarium Kew of the Royal Botanic Gardens (RBGKEW); Taxonomical types of vascular plants from the Herbarium of the Escuela Nacional de Ciencias Biológicas, Mexico (ENCB, IPN); Flora inventory of the Sierra of Pachuca, Hidalgo, Mexico (ENCB, IPN); Monographic study of Echinopepon Naud. (Cucurbitaceae) in México (ENCB, IPN); The useful flora from two native communities of the Valley of Tehuacan-Cuicatlan: Coxcatlan and Zapotitlan of Las Salinas, Puebla, Mexico (FES-I, UNAM); Herbarium of Geo. B. Hinton, Mexico; Collection of taxonomical types of vascular plants of the Herbarium of the University of Texas – Austin, Texas USA (LL, TEX); Collection of Mexican Plants pertaining to the families Loranthaceae and Lauraceae of the Herbarium of the University of Texas – Austin, Texas USA (LL, TEX); Program of repatriation of mexican specimens; Specimens collected by George Boole Hinton (1882-1943) deposited in the Herbarium at Kew: Family Leguminosae; Repatriation of plant specimens data from Arizona Herbarium (ARIZ); The genus Bursera in Mexico (IBUNAM). Bases de datos SNIB-CONABIO proyecto, México, D.F. Website http://www.conabio.gob.mx/remib_ingles/doctos/remibnodosdb.html (accessed May-June 2015).

LAERTIUS, D. Lives of Eminent Philosophers [De vitis philosophorum], edited and with an English translation by R. D. Hicks. The Loeb classical library, 185. Vol. 2. Harvard University Press, Cambridge, MA.

LEVIN, S. A. 1970. Community equilibria and stability, and an extension of the competitive exclusion principle. The American Naturalist 104(939):413-423.

LEWIS, P. O., AND M. T. HOLDER. 2008. NEXUS Class Library (version 2.1), http://sourceforge.net/projects/ncl/.

LIDDELL, H. G., AND R. SCOTT. 1940. A Greek-English Lexicon. revised and augmented throughout by Sir Henry Stuart Jones. with the assistance of Roderick McKenzie. Clarendon Press, Oxford.

LSJ CONTRIBUTORS. *Translatum - Greek Translation Vortal, Main Page [Internet]*. Liddell, Scott, Jones Ancient Greek Lexicon [LSJ] [cited 06:54 UTC 31 July 2015. Available from http://lsj.translatum.gr/w/index.php?title=Main_Page&oldid=231588.

LUEBERT, F., L. CECCHI, M. W. FROHLICH, M. GOTTSCHLING, H. H. HILGER, J. S. MILLER, M. MITTELBACH, M. NAZAIRE, M. NEPI, D. NOCENTINI, D. OBER, R. OLMSTEAD, F. SELVI, K. SUTORÝ, B. VALDÉS, G. K. WALDEN, AND M. WEIGEND. 2015 *in revision*. Familial classification of the Boraginales (Boraginales Working Group). Taxon.

MADDISON, D. R., AND K.-S. SCHULZ, eds. 2007. The Tree of Life Web Project. Website http://tolweb.org.

MCNEILL, J., F. R. BARRIE, W. R. BUCK, V. DEMOULIN, W. GREUTER, D. L. HAWKSWORTH, P. S. HERENDEEN, S. KNAPP, K. MARHOLD, J. PRADO, W. F. P. H. V. REINE, G. F. SMITH, J. H. WIERSEMA, AND N. J. TURLAND. 2012. International Code of Nomenclature for algae, fungi, and plants (Melbourne Code) adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011. Regnum Vegetabile 154.

MCNEILL, J., F. R. BARRIE, H. M. BURDET, V. DEMOULIN, D. L. HAWKSWORTH, K. MARHOLD, D. H. NICOLSON, J. PRADO, P. C. SILVA, J. E. SKOG, J. H. WIERSEMA, AND N. J. TURLAND, eds. 2006. International Code of Botanical Nomenclature (Vienna Code). Regnum Vegetabile. Vol. 146. A. R. G. Gautner Verlag K. G.

MICHAUX, A. 1803. Flora Borealis-Americana, sistens characteres plantarum quas in America septentrionali collegit & delexit Parisiis.

MILLER, M. A., W. PFEIFFER, AND T. SCHWARTZ. 2010. Creating the CIPRES Science Gateway for inference of large phylogenetic trees. Paper read at Proceedings of the Gateway Computing Environments Workshop (GCE), 14 Nov. 2010, at New Orleans, LA.

MOORE, G. 2001. A Review of the Nomenclatural Difficulties Associated with Misplaced Rank-Denoting Terms. Taxon 50(2):495-505.

MOORE, M. J., AND R. K. JANSEN. 2006. Molecular evidence for the age, origin, and evolutionary history of the American desert plant genus *Tiquilia* (Boraginaceae). Molecular Phylogenetics and Evolution 39(3):668-687.

MULLIS, K. B., F. FALOONA, S. SCHARF, R. SAIKI, G. HORN, AND H. A. ERLICH. 1987. Specific enzymatic amplification of DNA in vitro: the polymerase chain reaction. Cold Spring Harbor Symposia on Quantitative Biology 51:263-273.

NAZAIRE, M., AND L. HUFFORD. 2012. A broad phylogenetic analysis of Boraginaceae: implications for the relationships of *Mertensia*. Systematic Botany 37(3):758-783.

NUTTALL, T. 1848a. Descriptions of Plants Collected by Mr. William Gambel in the Rocky Mountains and Upper California. Proceedings of the Academy of Natural Sciences of Philadelphia 4:7-28.

———. 1848b. Descriptions of Plants Collected by Mr. William Gambel in the Rocky Mountains and Upper California. Journal of the Academy of Natural Sciences of Philadelphia series II 1:149-189.

OLMSTEAD, R. G., AND D. FERGUSON. 2001. A molecular phylogeny of the Boraginaceae/Hydrophyllaceae s. str. (Abstract). Botany 2001: Plants and People:131.

OLMSTEAD, R. G., H. J. MICHAELS, K. M. SCOTT, AND J. D. PALMER. 1992. Monophyly of the Asteridae and Identification of Their Major Lineages Inferred From DNA Sequences of rbcL. Annals of the Missouri Botanical Garden 79(2):249-265.

POSADA, D. 2003. Using MODELTEST and PAUP* to select a model of nucleotide substitution. Current protocols in bioinformatics:6.5. 1-6.5. 14.

———. 2008. jModelTest: Phylogenetic model averaging. Molecular Biology and Evolution 25(1253-1256).

POSADA, D., AND T. R. BUCKLEY. 2004. Model selection and model averaging in phylogenetics: advantages of the AIC and Bayesian approaches over likelihood ratio tests. Systematic Biology 53(793-808).

POSADA, D., AND K. A. CRANDALL. 1998. Modeltest: testing the model of DNA substitution. Modeltest 3.7. Bioinformatics 14(9):817-818.

RAMBAUT, A., M. SUCHARD, D. XIE, AND A. DRUMMOND. 2014. Tracer v.1.6.0 Available at http://beast.bio.ed.ac.uk/Tracer.

REFULIO-RODRIGUEZ, N. F., AND R. G. OLMSTEAD. 2014. Phylogeny of Lamiidae. American Journal of Botany 101(2):287-299.

REICHENBACH, H. G. L. 1830. Flora germanica excursoria ex affinitate regni vegetabilis naturali disposita, sive principia synopseos plantarum in Germania terrisque in Europa media adjacentibus sponte nascentium cultarumque frequentius. 2 vols. Vol. 1 (1830–1832). Carolum Cnobloch, Lipsiae.

REVEAL, J. L., AND V. S. SPEVAK. 1967. Publication Dates and Current Names of 144 Names Proposed in Two 1848 Thomas Nuttall Articles. Taxon 16(5):407-414.

RODRÍGUEZ, F., J. L. OLIVER, A. MARÍN, AND J. R. MEDINA. 1990. The general stochastic model of nucleotide substitution. Journal of theoretical biology 142(4):485-501.

RONQUIST, F., AND J. P. HUELSENBECK. 2003. MrBayes 3: Bayesian phylogenetic inference under mixed models. Bioinformatics (Oxford) 19(12):1572-1574.

RONQUIST, F., M. TESLENKO, P. VAN DER MARK, D. L. AYRES, A. DARLING, S. HÖHNA, B. LARGET, L. LIU, M. A. SUCHARD, AND J. P. HUELSENBECK. 2012. MrBayes 3.2: Efficient Bayesian Phylogenetic Inference and Model Choice Across a Large Model Space. Systematic Biology 61(3):539-542.

SCHWARZ, G. 1978. Estimating the dimension of a model. The Annals of Statistics 6(2):461-464.

SINGER-SAM, J., R. TANGUAY, AND A. RIGGS. 1989. Use of Chelex to improve the PCR signal from a small number of cells. Amplifications: A Forum for PCR Users 3(September):11.

SOUTHWEST ENVIRONMENTAL INFORMATION NETWORK [SEINET]. 2012–2015. Available from http//:swbiodiversity.org/seinet/index.php.

STAMATAKIS, A. 2006. RAxML-VI-HPC: Maximum likelihood-based phylogenetic analyses with thousands of taxa and mixed models. Bioinformatics 22(21):2688-2690.

———. 2014. RAxML Version 8: A tool for Phylogenetic Analysis and Post-Analysis of Large Phylogenies. Bioinformatics 10.1093/bioinformatics/btu033 http://bioinformatics.oxfordjournals.org/content/early/2014/01/21/bioinformatics.btu033.abstract

STAMATAKIS, A., P. HOOVER, AND J. ROUGEMONT. 2008. A fast bootstrapping algorithm for the RAxML web-servers. Systematic Biology 57(5):758-771.

STEARN, W. T. 2004. Botanical Latin. 4 ed. Timber Press, Portland.

STEVENS, P. F. 2001 onward. Angiosperm Phylogeny Website, version 13, June 2015 [and more or less continuously updated since] Website http://www.mobot.org/MOBOT/research/APweb/.

PAUP* Phylogenetic analysis using parsimony (*and other methods), version 4.0 beta 10. Sinauer Associates Inc. , Sunderland, Massachusetts.

TAVARÉ, S. 1986. Some probabilistic and statistical problems in the analysis of DNA sequences. Lectures on Mathematics in the Life Sciences 17:57-86.

TAYLOR, S. 2012. Molecular systematics and the origin of gypsophily in *Nama* L. (Boraginaceae). Ph.D. Dissertation, Plant Biology, University of Texas at Austin, Austin, Texas.

THWAITES, G. H. K. 1854. Description of some new Genera and Species of Ceylon Plants. Hooker's Journal of Botany and Kew Garden Miscellany 6:65-72, 298-304.

TORREY, J. 1856. No. 4. Descriptions of the general botanical collections. *In* J. Bigelow, G. Engelmann, J. Torrey, and W. S. Sullivant (eds.), Report on the botany of the expedition. Volume IV, part V, VI, and Appendices. Explorations and surveys for a railroad route from the Mississippi River to the Pacific Ocean. War Department. Route near the Thirty-fifth parallel, explored by Lieutenant A. W. Whipple, Topographical Engineers, in 1853 and 1854. . Beverley Tucker, Printer, etc., Washington, D.C.

UNITED STATES ARMY CORPS OF ENGINEERS, J. C. IVES, AND J. S. NEWBERRY. 1861. Report upon the Colorado River of the West, explored in 1857 and 1858 by Lieutenant Joseph C. Ives ... under the direction of the Office of Explorations and Surveys, A.A. Humphreys, Captain Topographical Engineers, in charge. By order of the Secretary of War. Vol. IV. Govt. Print. Off., Washington, D.C.

URBATSCH, L. E., B. G. BALDWIN, AND M. J. DONOGHUE. 2000. Phylogeny of the coneflowers and relatives (Heliantheae: Asteraceae) based on nuclear rDNA internal transcribed spacer (ITS) sequences and chlorplast DNA restriction site data. Systematic Botany 25(3):539-565.

WALDEN, G. K. 2010. Phylogeny of infrageneric relationships within *Phacelia* (Boraginaceae) inferred from chloroplast sequence data. M.S. Thesis, Biology, San Francisco State University, San Francisco.

WALDEN, G. K., L. M. GARRISON, F. W. CIPRIANO, G. S. SPICER, AND R. PATTERSON. 2014. Phylogenies and chromosome evolution of *Phacelia* (Boraginaceae: Hydrophylloideae) inferred from nuclear ribosomal and chloroplast sequence data. Madroño 61(1):16-47.

WALSH, P. S., D. A. METZGER, AND R. HIGUCHI. 1991. Chelex 100 as a medium for simple extraction of DNA for PCR-based typing from forensic material. Biotechniques 10(4):506-513.

WARD, D. E. 1984. Chromosome counts from New Mexico and Mexico. Phytologia 56(1):55-60.

WEIGEND, M., M. GOTTSCHLING, F. SELVI, AND H. H. HILGER. 2009. Marbleseeds are gromwells - Systematics and evolution of *Lithospermum* and allies (Boraginaceae tribe Lithospermeae) based on molecular and morphological data. Molecular Phylogenetics and Evolution 52(3):755-768.

WEIGEND, M., AND H. H. HILGER. 2010. Codonaceae-a newly required family name in Boraginales. Phytotaxa 10:26-30.

WEIGEND, M., F. LUEBERT, M. GOTTSCHLING, T. L. P. COUVREUR, H. H. HILGER, AND J. S. MILLER. 2013. From capsules to nutlets—phylogenetic relationships in the Boraginales. Cladistics:n/a-n/a.

WEIGEND, M., F. LUEBERT, F. SELVI, G. BROKAMP, AND H. H. HILGER. 2013. Multiple origins for Hound's tongues (*Cynoglossum* L.) and Navel seeds (*Omphalodes* Mill.) -The phylogeny of the borage family (Boraginaceae s.str.). Molecular Phylogenetics and Evolution 68(3):604-618.

WHITE, T. J., T. BRUNS, AND J. TAYLOR. 1990. Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. *In* M. A. Innis, D. H. Gelfand, J. J. Sinisky, and T. J. White (eds.), PCR protocols: a guide to methods and applications. Academic Press, Inc., New York.

WIT, E., E. V. D. HEUVEL, AND J. W. ROMEIJN. 2012. 'All models are wrong...': an introduction to model uncertainty. Statistica Neerlandica 66(3):217-236.

YAO, H., J. Y. SONG, C. LIU, K. LUO, J. P. HAN, Y. LI, X. H. PANG, H. X. XU, Y. J. ZHU, P. G. XIAO, AND S. L. CHEN. 2010. Use of ITS2 Region as the Universal DNA Barcode for Plants and Animals. PLoS ONE 5(10).

APPENDIX 2.1. SPECIMENS EXAMINED FOR MOLECULAR STUDY - *EUCRYPTA CHRYSANTHEMIFOLIA*.

Eucrypta chrysanthemifolia (Bentham) Greene, *Ferguson 48*, GH (n.v.), AF091165 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005) not georeferenced; Solano Co., Stebbins Cold Canyon Reserve, 19 April 2008, *G. K. Walden 41* (SFSU!); San Benito Co., Pinnacles National Monument, 26 May 2008, *G. K. Walden 143* (SFSU!); Monterey Co., 19 March 1977, *M. A. Hewlett 402* (SFSU08099!); San Bernardino Co., Providence Mountains, *B. Trowbridge 3151* (SFSU08103!); Santa Clara Co., 20 April 1965, *R. Fuller 105* (SFSU08100!); Baja California, Cataviña, 24 March 2009, *G. K. Walden 115* (SFSU!)

APPENDIX 2.2. SPECIMENS EXAMINED FOR MOLECULAR STUDY - *VERMISPERMA MICRANTHUM*.

**Eucrypta micrantha* (Torrey) A. A. Heller [*GenBank taxonomy identifier], *Chambers 5832*, GH (n.v.), AF091166 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005) not georeferenced; San Bernardino Co., white-lobed corolla, limestone outcropping, 31 March 2010, *G. K. Walden 283* (SFSU!); San Bernardino Co., pink-lobed corolla, volcanic outcropping, 31 March 2010, *G. K. Walden 289* (SFSU!); San Bernardino Co., Providence Mountains, *B. Trowbridge 3172* (SFSU08104!); Mexico, Sonora, 23 February 1933, *I. L. Wiggins 6243* (UC527800!).

APPENDIX 2.3. GENBANK ACCESSIONS AND ADDITIONAL MATERIAL INCLUDED FOR MOLECULAR STUDY. List of taxa sampled in this study: *named taxon* (presented in alphabetical order, with bolded type and botanical authority given for first instance of taxon), name of collector(s) and collection number, acronym of herbarium where voucher specimen is deposited and herbarium accession number (if available), and GenBank accession numbers for nrITS. Taxa names follow recent treatments in the second edition of *The Jepson Manual* (Baldwin et al. 2012) and treatments in preparation for FNANM, botanical authorities follow *Authors of Plant Names* edited by R.K. Brummitt and C.E. Powell (1992), and herbarium acronyms follow Index Herbariorum (http://sweetgum.nybg.org/ih/).

Borago officinalis L., *Ferguson 74* (GH), AF091151 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005); *Borago officinalis*, Germany, *O. Mohr 600* (BSB2070) FJ763248 (Weigend et al. 2009); ***Draperia systyla*** (A. Gray) Torr., Tulare Co., *R. Thorne 53719* (RSA341263, n.v.), AF091155 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005); Yuba/Sierra Co., 14 May 1989, *S. Pense 40* (SFSU! two sheets), AY630335 (Gilbert et al. 2005); Sierra Co., 17 may 1992, *K. Whitney 58* (SFSU!), FJ814620; Plumas Co., 16 May 1987, *J. Ahouse 28* (SFSU16432!), FJ814621; Placer Co., 24 June 1908, *H. A. Walker 1361* (UC147857!); Mariposa Co., 21 June 1935, *W. B. Augustine 158* (UC1124238!); Fresno Co., 21 June 1962, *E. Parchim 326* (SFSU08049!); Yuba Co., 11 October 2003, *L. Ahart 10625* (JEPS104416!); Yuba Co., n.d., *A. Davis 66* (SFSU08043!); Butte Co., 29 May 2007, *L. Ahart 13932* (JEPS113175!); Nevada Co., 16 May 1981, *B. A. Stein 540* (SFSU08044!); *Draperia systyla* var. *minor* Brand, Trinity Co., Coffee Creek, 5 June 1975, *H. D. Thiers 33857* (SFSU08048!); ***Ellisia nyctelea*** Linnaeus, *R. Olmstead 95-16*, WTU (n.v.), AF091157 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005); ***Emmenanthe penduliflora*** Bentham, *Ferguson 47*, GH (n.v.), AF091158 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005); San Diego Co., Indian Gorge, 22 March 2008, *G. K. Walden 10* (SFSU!); San Diego Co., Indian Gorge, 27 March 2010, *G. K. Walden 271* (SFSU!); Monterey Co., Ventana Wilderness, 3 June 2009, *G. K. Walden 162* (SFSU!); Inyo Co., 11 June 2009, *G. K. Walden 181* (SFSU!); San Diego Co., Anza Borrego Palm Canyon, 7 April 2011, *G. K. Walden 344* (SFSU!); San Benito Co., 25 May 1956, *Bacigalupi 5633* (JEPS18170!); San Benito Co., 8 June 1964, *D. T. Wicklow 171* (SFSU08059!); Santa Barbara Co., 6 May 1994, *S. R. Hubbard 42* (SFSU!); Santa Barbara Co., 11 April 1965, *J. Ammirati 102* (SFSU08064!); Santa Clara Co., 25 May 1969, *P. Kennedy 200* (SFSU08062!); Alameda Co., Red Mtn. area Red Mtn. (along Mines Rd), 22 May 1982, *R. Raiche 20377* (JEPS81593!); Los Angeles Co., 23 April 1950, *S. Carlquist 61* (SFSU08067!); ***Emmenanthe rosea*** (Brand) Constance, likely Monterey Co., 27 April 2010, *G. K. Walden 296* (SFSU!); San Benito Co., 20 June 1960, *M. P. Johnson 2* (SFSU08077!); San Benito Co., 10 June 1952, *J. R. Sweeney 948* (SFSU08076!); San Benito Co., 25 May 1956, *Bacigalupi 5654* (JEPS18152!); San Benito Co., 2 June 1962, *V. F. Hesse 3130* (JEPS28869!); Alameda Co., Red Mtn. area Red Mtn. (along Mines Rd), 22 May 1982, *R. Raiche 20378* (JEPS81594!); San Benito., approximately 1 mile northeast of the junction of Clear Creek road and Clear Creek, the collection was made on a 1 year serpentine chaparral burn, burning done in 1962, 10 June 1963, *D. T. Wicklow 154* (SFSU08075!); ***Hydrolea spinosa*** L. *Tressons et al. 3677* (GH) AF091168 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005); ***Hydrophyllum capitatum*** Douglas, *Ferguson 116*, GH (n.v.), AF091169 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005); ***Hydrophyllum tenuipes*** A. Heller, *Ferguson 66* (GH), AF091170 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005); *Hydrophyllum occidentale* (S. Watson) A. Gray, Sierra Co., 1

July 1991, *J. Dempcy 92* SFSU!); ***Nemophila menziesii*** Hooker & Arnott, *Ferguson 53,* GH (n.v.), AF091183 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005); *Nemophila menziesii*, San Benito Co., 15 April 2011, *G. K. Walden 359* (SFSU!); *Nemophila spatulata* Coville, Mono Co., Valentine Eastern Sierra Reserve, 11 Jun e2008, *G. K. Walden 64* (SFSU!); ***Nemophila parviflora*** Douglas ex Bentham, *Ferguson 96* (GH), AF091184; ***Pholistoma auritum*** (Lindley) Lilja ex Lindblom, USA, *Ferguson 41,* GH (n.v.), AF091204 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005); *Pholistoma auritum*, Kern Co., 1 May 2008, *G. K. Walden 43* (SFSU!); *Pholistoma auritum*, San Benito Co., 15 April 2011, *G. K. Walden 363* (SFSU!); *Pholistoma auritum*, San Diego Co., 12 April 1976, *R. Halling 1283* (SFSU08465!); *Pholistoma membranaceum* (Bentham) Constance, San Benito Co., 15 April 2011, *G. K. Walden 362* (SFSU!); *Pholistoma racemosum* (Nuttall ex A. Gray) Constance, Los Angeles Co., SHOBA, San Clemente Island, 9 April 2011, *G. K. Walden 349* (SFSU!).

APPENDIX 2.4. ADDITIONAL SPECIMENS EXAMINED FOR GEOREFERENCING - *EUCRYPTA CHRYSANTHEMIFOLIA* VAR. *CHRYSANTHEMIFOLIA*

MEXICO. BAJA CALIFORNIA: (TEX248028); (UCR-239763-4541248); (UCR-240227-4541687);

UNITED STATES. CALIFORNIA: ALAMEDA CO. : (JEPS73322); (UC162749); (SBBG29792, POM247427); (UC606882, JEPS1716); **COLUSA CO.:** (SDSU6059); **CONTRA COSTA CO.:** (CDA1171); (UC691714, JEPS1715); (UC1613298); (UC691712, JEPS1714); (UC592185); (UC691713); (UCSB5236); (UC592184); (UC24008); (UC24009); (JEPS87981); (UC1618208); (JEPS1733); (JEPS1727); (UC880659); (UC35514); (JEPS99575, RSA720801); (JEPS1724); (UC1005249); (JEPS112429); (NMC41655-3165871, SEINET3165871); **FRESNO CO.:** (CHSC47033); (UC766241); (PGM7164-B, PGM7164-A); (CHSC55121); **IMPERIAL CO.:** (SD76208); (UCR41483); **KERN CO.:** (OBI47588); (UCR186226); (UC923130); **LOS ANGELES CO.:** (CHSC36433); (UCSB46585); (RSA545281); (UCSB45209); (UCSB45218); (RSA652844); (RSA662610); (POM73397); (OBI69418); (OBI69243); (RSA608531); (RSA580964); (SFV16070); (UCSB41664); (RSA612172); (SFV15333); (UCSB5233); (UC24016); (OBI69299); (SFV6217); (RSA592512); (RSA612074); (SFV17288); (RSA785823); (UCSB21854); (UCSB10055); (SFV16835, UCD119356); (SFV12048, UCD119347); (RSA75982); (JEPS1713); (UCR19577); (RSA420824); (UC56880); (RSA420822); (POM50214); (UCR213354, RSA747883); (UC1124391); (SBBG64835); (UC1124387); (SBBG66015); (RSA669148); (UCSC890); (RSA226230); (UCR197188, UC1922282, RSA656329); (SBBG37803, RSA420817); (UCR178391, SFV20834, CHSC95778, RSA674251); (UCR200127, SFV22141, RSA653847); (RSA675865); (RSA675875); (UCD119355, SBBG17377, SFV2968); (SRP3238-2039141); (SFV2967, SBBG17351); (RSA608); (RSA7305); (RSA739751, CHSC100167); (RSA703206); (RSA703208); (RSA420825); (RSA708693, UCR200024, UC1922277); (RSA708681, UCR199997, UC1922667); (RSA11016); (RSA604730); (RSA420816); (RSA420823); (RSA128265); (LA32294); (RSA498203, POM155677); (UCR186763); (RSA665305); (POM7010); (SBBG106898, RSA595007); (RSA720157); (POM9025); (RSA182326); (UC421647); (RSA3542); (POM65285); (RSA549583); (SBBG96871); (RSA526579); (UC1584708, UCR85808); (SFV3050); (RSA529304); (UC1584870); (UC1587615, RSA533413); (RSA584060); (RSA587077); (RSA420813); (RSA569917); (RSA570041); (UC1211040); (UC1211091); (POM13947); (RSA75987); (RSA536087, SBBG98481); (RSA562936); (OBI4453, OBI13937); (RSA584295); (RSA580134); (SBBG64819); (RSA596038); (LA105329); (LA105384); (UCR205176, RSA746624); (RSA75984); (UCR95348); (RSA591919); (RSA599885); (RSA599847); (UCR216895, RSA762359); (UCR216857, RSA762463); (UCR219937, BRYV0003096-3860280); (RSA702907); (POM4510); (POM296801B); (RSA420828); (RSA158271, SBBG11584); (UC1228867); (RSA151311); (RSA158270); (RSA158273); (RSA167656); (RSA655984); (RSA656247); (RSA656246); (RSA131018); (UCR125378, IRVC26455, RSA725905); (RSA714885, SBBG120062, UCR125492, UCD119351); (RSA726007, SD234419, IRVC27968, UCR126645); (UCR126894, IRVC29542); (UCR165419, RSA709578); (UCR153579, SD178147); (UCR154618); (UCR153553); (UCR155382); (RSA670946); (RSA670170); (RSA177772); (UC1349035); (RSA188152); (SD69515, SBBG31474, RSA187879);

(UC1349359); (RSA187872); (SD90522); (RSA251388); (RSA279071); (RSA248871); (UCR222457, RSA752795); (SRP21360-2039144); (UC450819); (SDSU6019); (RSA420814, SD72726); (WCW13173-1962115); (RSA420820); (LA209963); (SD38505); (UCSB5231); (UCSB5234); (UCSB12429); (SEINET3301320); (UC440430); (POM21370); (UC457260); (RSA420818); (RSA420819); (RSA420821); (RSA420827); (UCR131818); (POM123379); (UC56879); (SBBG44678); (UCR99578); (RSA608650); (HSC13739); (UC56878); (RSA644298); (RSA420815); (UCR119058); (UCR209054); (UC24010); (RSA420826); (RSA598951); (UC187609); (UC107099); (POM49293); (SBBG29768); (RSA628890); (SFV18435); (GH91956); (SBBG113035); (UNM100397-4044459); **MARIN CO.:** (UC35513); (SEINET3165873); (NMC21625-3165873); **MARIPOSA CO.:** (UCSB58179); **MONTEREY CO.:** (SFSU08099); (UCSB47176); (UCSC1186); (NMC21632-3156112, SEINET3156112); (UCSB34153); (PGM5920); (JEPS1712); (UC767616); (UC58515); (POM65283); (UCR145540); (UC187616); (PGM5921); (PGM0704); (UC171617); **ORANGE CO.:** (RSA657747); (RSA609); (RSA420830); (UC1607994); (UCSB48082); (SBBG40450); (UCR250854); (POM50213); (POM202027); (UC537165, JEPS1720); (UCSC889); (UCR78042); (RSA794330); (POM4517); (UC421675, JEPS1722); (POM6266); (RSA3173); (UC592180); (RSA650645); (LA209965); (UCR98275, RSA598962); (RSA683068); (UCR209384, RSA749485); (UCR192463, RSA732086); (UCR191478, RSA732059); (UCR190979, RSA732244); (UCR191025); (UCR192089); (UCR193819, RSA751269); (JEPS1726); (PSM2133-2155281); (ILLS223408-7073420); (PSM6603-2159796); (HSC13690); (LA209966); (JEPS1725); (RSA603249); (RSA704833); **RIVERSIDE CO.:** (UCR231738); (UCR232044); (UC1537540); (SDSU14244); (RSA5017); (SDSU13329); (UCR216395); (SDSU12934); (UCR3955); (UCR93027); (UCR21927); (RSA704001); (SD137734, UCR91593); (RSA586119); (UCR25546); (UCR41397); (RSA420929); (POM128391); (RSA678425); (UC1618027); (DES00031651-3091500, SEINET3091500); (SDSU18406); (UCD119345); (SDSU18371); (UCR230047, RSA751624); (UCR119265); (UCR156080); (OBI29871); (RSA594775); (SBBG64804); (RSA556515); (JEPS1728); (SD140093); (RSA612503); (JEPS1718); (UCSB38662); (RSA612493); (RSA516880, UCD119342); (RSA612610); (RSA614403); (RSA271438); (UC1424860); (RSA615095); (UCR137507); (HSC85458); (UCR49223); (UCR111558); (RSA420931); (RSA790935); (UC449852); (UC702031); (UC917589); (UCR91449, RSA644108); (RSA495797); (UCR107414); (RSA496136); (RSA501056); (UCD119350); (UCR100303); (UCR112954); (RSA522740); (RSA524477); (RSA516424); (RSA525423); (POM13861); (UC880718); (RSA180274); (RSA543756); (RSA221008); (RSA561814, SD136824); (UCR251310); (RSA571314); (RSA583359); (RSA716393); (RSA708077, SD187425); (UCR149996); (UCR199741, UC1929299, RSA735923); (UCR225185, RSA777156); (UCR83197); (RSA420833); (UCR84886); (UCR86873); (UCR96706); (UTC00223957-272340, UCR98071, SEINET272340); (UCR104943, VVC269, SD144470); (JEPS1721); (UCD119343); (UCR112407); (UCR128565); (UCR116971); (HSC13506, UCD119344); (UC1287119); (UCR121308); (UCR127327); (UCR137045, RSA709795); (UCR140705); (UCR165411); (UCR152518, RSA715758); (UCR158524); (UCR173927, RSA715256); (UCR174050); (UCR174363); (UCR123876, ILLS211489-7048047); (ILLS211443-7048199, UCR239196); (UCR214147); (UCR214582); (UCR213615); (UCR241820); (UCR250317); (UCR250563); (CLARK-A1045-871); (UCR120658); (UCR214128); (SD133073); (UCR241636); (SD4023); (SDSU6013); (ILLS225601-7073449); (ILLS223541-7073346); (UCSB38378); (SD126650); (SEINET3091513); (DES00034064-3091513); (SD130318); (POM256724); (HSC92877);

(CSUSB109); (UCR27196); (UCR139162); (RSA516756); (UCR3345); (RSA420834); (LA209968); (OBI52783); (RSA508355); (UCR98684); (HSC78513); (UCR167433); (RSA564284); (UCR892); (UCR172223); (SBBG35042); (SBBG37500); (NY1206736-2977254, BRY614749-2445417, SEINET2445417); **SAN BENITO CO.:** (*G. K. Walden 143* SFSU!); (UCSC574); (UC719492); (UC1097039); (JEPS22695); (POM128146); (UC524136); (RSA83082); (RSA26734); (JEPS105432, JEPS105383); (UC1523528, HSC82799, RSA342258); (RSA420835); **SAN BERNARDINO CO.:** (SFSU08103!); (LA209996); (UCR16693); (RSA420839, UC284106); (UCR120203); (VVC692); (RSA652824); (RSA420836); (UCR175385); (RSA310147); (UCR120388); (UCR120376); (RSA222947); (OBI52761); (UCD119349); (LA209995); (LA88321); (RSA801846); (JOTR33664); (RSA572916); (RSA572917); (RSA221472); (RSA420838); (UCR78790); (POM4514); (RSA604873); (UCR103848); (RSA629036, SEINET2010956); (UC167106); (UCR181064, SEINET1004966, ARIZ394153-1004966); (POM4515); (UC284107); (UCR72701); (UCR75439); (UCR83173); (RSA627860, UCR87633); (UCR88564); (RENO32949-NESH 69970, UC1719475); (RSA657331B); (UCR125790, RSA711319); (UCR126084, SD212646, IRVC26470, RSA714215); (UCR170309); (UCR174588); (UCSB5232); (RSA420840); (POM4511); (UCR16562); (CSUSB111); (UCR137590); (CSUSB2187); (UCR199010); (LA209969); (LA105130); (UCR97644); (UCR157639); (RSA489148); (UCR230691); (JEPS1717); (UC24014); (RSA652203); (SJNM45995-6091773); (LA209967); (UCR241297); (UCR241476); **SAN DIEGO CO.:** (SD189727); (SD212250); (SD10383); (SDSU12081); (SD10572); (SD10984); (SD182238); (SD185709); (SDSU16930, SDSU16462); (SD195187); (JEPS1731, UC488955); (SD183615); (SD198502); (SD176715); (SD173892); (SD172441); (SD163703); (SD173893); (SEINET947832, SEINET2057635, SEINET2057113, SD172440, ARIZ386005-947832); (RSA654316); (SD158446, SDSU15871); (SD207909); (RSA654315); (SD165198); (SBBG113009); (SD198506); (SD193841); (SD185712); (SD165594, SFV21383, CHSC95364, RSA660773); (SD182237); (POM209390); (SD180236); (SD160301); (SD208900); (UC201898); (SD178530); (SDSU17747, SD185711); (SD157174); (SD158445, SBBG118314, SDSU15733); (SD181081); (SD203502); (SD169684); (SD198508); (SD157173); (UCSB5237); (SD167572); (UCSB5238); (UCSB5240, UCSB5239); (SD185710); (SD153270); (SD207910); (SD180235); (SD187999); (SD172439); (POM97205); (RSA761312, SD204384); (SD204386); (SD162259); (SD198505); (SD163431); (SD212248); (SD165595); (SEINET819742, ARIZ385995-819742); (SD169683); (SD198504); (SD204385); (SD199221); (SD180237); (SD212249); (SD199219); (SD165596); (SD227318); (SD178527); (SD183616); (SD178529); (SD217795); (UCR236778, SD220387); (JEPS1719); (SD198503); (SD199222); (SD199254); (SD192587); (SD198507); (SD203503); (POM179429); (UC403414, RSA747883); (SD195185); (SD192586); (SDSU16713, SD162482); (SD153269, SD205866); (SD203500); (SD195184); (SD203501); (SD233978); (UCR128039, IRVC27377, RSA681284); (SD195186); (SD201759); (RSA680456); (SD157171); (SD199220); (SD217796); (SD198501); (UCR51894); (SD204383); (SD205867); (SD216135); (UCD119358); (SDSU18529); (SD205868); (SD205869); (SD161497); (SD221130); (RSA732863); (SD185708); (SD221131); (SD118393); (RSA678044); (SD216136); (SD14415); (RSA517276); (UCR59541); (SD170714); (SD80643); (SD178528); (SD14614); (SD207908); (SD80403); (SD67730); (UC107081); (SD85291); (SD83566); (SD215560); (RSA613206); (SD85304); (SD48709); (UC1001624); (RSA420832); (SD215070); (SD15509); (RSA680731); (SD193839); (SD200902); (SD200903); (SD85353); (RSA420843); (SD201761); (RSA420842); (SD201758); (SD188924); (UC1019591); (RSA733200, SD193840); (SDSU17258, SD188925, UCR188775);

(SD188000); (SD38503); (SDSU6078); (UC880717); (SD201760); (SD218735); (UC880719); (SD67729, SEINET3225040, UTC00010794-3225040, POM73630); (SD218734); (SD218733); (SD111961, UCR170953); (RSA156567); (SD17285); (SD17447); (RSA710066, SD170715, IRVC27085, UCR152995); (SD17858); (SD124529); (RSA363924); (LA209971); (RSA801961); (UCR130691); (UC67065); (SD20741); (SD20995); (RSA12298); (SD233977); (UCR128867, IRVC28048); (SD146444); (SD38502); (SD148356, UCR149173); (SD148563, UCR148990); (UCR147503, SD152194); (SD154559, RSA689501, UCR147148); (LA103513); (SD24795); (SD24928); (RSA700987, ARIZ386594-947833, SD155170, SEINET947833); (SD158980); (SD26559); (SD26585); (JEPS29205); (SD160592, UC1790013); (POM219639); (UCR143660, SD159432); (JEPS1729); (UCR144554); (UCR143879, SD163010); (SEINET3091401, DES00004142-3091401); (UCR144565, SD163009); (SD28781, RSA29280); (POM14784); (CHSC35840); (UCR156649, SD166235); (SD171423); (SD175476); (SD175477); (SD177739); (SD179648, RSA731763); (SD184365); (SD184366, RSA731827); (SD184367); (SD186941); (SD186942); (UCR212696, SD195866); (SD197365); (SD197364); (SD204387); (SD206764); (JEPS1730); (SD210264); (UCR227989, RSA762033, SD206763); (SD206762); (SD206765); (SD209697); (SD213194); (SD216134); (SD216998); (SD216999); (SD216997); (SD221656); (SD219517); (SD221657); (SD226107); (UCR245373, SD228210); (SD228211); (UCR238871); (SD229985); (SD231658); (UCR136342, SD193303); (SD197795); (UCR137251); (SD197796); (UCR137220); (SD164692, UCR155036); (SD164691, UCR155634); (SD167104, UCR154249); (SD10344); (SD10396); (SD10717); (SD10944); (SD11029); (SDSU9980); (ILLS152327-6971465); (SDSU6066); (SD157172); (SD136551); (SD136552); (SD193842); (UC24012); (UC24013); (SD4028); (SD21988); (SD4027); (SD16993); (SDSU6072); (SDSU14800); (SDSU14798); (SDSU14801); (SDSU14799); (SD136186); (SDSU12595); (BCMEX); (BCMEX); (SD7201); (SD7202); (UC131645); (POM97977); (SD7449); (SD7203); (LA209970); (CDA14245); (SD4025); (UC107101); (UC472921); (RSA420841); (UC107102); (UC107082); (SD7204); (SD7205); (UC124677); (UC107094); (CSUSB110); (DES00059147-2057113, DES2057635); (ARIZ392337-998857, SD185713, SEINET998857, CDA10262); (ARIZ405127-3240207, SD184368, SEINET3240207); **SAN LUIS OBISPO CO.:** (OBI19542); (OBI72633); (OBI55255); (UCSB57258); (OBI50328); (OBI54452); (OBI54462); (OBI13935); (OBI35655); (OBI75464); (OBI23304); (UC639026, OBI70083); (OBI72241); (OBI17761); (OBI13934); (OBI6930); (SBBG44854); (UC124676); (OBI75085); (OBI3776); (UC24007); (UC1124389); (SBBG107116); (SBBG107814); (SBBG107815); (UCR122508, SD148144); (UCR161964); (UCR161926); (CAS1128615); (CDA11482, UCD119348); (OBI34408); (OBI39487); (OBI44840); (OBI56763); (OBI74646); (RSA778860, BRYV0039409-3929098); (OBI48382); (OBI54146); (OBI66266); (OBI58186); (OBI69502); (OBI57084); (NMC74626-3156113); (UCR161225); (SBBG118998, SBBG118431); (ILLS226342-7072475); (OBI56196); (OBI51335); (OBI66498); (UCD119354); (HSC91856); (UCR61713); (SBBG119084); (CDA17605); (SBBG34879); (UC55689); **SANTA BARBARA CO.:** (UCSB45248); (UCSB40915); (UCSB33911); (UCSB45190); (UCSB32842); (UCSB19046); (UC1084168); (UCSB51652); (UCSB51829); (UCSB16251); (SBBG108877); (UCSB41882); (UCSB5241); (UCSB5242); (UC473816); (UCSB10577); (UCSB43027); (UCSB5318); (UCSB39047); (SBBG15794); (UCSB5478); (UCSB44126); (UC1124388); (UC24015); (UCSB54464); (UCSB54463); (UCSB43441); (UC1124386); (SBBG6099); (SBBG6098, UCD119353); (UCSB39647); (UCSB70384, UCSB52522); (SBBG88895); (UCSB60047); (OBI70195); (SBBG88897); (SBBG6097); (RSA527831, SD133072); (RSA728641); (UCSB39266);

(SBBG96765); (SBBG22413); (UCSB38437); (UCSB47535); (UCSB14692); (UCSB55533); (UCSB61166); (UCSB61167); (RSA4738); (RSA4041); (SFV2966, UCSB27840, SBBG12293); (SBBG9169, RSA132247, RSA624420); (SBBG9092, RSA134474); (SD45221); (UC967407); (POM50055); (SBBG11314); (UC753514); (UC643341); (UC643342); (SBBG13131); (POM289840); (SBBG17527, SD194393); (SBBG106858); (RSA420846, POM219607); (LA209994); (SBBG111529); (RSA680183); (JEPS1732); (POM98465); (UC310421); (CDA13778); (POM171488); (POM171489); (JEPS1723); (OBI47686); (OBI53925); (OBI52583); (OBI65536); (RSA191678); (RSA362030); (RSA641054); (RSA286939); (SBBG14125, RSA641781); (OBI26725); (SBBG50253); (SBBG117175); (LA210361); (SBBG40692); (SBBG35255, SBBG22587, SBBG41623, SBBG29342, SBBG29359); (SD194392); (RSA624413); (SBBG32790); (SBBG48458); (UCSB49397); (UC107100); (UCSB5246); (UCSB61099); (SBBG78960); (SBBG78961); (UC675759); (SBBG42372); (SBBG46904); (RSA166547); (LA103793); (UC107097); (SBBG23197); (SBBG64814); (SBBG78965); (SBBG82539); (SBBG51696); (SBBG78962); (SBBG78964); (SBBG97078); (SBBG64817); (SBBG64813); (SBBG64812); (SBBG42392); (JEPS93521); (SBBG64834); (SBBG64816); (UCR20897); (SBBG90844); (SBBG90809); (SBBG97127); (SBBG97274); (SBBG100185); (SBBG54153); (SBBG89891); (SBBG89952); (SBBG54956); (SBBG55347); (SBBG90751); (SBBG90251); (RSA535854); (RSA549656); (RSA515366, UC1558133); (SBBG52942, SBBG52935); (SBBG102371); (SBBG102372, SBBG102370); (UCSB69211); (UCSB69254); (UCSB61287); **SANTA CLARA CO.:** (SJSU4281); (SJSU4279); (SJSU4257); (POM126777); (UC673235); (POM65450, SRP20235-2039142); (UC202793); **SOLANO CO.:** (*G. K. Walden 41* SFSU!); (UCD35334); (UC1562611, SD131877, UCD47986, RSA518635); (UC1561192); Tulare **CO.:** (UCSB55408); **TUOLUMNE CO.:** (SDSU6053); **VENTURA CO.:** (SFV16094); (SFV10445); (UCSB31516); (UCSB44332); (UCSB33549); (UC1124390); (SFV6367); (UCD119346); (SBBG37801, RSA420845); (OBI5818); (JEPS60182); (RSA603568); (LA201742); (SBBG13122, JEPS93240); (SBBG13130); (RSA75986); (UCR200744, SD231326, RSA727299, UC1928661); (RSA702009, UCR160039); (RSA60257, SEINET3165872, NMC78705-3165872); (POM59126, RENO32951-UNR 35360); (UCR158355); (UCR127442, IRVC26229); (SBBG21483); (SBBG32671); (RSA605574, SBBG54619); (UCR885); (SBBG91608); (SBBG112074); (SBBG64815); (CLARK-A1045-922); (UCD119357); (SBBG78963); (SBBG35931); (RSA420851); (SBBG64818); (RSA420844); (UC1021916); (RSA652204); (RSA420849, RSA420848); (SBBG30156); (SBBG26736); (UC527208, RSA1718); (RSA420850); (SBBG53666, RSA611093); (SBBG112153, RSA641666); (SBBG112083); (SBBG112130, RSA641658); (SBBG111970); **YOLO CO.:** (UCR228276, UCD73401).

APPENDIX 2.5. ADDITIONAL SPECIMENS EXAMINED FOR GEOREFERENCING - *EUCRYPTA CHRYSANTHEMIFOLIA* VAR. *BIPINNATIFIDA*

MEXICO. BAJA CALIFORNIA: (*G. K. Walden 115* SFSU!); (HCIB6053); (IEB66031); (ARIZ408973-3245352, UCR-226024-2465101); (HCIB1528); (UCR-106223-393554); (UCR-58023-393552); (UCR-80591-393550, ASU0031471-128532, DES00009386-3091421); (UCR-22471-393553); (LL248030); (TEX248034); (LL248033); (TEX248032); (BCMEX); (BCMEX); (SJNM30189-6067339); (11 March 1998 *J. Rebman s.n.* (BCMEX); 11 April 1998 *J. Rebman s.n.* (BCMEX); **SONORA**, (UCR-79606-393628); (UCR-80122-393627); (UCR-79660-393629); (USON1479-287864); (UCR-30133-393631); (USON10022-286224); (MABAson-trv-20340-3384146); (MABAson-trv-20339-3384145); (MABAson-trv-20338-3384144); (MABAson-trv-20336-3384142); (MABAson-trv-20337-3384143); (ARIZ392693-885797, USON12445-277616); (ARIZ368640-885802); (USON13999-4913214); (ARIZ409275-3245670); (USON6490-287526, ARIZ5553246); (USON4134-287793); (USON16701-4915492); (MABAson-trv-28351-6420811); (TEX248023); (USON18455-4915886); (USON18456-4915885); (MABAson-trv-28154-6420614); (USON5709-277535); (NMC73450-3152187); (ASU0031470-164964); (ASU0031465-248264, USON11214-287742, NMC72090-3147314); (ASU0031466-196425); (ASU0031469-194857, UCR-76859-393630); (ASU0031467-195194, ASU0031468-195193); (TEX248031); (TEX248029).

UNITED STATES. ARIZONA, GILA CO.: (UCR-40996-378142); (ARIZ372732-TONT 7177); (ASC63852-1026956); **GRAHAM CO.:** (UNM12796-4080435); **LA PAZ CO.:** (ASU265867-774957); (ASU248289-703101); (ASC63951-1012469); (ASU55480-703145); (ARIZ5549586); **MARICOPA CO.:** (ASU248290-703103); (UTC00223508-271895); (ASU122410-702844); (DES5322814); (ASU32345-703149); (ASU32346-703184); (ASU88628-702842); (ASU32340-703091); (ASU32339-703081); (ASU263254-712107); (ASU144872-703077); (DES5771058); (DES5524018); (ASU221653-756062); (ASU215519-702850); (ASU231987-702863); (ASU105861-703166); (ASU0061145-56447); (ASU28739-703087); (ASU69059-703094); (ASU747216); (ASU659442); (DES5322788); (DES5771034); (ASU180879-703124); (ASU87064-702855); (ASU87063-702841); (ASU129611-703162); (ASU272227-781290); (DES00007798-3091407); (DES00020044-3091468); (ASU87065-702833); (ASU246383-662529); (ASU282307-2038603); (ASU58935-703097); (ASU145146-702845); (ASU24227-702853); (DES00029188-3091491, UCR-42187-378140); (ASU23320-702846); (ASU154310-702859); (ASU287948-4535928); (ASU22256-702861); (ASU22253-703120); (ASU154255-702862); (ASU32348-702864); (ASU116960-703085); (ASU117583-702854); (ASU85017-702838); (ASU248287-652494); (ASU32356-702839); (DES00036013-3091519); (ASU652397); (ASU107007-702848); (DES00038142-3091527); (ASU233011-702830); (ASU49455-703071); (ASU24678-703123); (ASU24679-703114); (ASU139835-703069); (ASU139908-703105); (ASU24681-703073); (ASU24680-703074); (DES00045614-3091558); (ASU248288-703098); (DES5770692); (DES5770709); (DES5770717); (DES5770756); (DES5770778); (DES5770819); (DES5770836); (DES5771114); (DES5771135); (ASU200526-704589); (ASU200483-702834, UCR-145273-422947); (ASU158619-703112); (ASU40247-703075); (ASU200472-703160); (ASU87062-703167); (ASU766493); (ASU759225); (ASU748424); (ASU759221); (ASU748504); (ASU760972); (UCR-216348-2457195, DES00061796-2061574); (DES00018261-3091459); (ASU83452-

702852); (ASU96059-703084); (ASU102494-703079); (ASU86018-703092); (ASU85052-704592); (ASU32337-702857); (ASU32341-703089); (ASU117427-702849); (DES00008135-3091411); (DES00008195-3091414); (ASU759216); (ASU759220); (ASU748242); (ASU748071); (ASU766492); (ASC15776-2113322); (ASC14296-2087461); (DES00077412-5523306); (ARIZ417249-4558703, ARIZDES00072652-4561093, DES00072652-3382241); (ARIZ5549609); (ARIZ5549584, ASU191107-702860); (TEUI273709); (ASC41591-1026960); (ARIZ5549581, ASU24732-703117); (ARIZ5549606); (ARIZ376592-911762); (ASC81589-2125360); (DES00054752-2045048); (DES00048166-2045545); (DES00050233-2041092); (DES00057476-2051314, ASC91789-2125590); (ARIZ356959-885804); (ARIZ357316-885803, ASU246167-703134); (ARIZ358906-885796); (ARIZ369816-885801, ASU266945-776537); (ARIZ376574-911763); (ARIZ363013-885798); (ASC19570-2087458); (MNAB.26505-1939526); (MNAB.31850-1944368); (DES00061419-2061562); (DES00056474-2050022); (ARIZ5549594); (ASC30575-2087463); (ASC30410-2087460); (ARIZ364834-885799, ASU266966-776507); (ASU777116); (ASU777128); (ASU777243); Mohave **CO.:** (SUU000440-Lake 19008); (ASU279046-1915643); (RM49469-1369551); (ASC82554-2114736); (ASC82552-2115905); (ASC96659-2126308); (ASC94661-2118235); (ASC94301-2118187); (ASC96629-2118146); (ASU115176-703147); (ASU114607-703174); (ASU114604-703148); (ASU164285-703180); (ASU49191-704593); (ARIZ5549592); (ASC2078047); (ASC64587-2087459); (ASC62952-1026959); (ARIZ5549598); (MNAB.24750-1937880); **PIMA CO.:** (ARIZ421634-6633028); (RM172516-1226477); (RM147303-1228558); (SRP20234-2039143); (ASU0020184-263660); (MABAson-trv-27704-6328199); (ARIZ76624-ORPI 0016467); (ASC16272-2087462); (ARIZ5549580); (ARIZ5581050); (ARIZ388160-953860); (ARIZ219387-ORPI 0016466); (ASU200485-704588); (ASU200486-704591); (ARIZ5549604); (ARIZ5549615); (ASU129983-703157); (ASU129909-703154); (ARIZ5549616); (ARIZ5549603); (ASU652002); (ASU107384-703144); (ASU97104-703152); (ASU263660-775672); (ASU152778-703181, ASU263978-776654); (ASU152789-703177); (ARIZ5549617); (ASU158441-703137); (ARIZ7763-ORPI 0016469); (ARIZ5549579); (ASU267023-775700, ARIZ365185-ORPI 0016471); (ARIZ375004-ORPI 0016468); (ASU201007-703170); (ARIZ5549589); (ARIZ5549596); (ARIZ5549614); (ARIZ5549611, ARIZ282139-SAGU 6738); (MNAB.29693-1942629); (ARIZ5549610); (ARIZ278022-ORPI 0016470); (ARIZ282617-SAGU 6739, ARIZ5549597); (ARIZ5549583); (ARIZ282616-819692); (ARIZ5549612); (ARIZ5549618); (ASU168514-703141); (ARIZ242839-819693); (ARIZ5549595); (ARIZ5549590); (ARIZ5549593); (ARIZ5549585); (ASU32344-704594); (ARIZ405357-3244517); (ASU35772-703155); (ASU139912-703143); **PINAL CO.:** (ARIZ5585045); (DES00008094-3091409); (UCR-201343-470116, TEUI274688); (RENO33022-5496030); (MABAson-trv-28629-6642491); (ARIZ5549607); (ASU228240-704587); (ASU189960-702847); (ASU228301-704590); (ASU219633-753886); (ASU190952-702851); (ASU220205-753885); (ARIZ5549608); (ARIZ5549591); (ARIZ5549600); (ARIZ5549588); (ASU252433-652444); (ARIZ386928-911764); (DES00046667-1080765); (DES00048638-2045544); (DES00052925-2041496, ASU254384-747895); (ARIZ375523-819741); (ARIZ5549582); (ASU86486-702843); **YAVAPAI CO.:** (DES00017683-3091454); (ASC41903-1026958); (DES00054392-1082836); (ARIZ5549605); (DES00053273-2043315); **YUMA CO.:** (ARIZ5549613); (ASU151912-703169); (ASU157712-703163); (ASU157686-703172); (ASU157696-704628); (ARIZ5549587); (ASU124325-703168); (ASU70074-703171, DES00010327-3091425); (ARIZ5549601); (ASU32342-703139); (ARIZ5549599); (ARIZ5549602).

CALIFORNIA. IMPERIAL CO.: (UCR152576, RSA702613, SD155783, UC1787783); (UC1790222, SD162627); (RSA787871); Inyo **CO.:** (RSA301620); (UC598447); (UC1426680); (RSA296637); (RSA517552); (RSA274228); (UCR119647); (SBBG81746); (UCSB31812); (NTS16191-5514822); (UC696141); (RSA622224, RSA226862); (RSA618037); (RSA617082); (UC1534971, HSC85366, UCR47593); (UC1535158, UCR47809, HSC85180, RSA387823); (UC1535038); (HSC85077); (RSA387734); (UCR47711); (JEPS1703); (SEINET2013876); (RSA620782); (UC1259632, RSA625680); (UC880720, RSA27951); (UC128998, POM4508); (RSA75990); (RENO32952-NESH 7238, UC162521); (UCR218434, RSA771990); (POM255143, UC1021852); (UCR235227, RSA798275); (UCR235178); (JEPS1704); (JEPS1705); (SFV5512); (SJNM48918-6044433); (POM75714); (SBBG64828); (SBBG64811); (UC107088); (RSA678961); (UC107087); (RSA678962, RSA678963); **KERN CO.:** (RENO32946-NESH 7356); (UCR47118); (UCR47117, UCSB71119); (UCR196729, CHSC98000, RSA720761, UC1927547); (UCR196735, UC1927365, RSA720527); (UCR200050, UC1927423, RSA720227); (UCR185065, RSA721265, UC1927334); (RSA727662); (UC606879); (RSA620116); (POM289832); (JEPS76459); (DES00037992-3091526, RSA563095, RSA564267, SEINET3091526); (RSA552571, RSA563473); (RSA557831); (UC1562832, RSA517000); (UC1561404, RSA517290); (RSA75985); (CAS1127130); (SBBG26117); (POM96564); (POM289936); (UCD119352); (SBBG64810); **LOS ANGELES CO.:** (RSA586630); (RSA589178); **RIVERSIDE CO.:** (POM8546); (RSA420858); (RSA75988); (RSA703406); (UC666589); (JEPS1708); (POM145350); (JOTR33749); (JOTR34033); (UC880721, RSA27708); (RSA682860); (RSA681994); (UC494394, POM184547); (POM259685); (JOTR34342); (RSA314636); **SAN BERNARDINO CO.:** (RSA649960); (IRVC19277); (POM8424); (RSA296638); (UCSB13332); (RSA295898); (RSA301632); (RSA776922); (JEPS68712, UC625636); (RSA776758); (UCR215968); (JEPS3493); (JOTR1161, JOTR1160); (RSA711691); (UC922760); (JOTR28722, JOTR28716, JOTR28718, JOTR28720); (LA209995); (UCR22527); (UCSB5245); (RSA705708, CHSC98005); (RSA705860, SBBG119216); (RSA705937, SBBG119203); (RSA711685); (RSA705942, CHSC99606); (RSA420837); (RSA785868); (UC606881); (RSA705523); (RSA717709); (UC1478554, UCR33424); (UCR33426); (UCR214791, RSA756638); (UCR214747, RSA787384); (JOTR32891, JOTR32890); (UCR211826, RSA735494); (RSA795053); (RSA706786); (SD220066, RSA713689, IRVC27187, UCR154313); (SD220067, RSA713687, UCR154354, IRVC27184); (POM8554); (RSA710008); (RSA710013); (RSA714394); (RSA710049); (RSA710080); (RSA710089); (POM13968); (RSA779520, SD219047); (RSA15817); (UC128999, RENO32953-NESH 10525); (UCR175243); (UCR175591); (POM47392); (UC635175); (RSA24934); (RSA24963); (RSA703046); (RSA25064); (RSA752121); (UC184722); (RSA701414); (POM184774); (RSA780595); (UCR217188, RSA765582); (UCR216615); (UC569007, POM213690); (RSA270730); (UCR227168, RSA778816); (UCR226981); (UCR33263, RSA278459); (UCR226248); (UCR33262, RSA278462); (JEPS1707); (RSA778348); (UC1755077); (POM145351); (UCR232122); (UCR117294); (UCR101503); (UCR116434); (ILLS211907-7047989); (UCR211017); (RSA252008); (RSA279257); (RSA279289); (RSA275138); (RSA275520); (RSA275563); (RSA334569); (RSA711689); (RSA785869); (RSA732835); (RSA270720, CHSC27042); (SBBG64827); (OBI34802); (SDSU18189); (UCR139171); (UC718062); (SBBG64809); (SBBG64801); (POM347085); (POM49289); (UC774916);

(POM347084); (POM8012); (POM73631); **SAN DIEGO CO.:** (SD212247); (SD21339); (SD208899); (POM209617); (SD141397, UCR162910); (SD172443); (SD172445); (SD172444); (SD119122); (SD233518); (SD123369); (SD199218); (UC1019599, UC1019580); (UC1019600); (SD205865); (SD205870); (SD205864); (SD133768); (UC1539694); (SD221129); (RSA779753, SD219884); (SD24560); (RSA75989); (SD26757); (UCR146017, SD159433, UC1787886); (JEPS1711); (SD160593); (SD28546); (SD168316); (POM183557); (UC495233); (JEPS1710, OBI13936, UCD119359); (SD197363); (SD213193); (SD226106); (SD10463); (SD10558); (SD172442); (SEINET955975, ARIZ388973-955975); (POM73426); (UC107093); (UC107092); (UC107083);

NEVADA. CLARK CO.: (DES00042579-3091539); (RENO32948-UNR 16274); (RENO32950-NESH 67977); (RENO33021-5496029); (UTC00226533-234622); **LINCOLN CO.:** (RENO32954-NESH 58595); **NYE CO.:** (NTS17990-5516218); (RENO32947-UNR 86960).

APPENDIX 2.6. ADDITIONAL SPECIMENS EXAMINED FOR GEOREFERENCING - *VERMISPERMA MICRANTHUM*

MEXICO. BAJA CALIFORNIA: (ARIZ386366-911771); (HCIB4653); (IEB66032); (IEB66033); (HCIB13190); (UCR-52490-393558); (UC1755076); (UC1345879); (ASU0031474-261263); (UC1755078); (UC1445273); (DES00043035-3091543); (TEX248027); (UCR-23141-393559); (UC112185); (UC112184); (UCR-38467-393556); (UCR-67809-393557); **CHIHUAHUA,** (UCR-29756-393634); **SONORA,** (ARIZ392537-999053); (USON14830-4910672); (UCR-26343-393635); (UCR-30210-393633); (MABAson-trv-29109-6642971); (USON8699-276645); (TEX248026); (MABAson-trv-28746-6642608); (ARIZ203549-6633674); (MABAson-trv-19403-3368142); (USON11219-279480); (MABAson-trv-27821-6328316); (ASU0058803-282998); (UCR-30112-393632); (ASU0031475-163054); (UC527800!); (DES00003502-3091398); (UC1495224); (ARIZ5582575); (ARIZ392794-961022); (ASU0031476-248266, USON11227-287300); (ASU0031472-266343, USON10318-283100); (ASU0031473-267757, ARIZ5582067); (UCR-68572-393636); (TEX248025); (TEX248024).

UNITED STATES. ARIZONA, GREENLEE CO.: (DES00076348-4691014); (ASU109140-703273); (ASU109141-703272); (ASU103598-703187); **COCHISE CO.:** (DES00043517-3091547, DES00043516-3091546); (ASU6696029); (UC880665); (UTC00261321-5501833); (SWRS668-2027444); (ARIZ5549685); (ASU169553-704605); (ASU249943-690483, ARIZ378873-819843); (ARIZ5549626); (ARIZ5549658); **COCONINO CO.:** (GCNP1867320); (DES00042744-3091541); (DES00044460-3091554); (GCNP1862238); (GCNP1864881); (GCNP1862240); (ARIZ5549663); (ASC32892-GRCA-05445 cat# : 90815,); (NAVA4031-5766718); (ASU56071-703193); (ASC32891-GRCA-05445 cat# : 90816,); (MNAB.23320-GRCA 87351); (ARIZ375667-819842); (ASC57578-2087466, UNM88663-4006139); (ASC57582-2087465, UNM88797-4006140); (ASC91151-GRCA-05507 Cat. # 94578, GCNP3200961); (NAVA11715-5767875); (ASU192890-704614); (ASC2512-2087467); (MNAB.23656-GRCA 87349); (SEINet3372730); (ASU32351-703188, ASC7541-2087464); (DES00037523-3091524); (ASU190136-704618, GCNP1864145, DES00037524-3091525); (ASU193562-704621, GCNP1864127, DES00037498-3091523); (DES00048278-1079078, GCNP1868817); (DES00048575-1079077); (DES00052005-1074702); (DES00052141-1074619); (DES00058104-1088423); (DES00068798-3124451, DES68798-2068473); (DES00068849-3124468, DES68849-2068478); (ASC92632-GRCA 96041 (acc. GRCA-05522), GCNP3201737); (MNAB.25548-GRCA 87350); (MNAB.32601-1945117); (MNAB.34434-GRCA-110021); (MNAB.34435-GRCA-110022); (MNAB.26744-GRCA 87347); (ARIZ5549627, UC1025338); (NAVA1642-170272); (NAVA11190-2999785); (NAVA1644-170274); (NAVA1645-170275); (NAVA1643-170273); (ARIZ5549654); (MNAB.17315-GRCA 87348); (ASC69091-GRCA-05445 cat# : 90818,); (ASC69092-GRCA-05445 cat# : 90817,); (ASC61637-GRCA-05445 cat# : 90819,); (ASC61638-GRCA-05445 cat# : 90836,); (ASC91129-GRCA-05507 Cat. # 94546, GCNP3200796); **GILA CO.:** (RENO32966-5496066); (ARIZ5549678); **GRAHAM CO.:** (UC604393); (UC604389); (UC604392); (UC604391); (NMC36062-3156511, NMC36058-3156510); (ASU168600-703189); (ARIZ5549648); (ARIZ5549651, UC604387); (ASU158202-703286); (ASU151318-704601); **LA PAZ CO.:** (MISSA32032-6744418, ID117578-ID108940); (MISSA32011-6744416, ID117573-ID108951); (DES00036375-3091521); (ASU37203-703267); (ARIZ5549675); (ASU49931-703251);

(ASU55481-704611); (ASU61299-703186); (ASU65551-703295); (ARIZ5549689); **MARICOPA CO.:** (ASU32346-703185); (ASU69384-704602); (ASU243422-704608); (ASU264154-747217); (ASU781095); (ASU782369); (ASU782387); (ASU279909-1121980); (ASU279914-1121985); (ASU655316, UCR-119710-343755, ASU236750-704595); (ASU223955-756061); (ASU251195-662607); (ASU23443-704598); (ASU24677-704597); (ASU133647-703191); (UCR-78224-378150); (ASU283545-2165094); (ASU40248-704599); (UC589694); (UC489452); (UC489554); (UC499578); (ASU248364-703106); (ASU39030-703266); (ASU200479-655758); (ASU200474-703192); (ASU748111); (ASU759223); (ASU760975); (ASU760971); (ASU97073-704610); (ASU97074-703290); (ASU32353-704626); (ASU748053); (ASU760973); (ASC14280-2087468, ASU32355-703268); (DES00026994-3091486); (ARIZ360698-819826); (ARIZ5549652); (ARIZ5549683); (ARIZ357026-819839); (ARIZ357317-819838); (ARIZ366311-819834); (ARIZ366312-819835, ASU266987-776518); (ARIZ363011-819829); (DES00061403-2061760); (DES00058185-2052298); (ARIZ364863-819831); (ASU1957032); (ASU275980-782359); **MOHAVE CO.:** (UC711692); (DES00014778-3091444); (DES00014750-3091442); (DES00014749-3091441); (UVSC10057-2156339); (RM741357-1360760, NY1082774-2968131); (SUU000779-LAKE 18489, UVSC15714-3379156); (SRP20233-2039145); (SUU000020-LAKE 19019); (ASC103457-3371434); (ASCASC00109628-6816374); (UC1278968); (UC900324); (UC900323); (GCNP1863620); (RENO33025-5496095); (UCR-167478-442577); (UTC00233563-241262); (RM741734-1376278, UTC00233551-241250, RM741734-1576438); (BRY614546-2443144); (UCR-234125-4538228); (BRY614336-2443187, UCR-233923-3213233); (SRP34126-408769); (UNM109677-4106200); (BRY613527-2441458); (BRY613772-2441622); (SFSU08223); (DES00065557-3091566); (ASU279095-1915773); (ASU279047-1915642); (UTC00010840-3225039); (ASC96480-2126481); (ASC74074-1018344); (ASC82515-2114723); (MNAB.35781-88-10); (DES00014793-3091446); (DES00014853-3091448); (DES00014661-3091439); (ASU102274-704616, ARIZ5549671); (NY1082776-2889558); (ARIZ5549636, UC880723); (ASC96884-2124777); (ARIZ5549621, RM290418-1338756, UC1312852); (ASC35236-2087469, ASU96400-704607, ARIZ5549673); (ASU114605-703256); (ASU121869-704619, DES00019633-3091465, ASU113296-703254); (ASC16152-2087470); (ASC15804-2087471, UC1278969); (NY1082771-2900754); (ARIZ5549639); (ASU49168-704625); (ASU143588-703275); (ASU164020-703292); (ASU164025-703294); (ASU238692-704600); (ASU238888-704609, NY10827723-2967736); (NY1082777-2968143); (NY1082775-2893965); (ARIZ5549638, GCNP1862239); (NY1082772-2889232); (ARIZ5549688); (ARIZ5549664); (ARIZ5549656); (ASU91410-1110375); (MNAB.31669-GRCA 101969); (ASC61085-1026972); (ASC56650-2078049); (ARIZ5549662); (ASC69771-GRCA-05445 cat# : 90814,); (ASC91087-GRCA-05507 Cat. # 94504, GCNP3200786); (MNAB.21619-1935906); (MNAB.30449-1942994); (MNAB.9829-1925994); (MNAB.23199-GRCA 87346); **NAVAJO CO.:** (UC1359685); **PIMA CO.:** (UNM57742-4080439); (RM289025-1247644); (UC1353223); (NMC72063-3147216, ASU248069-718349); (UC708839); (DES00021499-3091475); (SJNM50899-6040369); (SJNM51106-6037550); (UC24515); (ARIZ76590-ORPI 0016475); (ARIZ5582372, ARIZ386419-911772); (ARIZ405355-3244520); (ARIZ5549640); (ARIZ5549628); (ARIZ5549643); (ARIZ387993-953634); (ARIZ5549620); (ASU212247-704606); (ASC2078048, ASU216440-703278, ASC52885-2078050); (ARIZ5549622); (ARIZ5549691); (ARIZ5549681); (ARIZ353626-911768); (ARIZ5549650); (ASC25898-2087472, UC1428352, ARIZ5549669, ASU70490-704613); (ASU129141-704603); (ASU129982-704627);

(ASU164604-704622, ID56956-ID108941, UC1359633, ARIZ5549693); (ARIZ5549679); (ARIZ5549623); (ARIZ5549642); (ARIZ5549676); (ARIZ5549649); (ARIZ5549684); (ARIZ5549677); (DES2058495, DES00059385-2057901); (ASU167831-704604); (ARIZ5549619); (ARIZ373619-819837); (ARIZ372502-819840); (ARIZ5549674, UC777710); (ASU55584-703288); (ASU50154-704623); (DES00050460-2041185); (ASU26505-703265); (ARIZ365338-ORPI 0016473); (ASU143723-704624); (ASU143724-703284); (ARIZ363012-819828); (ARIZ364386-819833); (ARIZ5549632); (ARIZ5549629); (ARIZ368063-819836); (ARIZ5549661); (ASC16408-2087473); (ARIZ5549659); (ARIZ5549657); (ASU107385-703298); (ARIZ5549667, ARIZ5549672); (MNAB.26408-1939430); (MNAB.28948-1941896); (ARIZ5549625); (ARIZ5549633); (ASU168515-703304); (ARIZ5549687); (ARIZ5549682); (ASU70338-703271); (ASC25949-2087474); (ARIZ5549630); (ARIZ5549647); (ARIZ5549660); (ASU32354-703269); (ARIZ76591-ORPI 0016472); (ASU32350-703296); (ARIZ405356-3244519); (ARIZ295202-ORPI 0016474); (ASU147594-703276); (ASU147601-704615); (ASU170222-703279); (ASU170414-703281); (ARIZ282332-SAGU 6741); (ARIZ5549690); (ARIZ5549666); (ARIZ5549680); (ARIZ282333-SAGU 6740); (ARIZ362480-819830); (ARIZ411289-3350030); **PINAL CO.:** (RM172515-1226907, UC595693); (ARIZ76606-CAGR 6575); (ASC74362-1018343); (ARIZ5549645); (ARIZ5549646); (ARIZ5549624); (ARIZ5549634); (ARIZ5549637); (ASU24348-703282); (ARIZ5549692, UC521480); (ARIZ358729-819822); (ARIZ358781-819825); (ASU236836-753884, ASU236836-659850, DES00047478-2045280); (ASU86624-704596); (ASU32338-703270); (ARIZ5582532); **SANTA CRUZ CO.:** (ARIZ420459-5586088); (ARIZ374625-TUMA 9002); (ARIZ367075-TUMA 8389); (ARIZ5574655); (ARIZ5574654); **YAVAPAI CO.:** (ASC94933-2123917); (ASC94972-2123936); (SEINet6166222); (SEINet6166227); (SJNM53362-6058594); (ARIZ372700-911767); (ASC33029-2111623, COC-AZ967-5423787); (ASC83801-1063652); (ASU6645715); (ASU5495612); (ARIZ5549668, ARIZ128134-MOCA 3944); **YUMA CO.:** (DES00010328-3091426, UC1426610, NY1082770-2968867, ASU70075-703190); (MABAson-trv-23368-4173103); (MABAson-trv-23491-4173226); (ARIZ5549670); (ARIZ5549686); (ARIZ5549665); (ASU157688-704617); (ASU157695-703258); (ASU157711-703264); (ASU157689-703261); (ARIZ5549653); (ARIZ5553247); (ASU125560-704612, ARIZ5549635); (ASU152573-703299); (ASU197075-704620, UC962056, ARIZ5549641); (DES00075354-4343449, ARIZ415984-3831828, ARIZ415986-3831826, ASU0079762-290628); (ARIZ415978-4557298); (ASU32358-703274); (MNAB.26099-1939174); (ASC33592-2087476); (MNAB.27267-1940229); (ARIZ5549644); (ARIZ5549631); (ASC50227-2087475); (ARIZ5549655); (DES00045823-3091559);

CALIFORNIA. IMPERIAL CO.: (UCR50450); (SD115564); (SDSU6031); (UCR48422, HSC85341, RSA388029); (SD37188); (UCR246528, CDA21353); (UC669321, POM38594); (UC669312, POM211596); (UC669318, POM211595); (SD125163); (UCR249698); (SD200428, UCR227946); (SD200427); (SD200037); (HSC13533); (RENO33027-NESH 58730, NY1082803-2889149); **INYO CO.:** (UC657668); (UC1733989); (RSA274229); (UC1733999); (UC1733997); (UCR42277); (RSA352228); (RSA352625); (SJSU4777); (UCSB56994); (RSA644241); (UCR42276); (UC696052); (UCR26115); (UC696135); (SFV2969); (RSA504962); (RSA616797); (UC606883, POM230850); (POM255188); (RSA623595); (RSA420855); (RSA622039); (UC1094527); (RSA618472); (RSA629244); (RSA616883, RSA206046); (RSA420852); (RSA618038); (UC1297467, SD62315, RSA181991); (RSA617956, RSA227018); (UC693731); (UC1300121); (RSA617075);

(UCR211879, RSA737657); (UCR47644, RSA370262, UC1534950, HSC85167); (UCR89193); (UCR215162, SD232264, UC1929475, RSA737579); (RSA737767); (UC967170); (RSA617576); (JEPS1690); (UC1190971, RSA152188); (RSA620835); (POM260659); (POM259352); (POM48670); (RSA624358); (RSA420854); (POM255948); (POM255949); (UC753406); (RENO33029-NESH 62224); (RSA620734); (UC1445359, RSA620733); (UC1445358, RSA620911); (RSA620912, RSA346624); (UC1281989); (UCR159684, RSA387437); (UC880724); (UCR23615); (UC1234868, SD52949, RSA155674); (NMC41654-3156493, SEINET3156493, UC129019, POM3750, RENO32975-NESH 10527); (SJSU3711); (JEPS100936); (UCR183422); (RSA565628); (RSA565767); (JEPS1697, RSA75994); (RSA420853); (UC499799, RSA8293); (RSA75993); (RSA75991); (POM145971); (RSA731065); (RSA802949); (UC494560, POM184049); (POM187841); (RSA190672); (RSA212892); (UCR236197); (JEPS1695); (JEPS1693); (RSA239901); (UC1426040, RSA247827, SD90250, CHSC23325); (POM247263); (UCR1352); (RSA492386); (HSC38442); (SD47997); (SD51626); (POM75295, POM75294); (RSA678960); (RSA319935); (POM73881); (RSA678959); (RSA120857B); (RSA420856); (UCR134207); (UC632457, POM248187); (UC632458); (POM73796); (NY1082805-2889151, NY1082805, RSA387492, UC1535094, HSC85221, UCR47414); (NY1082806-2889152, NY1082806, RSA387455, UC1535049, HSC84997, UCR47761); (NY1082807-2889588, NY1082807, RSA442944, UC1545336, UCR59884); (NY1082804-2889150); (DES00068312-3093591, SEINET3093591); (SFSU08222); **KERN CO.:** (RSA75992); (UC144185, POM126793); **LOS ANGELES CO.:** (UCSB26239); (RSA660140); **RIVERSIDE CO.:** (SFV6303); (RSA779807); (SJSU8848); (RSA776838); (UCR33572); (UCR18161); (JEPS1700); (UCR237628, RSA776021); (RSA420859); (RSA775663); (RSA776091); (POM305588); (JEPS1709); (JOTR28795); (RSA703488); (POM47495); (JEPS1692); (JEPS1691); (UCR51984, RSA480086); (JOTR32027); (JOTR35151); (UCR26225); (POM14368); (POM13894); (UC68785); (UCR41849); (JEPS22524); (UCR232518); (SEINET3409352, ASC103504-3409352); (RSA78474); (RSA78475); (UCR213266); (UCSB42179); (UCSB42178); (POM498192); (RSA347086); (POM431205); (RSA659190); (POM118675); (POM160074); (POM160093); (POM264073); (POM261028); (UCR23563); **SAN BERNARDINO CO.:** (<u>*G. K. Walden 283* SFSU!</u>); (<u>*G. K. Walden 289* SFSU!</u>); (SFSU13757); (SFSU); (RSA280908); (SFSU); (RSA296640); (RSA296639); (RSA305355); (RSA301631); (SD140893); (RSA798825); (JEPS3484); (RSA776921); (UCD119361); (UCR17830); (UCR17744); (UCR18134); (UCR224397, RSA768368); (UCR47213); (JEPS1701); (UCR217571); (JEPS1699); (JEPS1698); (JEPS3489); (JEPS3488); (RSA705476); (JOTR31033); (RSA705477); (RSA715454); (UCSB5292); (UC666350); (RSA271431); (UC1262276, RSA271450); (RSA278460); (RSA705718); (RSA705717)<u>; (SFSU08104!);</u> (JEPS23035, RSA151866, UC1078154); (JEPS23059); (RSA711684); (SD140092); (RSA705479); (UCR76775, RSA563892); (JEPS20473); (RSA705478); (UCR106756); (RSA756764); (UC606884); (RSA775087); (RSA715453); (SEINET1908401, RSA706151, ARIZ397232-1908401); (RSA790934); (UCR33427, RSA279209); (RSA757392); (RSA756484); (RSA732666); (UCR32362); (RSA732491); (UC967163, SD47982); (UC1003711, POM325057); (RSA793630); (POM7665); (POM7731); (RSA706899); (SDSU6037); (RSA706967); (RSA45512); (RSA808517); (RSA517960); (UCR25802); (JEPS22637); (UCR228586, RSA772049); (UCR173859); (RSA779521); (RSA15821); (UCR173439); (UC909936); (RSA570354); (POM47427); (RSA570302); (POM47874); (POM47876); (UC635174); (RSA270725); (POM7548); (RSA24927); (RSA25018); (SD42550, RSA24346); (RSA24500);

(RSA24503); (RSA725557); (RSA726163); (RSA708502); (POM145318); (OBI13933, UC1392979); (RSA620082); (UCR215851); (UCR217012); (UC494490, POM184082); (UCR218699); (RSA765602); (UCR218534); (RSA721147); (RSA718711); (UCR217983); (UCR217736); (UCR218821); (UCR218401); (UCR216786); (RSA765580); (JEPS20757); (UCR217043); (POM213680); (POM213763); (UC1051495, RSA114066, SD46111); (HSC79866); (UCR228746); (RSA278461); (UCR33264); (UCR88644); (UCR86583); (JOTR33046); (OBI43790); (JEPS1696, SD46084); (JEPS1689); (RSA808682); (UC1287022, UCD119360, HSC13505); (UCR194519); (UCR203408); (UCR203395); (UCR203518); (UCR203385); (UCR203826); (UCR210974); (UCR210994); (UCR210805); (UCR213607); (RSA275521); (RSA339686); (RSA275922); (RSA705475); (RSA711690); (RSA705522); (RSA732834); (RSA518753); (SD48003); (SD62074); (SD64285); (CLARK-A1045-253, CLARK-A1045-252); (CLARK-A1045-711); (OBI70444); (SJNM66823-6425758, SJNM66809-6425870, SJNM66816-6425856); (UCR229307); (RSA75996); (UCR85416); (POM73797); (UCR90292); (UCR15868); (RSA420860); (UC774914); (UC774963); (POM73484); (POM73627); (FLD2545-3105361, SEINET3105361); (NY1082802-2896527); **SAN DIEGO CO.:** (UCSB30513); (SD167571); (SD169682); (SD221132); (SD227319); (SD118121); (SD182239); (SD119040); (SD169269, RSA733319); (SD122418); (SD16673); (UC975000, RSA152533, JEPS4097); (RSA787641); (SD222015); (SD221133); (SD24466); (JEPS1694, SD58278); (CHSC35352, HSC79613); (RSA349860); (SD28654); (ID86644-ID108952); (UCR227941, SD204388); (UC1242709); (HSC13534); (SD172438); (UC131483); (CLARK-A1045-1291); (SD155452); (SD155451); **SANTA BARBARA CO.:** (UCSB63545).

NEVADA, CLARK CO.: (UC711696); (UC978175); (RENO33030-UNR 15177, UC900319); (NTS16372-5514995); (UC1112290); (NMC21657-3165874); (UC146628, NMC21658-3165875, RENO32976-NESH 11738); (ASCASC00107007-4338717); (ASCASC00109450-6697857); (UC900325); (UCR-161391-437227); (UC900321); (RENO33023-UNR 25331); (UC900146, UC908002, RENO32979-UNR 17481); (RENO33024-NESH 70119); (UC1353370); (UC1588024, UTC00217326-266010); (UC1588023); (RENO32969-5496073); (UTC00217154-265845, UC1588022, UCR-57232-371671); (UTC00217155-265846); (RENO32968-5496070); (RENO32967-5496067); (RENO32970-5496074); (RENO32980-UNR 47608); (CS78812-517816); (NY1082797-2889325, UC1426611); (ASC93758-2120652); **ESMERALDA CO.:** (UC1492518); (RENO32962-5496059); (RENO32959-5496054, UC1875103, SRP29519-2039541, RENO32960-5496056, ID137791-ID108953, CIC41300-2016391); (NY1082801-2889324); **LINCOLN CO.:** (ENLC00957-3270611); (ENLC02588-6702801); (RENO32971-NESH 66828); (UTC00210429-260849); (UTC4535573); (UTC00217153-265844); (RENO32972-UNR 71670); (UCR-31783-371675); (UCR-77458-371668); (NY1082796-2897393, RENO32961-5496058); **MINERAL CO.:** (NY1082794-2889612, RENO32964-NESH 71143, UTC00227123-235224); (NY1082799-2895868, RENO32965-5496064); **NYE CO.:** (RENO32977-UNR 20310); (RENO32978-UNR 21682); (RENO32955-5496047, CIC38693-2015992, UCR-211647-2454547, NY1153895-2972620); (SEINet6167778); (UCR-56983-371674, UTC00217152-265843); (RENO32974-UNR 46722); (RENO33028-NESH 52983); (RENO32963-NESH 52982); (NY1082798-2889323, UC1426612); (NY704227-2860451, RENO32973-5496080, UTC00244243-250976); (NY1082800-2893008); **WHITE PINE CO.:** (UCR-92947-371669); (RENO32957-5496051, NY1082795-2897317, UTC00247350-253727, CIC41293-2016386, ID138399-ID108939,

UC1875098, SRP29521-2039542); (CIC38678-2019833, NY1112351-2972319); (UCR-164813-440448); (RENO32956-5496050); (NY1082793-2889614); (NY1082792-2889618).

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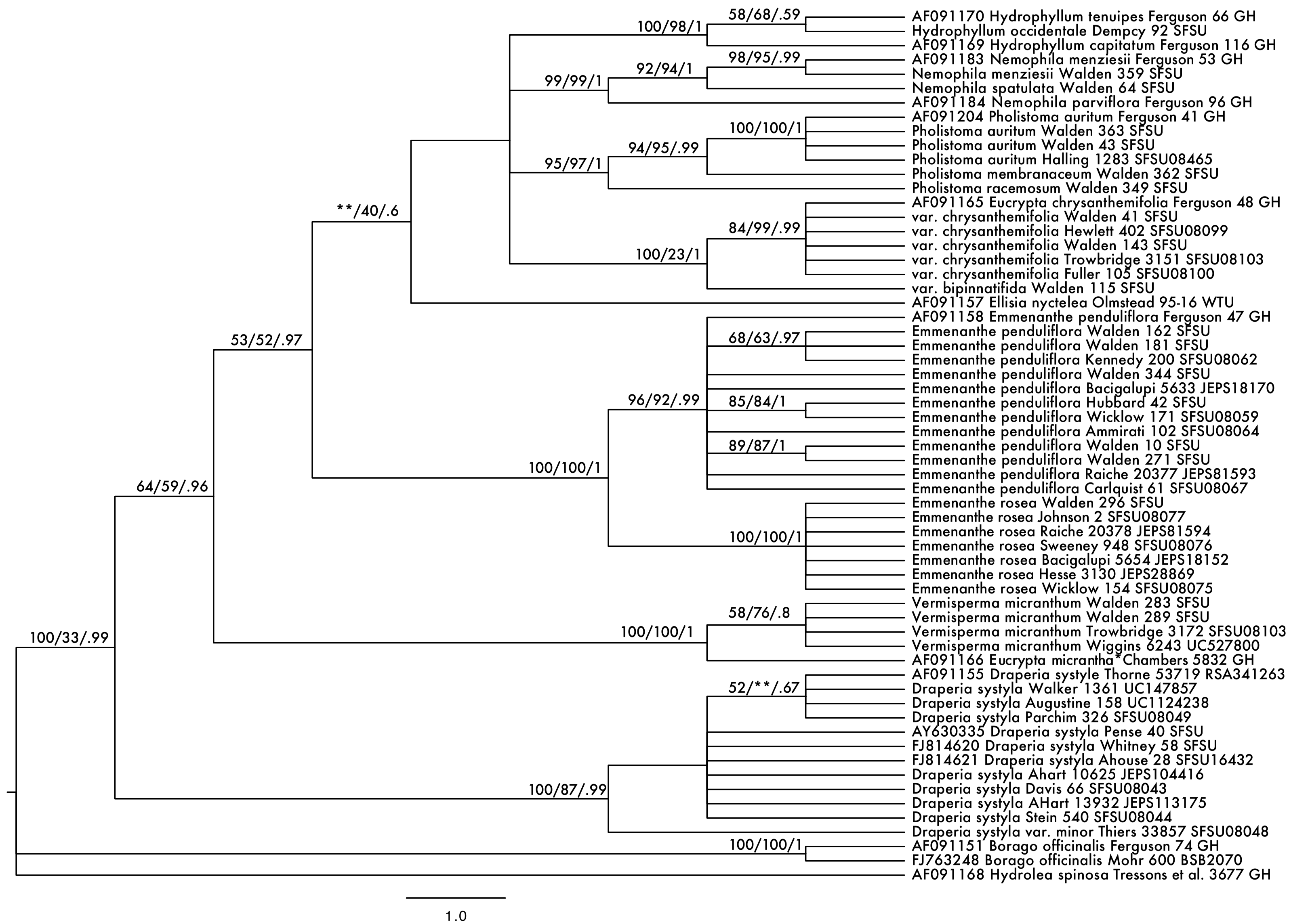
UTAH, KANE CO.: (NY1082783-2898466); (NY1082779-2897659); (NY1082778-2888570, UTC00245406-252146); **TOOELE CO.:** (UC605038); (UC107447); **WASHINGTON CO.:** (IDS2014.007-IDS0061985, RENO32958-5496053); (UC528715); (UTC00207333-258792); (UC880663); (UC676539); (UC676541); (UC604388); (SJNM29671-6041553); (SSLPSSLP06253-3397308); (UVSC8196-2156283); (NY1082790-2889320, NY1082787-2889321); (NY1082784-2969541, UC880725); (NY1082781-2889499); (NY1082789-2889319, UTC00010841-3225034, NY1082786-2889318); (NY1082791-2889322); (NY1082780-2889387); (NY1082785-2900973); (NY1082782-2889317); (NY1082788-6537319).

Fig. 2.1. The strict consensus of 95900 best trees for Maximum Parsimony [tree length 670 steps]. Support values are at nodes for MP bootstrap values / maximum likelihood (ML) bootstrap values / Bayesian posterior probabilities for nodes supported at ≥95% posterior probability. An asterisk (*) indicates clade with <75% support in the 0.5 majority-rule MP bootstrap tree or in the 0.5 majority-rule ML bootstrap tree. (scale bar = mean number of nucleotide substitutions per site). The accession AF091166 retains the GenBank identifier here.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Nemophila spatulata Walden 64 SFSU
AF091184 Nemophila parviflora Ferguson 96 GH
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var. bipinnatifida Walden 115 SFSU
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Emmenanthe penduliflora Bacigalupi 5633 JEPS18170
Emmenanthe penduliflora Hubbard 42 SFSU
Emmenanthe penduliflora Wicklow 171 SFSU08059
Emmenanthe penduliflora Ammirati 102 SFSU08064
Emmenanthe penduliflora Walden 10 SFSU
Emmenanthe penduliflora Walden 271 SFSU
Emmenanthe penduliflora Raiche 20377 JEPS81593
Emmenanthe penduliflora Carlquist 61 SFSU08067
Emmenanthe rosea Walden 296 SFSU
Emmenanthe rosea Johnson 2 SFSU08077
Emmenanthe rosea Raiche 20378 JEPS81594
Emmenanthe rosea Sweeney 948 SFSU08076
Emmenanthe rosea Bacigalupi 5654 JEPS18152
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Vermisperma micranthum Wiggins 6243 UC527800
AF091166 Eucrypta micrantha*Chambers 5832 GH
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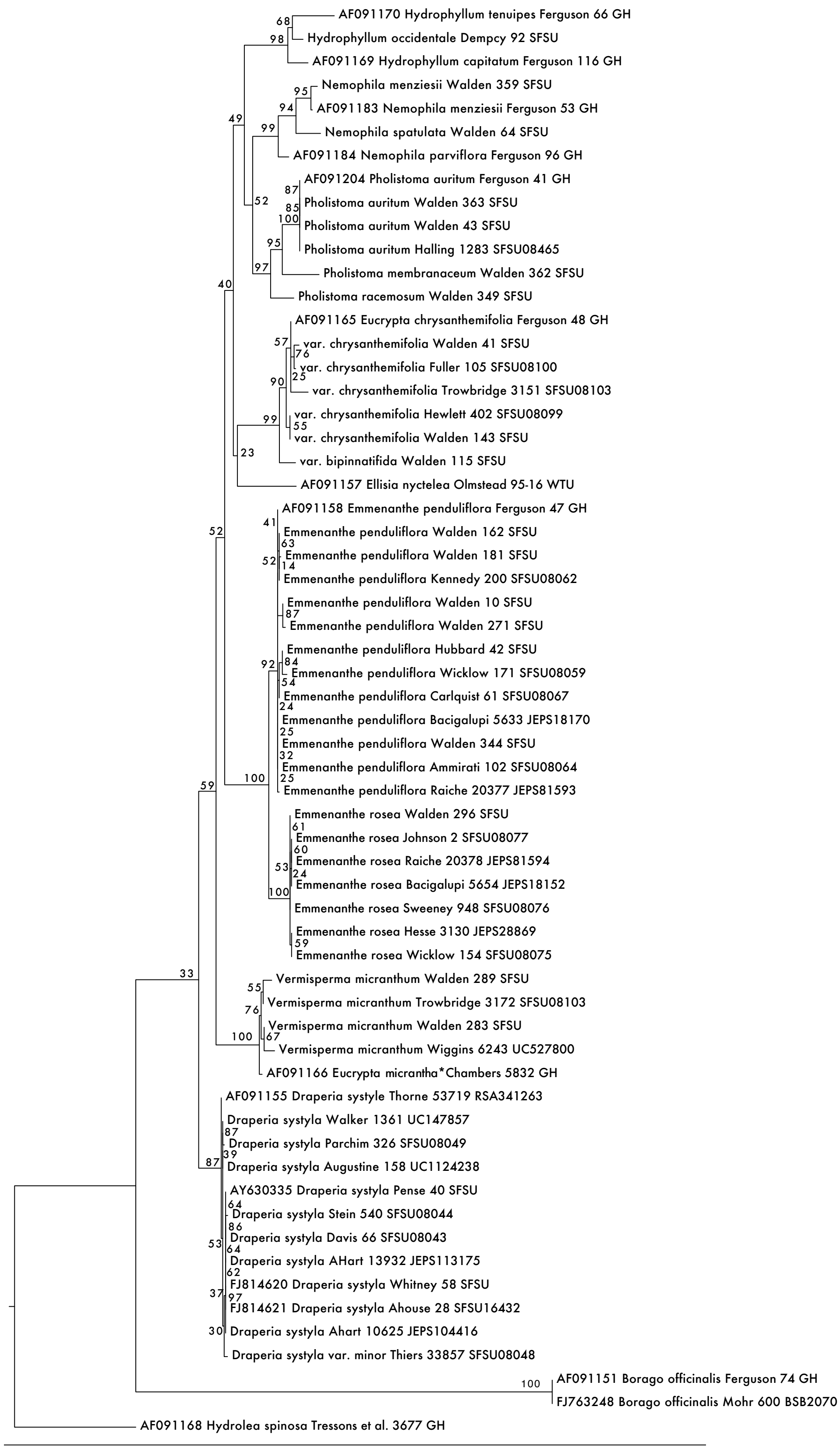
Draperia systyla Walker 1361 UC147857
Draperia systyla Augustine 158 UC1124238
Draperia systyla Parchim 326 SFSU08049
AY630335 Draperia systyla Pense 40 SFSU
FJ814620 Draperia systyla Whitney 58 SFSU
FJ814621 Draperia systyla Ahouse 28 SFSU16432
Draperia systyla Ahart 10625 JEPS104416
Draperia systyla Davis 66 SFSU08043
Draperia systyla AHart 13932 JEPS113175
Draperia systyla Stein 540 SFSU08044
Draperia systyla var. minor Thiers 33857 SFSU08048
AF091151 Borago officinalis Ferguson 74 GH
FJ763248 Borago officinalis Mohr 600 BSB2070
AF091168 Hydrolea spinosa Tressons et al. 3677 GH
1.0

Fig. 2.2. RAxML phylogram of the single, best tree [-lnL = 4639.165896, tree length = 1.699999]. Support values are at nodes for maximum likelihood (ML) bootstrap values (scale bar = mean number of nucleotide substitutions per site). The accession AF091166 retains the GenBank identifier here.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var. chrysanthemifolia Walden 41 SFSU
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Emmenanthe penduliflora Hubbard 42 SFSU
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Emmenanthe penduliflora Carlquist 61 SFSU08067
Emmenanthe penduliflora Bacigalupi 5633 JEPS18170
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Vermisperma micranthum Walden 283 SFSU
Vermisperma micranthum Wiggins 6243 UC527800
AF091166 Eucrypta micrantha*Chambers 5832 GH
AF091155 Draperia systyle Thorne 53719 RSA341263
Draperia systyla Walker 1361 UC147857
Draperia systyla Parchim 326 SFSU08049
Draperia systyla Augustine 158 UC1124238
AY630335 Draperia systyla Pense 40 SFSU
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Draperia systyla Ahart 10625 JEPS104416
Draperia systyla var. minor Thiers 33857 SFSU08048
AF091151 Borago officinalis Ferguson 74 GH
FJ763248 Borago officinalis Mohr 600 BSB2070
AF091168 Hydrolea spinosa Tressons et al. 3677 GH
2.0

Fig. 2.3. Distribution of georeferenced *Eucrypta chrysanthemifolia* var. *chrysanthemifolia* specimens in North America (California and Baja California). Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, GEBCO, and U.S. Department of State Geographer. Scale bar 700 miles.

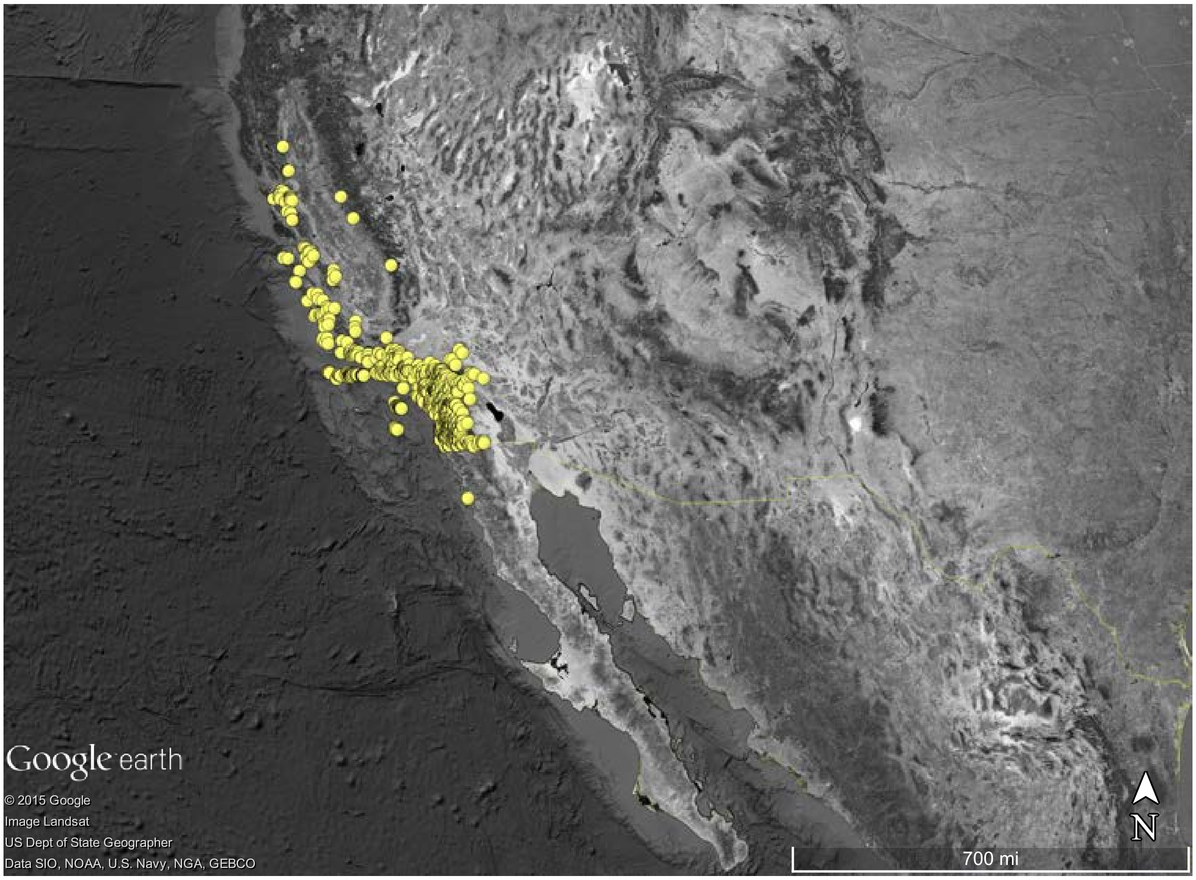

Google earth
© 2015 Google
Image Landsat
US Dept of State Geographer
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
700 mi
N

Fig. 2.4. Distribution of georeferenced *Eucrypta chrysanthemifolia* var. *bipinnatifida* specimens in North America (California, Nevada, Arizona, Baja California, Sonora). Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, GEBCO, and U.S. Department of State Geographer. Scale bar 700 miles.

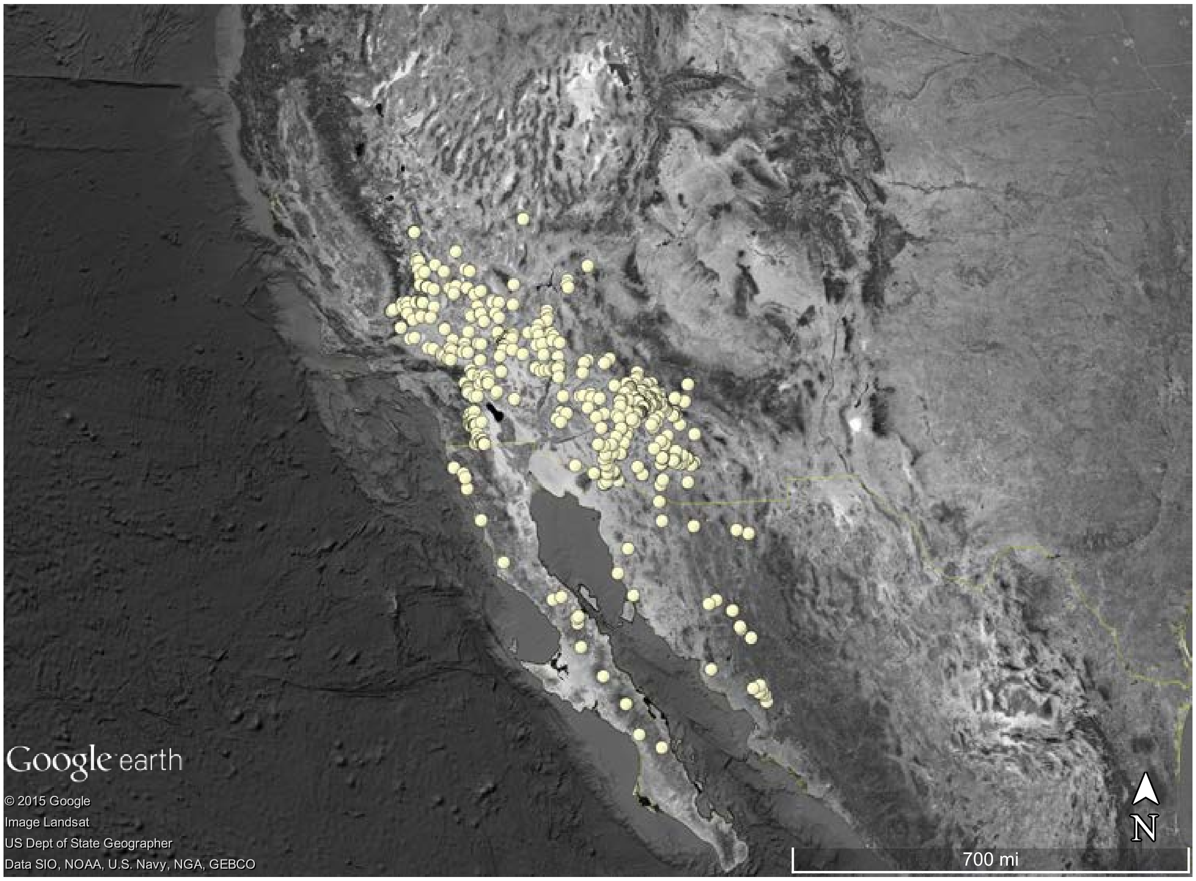
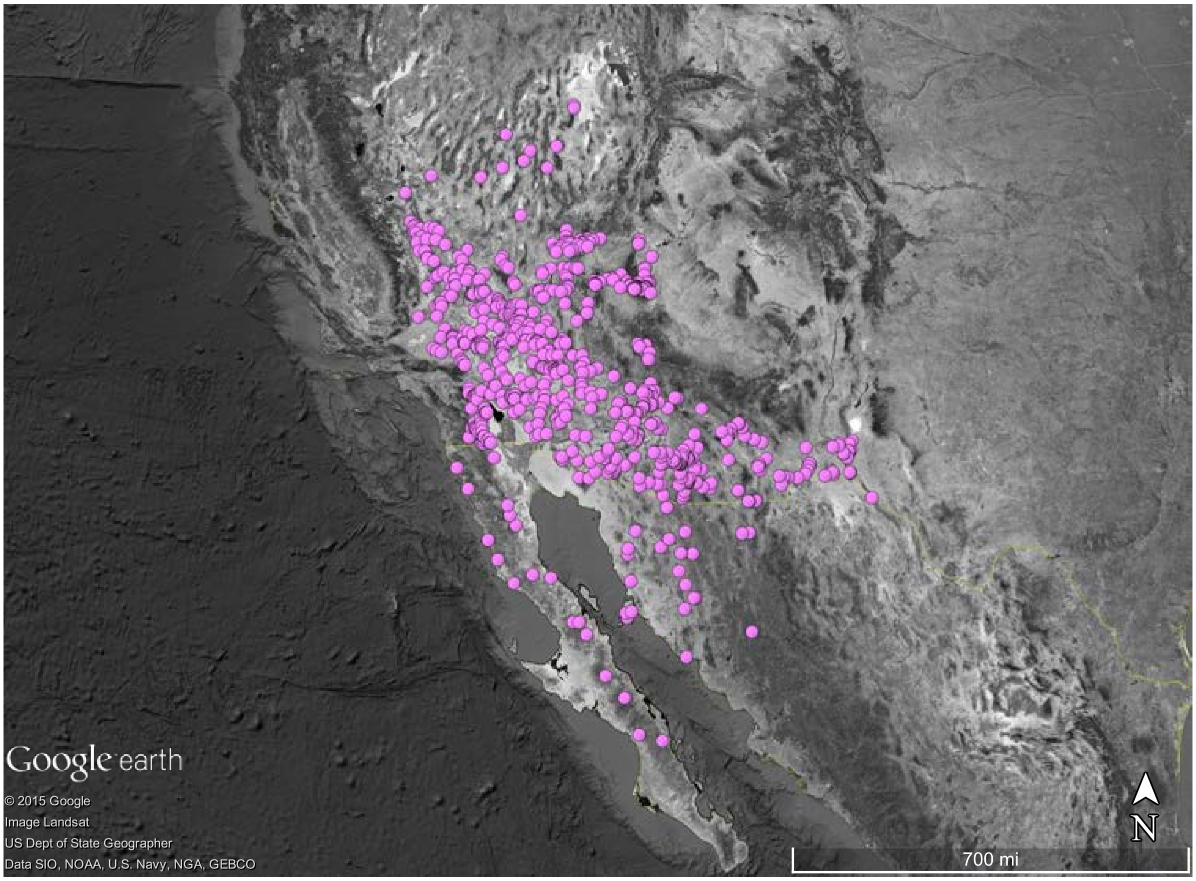

Google earth
© 2015 Google
Image Landsat
US Dept of State Geographer
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
700 mi
N

Fig. 2.5. Distribution of georeferenced *Vermisperma micranthum* specimens in North America (Arizona, California, Nevada, New Mexico, Texas, Utah, Baja California, Sonora, Chihuahua). Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, GEBCO, and U.S. Department of State Geographer. Scale bar 700 miles.


Google earth
© 2015 Google
Image Landsat
US Dept of State Geographer
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
700 mi
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CHAPTER THREE

PHACELIA SECT. *RAMOSISSIMAE*: A REVISION

ABSTRACT

Phacelia sect. *Ramosissimae* (Hydrophyllaceae; Boraginales), an entirely New World section of *Phacelia*, is a well-represented and recognizable group of the California Flora. Herbaria accession metadata (annotations, georeferencing, specimen citations) were used to investigate spatiotemporal patterns of taxonomic discovery, description, and delimitation in *P.* sect. *Ramosissimae*. Evidence from the literature, museum specimen collections (databased and digitized), and molecular phylogenetic analyses are used in combination to revise the taxonomy of *Phacelia* sect. *Ramosissimae* (Rydb.) Walden & R.Patt.

Key Words: digital curation, specimen citation, taxonomy, systematics, California

Introduction and Background

Systematics is the science of classifying living things, whether that thing is an individual, F_1 hybrid, or clade. Systematics strives to make sure that the things that we are talking about now are the same things that others have talked about in the past, and will talk about in the future. Major debates have surrounded how biological classifications should reflect relationships among organisms (Mayr 1942; Stebbins 1950; Simpson 1961; Baldwin 2000; Wheeler and Meier 2000; McNeill et al. 2006; Claridge 2009; Mishler 2009; Cantino and de Queiroz 2010). The basic understanding of living things requires their description and evolutionary history, and it has become clear that phylogeny provides the most explanatory and stable classification. A phylogenetic analysis evaluates these relationships using homologous characters, e.g., molecular sequences of gene regions. Molecular phylogenies are particularly helpful for understanding evolutionary relationships of organisms with very similar morphologies, as in the case of *Phacelia* sect. *Ramosissimae* (Rydb.) Walden & R. Patt. (Hydrophyllaceae; Boraginales), a small group of hydrophylls with widely and narrowly distributed taxa.

History of *Phacelia* sect. *Ramosissimae*

Brand published two major works that included classification for *Phacelia* sect. *Ramosissimae* (Brand 1912, 1913). Brand (1912) first grouped taxa of *P.* sect. *Ramosissimae* within the informal "*P. hispida conspectus formarum*", "*P. tanacetifolia conspectus formarum*," and "*P. distans conspectus formarum*" in his treatment of Hydrophyllaceae from the Sierra Nevada of California. In the following comprehensive revision of the family Hydrophyllaceae, Brand (1913) treated these same informal groups as "*P. hispida systema specie*", "*P. distans systema specie"*, and "*P. tanacetifolia systema specie."* These informal groups were made in part to accommodate published names and because of the considerable variation within each of these groups. Macbride (1917) revised many of Brand's groups, clarifying circumscriptions from collections at the Gray Herbarium at Harvard (GH). Rydberg (1917) published the basionym for the section (*Phacelia* [unranked] *Ramosissimae*) in his flora (Walden and Patterson 2012). Voss (1935) revised the majority of taxa centered in southern California, which he called the "*Phacelia hispida"* group. Constance (1963; 1982) treated the group as the informal "*Tanacetifoliae*," all with haploid chromosome counts of $n = 11$, except for *P. suffrutescens*, with a haploid count of $n = 10$ (Cave and Constance 1942, 1944, 1947, 1950, 1959; Constance 1963). There are other reports of variation in chromosome counts; see taxonomic section for particulars. Additional studies later in the century investigated more the ecology of *P. cicutaria* var. *hispida* (Griesel 1939), biosystematics of *P. distans* and *P. tanacetifolia* (Horner 1977), and recognition of additional taxa at the rank of species (Constance 1948; Garrison and Patterson 2009), but none conclusively dealt with systematics of the entirety of the section.

Previous molecular studies have supported sampled *P.* sect. *Ramosissimae* as monophyletic, sister to a monophyletic *P.* sect. *Glandulosae* (Gilbert et al. 2005; Garrison 2007; Hansen et al. 2009; Walden 2010; Walden and Patterson 2012; Walden et al. 2014), both placed within *P.* subg. *Phacelia* (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005; Garrison 2007; Hansen et al. 2009; Walden 2010; Walden and Patterson 2012; Walden et al. 2014). The goals of this study are to sample broadly within *P.* sect. *Ramosissimae*, including samples that are representative of named entities, and test taxonomic concepts in the section. In addition to the molecular systematic studies, previous researchers have discussed the taxa included in *P.* sect. *Ramosissimae* using morphology (descriptions), geography, and vouchered specimens as representative of taxonomic concepts and as a way to circumscribe entities through time and space. Taxonomic nomenclature is itself a necessary area of investigation, the basis for other fields of studies (e.g., evolution, ecology), and also the final product of those studies (Winsor 2009).

OBJECTIVES

This project sampled throughout *P.* sect. *Ramosissimae* using the internal transcribed spacer region (ITS-1, ITS-2, and 5.8S gene) of nuclear ribosomal DNA (nrITS) to infer an expanded nuclear phylogeny for the section, and to estimate phylogenetic relationships for taxa. I sampled from almost all named entities in the section (see details in the following sections), confirming many previous hypotheses of relationships of taxa. This study builds upon previous work by Ferguson (1998, 1998 [1999]), Gilbert et al. (2005), Garrison (2007), Hansen et al. (2009), and Walden et al. (2014), and adds to the understanding of systematics in *Phacelia*.

The proposed taxonomy of the section is presented in the conclusions, with complete synonymies, appendices of specimens examined for this research and for georeferencing, and updated distribution maps.

MATERIALS AND METHODS

Taxon sampling

Samples for DNA work were included from fieldwork and herbarium specimens, and determined morphologically at B, BLM Hollister, CAS, CGE, DAV, JEPS, K, OBI, P, SCI, SFSU, SJSU, and UC. Samples from herbarium specimens were included if destructive sampling was feasible and defensible. Additional material was sequenced from banked molecular vouchers with herbarium vouchers received from the William L. Brown Center at the Missouri Botanic Garden (MO). Material included for DNA work and downloaded from GenBank is detailed in Appendix 3.01. Appropriate material for DNA was not available from specimens representing several named entities, including *P. alvordensis, P. arthurii, P. brunoniana, P. decumbens, P. eximia, P. firmomarginata, P. heterosepala, P. cinerea*, *P. platyloba, P. ramosissima* var. *valida* (nomen invalidum), *P. setosa* Eastwood (in herb.)*, P. scabrella, P. tanacetifolia* var. *cinerea, P. tanacetifolia* forma *staminea*, and *P. tanacetifolia* var. *pseudodistans.*

The outgroup for the molecular phylogenetic study was *Hydrolea spinosa* L. (AF091168) (Davenport 1988; Di Fulvio 1997; Ferguson 1998, 1998 [1999]; Olmstead and Ferguson 2001; Erbar et al. 2005). Placement of Hydrophyllaceae in regards to various clades of Boraginales is somewhat unresolved (Nazaire and Hufford 2012; Weigend, Luebert, Gottschling, et al. 2013; Weigend, Luebert, Selvi, et al. 2013; Refulio-Rodriguez and Olmstead 2014). Codonaceae is the likely basally divergent clade for Boraginales (Weigend and Hilger 2010; Weigend, Luebert, Gottschling, et al. 2013). An outgroup outside of Boraginales was preferred to avoid issues related to within-order relationships, and chosen because this taxon had previously been used to root Ferguson's study (Ferguson 1998, 1998 [1999]). *Hydrolea* L. was, at one time, included within Hydrophyllaceae or considered the sister family (Hydroleaceae) (Linné 1762; Choisy 1833, 1846; Small 1903; Brand 1913). However, Hydroleaceae is now placed with good support within Solanales (Stevens 2001 onward; Bremer et al. 2002; Soltis et al. 2011). Solanales is sister to Boraginales, within the Lamiidae sensu Olmstead 1992 (also subclass Lamiidae sensu

Takhtajan 1987, asterids I sensu Chase et al. 1993, euasterids I sensu APG 1998, lamiids sensu Bremer 2002, Garryidae sensu Cantino et al. 2007) (Takhtajan 1987; Olmstead et al. 1992; Bremer et al. 1998; Bremer et al. 2002; APG II 2003; Judd and Olmstead 2004; Cantino et al. 2007; APG III 2009; Refulio-Rodriguez and Olmstead 2014).

Gene region sampled

I examined nrITS for inferring interspecific relationships in *P.* sect. *Ramosissimae*. nrITS is a variable, rapidly evolving region, previously used in phylogenetic studies to successfully resolve relationships at multiple taxonomic levels in the angiosperms (Baldwin et al. 1995; Álvarez and Wendel 2003; Yao et al. 2010; China Plant BOL Group et al. 2011), the Lamiidae sensu Olmstead et al. 1992 (Olmstead et al. 1992; Stevens 2001 onward; Maddison and Schulz 2007; Refulio-Rodriguez and Olmstead 2014), the Boraginales (Ferguson 1998; Moore and Jansen 2006; Weigend et al. 2009; Hasenstab-Lehman and Simpson 2012; Nazaire and Hufford 2012; Cohen 2013), and the hydrophylls in particular (Ferguson 1996, 1997; Gilbert et al. 2005; Taylor 2012; Barr 2014). There are known issues for nrITS regarding alignment difficulties for some clades in Boraginales (e.g., placement of the holoparasite family Lennoaceae, and polyploid taxa), and support can be weak at deeper nodes and where sampling is sparse (Walden et al. 2014). nrITS was an appropriate set of markers for the objectives of this study, as it provides resolution for inferring interspecific taxonomic relationships, as well as confirming membership within clades for *P.* sect. *Ramosissimae* (Gilbert et al. 2005; Garrison 2007; Hansen et al. 2009; Walden et al. 2014).

DNA isolation and PCR amplification

DNA Isolation. Protocol followed that of Walden et al. (2014) for nrITS and for methods detailed in the *Emmenanthe* chapter. Total genomic DNA was extracted from at least 0.020 mg (up to 0.050 mg) dry weight herbarium or silica-dried leaf material following Doyle and Dickson (Doyle and Dickson 1987) using Qiagen DNeasy Plant kits (Qiagen, Valencia, CA, USA). Young, green leaves near tips of growing shoots were preferred for extraction, but not always available from herbarium specimens. For older herbarium specimens (i.e., anything collected before 1965), target weight herbarium leaf material was 0.040–0.050 mg dry weight to increase starting material. The protocol was modified to include tissue homogenization with acid-clean 3.2 mm chrome-steel beads or 5 mm solid soda lime #3000 glass beads using a TissueLyser II (Qiagen, Valencia, CA, USA) instead of grinding tissue with liquid nitrogen using mortar and pestle. The weighed samples were frozen at 4ºC in 2 ml microcentrifuge tubes prior to homogenization. The TissueLyser Adapters (2 × 24 Set) were also frozen for a minimum 2 hours period prior to homogenization. Following the first homogenization cycle, the inner sample tubes were switched with outer sample tubes, and adapters were rotated and inverted for the second homogenization cycle. The incubation time was extended to 24 hrs for field-collected material, and to 48 hrs for herbarium material. To increase PCR signal for especially glandular material and very old herbarium material, 20 µL genomic DNA was added to 200 µL of 5% Chelex® 100 Chelating Resin (Bio-Rad Laboratories, Inc., Hercules, CA) and boiled for 20 minutes (Singer-Sam et al. 1989; Walsh et al. 1991).

PCR amplification for nrITS. Total genomic DNA elutions and supernatant from Chelex® reactions were serially diluted to 1:100 in Ultra-Pure distilled H_20 (Invitrogen, Grand Island, NY, USA) for best PCR amplification (Mullis et al. 1987) of nrITS with primers ITS-I (forward) (Urbatsch et al. 2000) and ITS4 (reverse) (White et al. 1990). Primers were obtained as

300 mM stock (Elim Biopharmaceuticals, Inc. Hayward, CA, USA), and diluted first to 100 mM stock with ultralow Tris-EDTA buffer (ULTE), and then to 10 mM with Ultra-Pure H_20. PCR was conducted with a final reaction volume of 20 µL in AccuPower PCR PreMix Bioneer strip tubes (Bioneer, Inc., Alameda, CA, USA), each containing 0.75 µL of forward and 0.75 µL of reverse primer at 10mM each, and 17.0 µL 1:100 dilution genomic DNA template. The PCR thermo-cycle profile had an initial denaturation step of 1 min at 96ºC, followed by 35 cycles of 30 sec at 94ºC, 30 sec at 56ºC, and 1 min at 72ºC, and a final extension at 72ºC for 5 min, with subsequent storage at 4ºC.

To verify amplification of PCR products, a combined total of 5 µL of template PCR product and 1 µL of 6× loading dye was run on a 1.8% agarose gel (APEX agarose) in 1× TBE buffer at 100 volts, with a standard 100 bp ladder to visually size fragments. The gel was stained in an ethidium bromide bath, rinsed in deionized water, and viewed under ultra-violet light. Gel photographs were taken for reference (not shown). Sequence polymorphism in the direct sequenced PCR products was not observed; successful amplifications showed only a single band.

DNA sequencing

Cycle sequencing for nrITS. PCR products were cleaned of excess nucleotides (dNTPs) and primers from the amplification reaction using 1 µL ExoSAP-IT (USB Corp, Cleveland, Ohio, USA) per 5 µL template, with an initial 37ºC incubation for 30 min for digestion, followed by 80ºC for 10 min to inactivate the enzymes. Cycle sequencing for nrITS was conducted with the forward amplification primer ITS4 and reverse internal cycle sequencing primer ITS-5A (Downie et al. 2000) in a final reaction volume of 12 µL, containing 6.20 µL ultra-pure H_20, 0.8 µL BigDye (Applied Biosystems, Inc., Foster City, CA, USA), 2.0 µL 5× buffer, 1.0 µL primer (forward or reverse), and 2.0 µL template DNA. Reaction parameters were an initial 2 min at 94ºC (denaturation step), followed by 25 cycles of 30 sec at 94ºC, 30 sec at 56ºC, and 30 sec at 72ºC, with terminal extension at 72ºC for 4 min, and storage at 4ºC.

Sequencing for nrITS. Cycle sequencing products were precipitated using an EDTA/sodium acetate in ethanol protocol, and then resuspended in 15 µL Hi-Di formamide (Applied Biosystems, Inc., Foster City, CA, USA). Products were denatured for 2 min at 95ºC, followed by 5 min at 4ºC to snap chill. Samples were loaded into 96-well plates or strip tubes and spun down at low speed (700 rpm for 1 min). Sequencing was conducted using an ABI PRISM 3100 Sequencer (Applied Biosystems, Inc., Foster City, CA, USA).

Data Analysis

Sequences were base-called in Sequencing Analysis Software 5.1 (Applied Biosystems, Inc., Foster City, CA, USA). Base calling was straightforward for nrITS; sequence polymorphism in the direct sequenced PCR products was not observed. Nucleotide sequences were edited and assembled using Sequencher 4.8 (Gene Codes Corporation, Inc., Ann Arbor, MI, USA).

This study combined eighteen previously published nrITS sequences downloaded from GenBank, i.e., seventeen for the ingroup and one for the outgroup (*Hydrolea spinosa* L.) (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005; Garrison 2007; Hasenstab-Lehman and Simpson 2012; Benson et al. 2013; Walden et al. 2014), plus 131 new sequences for a total of 149 nrITS sequences for *Phacelia* sect. *Ramosissimae* (Appendix 3.01). All sequences generated for this study will be deposited in GenBank.

Sequences were aligned in MAFFT (Katoh et al. 2002; Edgar 2004; Katoh et al. 2005; Katoh and Toh 2010) on XSEDE (Extreme Science and Engineering Discovery Environment) through the CIPRES (Cyberstructure for Phylogenetic Research) Science Gateway portal (Miller et al. 2010) using default parameters. Indels were edited manually in MacClade v.4.8 OSX (Sinauer Associates Inc., Sunderland, Massachusetts, [Maddison and Maddison 2001]).

Maximum parsimony phylogenetic analysis. The nrITS matrix was analyzed using the maximum parsimony criterion (MP) in PAUP* v.4.0b10 (Swofford 2002). MP phylogeny reconstruction was performed using a heuristic search of 1,000 random addition sequence replicates, with tree-bisection-reconnection (TBR) branch swapping algorithm, ACCTRAN, all characters unordered and weighted equally, gaps treated as missing data, and MAXTREES increased by 100 to a limit of 10,000. The maxtrees limit was not hit. Nonparametric bootstrap analyses were performed using the starting strict consensus tree obtained via stepwise addition, using a heuristic search, including 10 random addition sequence replicates with 100 bootstrap replicates (Felsenstein 1985).

DNA substitution model selection. NEXUS format of the sequence matrix was converted through the CIPRES Science Gateway portal (Miller et al. 2010) with NCLconverter version 2.1 (Lewis and Holder 2008) to a relaxed PHYLIP format on XSEDE (Extreme Science and Engineering Discovery Environment) (Stamatakis 2014). jModeltest2 version 2.1.6 on XSEDE with PHYML was used to test 88 models of evolution for best fit for the nrITS sequences (Posada and Crandall 1998; Guindon and Gascuel 2003; Posada and Buckley 2004; Posada 2008; Darriba et al. 2012).

Maximum likelihood phylogenetic analysis. Maximum likelihood (ML) analysis was initiated through the CIPRES Science Gateway portal (Miller et al. 2010) with RAxML-HPC2 version 8.1.11 analysis on XSEDE (Stamatakis 2014). The model of evolution was GTRGAMMA, with rapid bootstrapping, 1,000 bootstrap replicates, best tree search, and gaps and undetermined values treated as missing data (Stamatakis 2006; Stamatakis et al. 2008; Stamatakis 2014).

Bayesian phylogenetic analysis. Phylogenetic analyses using Bayesian inference (BI) were initiated in MrBayes 3.2.3 (Huelsenbeck and Ronquist 2001; Ronquist and Huelsenbeck 2003; Ronquist et al. 2012) using XSEDE through the CIPRES portal, with random starting trees and two independent runs of 10,000,000 generations each (sampled every 1,000 generations), using four chains (three hot and one cold) and the general time reversible model with gamma-distributed rate variation across sites (GTR+G, nst to 6, rates to gamma). The average standard deviation of split frequencies from each run was less than 0.01, and PSRF (Potential Scale Reduction Factor) approached one (0.999) or equaled one for the 95% credibility interval. The number of trees required to reach stationarity was determined using Tracer v.1.6 (Rambaut et al. 2014). Convergence of posterior probabilities of split frequencies of runs was assessed in AWTY (Are We There Yet?) using the between run compare diagnostic function; graphical plots did not reject convergence (p near one for burn-in at 25%) (Wilgenbusch et al. 2004; Nylander et al. 2008). Burn-in samples (2,500) were discarded (samples included for analysis from each run: 7,501), and runs were combined, with posterior probabilities of nodes ≥95% considered strongly supported.

Taxonomy

For typification and nomenclatorial purposes, specimens were examined at the following institutions: Botanischer Garten und Botanisches Museum Berlin-Dahlem, Zentraleinrichtung der Freien Universität Berlin (B), Bureau of Land Management Hollister (BLM Hollister), California Academy of Sciences (CAS), Cambridge University (Larkin et al.), University of California, Davis (DAV), Kew Herbarium (K), California Polytechnic State University, San Luis Obispo (OBI), Muséum National d'Histoire Naturelle (P), San Clemente Island Herbarium (SCI), San Francisco State University (SFSU), San Jose State University (SJSU), and University of California, Berkeley (UC/JEPS). Specimens were also made available by loan from the holding institutions: University of Arizona (ARIZ), California Department of Food and Agriculture (CDA), Field Museum of Natural History (F), and Smithsonian Institution (US). In many cases, the digital images of the type and other specimens were provided by the curatorial staff, or examined via the holding institutions online catalogue or data portal, and type specimens are indicated with a link to metadata landing page URL or digital image URL from the museum where the specimen is deposited (see Table 3.1). Where secondary sites mirrored the digital image as thumbnails for public [open] access, these were listed following the museum where the specimen was deposited.

Georeferencing

This study confirms and expands the documented distribution of taxa of *P.* sect. *Ramosissimae*. Georeferencing of herbarium specimens and databased accessions are visualized in Google Earth maps in the taxonomy sections. Databased herbarium accessions were extracted as .csv files from BajaFlora (BajaFlora 2015), Consortium of California Herbaria [CCH] (Consortium of California Herbaria [CCH] 2015), Consortium of Pacific Northwest Herbaria [CPNWH] (Consortium of Pacific Northwest Herbaria [CPNWH] 2015), La Red Mundial de Información sobre Biodiversidad [REMIB] (La Red Mundial de Información sobre Biodiversidad [REMIB] 2015), and the Southwest Environmental Information Network [SEINet] (SOUTHWEST ENVIRONMENTAL INFORMATION NETWORK [SEINet] 2012–2015). For additional details regarding methods see the georeferencing section in Chapter 1 (*Emmenanthe*). Herbarium accession numbers examined for georeferencing are included as appendices (see taxonomic section).

RESULTS

Model selection. Calculations via jModeltest2 using the Akaike information criterion (AIC) (Akaike 1973, 1974) indicated GTR+I+G (General Time Reversible model of nucleotide substitution with invariable sites and the gamma [Γ] model of rate heterogeneity) (Tavaré 1986; Rodríguez et al. 1990) as the best-fit model of evolution (-lnL score: 3741.50264, delta = 0.0), as did use of the corrected Akaike information criterion (AICc) (-lnL score: 3741.5026, delta = 0.0). Use of the Bayesian information criterion (BIC) (Schwarz 1978; Wit et al. 2012) indicated GTR+G (General Time Reversible model of nucleotide substitution with the gamma [Γ] model of rate heterogeneity) (Tavaré 1986) as the best-fit model of evolution (-lnL score: 3744.4973, delta = 0.0), as did use of Decision Theory Performance-based selection (DT) (-lnL score: 3744.4973, delta = 0.0).

Maximum parsimony phylogenetic analysis. The aligned nrITS matrix included 149 sequences and contained 2018 total characters. 1810 (89.69%) characters were constant and 83 (0.041%) variable characters were parsimony uninformative. The total number of parsimony informative characters was 125 (0.061%). The shortest MP tree length was 450 steps. The strict consensus of 9700 best trees is shown with MP bootstrap values, RAxML ML bootstrap values from the single, best tree [-lnL = 3741.684574, tree length = 1.506202], and BI posterior probabilities at nodes in Fig. 3.01.

Several clades were supported, as described below (also labeled in Fig. 3.01).

lyonii/ixodes **clade.** A clade consisting of samples of *P. lyonii* (UC1228865!, UC1228877!, UC1348876!) was sister to a clade consisting of samples of *P. ixodes*. There was no support for subclades corresponding to the varieties of *P. ixodes* (*P. ixodes* var. *ixodes*: UC753505!, DAV93730!, and *P. ixodes* var. *plumosa*: UC936005!, UC604998!, UC1247534!).

ciliata/thermalis **clade.** A clade consisting of samples of *P. ciliata* var. *ciliata* (UC881009!, UC1176831!, UC1069290!, *G. K. Walden 358* SFSU!, UC615569!), *P. ciliata* var. *opaca* (UC765452!, UC767565!, UC767563!), *P. ciliata* var. *mexicana* (UC967361!), and *P. thermalis* (UC881272!, *R. B. Kelley 2063* SFSU!, UC748324!, AF091202) was supported in all analyses. Samples assignable to *P. ciliata* var. *ciliata* were supported as monophyletic, sister to samples assignable to *P. ciliata* var. *mexicana*, *P. ciliata* var. *opaca*, and *P. thermalis*. Within the clade including *P. ciliata* var. *opaca, P. ciliata* var. *mexicana,* and *P. thermalis,* all but one sample of *P. thermalis* (AF091202) constitute a clade; other relationships within the clade were unresolved. AF091202 was a shorter sequence, which may have affected reconstruction of relationships in these analyses.

hirtuosa/cedrosensis+pauciflora **clade.** A clade consisting of samples of *P. cedrosensis* (UC107528!) and *P. pauciflora* (UC1345860!, UC1313725!, G. K. Walden 114 SFSU, G. K. Walden 128 SFSU, DAV133615!, UC1313730!, UC1116172!) was resolved in all analyses. *Phacelia hirtuosa* (UC1432927!) was supported as the sister taxon of that clade in ML and BI trees, but unresolved in the backbone topology in the strict consensus parsimony analysis. There was no support for two clades corresponding to *P. cedrosensis* and to *P. pauciflora*, although *P. cedrosensis* was represented by only a single sample.

cryptantha **clades.** Two clades were supported consisting of samples of *P. cryptantha*. One clade contained UC667340!, UC922738!, and JX233453, all from the western geographic cluster of San Bernardino and Riverside counties (see distribution maps in taxonomic section). Samples of the two varieties described by Voss, *P. cryptantha* var. *cryptantha* and *P. cryptantha* var. *derivata*, were not sampled in adequate depth in this study (Voss 1935). The other clade contained JEPS2288!, UC128902!, JEPS2281!, all from the eastern geographic cluster, which may be better treated as *P. eremica*. However, samples that were representative of *P. eremica* from San Diego County (type locality) were not available for this study (see discussion regarding excluded sequences in Appendix 3.1).

vallis-mortae/heliophila **clades.** Two clades were supported consisting of samples of *P. vallis-mortae* and varieties. One clade contained JEPS3509!, AY630332, UC1297468!, and UC736051!, all from the eastern geographic cluster corresponding to *P. vallis-mortae* var. *vallis-mortae*. AY630332 is an unmounted voucher with no label deposited at SFSU, previously determined as *P. tanacetifolia* (Gilbert et al. 2005), but morphologically determined as *P. vallis-mortae* var. *vallis-mortae* and supported in analyses within the *vallis-mortae* clade (Walden et al. 2014). Another sample (*Beal 12,* JEPS3509) was morphologically determined as *P. vallis-mortae* var. *vallis-mortae* and supported outside of both clades but weakly placed, possibly due to short sequence length.

The other clade contained UC719480!, UC1392984!, and UC923139!, from the western San Joaquin Valley and corresponding to *P. vallis-mortae* var. *heliophila* (and other synonyms) (Voss 1935). Support for relationships of the two clades of *P. vallis-mortae* to each other is low, and cohesiveness of the plants in morphology and geographic distribution warrants recognition of that taxon at species rank in the taxonomic treatment here.

Guadalupe Island *phyllomanica/floribunda* clade and California Channel Island *floribunda* clade. A clade consisting of *P. phyllomanica* (UC1228910 sheet 1) and *P. floribunda* (UC1083882!, UC24506!, UC1094548!, UC1094549) from Guadalupe Island was supported in all analyses, sister to the *P. ramosissima* clade.

A clade of samples of specimens identified as *P. floribunda* from San Clemente Island of the California Channel Islands (UC1426004!, UC1228878!, *G. K. Walden 353* SFSU!) was not supported in any analysis as part of a clade with samples of *P. floribunda* from Guadalupe Island.

***malvifolia/loasifolia/rattanii* clade.** A clade was supported containing *P. rattanii* (UC1299140!, UC201607!, DAV55495!), *P. loasifolia* (UC1167738!, UC762386!, JEPS27037!, UC920173!), and *P. malvifolia* (*G. K. Walden 149* SFSU!, *G. K. Walden 340* SFSU!, *G. K. Walden 342* SFSU!). Of those three species, only *P. rattanii* was resolved as monophyletic in all analyses.

***cicutaria/ cicutaria* var. *hispida* clade.** A large clade was resolved containing all samples of *P. cicutaria*.

A well-supported clade consisting of all samples of *P. cicutaria* var. *cicutaria* (UC1069326!, UC1069330!, UC1779149!, UC1069333!, UC310180!, JX233431, JX233432) was resolved. Material representative of *P. heterosepala* (treated here as a synonym of *P. cicutaria* var. *cicutaria*) was not available for this study.

The MP strict consensus tree did not support monophyly of *P. cicutaria* var. *hispida*, a result that has been previously noted (Garrison 2007). The samples of *P. cicutaria* var. *hispida* from Baja California were supported in a clade (*G. K. Walden 132* SFSU!, UC1313717!, UC1179590). Material representative of *P. eximia* (treated here as a synonym of *P. cicutaria* var. *hispida*) was not available for this study.

***gentryi* clade.** A clade consisting of samples identified as *P. gentryi* and samples previously identified as *P. distans* sensu lato from Arizona (JX233454, JX233455, *J. S. Miller and D. K. Harder 8176* MOBOT, UC1341989!, UC628460!, UC1619375!, UC1923900!) was supported in all analyses.

***ramosissima* clade.** A clade consisting of samples identified as *P. ramosissima* (SFSU08431!, *G. K. Walden 298* (SFSU!, SD186963,*G. K. Walden 76* SFSU!, UC1084192!, JEPS16760!, *G. K. Walden 67* SFSU!, UC496337!, UC1176936!, UC1400329!, *G. K. Walden 200a* SFSU!, *G. K. Walden 83* SFSU!, UC1445255!), UC1179587!, UC1782286!, AF091199, AY630327) was supported in all analyses, sister to the clade of *P. phyllomanica* and Guadalupe Island *P. floribunda*. I included samples assignable to most named entities now treated within *P. ramosissima*, except for *P. decumbens, P. ramosissima* var. *valida* (nomen invalidum), and geographic samples from Oregon, Washington (Columbia area is the type locality), and Arizona. There was little support for clades corresponding to named entities (especially to varieties). There was some support for a clade consisting of samples of *P. ramosissima* var. *montereyensis* and *P. ramosissima* var. *austrolitoralis* (*G. K. Walden 67* SFSU!, UC1400329!, UC496337!, JEPS16760!).

***hubbyi*/*tanacetifolia/distans* clade.** A large clade was supported in all analyses, containing three clades corresponding to *P. hubbyi, P. tanacetifolia,* and *P. distans* (in the broad sense).

The clade consisting of *P. hubbyi* (JEPS2179!, UC764436!, UC1069335!) was supported in all analyses.

The clade of *P. tanacetifolia* was supported in all analyses, and included two [likely] horticulture samples (*M. A. Hewlett s.n.* SFSU08256!, *M. Ely 76* SFSU!) and wild collected samples (*M. A. Hewlett 560mah* SFSU!, JEPS1299!, JEPS1295!, *G. K. Walden 343a* SFSU!, *G. K. Walden 354* SFSU!, *G. K. Walden 400a* SFSU!, *G. K. Walden 400b* SFSU!, *G. K. Walden 405* SFSU!).

A large clade consisting of samples of *P. distans* sensu lato was supported in all analyses (SFSU08449!, *J. Dempcy 009* SFSU!, SFSU08281!, *G. K. Walden 345* SFSU!, SFSU08296!, SFSU08282!, SFSU08283!, *C. Condos 20* SFSU!, *C. Condos 25* SFSU!, *R. Skinner 10* SFSU!, SFSU08298!, SFSU08927!, SFSU08295!, *G. K. Walden 281* SFSU!, *M. A. Hewlett 420* SFSU08443!, UC615239!, *G. K. Walden 361* SFSU!, *G. K. Walden 304* SFSU!, SFSU08286!, SFSU08448!, UC63894!, SFSU08443!, UC1093603!, *G. K. Walden 125* SFSU!, *G. K. Walden 129* SFSU!, UC1531333!, UC753508!, JX233478, JX233479, AY630280, (*cited as *P. crenulata* var. *minutifolia* in Gilbert et al. 2005) (Gilbert et al. 2005; Walden et al. 2014), AY630281 [see discussion at *P. cryptantha*] (Gilbert et al. 2005), AY630284 (Gilbert et al. 2005; Walden et al. 2014), FJ814654 (*cited as *P. tanacetifolia* in Hansen et al. 2009) (Garrison 2007; Hansen et al. 2009; Walden et al. 2014), JQ513452 (*cited as *P. crenulata* var. *minutiflora*) (Hasenstab-Lehman and Simpson 2012). These samples included broad geographic, edaphic, and morphological variation encompassing the characteristics ascribed to taxonomic entities of names included as synonyms in the treatment of *P. distans*.

A sample corresponding to *P. umbrosa* was included in all analyses within the *P. distans* clade, and so this taxon is included in the synonymy of *P. distans* in the taxonomic treatment. Material representative of *P. arthurii* and *P. scabrella* (treated here as synonyms of *P. distans*) were not available for this study.

Discussion

I. *lyonii/ixodes* clade. These results confirm that that *P. lyonii* is the sister taxon of *P. ixodes*, a hypothesis held by both Gray (1885) and Constance (1963).

Phacelia ixodes is considered a Baja Peninsula endemic (Riemann and Exequiel 2007; Harper et al. 2011), and not treated as occurring in California in the second edition of the Jepson Manual (Patterson et al. 2012). *Phacelia ixodes* is found in coastal scrub, coastal chaparral, coastal strand, and dune habitats of the Baja California Peninsula mainland and islands (except Guadalupe Island) (Johnson 1973, 1977). There was no support for clades corresponding to Brand's varieties of *P. ixodes* (Brand 1913) and most floristic treatments of the peninsula have recognized only a single entity, *P. ixodes* (Coyle and Roberts 1975; Wiggins 1980; Roberts 1989; Rebman et al. 2012; BajaFlora 2015). Varieties were recognized by Brand based on morphological characteristics and geographic separation along the Baja Peninsula (Brand 1913). Plants from the Coronado Islands and the northwestern coast of Baja California, with reddish stems, and included or scarcely exserted stamens, were treated by Brand as *P. ixodes* var. *plumosa*. Plants from Cedros Island and Punta Eugenia of Baja California, with greenish stems, and exserted stamens, were treated by Brand as *P. ixodes* var. *ixodes*. The degree of anthocyanin of plants is difficult to determine from herbarium specimens due to the dense glandularity of the entire plant that rapidly oxidizes during preservation. The stem of both varieties can become reddish, especially proximally to distally, and more so with age. This characteristic may also be environmentally affected due to exposure to wind and solar radiation, and perhaps water stress. The exsertion of stamens is a characteristic that is less useful or stable for distinguishing the varieties in the field and in the herbarium, and perhaps better described as included to scarcely exserted (*P. ixodes* var. *ixodes*). Herbarium specimens especially can appear to have stamens more exserted as an artifact from pressing. The remaining characteristic separating the varieties of Brand is thus geography, and lacking molecular support is not enough to warrant recognition of varieties.

Phacelia lyonii has been considered a California Channel Island endemic, occurring on the Southern Channel Islands of Santa Catalina Island and San Clemente Island (Carlquist 1965; Raven 1965; Carlquist and Eckhart 1984). *Phacelia ixodes* is the mainland (in part) relative with lavender or rose-colored corollas, and it is most likely that diversification occurred prior to migration to the islands, with the shortest route from the mainland to Santa Catalina Island, and from Santa Catalina Island to San Clemente Island. A recent discovery of a single plant of *P. lyonii* on the mainland at Marine Corps Base Camp Pendleton is a solitary waif and evidence of recent island-to-mainland dispersal by human transport (San Diego County, June 2011 [SD212759], Dieter Wilken, personal communication). The likely island of origin for the Camp Pendleton plant is San Clemente Island (light blue corollas, probably mediated by military transport). There are various corolla colors reported from island localities for *P. lyonii*: white or lavender (UC1348876) from Santa Catalina Island (the type locality), and blue to pale blue on plants from San Clemente Island (UC1228865, UC1228877). Material representative of white corollas from Santa Catalina Island was not available for this study. Variation within island floral morphs of *P. lyonii* is partially affected by phenology, habitat, and climate, but the floral morphs appear to be distinct and maintained between the two islands. These floral morphs have not previously been described as taxonomic entities, as is the case in subspecies of *Delphinium variegatum* Torr. & A. Gray (Ranunculaceae) on San Clemente Island (Dodd and Helenurm 2002). There is not [at this time] molecular support for separate clades corresponding to the two islands. However, sampling for this study was limited and additional investigation is needed.

Phacelia ixodes and *P. lyonii* have been considered insular taxa, along with *P. phyllomanica, P. floribunda* (in the broad sense), and the coastal varieties of *P. ramosissima* (var. *austrolitoralis* and var. *montereyensis*) (Carlquist and Eckhart 1984). *Phacelia lyonii* has been proposed as an example of evolution of insular woodiness (Carlquist and Eckhart 1984); unfortunately, the majority of populations of the largest, sub-suffrutescent *P. lyonii* on San Clemente Island were decimated by herbivory caused by feral goats ["chivos chingados", UC1177563] (Keegan et al. 1994).

II. *ramosissima* clade. At this time *P. ramosissima* is treated in a broad sense. Samples for the molecular phylogenetic analysis included most named entities, except for *P. decumbens, P. ramosissima* var. *valida* (nomen invalidum), and geographic samples from Oregon, Washington (Columbia River area is the type locality), and Arizona.

There was some support for a clade consisting of samples of *P. ramosissima* var. *montereyensis* and *P. ramosissima* var. *austrolitoralis*, which evidently should be treated as a single taxon but with a narrowly limited distribution of immediate coastal dune communities of California. Macbride (1917) also recognized that plants of the coast (later described as *P. ramosissima* var. *austrolitoralis* and *P. ramosissima* var. *montereyensis*) were best treated together as a single taxonomic entity. Macbride revised *P. ramosissima* var. *subsinuata* (=*P. subsinuata*) to include the coastal plants from part of Brand's treatment of *P. ramosissima* forma *suffrutescens* (Brand 1913). However, the type specimen of *P. subsinuata* (*J. Spence*) most closely resembles plants of *P. ramosissima* var. *latifolia*. Jepson (1943) considered *P. subsinuata* to include both the glandular plants of *P. suffrutescens* and coastal plants of *P. ramosissima* var. *austrolitoralis* (Jepson 1943). Although I recommend recognition of one taxon for the coastal plants corresponding to *P. ramosissima* var. *montereyensis* and *P. ramosissima* var. *austrolitoralis*, it is unclear what taxonomic rank is appropriate for that taxon and resolving that issue requires additional sampling throughout *P. ramosissima*. Munz (1958) published both var. *montereyensis* and var. *austrolitoralis* in the same article, so either name is available at varietal rank for the recommended coastal taxon.

The chromosome counts of Cave and Constance established a pattern of haploid counts of $n = 11$ for the taxa included in *P.* sect. *Ramosissimae*. The notable exception was for *P. suffrutescens*, which has sometimes been treated as a synonym of *P. ramosissima*. Although samples corresponding to *P. suffrutescens* were included within the ramosissima clade, their relationships were not resolved. This lack of resolution is further complicated by the problematical taxonomy of entities included in *P. ramosissima*, and difficulty assigning names to specimens that correspond appropriately to earlier taxonomic circumscriptions. Additional sampling throughout *P. ramosissima* is needed, as is a better understanding of the range of morphological characteristics in the group, to resolve taxonomic problems within *P. ramosissima*.

III. Guadalupe Island *phyllomanica/floribunda* clade and California Channel Island *floribunda* clade. *Phacelia phyllomanica* has previously been considered a potential relative of *P. ramosissima* because of the perennial life history of both species, and these results confirm a close relationship.

The revised circumscription of *P. floribunda* proposed here is restricted to plants of Guadalupe Island (treated as *P. floribunda* sensu stricto in the taxonomic treatment), which are evidently more closely related to the Guadalupe Island endemic P. phyllomanica than to plants previously treated as P. floribunda from San Clemente Island, in the California Channel Islands. The plants of the California Channel Islands require recognition as a distinct taxon (treated in the taxonomic treatment as undescribed taxon "NALFSCI-ensis" and labeled as NALFSCI in the tree). These plants require formal description and recognition.

There are also populations of (putative) *P. distans*, previously identified as *P. floribunda* (Greene 1886 [1885]; Raven 1963; Raven 1965; Walden and Patterson 2011)*,* on Santa Barbara Island and on San Clemente Island. These plants would otherwise be identified as *P. floribunda* s.l. in current floristic treatments and species circumscriptions, but partial sequences (not included here) do not include these populations with the NALFSCI clade. These accessions are excluded from the delimitation of the undescribed taxon, and included in the taxonomic treatment of *P. distans*. Adequate material for these populations was not available for this study, but their sampling should be a priority for future research.

The finding here that the two endemic Guadalupe Island species, *P. floribunda* sensu stricto and *P. phyllomanica*, constitute a clade is most readily explained as evidence for diversification on Guadalupe Island. As the most remote and most floristically disharmonious of the California Islands, Guadalupe Island has been considered the most likely site in the archipelago for in situ plant diversification, and has been shown to harbor at least one example of adaptive radiation, in the Compositae genus *Deinandra* (Carlquist 1965; Baldwin 2007).

IV. *Phacelia cinerea*. *Phacelia cinerea* is the only *Phacelia* known from San Nicolas Island, and this plant has not been re-collected since the type collections despite repeated and exhaustive searches (S. Junak, personal communication) (Eastwood 1898; Trask 1900; Howell

1935; O'Dell 1960; Halvorson et al. 1996). I was unable to find any collections from San Nicolas in herbaria that could serve as additional representative specimens. It has been included in synonymy with *P. distans* Bentham (Halse et al. 1993; Hickman 1993; Baldwin et al. 2012; Patterson et al. 2012; Walden et al. 2013; CNPS 2015; Jepson Flora Project [eds.] 2015), and so has not been considered for conservation status. However, the type specimens do appear to have woody bases and perennial or facultatively perennial growth similar to that of *P. ramosissima* and *P. phyllomanica* (Macbride 1917; Constance 1951; Carlquist and Eckhart 1984) (see Fig. 4065, p. 495 in Abrams). Material for destructive sampling was not available for this study, and so I retain *P. cinerea* as a separate, but otherwise isolated species.

Phacelia arthurii was another entity that was not included in this study, as the only collections are from the type locality. The Oakland locality for *P. arthurii* was almost immediately extirpated due to urban development, and documented as such by Greene, and although now considered to be a synonym of *P. distans* in the broad sense, it remains as evidence of previous habitat and range that has been lost recently in the last century from the San Francisco Bay Area (Greene 1888, 1894a).

V. *ciliata/thermalis* clade. *Phacelia ciliata* and *P. thermalis* are both found in clay substrates. The phylogenetic results warrant further investigation of the relationships among *P. thermalis*, *P. ciliata* var. *ciliata, P. ciliata* var. *mexicana*, and *P. ciliata* var. *opaca*. Results support expansion of the documented distribution of *P. ciliata* var. *opaca* along the eastern edge of the San Joaquin Valley.

VI. *hirtuosa/cedrosensis+pauciflora* clade. Although plants morphologically determined as *P. cedrosensis* have mostly been collected from Cedros Island and vicinity (Vasey et al. 1890; Junak and Philbrick 2000), there are also specimens identified as *P. pauciflora* (a mostly mainland taxon as previously delimited) collected from the nearby San Benito Islands, and more recently from Punta Eugenia (Brand 1913). If geography is used to delimit the two taxa, where *P. cedrosensis* is limited to the islands and *P. pauciflora* is a taxon of the mainland of Baja California, then the differences between *P. cedrosensis* and *P. pauciflora* appear to be minimal based on morphology and ecology, and are variable and not stable across environmental conditions. Diminutive plants of *P. pauciflora* that would be readily identified as *P. cedrosensis* can be found on the mainland of Baja California. *Phacelia cedrosensis* appears to be the smaller form of exposed and xeric habits, while *P. pauciflora* is a larger, shade form that has been circumscribed as occurring on the Baja California mainland. At this time, there is little support for the traditional maintenance of these two taxa as distinct species. *Phacelia pauciflora* is the older name, and has priority for purposes of synonymy (see taxonomic section). Future studies may determine that there is justification for an island taxon and a mainland taxon, but that requires substantially deeper sampling than the scope of this study. It is possible that some of the morphological characteristics previously used to distinguish *P. cedrosensis* from *P. pauciflora* (e.g., seed number, seed surface) were based on the totality of available vouchered specimens, which include immature specimens. Seed numbers vary from immature and mature specimens, as does the depth of the reticulations for the seed surface. Number of available collections is particularly impactful for understanding taxa like *P. cedrosensis* and *P. pauciflora* that do not have that the depth of representative material available (compare with widely distributed *P. cicutaria* and *P. distans*). For the georeferenced specimens, I included specimens identified and examined for *P. cedrosensis* and *P. pauciflora* in separate figures and with a combined distribution for the revised circumscription of *P. pauciflora*, which includes *P. cedrosensis* (see taxonomic treatment).

VII. *cryptantha* clades. *Phacelia cryptantha* is provisionally maintained here in a very broad sense, with obvious, unrecognized diversity that is not yet well understood. The populations associated with the westernmost edge of the Mojave Desert may be better recognized under the name [at an appropriate rank] of *P. eremica* Jepson; however, no samples assignable to that taxon in the original sense were included in this study. The characteristics used by Jepson to diagnose *P. eremica* are, as Voss noted (1935), confluent with those of *P. cryptantha* Greene. It is difficult to separate the clades resolved here except by geographic distribution at this time. *Phacelia cryptantha* may be better treated in a narrower sense, including only plants of the eastern Mojave Desert. Future studies are needed to investigate the varieties described by Voss (var. *derivata*, var. *typica*) and any pollinator selection associated with corolla scales.

VIII. *malvifolia/loasifolia/rattanii* clade. Seed number has been the main character used to distinguish *P. malvifolia, P. loasifolia,* and *P. rattanii*. However, identification is complicated by differential abortion of ovules, resulting in different numbers of mature seeds. My results demonstrate that there is greater diversity than previously documented within currently described taxonomic entities in this clade. I recommend recognition of three taxa at this time at the rank of species, although this is not an adequate reflection of relationships for these taxa and should be the focus of future studies. Additionally, my observations of *P. malvifolia* inflorescences in the field documented that the stamens exhibit sequential movement of the anthers, with staggered elongation of each individual stamen with dehiscence of pollen, followed by the filament bending down while other stamens continue to emerge. This developmental pattern appears to be similar to, although not as dramatic as, late-staminal development in *Parnassia* (Celastraceae) (Armbruster et al. 2013; Ren and Bu 2014). This pattern of stamen development may also be present in other taxa of *P.* sect. *Ramosissimae*, especially *P. ramosissima*. The significance of these floral observations is not fully understood, and requires additional investigation.

IX. *cicutaria/ cicutaria* var. *hispida* clade. *Phacelia cicutaria* var. *hispida* is treated in a broad sense in the taxonomic treatment, with the expectation that attention is needed to sample more deeply throughout the named entities (especially *P. eximia*), plants of Baja California, and the ecotypes of southern California (Griesel 1939). No available name exists for *P. cicutaria* var. *hispida* at species rank, as *P. hispida* Buckley has priority and blocks the invalid homonym of Gray. A replacement name at species rank will be needed for *P. cicutaria* var. *hispida*.

X. *gentryi* clade. Results for samples included in the gentryi clade warrant substantial expansion of Constance's (1948) circumscription of *P. gentryi* to include plants of Arizona and Sonora. There is considerable morphological variation contained in this new circumscription, which warrants further investigation of the gentryi clade.

XI. *hubbyi/tanacetifolia/distans* clade. A distinctive and aesthetically attractive member of the section, *P. hubbyi* is one of the more recent taxa to be recognized at species rank from results of molecular studies (Garrison and Patterson 2009). It is also distinctive in that the trichomes are generally not stout and stinging, as with those of *P. malvifolia* and *P. cicutaria*, but are soft in the field. Samples from Santa Cruz Island were not available for molecular study, nor from mainland Ventura County, but should be included in future investigations. Plants of *P. tanacetifolia* of Kern County have been sometimes considered as approaching *P. hubbyi*, due to the shaggy or wavy appearance of the inflorescence trichomes (e.g., *Smith 54* JEPS1295), but were placed as *P. tanacetifolia* in the molecular study.

Samples for *P. distans* included broad geographic, edaphic, and morphological variation encompassing the characteristics ascribed to taxonomic entities with names included in synonymy in the treatment of *P. distans*. The molecular phylogeny is not reflective of the described diversity, and provides little resolution for a complicated group of plants. This clade included a sample that best matched the protologue, types, and other specimens referable to *P. umbrosa*, and so this taxon is one included here in the synonymy of *P. distans*. *Phacelia umbrosa* has traditionally been considered to be a taxon of Baja California; however, the very few collections available are from oak foothills of San Diego County, California. Samples referable to *P. arthurii* and *P. scabrella* were not available for this study.

XII. *vallis-mortae* clades. The two clades of *P. vallis-mortae* warrant recognition of *P. vallis-mortae* and recognition of *P. vallis-mortae* var. *heliophila* at the rank of species in the taxonomic treatment here.

CONCLUSIONS: TAXONOMIC REVISION

PHACELIA SECTION *RAMOSISSIMAE*

Phacelia Juss. sect. *Ramosissimae* (Rydberg) Walden & R.Patt. Madroño. 59(No. 4):216–217. 2012. *Phacelia* [unranked] *Ramosissimae* Rydberg, Flora of the Rocky Mountains and adjacent plains, 702–703. 1917. ---TYPE SPECIES: *Phacelia ramosissima* Douglas ex Lehmann, Novarum et Minus Cognitarum Stirpium Pugillus (Lehmann) 2:21. 1830.

Distribution of georeferenced specimens in *P.* sect. *Ramosissimae*, Fig. 3.02 (North America, scale bar 1600 miles).

PHACELIA CICUTARIA

Phacelia cicutaria Greene, Pittonia 5(26A):20–21. 1902. *Phacelia hispida* (A. Gray) A. Gray subvar. ß *cicutaria* (Greene) Brand, University of California Publications in Botany 4:214, 215. 1912 (full trinomial *P. hispida* (A. Gray) A. Gray var. *genuina* Brand subvar. ß *cicutaria* (Greene) Brand). *Phacelia hispida* (A. Gray) A. Gray var. *cicutaria* (Greene) J. F. Macbride, Contributions from the Gray Herbarium, new series 49:28–29. 1917. ---TYPE: USA, California, Stanislaus Co., at Knight's Ferry, on the Stanislaus River, Middle California, 9 April 1895, *F. W. Bancroft s.n.* (holotype: NDG29337-41769 [JStor]; isotypes: UC24369! [UCJEPS Specimen Images, CCH, CollectionSpace, JStor).

Phacelia cicutaria Greene var. *heterosepala* (Greene) J. T. Howell, Leaflets of Western Botany 3(No. 5):120. 1942. *Phacelia heterosepala* Greene, Pittonia 5(26A):21. 1902. *Phacelia hispida* (A. Gray) A. Gray subvar. γ *heterosepala* (Greene) Brand, University of California Publications in Botany 4:214–215. 1912 (full trinomial *P. hispida* (A. Gray) A. Gray var. *genuina* Brand subvar. *heterosepala* (Greene) Brand, University of California Publications in Botany 4:214. 1912). *Phacelia hispida* (A. Gray) A. Gray var. *heterosepala* (Greene) J. W. Voss, Bulletin of the Southern California Academy of Sciences 33(3):173. 1934. ---TYPE: USA, California, Butte Co., Iron Cañon [Canyon], foothills of the mountains of Butte Co., above Chico, May 1896, *Mrs. R. M. Austin 281* (lectotype, designated by J. T. Howell 1943: NDG29381-41862 [JStor]; isolectotype: US287382-00110504 [NMNH, Collections Search Center, JStor]). SYNTYPES: USA:

California, Amador Co., 1894, ["part of the type, but not typical"], *George Hansen s.n.* (syntype: NDG not seen).

Greene (1902) wrote "Also apparently the same in Amador Co." in the protologue for *P. heterosepala*, referring to the similarity of the *Hansen* collection to that of the *Austin* collection. On the *G. Hansen s.n.* NDG label there is written "Part of the 'type', but not typical", which Howell (see p. 26) (1943) considered to be from Greene's hand, and an indication that the *Hansen* specimen was part of the original material and thus a syntype. The citation of the *Hansen* collection, variable morphologies, and additional collections available from the UC herbarium, are the likely reason Brand expanded the range of *P. cicutaria* substantially in his treatments (Brand 1912, 1913).

The 5 May 1883 *Austin* UC [UC107479!] specimen was cited as a "type" by Brand (1913), likely because Greene had removed his herbarium from UC by the time Brand examined specimens for his monograph. The 1883 *Austin* specimen is collected from the type locality (Iron Cañon) and is thus a topotype, noted by Brand "vom gleichen Sammler und Ort stammt das Original zu P. heterosepala" (p. 87, 1913). Although, speculatively, this specimen was available to Greene when describing *P. heterosepala*, the specimen was not cited in the protologue and so does not have type status.

Autonym:
Phacelia cicutaria Greene var. *cicutaria* is the accepted autonym (Howell 1942).

$n = 11$ (UC666592) (Cave and Constance 1944).
$n = 11$ (UC666585) (Cave and Constance 1944).

Distribution of georeferenced specimens in *P. cicutaria* (var. *cicutaria*), Fig. 3.03 (North America, scale bar 1600 miles), Fig. 3.04 (California and Nevada, scale bar 200 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.02.

PHACELIA CICUTARIA VAR. HISPIDA sensu lato

Phacelia cicutaria Greene var. ***hispida*** (A. Gray) J. T. Howell, Leaflets of Western Botany 3:120. 1942. *Phacelia ramosissima* Douglas ex Lehmann var. *hispida* A. Gray, Proceedings of the American Academy of Arts and Sciences 10:319. 1875, based on *Eutoca hispida* Nuttall in herb. only, name not published. *Phacelia cicutaria* Greene subsp. *hispida* (A. Gray) R. M. Beauchamp ex Thorne, Aliso 9(2):192. 1978. ---TYPE: USA, California, Santa Barbara Co., N. Cal., Santa Barbara [Sta. Barbara], *n.d.* [1834–1835], *T. Nuttall s.n.* (lectotype, designated here: PH01070244-00024884 (PH Type Collection, JStor). SYNTYPE: USA, California, [Los Angeles Co.] [1854–1855], *W. A. Wallace s.n.* (GH00093347 [kiki, JStor]). SYNTYPE: USA, California, Santa Barbara Co., 1865, *John Torrey 351* (GH00093346 [kiki, JStor]). SYNTYPE: USA, California, San Diego Co., 1874, *D. Cleveland s.n.* (GH00093348 [kiki, JStor]; isosyntypes K001070989 [Kew Catalogue], MNHN-P-P03861923 [MNHN-P, JStor]).

Gray (1875) cited no specimens or collectors in the protologue for *P. ramosissima* Douglas ex Lehmann var. *hispida* A. Gray, only a range "Santa Barbara to San Diego, California". Later, Gray (p. 161) (1878) cited collectors [lacking collection numbers] in order: *Nuttall, Wallace, Torrey,* and *Cleveland*, following the range "Western part of California, from Santa Barbara to

San Diego" for *P. hispida* (A. Gray) A. Gray [nomen invalidum]. Voss (p. 171) (1935) noted that the type locality and collector was probably Nuttall in Santa Barbara, as both were listed first in the protologue. This is an implicit lectotypification, which I formalize here in part (but see discussion below), with the collections of *Wallace, Torrey,* and *Cleveland* as syntypes, and add newly available barcode numbers from national and international digitization efforts.

Because Gray was based at Harvard, I assumed that the institution for all type specimens was GH, which is true for the syntypes listed here. However, neither Macbride (1917) nor Voss (1935) were able to locate Nuttall's collection at Harvard. The label from a *Nuttall* specimen at PH, previously assumed to be a duplicate, is annotated as *Eutoca hispida* Nuttall [*nomen nudum*] by Nuttall, with an additional annotation by Gray as *P. ramosissima* var. *hispida* [without a date], indicating that Gray examined the specimen. Nuttall send out duplicates of collections, including sets to Gray at Harvard from his collections in California [1835-1836], and so I considered that perhaps either the type collection of Nuttall is not easily located in the GH collections and has been overlooked, located but not yet publicly databased or digitized, or that the specimen [a duplicate of the type] had been returned to PH following loan with an annotation by Gray following publication. Nuttall did request return of specimens before leaving the US for England in 1843 (Dupree 1952). Gray also visited Philadelphia in 1840 to examine Nuttall's collections (Dupree 1952).

It is clear that that Gray based the name on the unpublished name of Nuttall (*Eutoca hispida*, name not published, in herb only, possibly in mss. also), from the specimen at PH. It is possible that, because of the controversy from publishing Nuttall's names in *A flora of North America* (Torrey and Gray 1838, 1841; Dupree 1952), Gray waited until revising the Hydrophyllaceae to publish the taxon (Gray 1875). No Hydrophyllaceae or Boraginaceae were included in *A flora of North America* (Torrey and Gray 1838, 1841), although names and collections were available to both Torrey and Gray. Although Gray did not cite Nuttall's name or specimen in the protologue, and Voss implicitly lectotypified GH as the institution for Nuttall's type, I select the Nuttall specimen at PH here as the lectotype.

Phacelia cicutaria Greene var. *eximia* (Eastwood) J. T. Howell, Leaflets of Western Botany 3:120. 1942. *Phacelia eximia* Eastwood, Bulletin of the Torrey Botanical Club 32(No. 4):204–205. 1905. *Phacelia hispida* (A. Gray) A. Gray var. *eximia* (Eastwood) J. W. Voss, Bulletin of the Southern California Academy of Sciences 33:171, 172. 1935. --- TYPE: USA, California, Los Angeles Co., Mount Wilson trail, Santa Anita Cañon, 31 December 1903, *F. Grinnell Jr. 109* (holotype: CAS932-0006871! [CAS, JStor]; isotype: UC126041! [UCJEPS Specimen Images]).

Invalid names:
Phacelia hispida (A. Gray) A. Gray, Syn. Fl. 2:161. 1878, invalid homonym (Gray 1878). Priority is *P. hispida* Buckley, Proceedings of the Academy of Natural Sciences of Philadelphia 13:463. 1862 [1861] (Buckley 1862 [1861]). Gray himself re-determined many of the types of Buckley almost immediately after publication, but this did not make the previously published name of Buckley invalid (Gray 1862).

Phacelia hispida (A. Gray) A. Gray var. *genuina* Brand, University of California Publications in Botany 4:214. 1912 (nomen invalidum, ICN 24.3).

Phacelia cicutaria Greene var. *hispida* (A. Gray) Jepson, A Flora of California 3(2):262–263. 1943, invalid isonym, priority is *P. cicutaria* Greene var. *hispida* (A. Gray) J. T. Howell, Leaflets of Western Botany 3:120. 1942 (Howell 1942).

Eutoca hispida Nuttall, in herb. only, name not published. Annotation on Nuttall hololectotype – PH01070244-00024884.

Distribution of georeferenced specimens in *P. cicutaria* var. *hispida*, Fig. 3.05 (North America, scale bar 1600 miles), Fig. 3.06 (California and Baja California, scale bar 300 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.03.

n = 11 (UC671730, as *P. eximia*) (Cave and Constance 1942).
2n = 22 (UC774146) (Constance 1963).

PHACELIA CILIATA

Phacelia ciliata Bentham, Transactions of the Linnean Society of London 17(2):280. 1835 [read 1834, issue published May 1835, entire vol. published 1837].. ---TYPE: USA, California, Nova California, [Dec 1829?] 1833, *n.d.*, "From California. *Mr. Douglas*", *D. Douglas s.n.* (hololectotype, designated here: K001070994! [Kew Catalogue]; isolectotypes: K001070996! [Kew Catalogue], G-DC-00134486 [Ville-GE], GH00093213 [kiki, JStor], NY83949 [sweetgum, JStor], NY83952 [sweetgum, JStor], P00640096 [coldbr, JStor]).
There are two specimens of *P. ciliata* of Douglas at Kew in the types catalogue, one stamped with Herbarium Benthamianum 1854 (K001070994!), and the other stamped with Herbarium Hookerianum 1867 (K001070996!). Both are likely from the original material, but I choose the Bentham herbarium material as the lectotype here.

Phacelia acanthominthoides Elmer, Botanical Gazette 41(No. 5):309-310. 1906. ---TYPE: USA, California, San Benito Co., Hernandez, 1 May 1903, *L. M. Lathrop s.n.* (holotype: DS24375-0006690! [CAS, JStor]).

Invalid names:
Phacelia ciliata Rafinesque ex Brand, Hydrophyllaceae. Pp. 62 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59). Verlag von Wilhelm Engelmann, Leipzig. 1913 (Brand 1913), illegitimate nomen nudum cited in synonymy of *P. purshii* Buckley, and a later homonym of *P. ciliata* Bentham. Also included in nomenclature of *P. purshii* Buckley in the revision of *Cosmanthus* (Constance 1949).

Phacelia ciliata Bentham var. *parvifolia* Jepson, nomen invalidum, name not published, in herbarium only, on label of JEPS2250!.

Phacelia setosa Eastwood, nomen invalidum, name not published, in herbarium only, on label of CAS936. This specimen is the only collection from a California Channel Island for this taxon (*P. ciliata*), and may represent dispersal from the mainland to Santa Catalina Island and subsequent extirpation. The material in the envelope is mixed, and should not be used for molecular studies.

Autonym:
Phacelia ciliata Bentham var. *ciliata* is the accepted autonym (Brand 1913).

Distribution of georeferenced specimens in *P. ciliata* (var. *ciliata*), Fig. 3.07 (North America, scale bar 1600 miles), Fig. 3.08 (California, scale bar 300 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.04.

2n = 22 (no voucher). Published in Heiser and Whittaker (1948), using lists of Darlington and Ammal (1945), Löve and Löve (1942), Maude (1939), and Tischler (1927, 1931, 1935, 1936, 1938).
n =11 (UC671726) (Cave and Constance 1942).

Phacelia ciliata Bentham var. ***mexicana*** Brand, Hydrophyllaceae. Pp. 93 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59). Verlag von Wilhelm Engelmann, Leipzig. 1913. --- TYPE: MÉXICO: Nördliches Mexiko, Valley of Palms, 7 April 1882, *M. E. Jones 3719* (lectotype, designated here, UC881013! [UCJEPS Specimen Images]; isolectotypes: US735600-00110487 [NMNH, Collections Search Center, JStor], US1083318-01014287 [NMNH, Collections Search Center, JStor], US220694-01014286 [NMNH, Collections Search Center, JStor], PH671895-00028227 [PH, JStor], BR0000005112364 [BR, JStor], MISSA6751802). SYNTYPE: MÉXICO: Chihuahua, Ojo de Vaca (Cow Spring), "nach Hemsley", n.d. (May 16-20? 1851 see Bartlett's account), *G. Thurber s.n.* (herbarium? either NY where Torrey was located, or GH which received the Thurber herbarium, pp. 165). SYNTYPE: MÉXICO: North México, Sonora, hillsides, March 1851, *Capt. E. K. Smith s.n.* (herbarium? likely NY where Torrey was located, for Edmund Kirby Smith [with Alexander Darnes?]).

Brand (1913) included three collections [syntypes] in the protologue for *P. ciliata* var. *mexicana*, citing the description from Hemsley's (1881-1882) treatment of *P. ciliata* in synonymy. The *M. E. Jones 3719* collection has a sheet annotated in Brand's hand [!Br] at UC, and it is this collection that is designated the lectotype, and the accession (UC881013!) as the hololectotype.

The two other collections (*G. Thurber s.n.* and *E. K. Smith s.n.*) are specimens from México, also cited in Hemsley's (p. 358, 1881-1882) treatment. These particular specimens were first reported from the Emory 1859 Botany report (pp. 145) (Emory et al. 1859), in Torrey's treatment of *P. ciliata*, along with two additional specimens from California (*C. C. Parry,* San Luis Rey, [San Diego Co., 1850, P03861907!], and *G. Thurber*, San Diego). I was unable to locate the México *G. Thurber s.n.* and México *E. K. Smith s.n.* specimens during my studies, but both are most likely at NY where Torrey was located and not yet publicly databased. These syntypes remain associated with var. *mexicana* at this time, pending determination, but it is likely that these specimens should be excluded from the typification of this taxon, based on other collections of *P. ciliata* east of California. For example, *P. ciliata* was reported from California and "the Great Colorado" (p. 125) (Torrey 1856). The "great Colorado" collections from the Whipple expedition, originally determined as *P. ciliata*, are *P. ambigua* M.E. Jones (=*P. crenulata* var. *ambigua*) (see *G. H. Thomas s.n.* NY 83951 [sweetgum] and *J. M. Bigelow s.n.*

NY 83950 [sweetgum]).

Distribution of georeferenced specimens in *P. ciliata* var. *mexicana*, Fig. 3.09 (North America, scale bar 1600 miles), Fig. 3.10 (Baja California, scale bar 200 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.05.

Phacelia ciliata Bentham var. ***opaca*** J. T. Howell, Leaflets of Western Botany 1(18):221. 1936. ---TYPE: USA, California, Merced County, clay hills bordering the San Joaquin Valley, 5 miles northeast of Merced, 25 April 1929, *J. T. Howell 4192* (holotype: CAS188192-0006756! [CAS, CCH, JStor], isotypes: DS295699-0006755! [CAS, CCH, JStor], UC765451! [UCJEPS Specimen Images, CCH], GH00093214 [kiki, JStor], US1829255-00110488 [NMNH, Collections Search Center, JStor], F1407331-0060827F negative number 62306! [EMUweb Field Museum, JStor], SBBG112614-000092 [CCH, JStor], POM299074 [CCH], RSA112768 [CCH].

Distribution of georeferenced specimens in *P. ciliata* var. *opaca*, Fig. 3.11 (North America, scale bar 1600 miles), Fig. 3.12 (California, scale bar 70 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.06.

PHACELIA CINEREA

Phacelia cinerea Eastwood ex J. F. Macbride, Contributions from the Gray Herbarium of Harvard University, new series 49:26–27. 1917. *Phacelia ramosissima* Douglas ex Lehmann var. *cinerea* (Eastwood ex J. F. Macbride) Jepson, Manual of the Flowering Plants of California 823. 1925. ---TYPE: USA, California, Ventura Co., San Nicolas Island, moist flats, flowers sky blue [from label metadata], April 1901, *B. Trask 82* (holotype: GH00093215 [kiki, JStor]; isotypes: NY83948 [sweetgum, JStor], US00618878-00110489 [NMNH, Collections Search Center, JStor], UC185278 [UCJEPS Specimen Images])

The label metadata from the holotype notes "2 localities", but the collection information from sheets of *B. Trask 82* is "flats - moist", which matches the protologue (Macbride 1917), and does not indicate a mixed gathering for the type collection. The second location referenced is the non-type collection *B. Trask s.n.* (RSA428255, ex LAM) [USA, California, Ventura Co., San Nicolas Island, frequent in one location, 6–18 in. tall, flowers sky blue, April 1901, *B. Trask s.n.* RSA428255 [CCH, JStor]. A collection with similar habit metadata from Santa Catalina Island was made in March [USA, California, Los Angeles Co., Santa Catalina Island, Avalon, frequent in one locality - cañon, 6–18 in. tall, flowers sky blue, March 1901, *B. Trask s.n.* (K!, RSA426183B).

Distribution of georeferenced specimens in *P. cinerea*, Fig. 3.13 (North America, scale bar 1600 miles), Fig. 3.14 (California, Ventura County, San Nicolas Island, scale bar 30 miles). There are no additional specimens for this taxon beyond those listed in the taxonomic treatment.

PHACELIA CRYPTANTHA

Phacelia cryptantha Greene, Pittonia 5:21. 1902. *Phacelia hispida* (A. Gray) A. Gray var. *brachyantha* Coville, Contributions from the United States National Herbarium 4:158–159. 1893. ---TYPE: USA, California, Inyo Co., Surprise Cañon [Canyon], Panamint Mountains, Death Valley Expedition, altitude 1300 m, 13 April 1891, *F. Funston [and F. V. Coville] 607* (hololectotype, designated here: US47965-00110506 [NMNH, Collections Search Center, JStor]; isolectotypes: US47966-00110507 [NMNH, Collections Search Center, JStor], POM73398-0003826! fragment of type in envelope, excluding material of *M. E. Jones s.n.* on sheet [JStor]).

Coville (1893)clearly identified the type collection from original material cited in the protologue, along with additional representative specimens cited [paratypes]. There are two duplicate sheets from the type collection number (*607*) deposited at US - all with labels from the Death Valley Expedition, United States Department of Agriculture labels, and with consecutive US accession numbers. The hololectotype is designated here as US47965, and the isolectotype is US47966.

Phacelia brachyantha Bentham (Bentham 1835 [read June 17th, 1834, issue published 1835, volume published 1837]) had priority, and so Greene published the replacement name based on the basionym of Coville (Coville 1893; Greene 1902).

Phacelia eremica Jepson, Manual of the Flowering Plants of California 823. 1925. ---TYPE: USA, California, San Diego Co., Indian Cañon, Collins Valley, [Rocky hillside, cor. blue, its throat irregularly translucent], 1500 ft., 28 April 1920, *W. L. Jepson 8852* (holotype: JEPS2786! [UCJEPS Specimen Images, JStor] isotype: POM187122-0003830! [JStor])

Phacelia cryptantha Greene var. *derivata* J. W. Voss, Bulletin of the Southern California Academy of Sciences 33(3):174-175, pl. 56, fig. 6. 1934. ---TYPE: USA, California, Inyo Co., North Mojave Desert region, Shepherds Canyon, Argus Mountains of the Panamint Ranges, 30 April 1897, *M. E. Jones s.n.* (holotype: POM73398-0003826! excluding envelope material *F. Funston [and F. V. Coville] 607* [JStor]).

Invalid names and autonyms:

Phacelia cryptantha Greene var. *cryptantha* is the accepted autonym, and replaces *P. cryptantha* Greene var. *typica* J. W. Voss, Bulletin of the Southern California Academy of Sciences 33:174. 1935 (nomen invalidum, ICN 24.3) (Voss 1935; McNeill et al. 2012).

Distribution of georeferenced specimens in *P. cryptantha*, Fig. 3.15 (North America, scale bar 1600 miles), Fig. 3.16 (USA: Arizona, California, Nevada, New Mexico, Utah; México: Baja California and Sonora, scale bar 300 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.07.

n = 11 (UC666575) (Cave and Constance 1944).

PHACELIA DISTANS sensu lato

Phacelia distans Bentham, The Botany of the Voyage of the H.M.S. Sulphur. 36-37. 1844. ---

TYPE: USA, California, Sonoma Co., Bodegas [Bay]. 1841, *R. B. Hinds s.n.* (holotype: K001070990! [Kew Catalogue]; isotype: GH00093326 [kiki JStor]).

Phacelia tanacetifolia Bentham var. *tenuifolia* Torrey, Botany of the Boundary. 2(pt. 1) 143. 1859. *Phacelia tenuifolia* Coulter ex Harvey nomen in schedula, nomen invalidum in synonymis, cited as *Harv. MSS. Pl. Coult*. ---TYPE: USA, California, 1831-1832, *Dr. Coulter s.n.* (hololectotype, designated here: US not seen; isolectotypes K not seen, GH not seen, CGE!). SYNTYPE: USA, California, March 1853-1854, *C. C. Parry s.n.*. (US not seen) SYNTYPE: USA, California, March 1853-1854, *Thurber s.n.* (US not seen).
Torrey based the varietal name on the unpublished name *P. tenuifolia* Coulter in schedula (Emory et al. 1859). Harvey sent out specimens of Coulter from Trinity College to K, GH, US, and CGE (Harvey 1869; Coville 1895). Additional syntypes of Parry and Thurber are given in the protologue.

Phacelia scabrella Greene, Pittonia 1(3):35–36. 1887, as Phacelia (Euphacelia) scabrella. *Phacelia distans* Bentham var. *scabrella* (Greene) Brand, Pflanzenr. Engler 4, Fam. 251:90. 1913. ---TYPE: USA, California, Santa Barbara Co., San Miguel Island, September 1886, *E. L. Greene s.n.* (hololectotype, designated here, NDG40592-42047 [JStor]; isolectotypes NDG40591-42046 [JStor], CAS938-0006820! [CAS, JStor], UC107365! [UCJEPS Specimen Images], UC107366! [UCJEPS Specimen Images], NY83878 [sweetgum, JStor], PH1087088-00028301 [JStor], PH1087089-00028300 [JStor], PH748990-00028302 [JStor].
There are two sheets deposited at NDG of *P. scabrella*, I designate NDG40592-42047 with the Herbarium Greeneanum stamp as the lectotype and NDG40591-42046 as the isolectotype (Howell, 1943 #208; Greene, 1887 #5459).

Phacelia arthurii Greene, Pittonia 1(15):224. 1888. ---TYPE: USA, California, Alameda Co., Oakland, bystreet toward the western part of the city, sterile branch, 1887, *Arthur B. Simonds s.n.* (hololectotype, designated here: (Oakland, July 1888 label) NDG29307-41745 [JStor]; isolectotypes: (Oakland, July 1888 label) NDG46807 [JStor], (Oakland, July 1888 label) G 00305435 [ville.ge]).
No material that completely matches the collector, date, and locality has been so far located in collections (Greene 1888; Howell 1943). Two sheets in the NDG herbarium, in Greene's hand, were determined as *P. arthurii* Greene (Oakland, July 1888) (Howell 1943). If these are separate collections made by Greene, then these were also available as original material, as specimens were collected prior to publication of the name in Pittonia (issued 18 October 1888). It seems unlikely that these were separate vouchered Greene collections, as Greene did not cite additional collections in the Manual of the botany of the region of San Francisco Bay (p. 255), and notes that the population was extirpated (Greene 1894a). It is most likely that these are the Simonds' collections, but bear Greene labels, which were added after publication of the name. Howell (1943) considered these sheets as type material. Brand (p. 92, 1913) cited an additional specimen from G-DC as an isotype. I choose the sheet bearing the Herbarium Greeneanum stamp as the hololectotype here.

Phacelia leptostachya Greene, Erythea 2:190-191. 1894. *Phacelia distans* Bentham subvar. *leptostachya* (Greene) Brand, Pflanzenr. Engler 4, Fam. 251:89. 1913, as subvar. γ *leptostachya*. ---TYPE: USA, California, Alameda Co., Alameda, 16 June 1892, *E. L. Greene s.n.* (hololectotype, designated here: NDG29249-41926 [JStor]; isolectotypes: NDG29250-41925 [JStor], NDG29251-41924 [JStor], NDG49174-41923 [JStor], NDG46806 [JStor], NDG46808 [JStor], K!, UC24348!).

There are six sheets deposited in the NDG herbarium, four of which bear the Herbarium Greeneanum stamp. I choose the lowest accession number and larger specimen (NDG29249-41926) as the hololectotype.

Phacelia conmixta Greene, Pittonia 5:21-22. 1902. ---TYPE: USA, California, San Bernardino Co., 15 May 1891, *S. B. Parish and W. F. Parish s.n.* (holotype: NDG29342-41792, excluding plant on the left [JStor]).

Phacelia distans Bentham subvar. *ammophila* Brand, University of California Publications in Botany 4:216. 1912, as subvar. *β ammophila* (Greene) Brand. *Phacelia ammophila* Greene in Baker, West American Plants 2:15. 1903, nomen nudum, lacking diagnosis. ---TYPE: USA, California, Contra Costa Co., Antioch, 1–1 ½ feet, common in the sand hills, "also collected by me long ago at the same place", 28 April 1903, *C. F. Baker 2806* (hololectotype, designated here: NDG28537-41740 (28 May 1903) [JStor]; isolectotypes: POM65421 not seen, UC131485!, ECON 14089-00093123 [kiki, JStor], NY83970 [sweetgum, JStor], CAS953531-006694! [CAS, JStor], US440769-00110491 [NMNH, Collections Search Center, JStor], COLO 279570-402453 [RM, JStor], K!, MO 2518938-503926 [TROPICOS, JStor]).

Brand based the subvariety on the invalid name *P. ammophila* Greene (Brand 1912). Baker published names in West American Plants, with *P. ammophila* Greene unfortunately lacking a description or diagnosis (as *2806 *Phacelia ammophila* Greene n. sp. M W. Cal [p. 15, 1903]), and distributed sets of collections of *P. ammophila* Greene in schedula (Baker 1903). Greene determined the specimens for Baker. The specimen deposited at NDG has a handwritten label by Greene, and bears the date May 28/03, but is part of the original material, and retained in Greene's herbarium. Howell considered this to be the type specimen, and it this specimen that I formally designate as the hololectotype (Howell 1943). The other specimens cited by Brand (p. 216, 1912) follow the em dash, and are paratypes (Brand 1912, 1913).

Phacelia distans Bentham var. *australis* Brand, University of California Publications in Botany 4:216. 1912. ---TYPE: USA, California, Kern Co., Greenhorn Range, Southern Sierra Nevada Mountains, east slope, 1500 m, 2–10 June 1904, *H. M. Hall and H. D. Babcock 5071* (holotype: UC63348! [UCJEPS Specimen Images, CCH]).

Phacelia umbrosa Greene, Erythea 2(12):191. 1894. *Phacelia hispida* (A. Gray) A. Gray var. *umbrosa* (Greene) Brand, Pp. 88 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59). Verlag von Wilhelm Engelmann, Leipzig. 1913, as *Phacelia hispida* (A. Gray) A. Gray var. c. *umbrosa* (Greene) Brand. ---TYPE: México, Baja California, Northern Lower California, 11 July 1885, *C. R. Orcutt s.n.* (lectotype, designated by Brand 1913, UC107404! [UCJEPS Specimen Images, CCH]; isolectotypes: K000612642! [Kew Catalogue, JStor], UC107403! [UCJEPS Specimen Images], JEPS1327! [UCJEPS Specimen Images, CCH, JStor], not georeferenced).

Invalid names:
Phacelia distans Bentham var. *eu-distans* Brand, University of California Publications in Botany 4:216. 1912 (nomen invalidum, ICN 24.3).

Phacelia distans Bentham subvar. *genuina* Brand, Pflanzenr. Engler 4, Fam. 251:89-90. 1913 (nomen invalidum, ICN 24.3).

Eutoca floribunda Nuttall, not published, in herbarium (PH00024883 [JStor], excluding material of PH00024882 and PH00013968), from USA, California, St. [San] Diego. Greene (1894b) cited Nuttall's name and transferring the identification to the genus *Phacelia* (as "P. floribunda") in discussion of the various forms of *P. distans* sensu lato in California, assigning it in synonymy to the type as the typical form, widely dispersed (p. 191). Other material distributed with *Phacelia floribunda*, but it is unclear if this was by Nuttall, by Greene, or by another. Greene favored 'floribunda' as a descriptive epithet, as he later published *P. floribunda* Greene for the plants from Guadalupe Island.

Phacelia australis Morton, nomen nudum, in herbarium only, possibly in schedula? (PH745593-00028223 [JStor]). A specimen from México, San Luis Potosi, Catorce, Sierra de Catorce, crevices of shale, corolla violet, plant herb, 24-25 July 1934, *F. W. Pennell 17598*. The printed label notes this is an isotype, and so additional sheets may have been distributed with this name. This specimen is part of the *P.* sect. *Glandulosae* (Rydb.) Walden & R. Patt.

Autonym:
Phacelia distans Bentham var. *distans* is the accepted autonym (Brand 1912).

Distribution of georeferenced specimens in *P. distans*, Fig. 3.17 (North America, scale bar 1600 miles). Distribution of georeferenced specimens of *P. umbrosa* (included as a synonym of *P. distans* in the taxonomic treatment), Fig. 3.18 (California, San Diego Co., scale bar 50 miles). List of accession numbers for specimens examined and georeferenced for *P. distans*, Appendix 3.08. Accession numbers for specimens examined and georeference for *P. umbrosa* included separately at the end.

n = 11 (UC671727, as *P. ammophila*) (Cave and Constance 1942).
n = 11 (UC671680, as *P. distans*) (Cave and Constance 1942).
n = 11 (UC671731, as *P. distans*) (Cave and Constance 1942).
n = 11 (UC671736, as *P. distans* var. *australis*) (Cave and Constance 1942).
$2n$ = 24 (TEX T 92-21) (Zhao and Turner 1993).

PHACELIA FLORIBUNDA SENSU STRICTO

Phacelia floribunda Greene, Bulletin of the California Academy of Sciences 1(4A):200–201. 1885[1886]. ---TYPE: MÉXICO, Baja California, Guadalupe Island, 20 April 1885, *T. S. Brandegee s.n.* (lectotype designated by Walden and Patterson 2011: UC107314! [UCJEPS Specimen Images]).

Phacelia phyllomanica A. Gray var. *interrupta* A. Gray, Proceedings of the American Academy of Arts and Sciences 11:87. 1876. ---TYPE: MÉXICO, Baja California, Guadalupe

Island, frequent in warm nooks in rocky ravines in the middle and at the south end, February to May [Watson, p. 118], 1875, *E. Palmer 72* (lectotype, designated by R. Moran 1996: GH00303824! [kiki, JStor]; isolectotypes MO217214-399521! (mounted on sheet with MO214213, *E. Palmer 71*) [TROPICOS, JStor], MO217212-399522! [TROPICOS, JStor], NY1239401! [sweetgum, JStor], NY1239402! [sweetgum, JStor]), PH00028280 (mounted on sheet with PH00028279, *E. Palmer 71*) [JStor], YU002023 [YU, JStor], F221242-0060863F (plant on the left is *phyllomanica* var. *interrupta E. Palmer 72*, and the plant on the right is *P. phyllomanica E. Palmer 71*, but only one label on sheet [EMUweb Field Museum, JStor], K001070988 [Kew Catalogue, JStor], P 00640181 [cold.br, JStor], P 03540547 [cold.br].

Distribution of georeferenced specimens in *P. floribunda* sensu stricto, Fig. 3.19 (México, Guadalupe Island, scale bar 10 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.10.

n = 11 (UC1083883) (Cave and Constance 1959).
n = 11 (UC1112225) (Cave and Constance 1959).

***UNNAMED SPECIES, circumscribed as restricted to San Clemente Island, previously treated as *P. floribunda*. Tentatively called here 'NALFSCI-ensis', an informal species.** The earliest collection is from Nevin and Lyon in 1885. A formal description is forthcoming.

Distribution of georeferenced specimens in *"NALFSCI-ensis"*, Fig. 3.20 (California, Los Angeles Co., San Clemente Island, scale bar 50 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.11.

PHACELIA GENTRYI

Phacelia gentryi Constance, Madroño 9(8):255–257. 1948. ---TYPE: MÉXICO, Sonora, San Bernardo, Rio Mayo, wooded slopes, casual and scattered, colonial in one place, [also on label "Tropical Sonoran, Tomosita, Mex. Tomasa W."], 26 February 1935, *H. S. Gentry 1364* (holotype: GH not seen; isotypes: MO 1089147-156572 [TROPICOS, JStor], ARIZ 88546-BOT-0005123 [SEINet, JStor], ARIZ 27392-BOT-0005117 [SEINet, JStor], UC646330!, MEXU not seen).

Distribution of georeferenced specimens in *P. gentryi*, Fig. 3.21 (North America, scale bar 1600 miles), Fig. 3.22 (USA: Arizona; México: Sonora, scale bar 300 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.12.

PHACELIA HELIOPHILA

Phacelia heliophila (J. F. Macbride) Walden, **stat. et comb nov.** *Phacelia hispida* (A. Gray) A. Gray var. *heliophila* J.F. Macbride, Contributions from the Gray Herbarium of Harvard

University n.s. 49:29. 1917. *Phacelia vallis-mortae* J.W.Voss var. *heliophila* (J.F. Macbride) J.W.Voss, Bulletin of the Southern California Academy of Sciences 33:176, fig. 2, G. 1935. *Phacelia cicutaria* Greene var. *heliophila* (J.F. Macbride) Jepson, A Flora of California 3:261–262, 263. 1943. *Phacelia cryptantha* Greene var. *heliophila* (J.F. Macbride) Hoover, Vascular Plants San Luis Obispo Co., California 237. 1970. ---TYPE: USA, California, Kern Co., Sunset [Oil District], 20 April 1905, *A. A. Heller 7730* (holotype: GH00093349 digital image! [kiki, JStor]; isotypes: NY00380641 [sweetgum, JStor], US611486-00110508 [NMNH, Collections Search Center, JStor]).

Distribution of georeferenced specimens in *P. heliophila*, Fig. 3.23 (North America, scale bar 1600 miles), Fig. 3.24 (USA: California, scale bar 100 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.13.

n = 11 (UC671722, as *P. hispida* var. *heliophila*) (Cave and Constance 1942).

PHACELIA HIRTUOSA

Phacelia hirtuosa A. Gray, Proceedings of the American Academy of Arts and Sciences 22:310. 1887 [8 December 1886]. ---TYPE: MÉXICO, Northern Lower California, San Telmo, 17 April 1886, [protologue reads 'May' in error], *C. R. Orcutt [1342]* (holotype: GH00093509 [kiki, JStor]; isotypes: UC107524! [UCJEPS Specimen Images, JStor], UC24509! [UCJEPS Specimen Images, JStor], NY00083868 [sweetgum, JStor], NY00083869 [sweetgum, JStor], US45603-00110505 [NMHN, Collections Search Center, JStor], US1338235-00811213 [NMHN, Collections Search Center, JStor], US0093950-00811214 [NMHN, Collections Search Center, JStor], US0095972-00930956 [NMHN, Collections Search Center, JStor], PH28245 [JStor], G 00355695 [Ville-GE, JStor], G 00305432 [Ville-GE], MICH 1192362 [herb2ic, JStor], YU002016 [YU, JStor], YU002017 [YU, JStor], MSC 0092598 [JStor], S 12-4754 [JStor]).

Gray's protologue has the date of collection as "May 17, 1886" in error, the labels of Orcutt are from April (Gray 1887). Gray included no collection number, but Brand added the number *1342* in his revision (p. 113) (Brand 1913). TROPICOS did not include this name in its server bank (Missouri Botanical Garden [MOBOT] 2015), but IPNI did (The International Plant Names Index [IPNI] 2014).

Distribution of georeferenced specimens in *P. hirtuosa*, Fig. 3.25 (North America, scale bar 1600 miles), Fig. 3.26 (México: Baja California, scale bar 100 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.14.

n = 11 (UC774145) (Cave and Constance 1950).
n = 11 (UC10095217) (Cave and Constance 1959).

PHACELIA HUBBYI

Phacelia hubbyi (J. F. Macbride) L. M. Garrison, Madroño 56(3):205-207. 2009. *Phacelia hispida* (A. Gray) A. Gray var. *hubbyi* J. F. Macbride, Contributions from the Gray

Herbarium of Harvard University, new series 49:28, 29. 1917. *Phacelia cicutaria* Greene var. *hubbyi* (J. F. Macbride) J. T. Howell, Leaflets of Western Botany 3 (No. 5):120. 1942. *Phacelia tanacetifolia* Bentham var. *hubbyi* (J. F. Macbride) Jepson & Hoover, in Jepson, A Flora of California 3:258. 1943. ---TYPE: USA, California, Ventura County, grows in considerable profusion on Mt. slopes and foothills, Ojai Valley, 20 May 1896, *F. W. Hubby 31* (holotype: GH93350 [kiki, JStor).

Distribution of georeferenced specimens in *P. hubbyi*, Fig. 3.27 (North America, scale bar 1600 miles), Fig. 3.28 (southern California and Santa Cruz Island, scale bar 60 miles). Figure 3.29, screen grab from BerkeleyMapper 2.0 georeferencing of *P. hubbyi* accession, Mission Canyon, Santa Barbara County, California. List of accession numbers for specimens examined and georeferenced, Appendix 3.15.

n = 11 (UC794429) (Cave and Constance 1947).

PHACELIA IXODES

Phacelia ixodes Kellogg, Bulletin of the California Academy of Sciences 1(1):6–7. 1884 [read 1877]. ---TYPE: MÉXICO, Baja California, from Cedros Island, [June-August 1859] s.d., *J. A. Veatch s.n.* (holotype: CAS928-0003891! [CAS, JStor]; isotypes: DS 8439! (as Cerros Island) [CAS], UC107485! [excluding non-type material of one large piece on the right side sheet UC107486!]).

Phacelia ixodes Kellogg var. *plumosa* Brand, Pp. 112 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59). Verlag von Wilhelm Engelmann, Leipzig. 1913, as "[v]ar. b. plumosa (Kellogg) Brand". Based on *P. plumosa* Kellogg in herb. ex Brand, Pp. 112 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59). Verlag von Wilhelm Engelmann, Leipzig. 1913, nomen nudum and invalidum, name not published, in mss. [in reference to specimen labels]. ---TYPE: MÉXICO, Baja California, 'Flora of Southern California', Coronado Islands, 18 August 1888, *E. Palmer 264* (hololectotype, designated here: P00640149! [cold.br, JStor]; isolectotypes G [Herb. Boissier] not seen, US93652-00850597 [NMNH, Collections Search Center], US93653- 00850598 [NMNH, Collections Search Center]). SYNTYPE: MÉXICO, Baja California, Flora of Lower California, Todos Santos Bay, 9 mo. 22 day, 1884, *C. R. Orcutt s.n.,* (UC107481!). SYNTYPE: MÉXICO, Baja California, Flora of Lower California, Ensenada, 4 June 1893, *T. S. Brandegee s.n.* (UC107487!). SYNTYPE: MÉXICO, Baja California, Flora of Lower California, San Martin Island, 12 March 1897, *T. S. Brandegee s.n.* (UC107484!).

The collection date for the holotype is from the report of Veatch (1869). The original name for *P. ixodes* was to be *P. plumosa* (invalid name), as indicated on the label of the holotype (CAS928-0003891) (Kellogg 1884). However, "at the suggestion of Dr. Gray *P. ixodes* was adopted instead" (UC107481) [the initials K.B. are likely for Katherine Brandegee]. Brand, when separating the two varieties, gave the plants of the mainland and northern islands the epithet Kellogg originally intended (*P. ixodes* var. *plumosa*, with the plants restricted to the southern islands as the typical variety [now replaced by the autonym *P. ixodes* var. *ixodes*] (Brand 1913).

Brand cited four specimens in the description of var. *plumosa*. The first listed specimen was *E. Palmer 264*, from the Coronado Islands. Brand cites a specimen deposited in the Boissier

Herbarium [Herb. Boissier], now incorporated at Conservatoire et Jardin Botanique de la Ville de Genève [G]. The kind curators were unable to locate this specimen in the collections of Genève during my studies, and generously searched and digitized type specimens while undergoing renovations, for which I am very grateful. There is a duplicate sheet deposited at Paris, and two sheets at US. I select this collection [*E. Palmer 264*] as the lectotype, as the duplicates are widely distributed and the specimens are representative of the protologue (Brand 1913). The Paris specimen is designated here as the hololectotype, and other duplicates as isolectotypes. There are two specimens deposited at US that have collection numbers written in pencil [70], but these are from the same day and locality as the Paris specimen, and I consider these part of the original materials.

The other three collections [syntypes] are all deposited at UC, and were annotated by Brand ("Phacelia ixodes plumosa !Br"). There is an additional collection of Orcutt from Todos Santos Bay deposited at NY, but the label has a different collection date and number, and so is not part of a single gathering and not a syntype (MÉXICO, Baja California, Flora of Lower California, Todos Santos Bay, 1 mo. 23 day, 1883, *C. R. Orcutt 715* (NY00083866 [sweetgum, JStor]).

Invalid names and autonyms:
Phacelia ixodes Kellogg var. *ixodes* is the accepted autonym if varieties are recognized in *P. ixodes*, and replaces *P. ixodes* Kellogg var. *typica* Brand, Pp. 112 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59). Verlag von Wilhelm Engelmann, Leipzig. 1913 (nomen invalidum, ICN 24.3) (McNeill et al. 2012).

Distribution of georeferenced specimens in *P. ixodes* (*P. ixodes* var. *ixodes* and *P. ixodes* var. *plumosa*), Fig. 3.30 (North America, scale bar 1200 miles), Fig. 3.31 (México: Baja California, scale bar 200 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.16.

n = 11 (UC753407) (Cave and Constance 1950).

PHACELIA LOASIFOLIA

Phacelia loasifolia (Bentham) Torrey, Report on the United States and Mexican Boundary, Botany 2(1):143. 1859, as Phacelia (Eutoca) loasæfolia. *Phacelia malvifolia* Chamisso var. *loasifolia* (Bentham) Brand, Pp. 94 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59). Verlag von Wilhelm Engelmann, Leipzig. 1913. *Eutoca loasaefolia* Bentham, Transactions of the Linnean Society of London 17(2):277. 1835 [read 1834, issue published May 1835, entire vol. published 1837], as E. loasæfolia. *Phacelia malvaefolia* Chamisso subsp. *loasaefolia* (Bentham) A. E. Murray, Kalmia 12:22. 1982. ---TYPE: USA, California, "From California", 1833, *D. Douglas s.n.* (hololectotype, designated here: K001070999! [Kew Catalogue]; isolectotypes K001070998! [Kew Catalogue], G-DC-00134497 [ville.ge], BM 000503458 [BM, JStor], GH00093408 [kiki], NY00337116 (excluding plant material [calyces] of Rev. A. Fitch) [sweetgum, JStor]).

There are two specimens included in the type catalogue at Kew. I designate the sheet stamped with Herbarium Benthamianum 1854 as the hololectotype (K001070999!), and the sheet stamped with Herbarium Hookerianum 1867 as the isolectotype (K001070998!).

Invalid names:
Phacelia horrida A. Heller ex Brand, nomen invalidum in synonymis, cited as *Heller* collection 6716 in schedula, in synonymy with *P. malvaefolia* var. *loasaefolia* (Brand, p. 94) (Brand 1913). Heller distributed specimens with the unpublished name [Phacelia horrida Heller, sp. nov.], and likely intended to publish the name in the Botanical Gazette, but never did. Although an invalid name and of no taxonomic importance, it is important to note here, as the collection locality of Heller has come to represent the type locality for *P. loasifolia* because the type locality of Douglas (for *Eutoca loasifolia*) is unknown (Bentham 1835 [read June 17th, 1834, issue published 1835, volume published 1837]). However, specimens of *P. horrida* are morphologically determined as *P. malvifolia* with four seeded capsule, and because of the difficulty separating plants from the southern distribution of *P. malvifolia* and plants from the northern distribution of *P. loasifolia*, these collections should not be considered as a proxy type locality or comparable to the type specimen of that of Douglas.
USA, California, Monterey Co., Pacific Grove in pine woods, 13 May 1903, *A. A. Heller 6716* (UC58410!, P 00640171! [cold.br], PH507253-00028246 [PH], F 158095-V0060831F neg. number 62311! [EMUweb Field Museum], RSA60750 not seen, POM261895 not seen).

Distribution of georeferenced specimens in *P. loasifolia*, Fig. 3.32 (North America, scale bar 1600 miles), Fig. 3.33 (USA: California, scale bar 90 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.17.

n = 11 (UC671735) (Cave and Constance 1942).

PHACELIA LYONII

Phacelia lyonii A. Gray, Proceedings of the American Academy of Arts and Sciences 20: 303. 1885, as Phacelia (Eutoca) Lyoni. --- TYPE, USA, California, Los Angeles Co., Island of Santa Catalina off Los Angeles, July 1884, *W. S. Lyon [and Nevin] s.n*. (holotype: GH00093414 [kiki, JStor]; isotypes: CAS939-0006848! [CAS], F 494021-0060836F! (no. 223, envelope material, refers to GH specimen, mounted on sheet with *S. F. Blake 967*) [EMUweb Field Museum, JStor], F 494022-V0060837F! (photograph of holotype mounted on sheet with isotype material in envelope) [EMUweb Field Museum, JStor], K001096015! (1885) [Kew Catalogue]).

Gray sent a specimen to Kew after publication (1885), which was accessioned in 1889. Although corresponding to other type specimens (especially the CAS material), the collection date on the label is given as 1885, and the protologue gives 1884. This Kew specimen could perhaps not be part of the original material, but I retain this in the list of type specimens at this time.

Invalid names:
Phacelia ixodes Kellogg var. *lyonii* A. Gray, nomen invalidum, name not published, in herb on GH93414 (the holotype).

Distribution of georeferenced specimens in *P. lyonii*, Fig. 3.34 (North America, scale bar 1600 miles), Fig. 3.35 (USA: California, scale bar 30 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.18.

PHACELIA MALVIFOLIA

Phacelia malvifolia Chamisso, Linnaea 4:494-496. 1829, as "Phacelia *malvaefolia* N.". --- TYPE: USA, California, Legimus ad Portum Sancti Francisci, 1828, *L. K. A. von Chamisso s.n.* (holotype likely at Berlin, destroyed in 1943). Neotype, designated here, USA, California, San Francisco Co., San Francisco, Land's End, nw slope facing Golden Gate, 9 May 1910, *Harriet A. Walker 1992* (neotype: UC163948!; isoneotypes: CHSC76199, POM65404).

Chamisso's type material of *P. malvifolia* was likely at Berlin. Brand (1913) cited a collection of Chamisso from "Bei San Francisco", without additional notation to indicate he borrowed it from another herbarium than his home institution, Berlin. Bentham (Bentham 1835 [read June 17th, 1834, issue published 1835, volume published 1837]) also cited Chamisso, but did not receive a specimen as he did not "see the plant" (p. 279) (Bentham 1835 [read June 17th, 1834, issue published 1835, volume published 1837]) . Macbride did not include the specimen amongst type negatives from Berlin, perhaps because his project was focusing on the neotropical taxa (Grimé and Plowman 1987). No other type material of *Phacelia*, outside of the material deposited in the Willdenow Herbarium at Berlin, appears to have survived the bombing of the museum in 1943 (Hiepko 1978, 1987). I was unable to find additional type material at Berlin during my research. Duplicate collections of Chamisso were not located in searches at other institutions, or other material by Schlechtendal (Braun and Wittig 2013), or from the expedition of the Rurik that might serve as representative material. No illustrations were made in the protologue that might be used.

The type locality was described as "Legimus ad Portum Sancti Francisci, Californiae." (p. 494, [Collected at the Port of St. Francis, California]) (Chamisso 1829). The Rurik made port at the Presidio, and the type collection was most likely from the grounds there (Chamisso and Kratz 1986). *Phacelia malvifolia* remains a commonly encountered plant of rocky cliffs of San Francisco, although extirpated from some of its previous range by loss of habitat due to urban development. However, much of the area near the type locality has been preserved by the long term management as military lands of the Presidio of San Francisco (U.S. Army), now part of the U.S. National Park Service. Presidio Because no original material exists, a neotype must be designated here from the collections that are representative of the description and type locality.

Autonym:
Phacelia malvifolia Cham. var. *malvifolia* is the accepted autonym, if varieties are recognized in this taxon (Brand 1913).

Distribution of georeferenced specimens in *P. malvifolia,* Fig. 3.36 (North America, scale bar 1600 miles), Fig. 3.37 (USA: California, scale bar 200 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.19.

PHACELIA PAUCIFLORA

Phacelia pauciflora S. Watson, Proceedings of the American Academy of Arts and Sciences 24:61. 1889, as Phacelia (Eutoca) pauciflora. ---TYPE: MÉXICO, Baja California, [o]n Mountains near Los Angeles Bay, [Gulf of California], [Nov-Dec] 1887, *E. Palmer 583* (hololectotype, designated here: US46838-00110547 [NMNH, Collections Search Center, JStor]; isolectotypes: US1338261-00811215 [NMNH, Collections Search Center, JStor], NY00083863 (Apr-Dec) [sweetgum, JStor], GH00093521 [kiki, JStor]).

The dates of collection in the area are given in introductory material for the protologue (pp. 36–38), and the locality and collection number from the description (Watson 1889). Two sheets are deposited at US. I designate the hololectotype as the sheet bearing two labels, a "Flora of Lower California" on the lower left and a United States Department of Agriculture label on the lower right. Both labels indicate the locality as "Los Angeles Bay", collected in 1887, and "n. sp." follows the name. The isolectotype deposited at US bears a "Flora of Guaymas" label, the earlier expedition of Palmer from April to November of 1887 [see discussion of journey by Sereno Watson, pp. 36–38] (Watson 1889). Other isolectotypes are deposited at NY [with the date April-Dec] and GH. All of these specimens are likely from one locality and one population, despite the variation between labels, and constitute original material.

Phacelia cedrosensis Rose, Contributions from the United States National Herbarium 1:13, 18. 1890, [p. 13 as Phacelia Cedrocensis Rose, p. 18 as Phacelia (Eutoca) Cedrosencis Rose n. sp.]. ---TYPE: MÉXICO, [Baja California] Lower California, [north end of island], Cedros Island, 18–20 March 1889, *E. Palmer 715* (holotype: US47266-00110485 [NMNH, Collections Search Center, JStor]; isotypes: GH00093506 [kiki, JStor], K000612639! [Kew Catalogue, JStor], [March 1889] MICH 1192356 (herb2ic), NDG29936-41768 (JStor).

Various spelling of the specific epithet of the Cedros Island phacelia were encountered in the literature, herbaria, and databases. The protologue included the taxon name spelled as "Phacelia Cedrocensis" on p. 13 in the list of new species, and as "Phacelia (Eutoca) Cedrosencis" on p. 18 in the new species description (Vasey and Rose 1890). The labels on the holotype sheet both read "Phacelia cedrosensis", one from the Herbarium of the United States Department of Agriculture and the other from Flora of Lower California, respectively. The correct spelling of the specific epithet includes the island name, Cedros Island, with the ending "ensis", as it is a geographic name (Rec. 60D.1) (McNeill et al. 2012). TROPICOS has this taxon as "*Phacelia cedroensis*" (http://www.tropicos.org/Name/50291003). Thus, *P. cedrosensis* Rose is the correct spelling.

Distribution of georeferenced specimens in *P. pauciflora* (combined distribution of georeferenced *P. cedrosensis* and *P. pauciflora* specimens), Fig. 3.38 (North America, scale bar 200 miles). Distribution of georeferenced *P. pauciflora* (traditional circumscription) specimens, Fig. 3.41 (North America, scale bar 200 miles). Distribution of georeferenced *P. cedrosensis* (traditional circumscription) specimens, Fig. 3.39 (México: Baja California, scale bar 20 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.40.

n = 11 (UC1001699 as *P. cedrosensis*) (Cave and Constance 1959).
n = 11 (UC1116172, as *P. pauciflora*) (Constance 1963).
n = 11 (UC1242666, as *P. pauciflora*) (Constance 1963).
n = 11 (UC1345862, as *P. pauciflora*) (Constance 1963).
n = 11 (UC1345863, as *P. pauciflora*) (Constance 1963).
n = 11 (UC1345846, as *P. pauciflora*) (Constance 1963).
n = 11 (UC1345860, as *P. pauciflora*) (Constance 1963).
n = 11 (UC1345861, as *P. pauciflora*) (Constance 1963).

PHACELIA PHYLLOMANICA

Phacelia phyllomanica A. Gray, Proceedings of the American Academy Arts 11:87. 1876. ---TYPE: MÉXICO, Baja California, Guadalupe Island, in large compact masses in the crevices of high rocks in the middle of the island, rare [Watson, p. 118], 1875, *E. Palmer 71* (hololectotype, designated by Walden and R. Patterson 2011: GH00093523! [kiki, JStor]; isolectotypes P 00640180! [cold.br, JStor], MO217213-399521 (mounted on sheet with MO217414 *E. Palmer 72*) [TROPICOS, JStor], MO217211-399524! [TROPICOS, JStor], NY83859! (lacking Palmer label) [sweetgum, JStor], NY83860 (metadata review only) [sweetgum], NY83861! [sweetgum], NY83862! [sweetgum, JStor], K000612643! [Kew Catalogue, JStor]); YU002024 [YU, JStor], PH00028279 (mounted on sheet with PH00028280 *E. Palmer 72*) [JStor], PH544280-00028278 (Canby label) [JStor]).
Since designation of the lectotype (see Walden and Patterson 2011) additional type specimens were identified from dissertation studies. They are included here as the best reflection of the iterative nature of taxonomic research.

Distribution of georeferenced specimens in *P. phyllomanica,* Fig. 3.41 (México: Guadalupe Island, scale bar 10 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.21.

n = 11 (UC1179597) (Constance 1963).

PHACELIA PLATYLOBA

Phacelia platyloba A. Gray, Proceedings of the American Academy of Arts and Sciences 17:223–224. 1882. ---TYPE: USA, California, Fresno Co., 1881, *C. C. Parry 199 [½]* (holotype: GH00093446 ([kiki, JStor], not georeferenced).
The protologue includes the collection of *Parry* from 1881 (Gray 1882), and the associated collection number deposited at GH is *199 1/2*. It does not appear to indicate a two-sheet holotype (i.e., notation for sheet 1 of 2), but there may be another sheet deposited at GH with the collection number *199 2/2*. Or it may indicate that a duplicate collection was taken, and that there may be another isotype in existence, possibly deposited elsewhere.

Distribution of georeferenced specimens in *P. platyloba,* Fig. 3.42 (North America, scale bar 1600 miles), Fig. 3.43 (USA: California, scale bar 70 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.22.

n = 11 (UC764459) (Cave and Constance 1950).

PHACELIA RAMOSISSIMA sensu lato

Phacelia ramosissima Douglas ex Lehmann, Novarum et Minus Cognitarum Stirpium Pugillus 2:21. 1830 [27 July 1830]. ---TYPE: USA, Washington, "near the Priests Rapid", 8 June 1826, *D. Douglas s.n.* (holotype: HBG not seen; isotypes K001070992! [Kew Catalogue], K001070991! [Kew Catalogue], BM 000502845 [BM, JStor], not georeferenced)

No collector or collection was cited in the protologue, only reference to "Dougl. in mss." (Lehmann 1830), which may refer to labels included with the specimens, the field journal, or other correspondence sent by Douglas. In the condensed journal of Douglas, "*Phacelia ramosissima*" was collected in 1826 "near the Priests Rapid" (Douglas 1914). Bentham (p. 280) (Bentham 1835 [read June 17th, 1834, issue published 1835, volume published 1837]) cited two collection localities made by Douglas "in California and on the Columbia". Hooker listed two collections from (pp. 80–81) "[d]ry rocky places of the Columbia, near Priest's Rapid, and at the Stony Islands. N.W. America. *Douglas*." (Hooker 1840). The Stony Islands locality immediately precedes that of Priest's Rapid in the journal, and a Douglas specimen at BM and at K includes the note "near the Priests Rapid and Stony Island of the Columbia 1826". It is possible that there are two [or more] collecting localities for specimens associated with the name. However, it is also possible that the collections were made at one place [Priest Rapids] as indicated in the journal, and that similar plants were also seen at the Stony Islands, and that the various concatenations of habitat notes are from reconstructing Douglas' collecting localities in retrospect. The Priest Rapids Dam, the Rock Island Dam, and the Wells Dam may have extirpated the collecting localities of Douglas along the Columbia River in Washington. Lehmann likely examined a specimen at Hamburg, and as HBG was damaged in WWII, but the collections were removed to various institutions until eventually returned in 1990, it is likely that the type will be found at HBG (Poppendieck 2001).

Douglas was traveling from Kettle Falls towards Walla Walla, and collected *P. ramosissima* during this trip from the Stony Islands on to Priest Rapids. Thus, it is safe to assume that the Stony Islands are those of the Columbia River of Washington, and not the Stony Islands of the Fraser River (British Columbia), which is the famous location of the loss of many of Douglas' collections. Although Jepson (p. 259) (Jepson 1943) considered the type material to be from California, Douglas did not travel to California until December 1830 (Jepson and Douglas 1933). Collections made by Douglas in California would have been made and sent after the July 1830 publication of the name by Lehmann. This excludes the California collections from consideration as type material (e.g., K001070993! [Kew Catalogue], G-DC-00134374 [ville.ge], CGE!).

Phacelia decumbens Greene, Pittonia 5:17-18. 1902. *Phacelia ramosissima* Douglas ex Lehmann forma *decumbens* (Greene) Brand, Univ. Calif. Publ. Bot. 4:215. 1912, in part. ---TYPE: USA, California, Siskiyou Co., near Yreka, 28 June 1876, *E. L. Greene 896* (lectotype designated by Howell 1943, NDG not seen; isolectotypes: GH93324 not seen, PH28235 not seen). SYNTYPE: USA, California, Lake Co., southern flanks of Uncle Sam Mt. [Mt. Konocti], July-August 1892, *W. L. Jepson s.n.* (syntype: NDG not seen "description of capsule and seeds was from this", designated by Howell 1943; isosyntypes: UC24460!, JEPS1342!).

Phacelia suffrutescens Parry, Proceedings of the Davenport Academy of Natural Sciences 4:38. 1884 [read 28 December 1883]. *Phacelia ramosissima* Douglas ex Lehmann var. *suffrutescens* (Parry) Parry ex A. Gray, Synoptical Flora of North America, second edition, 2(1, supplement):416. 1886. *Phacelia ramosissima* Douglas ex Lehmann forma *suffrutescens* (Parry) Brand, in part, Pp. 92 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59). Verlag von Wilhelm Engelmann, Leipzig. 1913, as f. 2. *suffrutescens*. ---TYPE: USA, California, southern California, [San Bernardino, Mohave River, June] 1876, *C. C. Parry* [*and J. G. Lemmon 262]* (hololectotype, designated here: GH not seen; isolectotypes: CAS154383! [CAS, JStor], UC172762!).

Parry did not explicitly cite any specimens in the protologue, but was likely the [or a] collector (Parry 1884 [read 28 December 1883]). Macbride (p. 31) (1917) included the specimen *Parry and Lemmon 262* in his treatment of the taxon. This collection (isotype CAS154383!) matches the protologue description in every way. This collection (isotype CAS154383!) matches the protologue description in every way. I designate this collection as the type, and the specimen at Harvard as the lectotype. An additional collection of Parry's was included by Macbride, lacking a location [1881, *C. C. Parry 200*]. Not having examined this specimen (likely at GH), and based on the collection number and year of collection, the collection might have been from the Sierra Nevada or San Bernardino, and may be a duplicate of P00648901. Jepson noted the type as "from S. Cal, *Parry*" (p. 259, 1943), but included *Parry and Lemmon 262* in his circumscription of *P. subsinuata* (see discussion at that name). The isotype at UC includes label data of San Bernardino, Mohave River. Parry made additional collections of *P. ramosissima* from California, and these may have informed his taxonomic concept, but do not entirely match the protologue and so are not considered syntypes here. (USA, California, Monterey, 1850, *C. C. Parry s.n.* P0084902! [JStor], excluded because of northern California location; USA, California, n.d., [S. Cal.], *C. C. Parry s.n.* P00648901! [JStor], excluded because not conspicuously glandular).

TROPICOS considers *P. ramosissima* var. *suffrutescens* a superfluous name (Missouri Botanical Garden [MOBOT] 2015), but Gray cited the basionym and so implicitly included the type element (Gray 1886). Gray apparently based the name on a note by Parry on a herbarium specimen sent to (or at) Harvard. That constitutes a valid publication of the name at the rank of variety (McNeill et al. 2012).

Phacelia ramosissima Douglas ex Lehmann var. *latifolia* (Torrey) Cronquist, Intermount. Fl. 4:185. 1984. *Phacelia tanacetifolia* Benth. var. *latifolia* Torrey ex Emory, Rep. U.S. Mex. Bound., Bot. 143. 1858 (Jul-Dec 1858). ---TYPE: USA, California, Mountains east of San Diego, fl. blue, June 1850, *C. C. Parry s.n.* (holotype: NY83872 [sweetgum, JStor]).

The NY83872 specimen from the Torrey Herbarium [stamp] matches the protologue in all ways.

Phacelia bifurca Greene, Pittonia 5:18. 1902. ---TYPE: USA, California, Kern Co., Mountains near Tehachapi, 22 June 1889, *E. L. Greene s.n.* (holotype NDG29310-41748 [JStor]).

Phacelia fastigiata Greene, Pittonia 5:18–19. 1902. ---TYPE: USA, California, Tulare Co., Long Meadow, alt. 8000–9000 ft., 7–14 June 1888, *E. Palmer and Wright 205* (holotype:

NDG29372-41847 [JStor]; isotypes: NY83938 [sweetgum, JStor], P 00640198! [cold.br, JStor], US45614-00850745 [NMNH, Collections Search Center], K!).
Greene indicates in the protologue and in his hand on the holotype label that the collection was made by Palmer and Wright; all of the isotype labels bear only Palmer's name (Greene 1902; Howell 1943).

Phacelia polystachya Greene, Pittonia 5:19. 1902. ---TYPE: USA, California, San Diego Co., Witch Creek, 1893, *R. D. Alderson s.n.* (holotype NDG40574-42013 [JStor]).
This is the particularly glandular form, commonly identified as *P. suffrutescens*.

Phacelia subsinuata Greene, Pittonia 5:19–20. 1902. *Phacelia ramosissima* Douglas ex Lehmann *var. subsinuata* (Greene) J. F. Macbride, Contributions from the Gray Herbarium of Harvard University, new series 49: 30. 1917, in part. ---TYPE: USA, California, Santa Barbara Co., San Rafael Mountains, 1886, *J. Spence s.n.* (holotype: NDG40602-42052 [JStor]).

Phacelia eremophila Greene, Pittonia 5:20. 1902. *Phacelia ramosissima* Douglas ex Lehmann forma *decumbens* (Greene) Brand, Univ. Calif. Publ. Bot. 4:215. 1912, in part. *Phacelia ramosissima* Douglas ex Lehmann var. *eremophila* (Greene) J. F. Macbride, Contributions from the Gray Herbarium of Harvard University, new series 49:30, 31. 1917. ---TYPE: USA, Nevada, Pershing Co., West Humboldt Mountains, July 1894, *E. L. Greene s.n.* (holotype: NDG29371-41846 [JStor]).
Greene listed two specimens in the protologue for *P. eremophila*, his collection and that of *C. F. Baker 1198* (Greene 1902). Greene preferred his own collection as the "West Humboldt type", noted "type" on the label for NDG29371-41846, and Howell also listed only the Greene collection as the type (Howell 1943). The Baker collection is thus a paratype (USA, Nevada, Ormsby Co., King's Canon near Carson, frequent in moist thickets, 1700–2000 m, 30 June 1902, *C. F. Baker 1198* (NDG32132-41844 [JStor], NDG40586-41845 [JStor]).

Phacelia ramosissima Douglas ex Lehmann var. *subglabra* M. Peck, Torreya 28(3):55-56. 1928 ---TYPE: USA, Oregon, Klamath Co., collected on a rocky hillside at Keno, 7 July 1920, *M. E. Peck 9367* (holotype: OSC-ORE95924 not seen; isotypes UWBM-158386 not seen, K!).

Phacelia alvordensis M. E. Jones, Contributions to Western Botany no. 17:30–31. 1930. ---TYPE: USA, Oregon, lower slopes of Stein's mountain, Alvord Ranch, 5 July 1930, *M. E. Jones 25566* (holotype: POM178977-RSA0003805 [JStor]; isotypes: RSA476495-0003806 [JStor], NY83971 [sweetgum, JStor], DS230127-0006692! [CAS, JStor], COLO405816-397661 [RM, JStor], WTU 670JWT-WTU-V-000836 [CPNWH, JStor], BM000503460 [BM, JStor], WISv0256080WIS [JStor]).

Phacelia ramosissima Douglas ex Lehmann var. *montereyensis* Munz, Aliso 4:97. 1958. ---TYPE: USA, California, Monterey Co., Sand hills bordering Carmel Bay, Carmel, 3 August 1930, *J. T. Howell 5434* (holotype: RSA26545-0003879 [JStor]; isotypes: CAS188425-0006835! [CAS, JStor], POM299079-0003880 [JStor]).
Phacelia ramosissima Douglas ex Lehmann var. *austrolitoralis* Munz, Aliso 4:97. 1958. ---

TYPE: USA, California, Orange Co., Sandy soil in an arroyo one mile north of Laguna Beach, plants 8-10 feet tall [wide maybe, comment by me], altitude 50 feet, 17 July 1927, *J. T. Howell 2790-field number 421* (holotype: RSA630-0003878 [JStor]; isotype CAS188402-0006834! [CAS, JStor]).

Invalid names:
Phacelia ramosissima Douglas ex Lehmann var. *valida* M. Peck, Torreya 28:56. 1928. ---TYPE: USA, Oregon, Lake Co., Lakeview, dry rocky slope near Lakeview, 5 July 1927, *M. E. Peck 15496* (Holotype OSC-WILLU14659 not seen [det. by *R. Halse*]; Isotype UWBM158387 not seen, OSC-ORE95925 not seen). (nomen invalidum, ICN 24.3).

Autonym:
Phacelia ramosissima Douglas ex Lehmann var. *ramosissima* is the accepted autonym.

Distribution of georeferenced specimens in *P. ramosissima,* Fig. 3.44 (North America, scale bar 1600 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.22.

n = 11 (UC614673, as *P. ramosissima*) (Cave and Constance 1942).
n = 11 (UC666546, as *P. ramosissima*) (Cave and Constance 1944).
n = 11 (UC735067, as *P. ramosissima*) (Cave and Constance 1947).
n = 11 (UC708748, as *P. ramosissima*) (Cave and Constance 1947).
n = 10 (UC697613, as *P. suffrutescens*) (Cave and Constance 1947).
n = 10 (UC697614, as *P. suffrutescens*) (Cave and Constance 1947).

PHACELIA RATTANII

Phacelia rattanii A. Gray, Proceedings of the American Academy of Arts and Sciences 20:302–303. 1885, as 'Phacelia Rattani'. ---TYPE: USA, California, Lake Co., Coast Mountains north of San Francisco Bay, moist shaded ground along streams, June 1884, *V. Rattan s.n. [41]* (hololectotype, designated here: GH00093457 [kiki, JStor]; isolectotype K!, UC201731!, P 00648903! [cold.br, JStor], P 00648904! [cold.br, JStor], BM 000503461 [BM, JStor], not georeferenced). SYNTYPE: USA, California, Lake Co., July 1884, *Mrs. Katherine Layne Curran* (syntype GH not seen; isosyntype K!, DS 8508-006836! [CAS, JStor], DS 8507-006837! [CAS, JStor]); SYNTYPE: USA, Oregon, [Josephine Co.], S. Oregon, Grant’s Pass, 24 June 1884, *Thomas J. Howell* (syntype GH not seen, isosyntype CAS, S 12-4826 [andor, JStor], S 12-4824 [andor, JStor]).
Gray noted in the protologue that three collectors (i.e., *Rattan, Howell, Curran*) sent specimens [syntypes], "but first came to hand from Mr. Rattan.” (p. 303) (Gray 1885). Following Gray's effective choice, I designate the Rattan specimen that best matches the information in the protologue as the lectotype here, and the collections of Curran and Howell as syntypes. The Rattan labels were probably collected in 1884; however, the '4' looks like a '2' on some labels, and so has been databased as collection year 1882 or 1884. Gray sent out duplicates after publication lacking some of the label information (e.g., collection number, locality); however, these are likely part of the original material and are included in the list of isolectotypes here.

Phacelia flaccida Elmer, Botanical Gazette 41(No. 5):323. 1906. ---TYPE: USA, California, Santa Clara Co., Schattige Ufer des Los Gatos Creek, Wright's Station on banks of Los Gatos Creek, [elev not given], June 1903, *A. D. E. Elmer 4404*. 'original zu *P. flaccida*'. (holotype: DS 65077-0027104! [CAS]; isotypes CAS141158-0006874! [CAS, JStor], NY00083935 [sweetgum, JStor], POM64980-RSA0003834 [JStor], UC306566! [UCJEPS Specimen Images], SBBG 33316-000093 [JStor], MICH 1192359 [herb2ic, JStor], ARIZ 88633-BOT-0005105 [SEINet, JStor], ORE 95928-0000697 [Oregon Digital, JStor], OSC 15805-0001503 [Oregon Digital, JStor], US665300-00110497 [NMNH, Collections Search Center, JStor], WS-VP-82976 [WSU]).

Distribution of georeferenced specimens in *P. rattanii,* Fig. 3.45 (North America, scale bar 1600 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.23.

n = 11 (UC735116) (Cave and Constance 1947).

PHACELIA TANACETIFOLIA

Phacelia tanacetifolia Bentham in Lindley, Edward's Botanical Register, Vol. 20 (new series 7), t. 1696. 1835 [1 August 1834]. ---LECTOTYPE, designated by Cecchi and Selvi, 2013 [2014]: USA, California, 1833, *D. Douglas s.n.* (hololectotype: K000857695! (wild-collected material on right, excluding left plant of K000857694! *P. tanacetifolia* grown in garden of Bentham at Kew) [Kew Catalogue, JStor]; isolectotypes: E 00288426 (wild-collected material on right, excluding two plants on left grown in garden of Bentham at Kew) [RGBE, JStor], G-DC-00134391 (wild-collected material on left, excluding plant on the right *P. distans* sensu lato) [ville.ge], CGE064606!; paralectotypes: E 00288426 (two plants on left grown in garden of Bentham at Kew, excluding wild-collected material on right), K000857694! (*P. tanacetifolia* grown in garden of Bentham at Kew on left, excluding wild-collected material K000857695! on right).

Cecchi and Selvi (2013 [2014]) recently lectotypified *P. tanacetifolia*, an important taxon of wide distribution for horticultural purposes. Additional isolectotypes are added here from G-DC and CGE. I exclude the isolectotype K000857692! [Kew Catalogue, JStor] (on left, mounted with K000857693!, Expedition to California 1845-7, *Torrey in 1850* [sic], *P. tanacetifolia*) from the circumscription of the name, as this is a Douglas collection of *P. distans* sensu lato. The specimen is annotated as *P. tanacetifolia* with the stamp from Bentham's herbarium. The sketches on the sheet are associated with K000857693 and best match the morphology of that specimen, and recapitulate the protologue plate closely. It is unlikely that K000857692 material was used as the basis of the original descriptions or in horticulture.

Bentham described the taxon from material of Douglas from California, and read the description on June 17th, 1834 (p. 267), and the description appeared in the issue published May 1835, with the volume not appearing until 1837 (Bentham 1835 [read June 17th, 1834, issue published 1835, volume published 1837]). That same day (17 June 1834), Bentham also described horticultural successes from the collections of Douglas, including an amplified description for *P. tanacetifolia*, which was later published in 1835 in a separate article (Bentham 1835 [read June 17th, 1834]). Bentham sent material grown from his garden (at Kew) with the wild-collected type material of Douglas as duplicates. Lindley presented *P. tanacetifolia* in volume 20, plate 1696 of the Botanical Register [1 August 1834] (Lindley 1834 [1 August 1834]). Volume 20 includes plates 1653–1741, and was issued March 1834 through February 1835, and the entire volume published in 1835 (Lindley 1835 [1 March 1834 to 1 February 1835]). The description of *P. tanacetifolia* cited the page number and volume for the Trans. Hort. publication, and Benth. Mss. for the article that would later be published in the Trans. Linn. Soc., but has publication priority for the name.

Phacelia tanacetifolia Bentham forma *staminea* Brand, University of California Publications in Botany 4:216. 1912. ---TYPE: USA, California, Tulare Co., Felder, Deer Creek, altitude 500-600 ft., May-October 1898, *C. A. Purpus 5687* (holotype: UC131467! [UCJEPS Specimen Images, JStor]).

Phacelia tanacetifolia Bentham var. *cinerea* Brand, University of California Publications in Botany 4:216. 1912, as 'var. b. cinerea' in the key. ---TYPE: USA, California, Inyo Co., sunny slopes, Argus Mts., altitude 4000–5000 ft., [1 June] June-September 1897, *C. A. Purpus 5042* (holotype: UC131697! [UCJEPS Specimen Images, JStor]).
This is a mounded, smaller form that occurs on granitic sandy slopes and after burns, infrequently.

Phacelia tanacetifolia Bentham subvar. *tenuisecta* Brand, Pp. 90, 91 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59). Verlag von Wilhelm Engelmann, Leipzig. 1913, as "subvar. *β tenuisecta*". ---TYPE: USA, California, San Bernardino County [possibly Riverside County], along Gage Canal at mouth of canyon, vicinity of San Bernardino, Reche Canyon, 1000–2500 ft., 15 May 1897, *S. B. Parish 4314* (lectotype, designated here: UC64051!). SYNTYPE: USA, California, Sutter Co., [Yuba Co. indicated on protologue], Willow Branch, Butte Pass, Marysville Buttes, 20 April 1891, *W. L. Jepson 21032* (syntype: JEPS1304! [UCJEPS Specimen Images, JStor]). SYNTYPE: USA, California, San Francisco Co., "Bei San Francisco" [San Francisco Bay], no collector given, (Herb. Boissier). SYNTYPE: USA, California, Contra Costa Co., Antioch [Es ist beachtenswert, wie viel verschiedene Formen von *P. distans* und *tanacetifolia* gerade bei Antioch vorkommen], 7 April 1895, *J. B. Davy 952* (UC24487!). SYNTYPE: USA, California, San Joaquin Co., Tracy, May 1889, *T. S. Brandegee s.n.* (UC107558!). SYNTYPE: USA, California, Fresno County, Alcalde, n.d., *T. S. Brandegee s.n.* (UC107464!). SYNTYPE: USA, California, Fresno County, Huron, n.d., *K. Brandegee s.n.* (UC107562!). SYNTYPE: México, Bei Los Angeles [Los Angeles Bay], *Franceschi s.n.* (Herb. Boissier).
Brand listed several specimens without designating a type. Brand cited Jepson (p. 326) (Jepson 1891) and Parish (p. 90–91) (Parish 1898) as references for the new subvariety "*tenuisecta*". The reference of Jepson is a determination and locality for specimen *W. L. Jepson 21032*. These two references are reflected in Brand's key to varieties and subvarieties of *P. tanacetifolia* (p. 90) to diagnose taxa (Brand 1913). Although Jepson is the first reference and specimen, I select the last listed specimen of Parish as the lectotype, as it provided the basis for the full original description of subvar. *tenuisecta*. All other listed specimens are syntypes.

The collection from Alcalde was given as a Brandegee collection, and there are several specimens on Brandegee labels from this location. The sheet that Brand annotated is designated here as the syntype (UC107464!). Brand was quite thorough in annotating and citing specimens that he examined. Brand annotated other specimens at UC that were not cited in his treatment with the name (e.g., !Br Ph. tanacetifolia tenuisecta, UC126004!). The other Brandegee collection from Alcalde (UC107378!) [Alcalde, May 1891], and another, very similar specimen (UC107466!) is also on a Brandegee label, with Brandegee crossed out, and the collector as Alice Eastwood [Alcalde, 9 May 1893]. It is difficult to determine the relationship of the specimens to each other [time, locality, collector] with the current state of documentation of Brandegee collections, but these collections may be eligible for consideration as syntypes.

Phacelia tanacetifolia Bentham var. *pseudodistans* Brand, Pp. 90, 91 *in* A. Engler (ed.), Das Pflanzenreich IV, Vol. 251 (Heft 59), Verlag von Wilhelm Engelmann, Leipzig. 1913, as "var. b. *pseudo-distans*". ---TYPE: USA, California, Stanislaus Co., Red Mountains, Mt. Hamilton Range, May 1903, *A. D. E. Elmer 4338* (holotype: Herb. Delile in MPU not seen; isotypes: JEPS1285!, UC306556!, POM65352 not seen, US665235-00110570 [NMNH, Collections Search Center, JStor]).
This is the form that occurs on serpentine soils.

Invalid names and autonyms:
Phacelia tanacetifolia Bentham var. *tanacetifolia* is the accepted autonym, and replaces *P. tanacetifolia* Bentham var. *genuina* Brand, University of California Publications in Botany 4:216. 1912, as "var. a. *genuina*" ["Die häufigste form" p. 91, Brand in Engler 1913] (nomen invalidum, ICN 24.3).

Distribution of georeferenced specimens in *P. tanacetifolia,* Fig. 3.46 (North America, scale bar 1600 miles). Figure 3.47, screen grab from BerkeleyMapper 2.0 georeferencing of *P. tanacetifolia* accession, Hwy 58, near McKittrick, Kern County, California. List of accession numbers for specimens examined and georeferenced, Appendix 3.24.

n = 9 (no voucher cited, 328, Pp. 329 Fig. 1, a&b) (Tjebbes 1928).
n = 11 (no voucher cited) (Sugiura 1936).
n = 11 (UC614678) (Cave and Constance 1942).
n = 11 (UC671733) (Cave and Constance 1942).
$2n$ = 22 (no voucher). Published in Heiser and Whittaker (1948), using lists of Darlington and Ammal (1945), Löve and Löve (1942), Maude (1939), and Tischler (1927, 1931, 1935, 1936, 1938).
n = 11 (no voucher cited) (Feráková 1974).
n = 11 (no voucher cited) (Uhríková 1978).
n = 11 (no voucher cited) (Izmailow 1991).

PHACELIA THERMALIS

Phacelia thermalis Greene, Erythea 3(No. 4):66. 1895. *Phacelia ciliata* Bentham var. *thermalis* (Greene) Jepson, Manual of the Flowering Plants of California 824. 1925. ---TYPE: USA, California, Modoc Co., Little Hot Springs Valley, 4 June 1894, *M. S. Baker and F. Nutting s.n.* (holotype: NDG40512-42067 [JStor]; isotypes: JEPS2794! [UCJEPS Specimen Images, CCH, JStor])

Howell cited an additional isotype at CAS for *P. thermalis*, but this specimen is a topotype, collected 18 August 1899 - after publication of the protologue (Greene 1895; Howell 1943). TOPOTYPE: USA, California, Modoc Co., Little Hot Springs Valley, 18 August 1899, *M. S. Baker and F. Nutting s.n.* (UC56441!, CAS937!, K!).

Phacelia firmomarginata A. Nelson, Botanical Gazette 54(2):143. 1912. ---TYPE: USA, Idaho, Owyhee Co., Twilight Gulch, dry slopes, 5500 feet, 23 June 1911, *J. F. Macbride 979* (holotype: RM 71564-0002831 [RM, JStor]; isotypes: RM 293809-0002832 [RM, JStor], GH93332 [kiki, JStor], NY83936 [sweetgum, JStor], US543666-00110496 [NMHM, Collections Search Center, JStor], F345869-V0060829F digital image! [EMUweb Field Museum, JStor], MIN177521-1002025 [JStor], POM65805-RSA0003832 [JStor], RSA350993-0003833 [JStor]), UC165332!.

Distribution of georeferenced specimens in *P. thermalis,* Fig. 3.48 (North America, scale bar 1600 miles), Fig. 3.49, (North America, scale bar 300 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.25.

n = 11 (UC791037) (Cave and Constance 1950).

PHACELIA VALLIS-MORTAE

Phacelia vallis-mortae J.W.Voss, Bulletin of the Southern California Academy of Sciences 33(3):175–176, fig. 5. 1935. ---TYPE: USA, California, Inyo Co., common in sandy wash, peculiar reddish lavender [in reference to the corolla], Keane's Spring, Amargosa Range, Death Valley, altitude 3500 ft., 9 May 1932, *P. A. Munz 12580* (holotype: POM187405-RSA0003885 [CCH, JStor]; isotypes: MO1071913-694507 [TROPICOS, JStor], US1635771-00110572 [NMNH, Collections Search Center, JStor], GH00093501[kiki, JStor]).

Phacelia vallis-mortae J.W.Voss var. *vallis-mortae* is the accepted autonym if varieties are recognized in *P. vallis-mortae*, and replaces *P. vallis-mortae* J.W.Voss var. *typica* J.W.Voss, Bulletin of the Southern California Academy of Sciences 33:176. 1935. (nomen invalidum) (Voss 1935; McNeill et al. 2012).

Distribution of georeferenced specimens in *P. vallis-mortae,* Fig. 3.50 (North America, scale bar 1400 miles), Fig. 3.51, (North America, scale bar 200 miles). List of accession numbers for specimens examined and georeferenced, Appendix 3.26.

n = 11 (UC753387) (Cave and Constance 1950).

LITERATURE CITED

AKAIKE, H. 1973. Information theory and an extension of the maximum likelihood principle. Pp. 267–281. *In* B. N. Petrov and F. Caski (eds.), Proceedings of the Second International Symposium on Information Theory. Akademiai Kiado, Budapest. Springer-Verlag, New York, NY.

———. 1974. A new look at the statistical model identification. IEEE Transactions on Automatic Control 19(6):716–723.

ÁLVAREZ, I., AND J. F. WENDEL. 2003. Ribosomal ITS sequences and plant phylogenetic inference. Molecular Phylogenetics and Evolution 29(3):417–434.

APG II. 2003. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG II. Botanical Journal of the Linnean Society 141:399–436.

APG III. 2009. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants. Botanical Journal of the Linnean Society 161(2):105–121.

ARMBRUSTER, W. S., S. A. CORBET, A. J. VEY, S.-J. LIU, AND S.-Q. HUANG. 2013. In the right place at the right time: *Parnassia* resolves the herkogamy dilemma by accurate repositioning of stamens and stigmas. Annals of botany:mct261.

BAJAFLORA. *The Flora of Baja California. Specimen data obtained from a combined multi-herbarium specimen database called the Baja California Botanical Consortium hosted by the San Diego Natural History Museum. Herbarium specimen data provided by: San Diego Natural History Museum (SDNHM), San Diego State University (SD), Rancho Santa Ana Botanic Garden (RSA), Pomona College (POM), Centro del Investigaciones Biologicas del Noroeste, La Paz (HCIB), and Universidad Autonoma de Baja California, Ensenada (BCMEX)* 2015. Available from http://www.bajaflora.org.

BAKER, C. F. 1903. West American Plants: Distributed by C. F. Baker. II.

BALDWIN, B. G. 2000. Roles for modern plant systematics in discovery and conservation of fine-scale biodiversity. Madroño 47(4):219–229.

———. 2007. Adaptive radiation of shrubby tarweeds (*Deinandra*) in the California Islands parallels diversification of the Hawaiian silversword alliance (Compositae-Madiinae). American Journal of Botany 94(2):237–248.

BALDWIN, B. G., D. H. GOLDMAN, D. J. KEIL, R. PATTERSON, T. J. ROSATTI, AND D. H. WILKEN, eds. 2012. *The Jepson Manual: vascular plants of California*, Second Edition. University of California Press, Berkeley, California.

BALDWIN, B. G., M. J. SANDERSON, J. M. PORTER, M. F. WOJCIECHOWSKI, C. S. CAMPBELL, AND M. J. DONOGHUE. 1995. The ITS region of nuclear ribosomal DNA: a valuable source of evidence on angiosperm phylogeny. Annals of the Missouri Botanical Garden 82(2):247–277.

BARR, C. M. 2014. Phylogenetic relationships and crossing data reveal a new species of *Nemophila* (Boraginaceae). Madroño 61(3):308–315.

BENSON, D. A., M. CAVANAUGH, K. CLARK, I. KARSCH-MIZRACHI, D. J. LIPMAN, J. OSTELL, AND E. W. SAYERS. 2013. GenBank. Nucleic Acids Res 41(Database issue):D36–42.

BENTHAM, G. 1835 [read June 17th, 1834, issue published 1835, volume published 1837]. Review of the order of Hydrophylleae. Transactions of the Linnean Society 17:267–282.

———. 1835 [read June 17th, 1834]. Report on some of the more remarkable Hardy Ornamental Plants raised in the Horticultural Society's Garden from seeds received from Mr. David

Douglas, in the years 1831, 1832, 1833. Transactions of the Horticultural Society of London, series 2 1:476–481.
BRAND, A. 1912. Die Hydrophyllaceen der Sierra Nevada. University of California Publications in Botany 4(13):209–227.
———. 1913. Hydrophyllaceae. Pp 1-210 *In* Das Pflanzenreich IV, Vol. 251 (Heft 59), Adolf Engler (ed.). Verlag von Wilhelm Engelmann, Leipzig [in German, translation by GKW].
BRAUN, U., AND A.-K. WITTIG. 2013. Typusmaterial des Herbariums der Martin-Luther-Universität Halle-Wittenberg (HAL) Teil 4: Taxa beschrieben von DFL von Schlechtendal. Schlechtendalia 10:15–65.
BREMER, B., K. BREMER, N. HEIDARI, P. ERIXON, R. G. OLMSTEAD, A. A. ANDERBERG, M. KÄLLERSJÖ, AND E. BARKHORDARIAN. 2002. Phylogenetics of asterids based on 3 coding and 3 non-coding chloroplast DNA markers and the utility of non-coding DNA at higher taxonomic levels. Molecular phylogenetics and evolution 24(2):274–301.
BREMER, K., M. W. CHASE, P. F. STEVENS, A. A. ANDERBERG, A. BACKLUND, B. BREMER, B. BRIGGS, P. K. ENDRESS, M. F. FAY, P. GOLDBLATT, M. H. G. GUSTAFSSON, S. B. HOOT, W. S. JUDD, M. KALLERSJÖ, E. A. KELLOGG, K. A. KRON, D. H. LES, C. M. MORTON, D. L. NICKRENT, R. G. OLMSTEAD, R. PRICE, C. J. QUINN, AND J. E. RODMAN. 1998. An ordinal classification for the families of flowering plants. Annals of the Missouri Botanical Garden 85(4):531–553.
BUCKLEY, S. B. 1862 [1861]. Description of new plants from Texas. Proceedings of the Academy of Natural Sciences of Philadelphia:448–449, 462–463.
CANTINO, P. D., AND K. DE QUEIROZ. *Phylocode (version 4c): A phylogenetic code of biological nomenclature* 2010. Available from http://www.ohio.edu/phylocode/index.html.
CANTINO, P. D., J. A. DOYLE, S. W. GRAHAM, W. S. JUDD, R. G. OLMSTEAD, D. E. SOLTIS, P. S. SOLTIS, AND M. J. DONOGHUE. 2007. Towards a phylogenetic nomenclature of Tracheophyta. Taxon 56(3):E1–E44.
CARLQUIST, S. J. 1965. Island life; a natural history of the islands of the world. Illustrations by S. Carlquist, J. R. Janish, and C. S. Papp. Published for the American Museum of Natural History by the Natural History Press, Garden City, N.Y.
CARLQUIST, S. J., AND V. M. ECKHART. 1984. Wood anatomy of the Hydrophyllaceae. II. Genera other than Eriodictyon, with comments on parenchyma bands containing vessels with large pits. Aliso 10:527–546.
CAVE, M. S., AND L. CONSTANCE. 1942. Chromosome numbers in the Hydrophyllaceae. University of California Publications in Botany 18:205–216.
———. 1944. Chromosome numbers in the Hydrophyllaceae, II. University of California Publications in Botany 18:293–298.
———. 1947. Chromosome numbers in the Hydrophyllaceae, III. University of California Publications in Botany 18:449–465.
———. 1950. Chromosome numbers in the Hydrophyllaceae, IV. University of California Publications in Botany 23:363–382.
———. 1959. Chromosome numbers in the Hydrophyllaceae, V. University of California Publications in Botany 30:233–258.
CECCHI, L., AND F. SELVI. 2013 [2014]. A synopsis of Boraginaceae subfam. Hydrophylloideae and Heliotropioideae in Italy. Plant Biosystems-An International Journal Dealing with all Aspects of Plant Biology 148(1):2–12.

CHAMISSO, A. V. 1829. Boragineae. *In* Linnaea: Ein Journal für die Botanik in ihrem ganzen Umfange, edited by A. Garcke and D. F. L. v. Schlechtendal. F. Dümmler, Berlin.
CHAMISSO, A. V., AND H. KRATZ. 1986. A voyage around the world with the Romanzov exploring expedition in the years 1815-1818 in the brig Rurik, Captain Otto von Kotzebue. Translated by H. Kratz. University of Hawaii Press, Honolulu.
CHINA PLANT BOL GROUP, D.-Z. LI, L.-M. GAO, H.-T. LI, H. WANG, X.-J. GE, J.-Q. LIU, Z.-D. CHEN, S.-L. ZHOU, S.-L. CHEN, J.-B. YANG, C.-X. FU, C.-X. ZENG, H.-F. YAN, Y.-J. ZHU, Y.-S. SUN, S.-Y. CHEN, L. ZHAO, K. WANG, T. YANG, AND G.-W. DUAN. 2011. Comparative analysis of a large dataset indicates that internal transcribed spacer (ITS) should be incorporated into the core barcode for seed plants. Proceedings of the National Academy of Sciences 108(49):19641–19646.
CHOISY, J. D. 1833. Description des Hydroléacées. Mem Soc Phys 6:95–122, plate 1–3.
———. 1846. Hydroleaceae, Pp. 179–185. *In* A de Candolle (ed.), Prodromus Systematis Naturalis Regni Vegetabilis. Sumptibus Sociorum Treuttel et Würtz, Paris.
CLARIDGE, M. F. 2009. Species are Real Biological Entities. *In* Contemporary Debates in Philosophy of Biology. Wiley-Blackwell.
California Native Plant Society (CNPS), Inventory of Rare and Endangered Plants. 2015. http://www.cnps.org/inventory.
COHEN, J. I. 2013. A phylogenetic analysis of morphological and molecular characters of Boraginaceae: evolutionary relationships, taxonomy, and patterns of character evolution. Cladistics Online edition, DOI: 10.1111/cla.12036 (accessed 12 July 2013):1–31.
CONSORTIUM OF CALIFORNIA HERBARIA [CCH]. *Data provided by the participants of the Consortium of California Herbaria [CCH]*. Regents of the University of California 2015. Available from <http://ucjeps.berkeley.edu/consortium/.
CONSORTIUM OF PACIFIC NORTHWEST HERBARIA [CPNWH]. *Herbarium specimen data provided by: B. A. Bennett Herbarium, Yukon Government (BABY), Boise District Bureau of Land Management (BBLM), Boise State University, Snake River Plains Herbarium (SRP), Bureau of Land Management, Medford District (BLMMD), College of Idaho, Harold M. Tucker Herbarium (CIC), Eastern Washington University (EWU), Evergreen State College (EVE), Friday Harbor Laboratories (FHL), H.J. Andrews Experimental Forest (HJAEF), Humboldt State University (HSC), Idaho State University, Ray J. Davis Herbarium (IDS), Linfield College (LINF), Milner Gardens and Woodland, Vancouver Island University (VIU), Montana State University (MONT), Oregon State University (OSC), Pacific Lutheran University (PLU), Pacific Northwest Herbarium, Western Washington University (WWB), Portland State University (HPSU), Reed College (REED), Royal British Columbia Museum (V), Southern Oregon University (SOC), The New York Botanical Garden (NY), University of Alaska, Anchorage (UAAH), University of Alaska, Fairbanks - Museum of the North (ALA), University of British Columbia (UBC), University of Idaho, Stillinger Herbarium (ID), University of Lethbridge (LEA), University of Montana (MONTU), University of Puget Sound (PSM), University of Washington (WTU), University of Wyoming, Rocky Mountain Herbarium (RM), Washington State University, Marion Ownbey Herbarium (WS), Whitman College (WCW). Accessed through the Consortium of Pacific Northwest Herbaria web site* 2015. Available from www.pnwherbaria.org.
CONSTANCE, L. 1948. A new species of *Phacelia* from Sonora, México. Madroño 9(8):255–256.

———. 1949. A revision of *Phacelia* subgenus *Cosmanthus* (Hydrophyllaceae). Contributions to the Gray Herbarium 168:1–48.

———. 1951. Hydrophyllaceae, Pp. 476–532. Illustrations by J. R. Janish. *In* L. R. Abrams and R. S. Ferris, (eds.), Illustrated Flora of the Pacific States. 4 vols. Vol. 3. Geraniaceae to Scrophulariaceae, geraniums to figworts. Stanford University Press, Stanford, California.

———. 1963. Chromosome number and classification in Hydrophyllaceae. Brittonia 15:273–285.

CONSTANCE, L., AND T.-I. CHUANG. 1982. SEM survey of pollen morphology and classification in Hydrophyllaceae (Waterleaf Family). American Journal of Botany 69:40–53.

COVILLE, F. V. 1893. Botany of the Death Valley Expedition. Contributions U.S. National Herbarium 4:1–318.

———. 1895. The Botanical Explorations of Thomas Coulter in Mexico and California. Botanical Gazette 20(12):519–531.

COYLE, J., AND N. C. ROBERTS. 1975. A field guide to the common and interesting plants of Baja California. Natural History Publications Company, La Jolla, CA.

DARLINGTON, C. D., AND E. K. J. AMMAL. 1945. Chromosome atlas of cultivated plants. G. Allen & Unwin Ltd., London.

DARRIBA, D., G. L. TABOADA, R. DOALLO, AND D. POSADA. 2012. jModelTest 2: more models, new heuristics and parallel computing. Nature methods 9(8):772–772.

DAVENPORT, L. J. 1988. A monograph of Hydrolea (Hydrophyllaceae). Rhodora 90:169–208.

DI FULVIO, T. E. 1997. Morfología y vascularización floral en Hydroleae e Hydrophylleae (Hydrophyllaceae). Kurtziana 25:7–34.

DODD, S. C., AND K. HELENURM. 2002. Genetic diversity in *Delphinium variegatum* (Ranunculaceae): a comparison of two insular endemic subspecies and their widespread mainland relative. American Journal of Botany 89(4):613–622.

DOUGLAS, D. 1914. Journal kept by David Douglas during his travels in North America 1823-1827 together with a particular description of thirty-three species of American oaks and eighteen species of *Pinus*, with appendices containing a list of the plants introduced by Douglas and an account of his death in 1834. Published under the direction of the Royal Horticultural Society by W. Wesley & Son, London. Website http://www.archive.org/details/journalkeptbydav00dougiala (accessed 18 January 2014).

DOWNIE, S. R., D. S. KATZ-DOWNIE, AND M. F. WATSON. 2000. A phylogeny of the flowering plant family Apiaceae based on chloroplast DNA *rpl16* and *rpoc1* intron sequences: towards a suprageneric classification of subfamily Apioideae. American Journal of Botany 87:273–292.

DOYLE, J. J., AND E. E. DICKSON. 1987. Preservation of plant samples for DNA restriction endonuclease analysis. Taxon 36:715–722.

DUPREE, A. H. 1952. Thomas Nuttall's controversy with Asa Gray. Rhodora 54(648):293–303.

EASTWOOD, A. 1898. Notes on the plants of San Nicolas Island. Proc. Calif. Acad. Sci., ser 3(1):89–120.

EDGAR, R. C. 2004. MUSCLE: multiple sequence alignment with high accuracy and high throughput. Nucleic Acids Research 32(5):1792–1797.

EMORY, W. H., G. ENGLEMANN, C. C. PARRY, AND J. TORREY. 1859. Report on the United States and Mexican boundary survey: made under the direction of the secretary of the Interior. By William H. Emory, major First Cavalry, and United States commissioner. Vol. Volume 2, part 1, Botany of the Boundary. C. Wendell, printer, Washington, D.C.

ERBAR, C., S. POREMBSKI, AND P. LEINS. 2005. Contributions to the systematic position of Hydrolea (Hydroleaceae) based on floral development. Plant Systematics and Evolution 252(1):71–83.

FERÁKOVÁ, V. 1974. *In* Májovský, J., et al. (ed.). Index of chromosome numbers of Slovakian flora (Part 4). Acta Facultatis rerum naturalium Universitatis Comenianae, Botanica. 23:1-23.

FERGUSON, D. M. 1996. Phylogenetic analysis of Hydrophyllaceae and a preliminary study of biogeographic patterns and life history evolution. American Journal of Botany (supplement) 83:155–156.

———. 1997. Phylogenetics systematics in Hydrophyllaceae as inferred from the chloroplast gene *ndhF* and the nuclear rDNA *ITS* region. American Journal of Botany (supplement) 84:557.

———. 1998. Phylogenetic systematics of Hydrophyllaceae. Ph.D. Dissertation, Biology, Harvard, Cambridge.

———. 1998 [1999]. Phylogenetic analysis and relationships in Hydrophyllaceae based on *ndh*F sequence data. Systematic Botany 23(3):253–268.

GARRISON, L. M. 2007. Phylogenetic relationships in *Phacelia* (Boraginaceae) inferred from *nrITS* sequence data. M.S. Thesis, Biology, San Francisco State University, San Francisco.

GARRISON, L. M., AND R. PATTERSON. 2009. Elevation of *Phacelia cicutaria* var. *hubbyi* (Boraginaceae) to species status. Madroño 56(3):205–207.

GILBERT, C., J. M. DEMPCY, C. K. GANONG, R. PATTERSON, AND G. S. SPICER. 2005. Phylogenetic relationships within *Phacelia* subgenus *Phacelia* (Hydrophyllaceae) inferred from nuclear rDNA ITS sequence data. Systematic Botany 30:627–634.

GRAY, A. 1862. Notes upon the "Description of New Plants from Texas, by S. B. Buckley" Proceedings of the Academy of Natural Sciences of Philadelphia 14:161–168.

———. 1875. A Conspectus of the North American Hydrophyllaceae. Proceedings of the American Academy of Arts and Sciences 10:312–332.

———. 1878. Synoptical Flora of North America. Vol. II, part I. Smithsonian Institute, Washington, D.C.

———. 1882. Contributions to North American botany. Proceedings of the American Academy of Arts and Sciences 17:163–230.

———. 1885. Contributions to the Botany of North America. Proceedings of the American Academy of Arts and Sciences 20:257–310.

———. 1886. Supplement to Vol. II., Part I., additions and corrections. Pp. 394-494, 413-418. *In* A. Gray, Synoptical flora of North America. Ivison, Blakeman, Taylor and Co., New York, NY.

———. 1887. Contributions to American botany, revision of some polypetalous genera and orders precursory to the Flora of North America. Proceedings of the American Academy of Arts and Sciences 23:270–287.

GREENE, E. L. 1886 [1885]. Studies in the botany of California and parts adjacent, II. Bulletin of the California Academy of Sciences 1(4):179–228.

———. 1888. New or noteworthy species. Pittonia 1:215–230.

———. 1894a. Manual of the botany of the region of San Francisco Bay. Cubery and Company, San Francisco.

———. 1894b. Novitates occidentales, IX. Erythea 2(12):189–191.

———. 1895. Novitates Occidentales XII. Erythea 3(4):62–68.
———. 1902. Some *Phacelia* segregates. Pittonia 5:17–23.
GRIESEL, W. O. 1939. Ecotypes of *Phacelin hispida* Gray var. *genuina* Brand as found in the Hollywood hills. Thesis, Botany, University of California Los Angeles, Los Angeles.
GRIMÉ, W. E., AND T. PLOWMAN. 1987. Type Photographs at the Field Museum of Natural History. Taxon 36(2):425–426.
GUINDON, S., AND O. GASCUEL. 2003. A simple, fast, and accurate algorithm to estimate large phylogenies by maximum likelihood. Systematic Biology 52(696-704).
HALSE, R. R., D. WILKEN, AND R. PATTERSON. 1993. Hydrophyllaceae. *In* The Jepson Manual: Higher plants of California, J. C. Hickman (ed. University of California Press, Berkeley.
HALVORSON, W. L., S. JUNAK, C. SCHWEMM, AND T. KEENEY. 1996. Plant Communities of San Nicolas Island, California. National Biological Service, Cooperative Park Resources Studies Unit, School of Renewable Natural Resources.
HANSEN, D. R., G. S. SPICER, AND R. PATTERSON. 2009. Phylogenetic relationships between and within *Phacelia* sections *Whitlavia* and *Gymnobythus* (Boraginaceae). Systematic Botany 34(4):737–746.
HARPER, A. B., S. VANDERPLANK, M. DODERO, S. MATA, AND J. OCHOA. 2011. Plants of the Colonet region, Baja California, Mexico, and a vegetation map of Colonet Mesa. Aliso: A Journal of Systematic and Evolutionary Botany 29(1):25–42.
HARVEY, W. H. 1869. Memoir of W. H. Harvey : M.D., F.R.S., etc., etc., late professor of botany, Trinity College, Dublin. with selections from his journal and correspondence. Bell and Daldy, London.
HASENSTAB-LEHMAN, K. E., AND M. G. SIMPSON. 2012. Cat's eyes and popcorn flowers: phylogenetic systematics of the genus *Cryptantha* s.l. (Boraginaceae). Systematic Botany 37(3):738–757.
HEISER, C. B., JR., AND T. W. WHITAKER. 1948. Chromosome number, polyploidy, and growth habit in California weeds. American Journal of Botany 35(3):179–186.
HEMSLEY, W. B. 1881-1882. Biologia Centrali-Americani; or, Contributions to the Knowledge of the Fauna and Flora of México and Central America, edited by Frederick Du Cane Godman and Osbert Slavin. Botany. 5 vols. Vol. 2. Published for the editors by R. H. Porter and Dulau, 1879-1888., London.
HICKMAN, J. C., ed. 1993. The Jepson Manual: Higher plants of California. University of California Press, Berkeley.
HIEPKO, P. 1978. Collections at the Botanical Museum Berlin Dahlem West Germany saved from destruction in 1943. Willdenowia 8(2):389–400.
———. 1987. The collections of the Botanical Museum Berlin-Dahlem (B) and their history. Englera 7:219–252.
HOOKER, W. J. 1840. Flora boreali-americana, or, the botany of the northern parts of British America: compiled principally from the plants collected by Dr. Richardson & Mr. Drummond on the late northern expeditions, under command of Captain Sir John Franklin, R.N. To which are added (by permission of the Horticultural society of London,) those of Mr. Douglas, from north-west America, and of other naturalists. Vol. 2. H.G. Bohn, London.
HORNER, P. F. 1977. Biosystematics of the *Phacelia distans - P. tanacetifolia* complex. Dissertation, Botany, University of California Riverside, Riverside, Calif.

HOWELL, J. T. 1935. The Templeton Crocker Expedition of the California Academy of Sciences, 1932. No. 22. The vascular plants from San Nicolas Island, California. Proceedings of the California Academy of Sciences, Series 4, Botany 21: 277 284.
———. 1942. Studies in *Phacelia*. II. Leaflets of Western Botany 3(5):117–120.
———. 1943. Sertulum Greeneanum II, Types of *Phacelia* in the Greene Herbarium. American Midland Naturalist 30:18–39.
HUELSENBECK, J. P., AND F. RONQUIST. 2001. MRBAYES: Bayesian inference of phylogeny. Bioinformatics 17:754–755.
IZMAILOW, R. 1991. Pp. 32-33. *In* Pogan, E., A. Jankun, and H. Wcislo (eds.). Further studies in chromosome numbers of Polish angiosperms. Part XXIV. Acta Biologica Cracoviensia. Series: Botanica 33:26-43.
JEPSON FLORA PROJECT [EDS.]. *Jepson eFlora* 2015. Available from http://ucjeps.berkeley.edu/IJM.html [accessed from 2010–2015].
JEPSON, W. L. 1891. Botany of the Marysville Buttes. Bulletin of the Torrey Botanical Club 18(2):317–327.
———. 1943. Flora of California. Vol. 3. Associated Students Store, University of California Berkeley, Berkeley.
JEPSON, W. L., AND D. DOUGLAS. 1933. David Douglas in California. Madroño 2(12):97–100.
JOHNSON, A. F. 1973. A survey of the strand and dune vegetation along the Pacific coast of Baja California, Mexico. M.S. Thesis, University of California, Davis, Davis, California.
———. 1977. A survey of the strand and dune vegetation along the Pacific and Southern Gulf Coasts of Baja California, Mexico. Journal of Biogeography 4(1):83–99.
JUDD, W. S., AND R. G. OLMSTEAD. 2004. A survey of tricolpate (eudicot) phylogenetic relationships. American Journal of Botany 91(10):1627–1644.
JUNAK, S. A., AND R. PHILBRICK. 2000. Flowering plants of the San Benitos Islands, Baja California, Mexico. Paper read at Proceedings of the fifth California islands symposium.
KATOH, K., K.-I. KUMA, H. TOH, AND T. MIYATA. 2005. MAFFT version 5: improvement in accuracy of multiple sequence alignment. Nucleic acids research 33(2):511–518.
KATOH, K., K. MISAWA, K. I. KUMA, AND T. MIYATA. 2002. MAFFT: a novel method for rapid multiple sequence alignment based on fast Fourier transform. Nucleic acids research 30(14):3059–3066.
KATOH, K., AND H. TOH. 2010. Parallelization of the MAFFT multiple sequence alignment program. Bioinformatics 26(15):1899–1900.
KEEGAN, D. R., B. E. COBLENTZ, AND C. S. WINCHELL. 1994. Feral goat eradication on San Clemente Island, California. Wildlife Society Bulletin 22(1):56–61.
KELLOGG, A. 1884. New species of Cedros Island plants, collected by Dr. J. A. Veatch. Bulletin of the California Academy of Sciences 1:6–7.
LA RED MUNDIAL DE INFORMACIÓN SOBRE BIODIVERSIDAD [REMIB]. 2015. Datos provenientes de las siguientes instituciones: The Herbarium XAL of the Institute of Ecology, A.C., Mexico (IE-XAL); The Herbarium of the National School of Biological Sciences, Mexico (ENCB, IPN); National Vegetable Germplasm Bank, Mexico (BANGEV, UACH); The Herbarium of the University of Texas - Austin, USA (LL, TEX); The Herbarium IEB of the Institute of Ecology, A.C., Mexico (IE-BAJIO) (NOTE); The Herbarium of the University of Sonora, Mexico (USON); Collection of Mexican Monocotyledons (UAM-I); Pines from the Northeast of Mexico (UANL); Columnar Cacti from Mexico (IE-MORELIA, UNAM); Native Trees and Shrubs for Restoration

and Reforestation of Mexico (IE-DF, UNAM); Trees from the Yucatan Peninsula, Flora from Tehuantepec, Oaxaca and Asteraceae Family in Mexico (IBUNAM); w3TROPICOS, Missouri Botanical Garden (MO); Herbarium of the CIBNOR; The Herbarium Weberbauer of the La Molina Agrarian National University (MOL); Cacti from the Peninsula of Baja California, Mexico (UABC); Vascular Flora from the Sierra of San Pedro Martir, Baja California, Mexico (UABC); Actual Status and Phytogeography of the Species of the Endemic Family Cucurbitaceae of Mexico (FES-I, UNAM); Flora from the Valley of Tehuacan-Cuicatlan, Mexico (FES-I, UNAM); Taxonomic Study of the Genus Quercus (Fagaceae) from the State of Mexico, Mexico (FES-I, UNAM); Herbarium of the Autonomous University of Baja California, Mexico (UABC); Herbarium of the University of Arizona, USA (ARIZ); Herbarium of the Yucatan Scientific Research Center, Mexico (CICY); Bioactive Agents from Dryland Biodiversity of Latin America (ICBG); Herbarium Kew of the Royal Botanic Gardens (RBGKEW); Taxonomical types of vascular plants from the Herbarium of the Escuela Nacional de Ciencias Biológicas, Mexico (ENCB, IPN); Flora inventory of the Sierra of Pachuca, Hidalgo, Mexico (ENCB, IPN); Monographic study of Echinopepon Naud. (Cucurbitaceae) in México (ENCB, IPN); The useful flora from two native communities of the Valley of Tehuacan-Cuicatlan: Coxcatlan and Zapotitlan of Las Salinas, Puebla, Mexico (FES-I, UNAM); Herbarium of Geo. B. Hinton, Mexico; Collection of taxonomical types of vascular plants of the Herbarium of the University of Texas – Austin, Texas USA (LL, TEX); Collection of Mexican Plants pertaining to the families Loranthaceae and Lauraceae of the Herbarium of the University of Texas – Austin, Texas USA (LL, TEX); Program of repatriation of mexican specimens; Specimens collected by George Boole Hinton (1882-1943) deposited in the Herbarium at Kew: Family Leguminosae; Repatriation of plant specimens data from Arizona Herbarium (ARIZ); The genus Bursera in Mexico (IBUNAM). Bases de datos SNIB-CONABIO proyecto, México, D.F. Website http://www.conabio.gob.mx/remib_ingles/doctos/remibnodosdb.html (accessed May-June 2015).

LARKIN, M. A., G. BLACKSHIELDS, N. P. BROWN, R. CHENNA, P. A. MCGETTIGAN, H. MCWILLIAM, F. VALENTIN, I. M. WALLACE, A. WILM, R. LOPEZ, J. D. THOMPSON, T. J. GIBSON, AND D. G. HIGGINS. 2007. Clustal W and Clustal X version 2.0. Bioinformatics 23(21):2947–2948.

LEHMANN, J. G. C. 1830. Novarum et Minus Cognitarum Stirpium Pugillus. Vol. 2 Hamburg.

LEWIS, P. O., AND M. T. HOLDER. 2008. NEXUS Class Library (version 2.1), http://sourceforge.net/projects/ncl/.

LINDLEY, J. 1834 [1 August 1834]. *Phacelia tanacetifolia* Bentham in Lindley, t. 1696. *In* J. Lindley (ed.)., Edwards's botanical register, or, Ornamental flower-garden and shrubbery: consisting of coloured figures of plants and shrubs, cultivated in British gardens; accompanied by their history, best method of treatment in cultivation, propagation, &c. Vol. 20 (new series Vol. 7). James Ridgway and Sons, Piccadilly, London.

———, ed. 1835 [1 March 1834 to 1 February 1835]. Edwards's botanical register, or, Ornamental flower-garden and shrubbery: consisting of coloured figures of plants and shrubs, cultivated in British gardens; accompanied by their history, best method of treatment in cultivation, propagation, &c. Vol. 20 (new series Vol. 7). James Ridgway and Sons, Piccadilly, London.

LINNÉ, C. V. 1762. Species plantarum: exhibentes plantas rite cognitas, ad genera relatas, cum differentiis specificis, nominibus trivialibus, synonymis selectis, locis natalibus, secundum systema sexuale digestas, editio 2. Laurentii Salvii, Impensis Direct, Holmiae.

LÖVE, A., AND D. LÖVE. 1942. Chromosome numbers of Scandinavian plant species. Botaniska Notiser 94:19–59.

MACBRIDE, J. F. 1917. Notes on the Hydrophyllaceae and a few other North American spermatophytes. Contributions from the Gray Herbarium, new series 49(3):23–59.

MADDISON, D. R., AND K.-S. SCHULZ, eds. 2007. The Tree of Life Web Project. Website http://tolweb.org.

MAUDE, P. F. 1939. The Merton Catalogue. A list of the chromosome numerals of species of British flowering plants. New Phytologist 38(1):1–31.

MAYR, E. 1942. Systematics and the origin of species. Columbia University Press, New York.

MCNEILL, J., F. R. BARRIE, W. R. BUCK, V. DEMOULIN, W. GREUTER, D. L. HAWKSWORTH, P. S. HERENDEEN, S. KNAPP, K. MARHOLD, J. PRADO, W. F. P. H. V. REINE, G. F. SMITH, J. H. WIERSEMA, AND N. J. TURLAND. 2012. International Code of Nomenclature for algae, fungi, and plants (Melbourne Code) adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011. Regnum Vegetabile 154.

MCNEILL, J., F. R. BARRIE, H. M. BURDET, V. DEMOULIN, D. L. HAWKSWORTH, K. MARHOLD, D. H. NICOLSON, J. PRADO, P. C. SILVA, J. E. SKOG, J. H. WIERSEMA, AND N. J. TURLAND, eds. 2006. International Code of Botanical Nomenclature (Vienna Code). Regnum Vegetabile. Vol. 146. A. R. G. Gautner Verlag K. G.

MILLER, M. A., W. PFEIFFER, AND T. SCHWARTZ. 2010. Creating the CIPRES Science Gateway for inference of large phylogenetic trees. Paper read at Proceedings of the Gateway Computing Environments Workshop (GCE), 14 Nov. 2010, at New Orleans, LA.

MISHLER, B. D. 2009. Species are not Uniquely Real Biological Entities. *In* Contemporary Debates in Philosophy of Biology. Wiley-Blackwell.

Tropicos, botanical information system at the Missouri Botanical Garden (TROPICOS). 2015. www.tropicos.org.

MOORE, M. J., AND R. K. JANSEN. 2006. Molecular evidence for the age, origin, and evolutionary history of the American desert plant genus *Tiquilia* (Boraginaceae). Molecular Phylogenetics and Evolution 39(3):668–687.

MULLIS, K. B., F. FALOONA, S. SCHARF, R. SAIKI, G. HORN, AND H. A. ERLICH. 1987. Specific enzymatic amplification of DNA in vitro: the polymerase chain reaction. Cold Spring Harbor Symposia on Quantitative Biology 51:263–273.

MUNZ, P. A. 1958. California miscellany IV. Aliso 4:87–100.

NAZAIRE, M., AND L. HUFFORD. 2012. A broad phylogenetic analysis of Boraginaceae: implications for the relationships of *Mertensia*. Systematic Botany 37(3):758–783.

O'DELL, S. 1960. Island of the Blue Dolphins. Houghton Mifflin, Boston.

OLMSTEAD, R. G., AND D. FERGUSON. 2001. A molecular phylogeny of the Boraginaceae/Hydrophyllaceae s. str. (Abstract). Botany 2001: Plants and People:131.

OLMSTEAD, R. G., H. J. MICHAELS, K. M. SCOTT, AND J. D. PALMER. 1992. Monophyly of the Asteridae and Identification of Their Major Lineages Inferred From DNA Sequences of rbcL. Annals of the Missouri Botanical Garden 79(2):249–265.

PARISH, S. B. 1898. New or little known plants of southern California. I. Erythea 6(9):85–92.

PARRY, C. C. 1884 [read 28 December 1883]. New plants from Southern and Lower California. Proceedings of the Davenport Academy of Natural Sciences 4:38–40.

PATTERSON, R., L. M. GARRISON, AND D. R. HANSEN. 2012. *Phacelia.* Pp 485-501. *In* B. G. Baldwin, D. H. Goldman, D. J. Keil, R. Patterson, T. J. Rosatti, and D. H. Wilken (eds.), The Jepson Manual: Vascular plants of California, Second Edition. University of California Press, Berkeley, California.

POPPENDIECK, H. 2001. A botanical odyssey: the evacuation of the Hamburg Herbarium 1943–1990. Biological collections and biodiversity. Otley, Westbury Academic & Scientific Publishing.

POSADA, D. 2008. jModelTest: Phylogenetic model averaging. Molecular Biology and Evolution 25(1253-1256).

POSADA, D., AND T. R. BUCKLEY. 2004. Model selection and model averaging in phylogenetics: advantages of the AIC and Bayesian approaches over likelihood ratio tests. Systematic Biology 53(793-808).

POSADA, D., AND K. A. CRANDALL. 1998. Modeltest: testing the model of DNA substitution. Modeltest 3.7. Bioinformatics 14(9):817–818.

RAMBAUT, A., M. SUCHARD, D. XIE, AND A. DRUMMOND. 2014. Tracer v.1.6.0 Available at http://beast.bio.ed.ac.uk/Tracer.

RAVEN, P. H. 1963. A flora of San Clemente Island, California. Rancho Santa Ana Botanic Garden, Anaheim, CA.

RAVEN, P. H. 1965. The floristics of the California Islands.

REBMAN, J. P., R. N. C., AND E. EXEQUIEL. 2012. Baja California plant field guide. Third Edition. San Diego Natural History Museum and Sunbelt Publications, San Diego, CA.

REFULIO-RODRIGUEZ, N. F., AND R. G. OLMSTEAD. 2014. Phylogeny of Lamiidae. American Journal of Botany 101(2):287–299.

REN, M.-X., AND Z.-J. BU. 2014. Is there'anther-anther interference'within a flower? Evidences from one-by-one stamen movement in an insect-pollinated plant. PloS one 9(1):e86581.

RIEMANN, H., AND E. EXEQUIEL. 2007. Endemic Regions of the Vascular Flora of the Peninsula of Baja California, Mexico. Journal of Vegetation Science 18(3):327–336.

ROBERTS, N. C. 1989. Baja California plant field guide. Natural History Publications Company, La Jolla.

RODRÍGUEZ, F., J. L. OLIVER, A. MARÍN, AND J. R. MEDINA. 1990. The general stochastic model of nucleotide substitution. Journal of theoretical biology 142(4):485–501.

RONQUIST, F., AND J. P. HUELSENBECK. 2003. MrBayes 3: Bayesian phylogenetic inference under mixed models. Bioinformatics (Oxford) 19(12):1572–1574.

RONQUIST, F., M. TESLENKO, P. VAN DER MARK, D. L. AYRES, A. DARLING, S. HÖHNA, B. LARGET, L. LIU, M. A. SUCHARD, AND J. P. HUELSENBECK. 2012. MrBayes 3.2: Efficient Bayesian Phylogenetic Inference and Model Choice Across a Large Model Space. Systematic Biology 61(3):539–542.

RYDBERG, P. A. 1917. Flora of the Rocky Mountains and adjacent plains. Published by the Author, New York.

SCHWARZ, G. 1978. Estimating the dimension of a model. The Annals of Statistics 6(2):461–464.

SIMPSON, G. G. 1961. Principles of animal taxonomy (Columbia Biological Series No. XX.). Principles of animal taxonomy. Columbia University Press, New York 27.

SINGER-SAM, J., R. TANGUAY, AND A. RIGGS. 1989. Use of Chelex to improve the PCR signal from a small number of cells. Amplifications: A Forum for PCR Users 3(September):11.

SMALL, J. K. 1903. Hydroleaceae, Pp. 969-975. *In* J. K. Small and P. A. Rydberg (eds.). Flora of the southeastern United States : being descriptions of the seed-plants, ferns and fern-allies growing naturally in North Carolina, South Carolina, Georgia, Florida, Tennessee, Alabama, Mississippi, Arkansas, Louisiana and the Indian territory and in Oklahoma and Texas east of the one-hundredth meridian. The author, New York, NY.

SOLTIS, D. E., S. A. SMITH, N. CELLINESE, K. J. WURDACK, D. C. TANK, S. F. BROCKINGTON, N. F. REFULIO-RODRIGUEZ, J. B. WALKER, M. J. MOORE, AND B. S. CARLSWARD. 2011. Angiosperm phylogeny: 17 genes, 640 taxa. American Journal of Botany 98(4):704–730.

SOUTHWEST ENVIRONMENTAL INFORMATION NETWORK [SEINET]. 2012–2015. Available from http//:swbiodiversity.org/seinet/index.php.

STAMATAKIS, A. 2006. RAxML-VI-HPC: Maximum likelihood-based phylogenetic analyses with thousands of taxa and mixed models. Bioinformatics 22(21):2688–2690.

———. 2014. RAxML Version 8: A tool for Phylogenetic Analysis and Post-Analysis of Large Phylogenies. Bioinformatics 10.1093/bioinformatics/btu033 http://bioinformatics.oxfordjournals.org/content/early/2014/01/21/bioinformatics.btu033.abstract

STAMATAKIS, A., P. HOOVER, AND J. ROUGEMONT. 2008. A fast bootstrapping algorithm for the RAxML web-servers. Systematic Biology 57(5):758–771.

STEBBINS, G. L., JR. 1950. Variation and evolution in plants. Columbia University Press, New York.

STEVENS, P. F. 2001 onward. Angiosperm Phylogeny Website, version 13, June 2015 [and more or less continuously updated since] Website http://www.mobot.org/MOBOT/research/APweb/.

SUGIURA, T. 1936. Studies on the chromosome numbers in higher plants, with special reference to cytokinesis, I. Cytologia 7(4):544–595.

PAUP* Phylogenetic analysis using parsimony (*and other methods), version 4.0 beta 10. Sinauer Associates Inc. , Sunderland, Massachusetts.

TAKHTAJAN, A. 1987. Systema Magnoliophytorum. Nauka, Leningrad.

TAVARÉ, S. 1986. Some probabilistic and statistical problems in the analysis of DNA sequences. Lectures on Mathematics in the Life Sciences 17:57–86.

TAYLOR, S. 2012. Molecular systematics and the origin of gypsophily in *Nama* L. (Boraginaceae). Ph.D. Dissertation, Plant Biology, University of Texas at Austin, Austin, Texas.

THE INTERNATIONAL PLANT NAMES INDEX [IPNI]. 2014. www.ipni.org.

TISCHLER, G. F. L. 1927. Pflanzliche Chromosomen-zahlen. Tabulae Biologicae. Pp. 1–83. Vol. 4. W. Junk, Berlin, Germany.

———. 1931. Pflanzliche Chromosomen-zahlen. Tabulae Biologicae. Pp. 109–226. Vol. 7. W. Junk, Berlin, Germany.

———. 1935. Pflanzliche Chromosomen-zahlen. Tabulae Biologicae. Pp. 281–304. Vol. 11. W. Junk, Berlin, Germany.

———. 1936. Pflanzliche Chromosomen-zahlen. Tabulae Biologicae. Pp. 57–115. Vol. 12. W. Junk, Berlin, Germany.

———. 1938. Pflanzliche Chromosomen-zahlen. Tabulae Biologicae. Pp. 162–218. Vol. 16. W. Junk, Berlin, Germany.

TJEBBES, K. 1928. The chromosome numbers of some flowering plants. Hereditas 10(3):328–332.

TORREY, J. 1856. No. 4. Descriptions of the general botanical collections. *In* J. Bigelow, G. Engelmann, J. Torrey, and W. S. Sullivant (eds.), Report on the botany of the expedition.

Volume IV, part V, VI, and Appendices. Explorations and surveys for a railroad route from the Mississippi River to the Pacific Ocean. War Department. Route near the Thirty-fifth parallel, explored by Lieutenant A. W. Whipple, Topographical Engineers, in 1853 and 1854. . Beverley Tucker, Printer, etc., Washington, D.C.

TORREY, J., AND A. GRAY. 1838. A flora of North America: containing abridged descriptions of all the known indigenous and naturalized plants growing north of Mexico, arranged according to the natural system Vol. 1 (1838-1840). Wiley & Putnam, New York, NY.

———. 1841. A flora of North America: containing abridged descriptions of all the known indigenous and naturalized plants growing north of Mexico, arranged according to the natural system Vol. 2 (1841-1843). Wiley & Putnam, New York, NY.

TRASK, B. 1900. Dying San Nicolas. Land of Sunshine 13(2):95, 97–100.

UHRÍKOVÁ, A. 1978. *In* Májovský, J., et al. (ed.). Index of chromosome numbers of Slovakian flora (Part 4). Acta Facultatis rerum naturalium Universitatis Comenianae, Botanica. 26:1-42.

URBATSCH, L. E., B. G. BALDWIN, AND M. J. DONOGHUE. 2000. Phylogeny of the coneflowers and relatives (Heliantheae: Asteraceae) based on nuclear rDNA internal transcribed spacer (ITS) sequences and chlorplast DNA restriction site data. Systematic Botany 25(3):539–565.

VASEY, G., AND J. N. ROSE. 1890. List of plants collected by Dr. Edward Palmer in 1890 in Lower California and Western México: at 1. La Paz. 2. San Pedro Martin Island. 3. Raza Island. 4. Santa Rosalia and Santa Agueda. 5. Guyamas. Govt. Print. Off., Washington, D.C.

VASEY, G., J. N. ROSE, AND E. PALMER. 1890. List of plants collected by Dr. Edward Palmer in 1888 in Southern California; List of plants collected by Dr. Edward Palmer in 1889 at 1. Lagoon Head, 2. Cedros Island, 3. San Benito Island, 4. Guadalupe Island, 5. Head of the Gulf of California. Contributions from the United States National Herbarium, no. 1. U.S. Dept. of Agriculture, Division of Botany : G.P.O., Washington [D.C.].

VEATCH, J. A. 1869. Report of Dr. John A. Veatch on Cerros or Cedros Island. Pp. 143–154. *In* J. R. Brown (ed.). A sketch of the settlement and exploration of Lower California. H. H. Bancroft and Company, San Francisco, California.

VOSS, J. W. 1935. A revisional study of the *Phacelia hispida* group. Bulletin of the Southern California Academy of Sciences 33(3):169–178.

WALDEN, G. K. 2010. Phylogeny of infrageneric relationships within *Phacelia* (Boraginaceae) inferred from chloroplast sequence data. M.S. Thesis, Biology, San Francisco State University, San Francisco.

WALDEN, G. K., L. M. GARRISON, F. W. CIPRIANO, G. S. SPICER, AND R. PATTERSON. 2014. Phylogenies and chromosome evolution of *Phacelia* (Boraginaceae: Hydrophylloideae) inferred from nuclear ribosomal and chloroplast sequence data. Madroño 61(1):16–47.

WALDEN, G. K., AND R. PATTERSON. 2011. Nomenclatural kankedorts in *Phacelia* (Boraginaceae: Hydrophylloideae). Madroño 58(4):267–272.

WALDEN, G. K., AND R. PATTERSON. 2012. Nomenclature of subdivisions in *Phacelia* (Boraginaceae). Madroño 59(4):211–222.

WALDEN, G. K., R. PATTERSON, L. M. GARRISON, AND D. R. HANSEN. 2013. *Phacelia* in Revision 1, Jepson Flora Project (eds.). *Jepson eFlora* [http://ucjeps.berkeley.edu/TJM2_Supplement.pdf] [http://ucjeps.berkeley.edu/cgi-bin/get_IJM.pl?tid=9655] [Accessed on 27 July 2013].

WALSH, P. S., D. A. METZGER, AND R. HIGUCHI. 1991. Chelex 100 as a medium for simple extraction of DNA for PCR-based typing from forensic material. Biotechniques 10(4):506–513.

WATSON, S. 1889. VI. Contributions to American Botany. 1. Upon a collection of plants made by Dr. E. Palmer, in 1887, about Guaymas, Mexico, at Mulejo and Los Angeles Bay in Lower California, and on the Island of San Pedro Martin in the Gulf of California. Proceedings of the American Academy of Arts and Sciences 24, new series vol. 16:36–87.

WEIGEND, M., M. GOTTSCHLING, F. SELVI, AND H. H. HILGER. 2009. Marbleseeds are gromwells - Systematics and evolution of *Lithospermum* and allies (Boraginaceae tribe Lithospermeae) based on molecular and morphological data. Molecular Phylogenetics and Evolution 52(3):755–768.

WEIGEND, M., AND H. H. HILGER. 2010. Codonaceae-a newly required family name in Boraginales. Phytotaxa 10:26–30.

WEIGEND, M., F. LUEBERT, M. GOTTSCHLING, T. L. P. COUVREUR, H. H. HILGER, AND J. S. MILLER. 2013. From capsules to nutlets—phylogenetic relationships in the Boraginales. Cladistics:n/a–n/a.

WEIGEND, M., F. LUEBERT, F. SELVI, G. BROKAMP, AND H. H. HILGER. 2013. Multiple origins for Hound's tongues (*Cynoglossum* L.) and Navel seeds (*Omphalodes* Mill.) -The phylogeny of the borage family (Boraginaceae s.str.). Molecular Phylogenetics and Evolution 68(3):604–618.

WHEELER, Q., AND R. MEIER. 2000. Species concepts and phylogenetic theory: A debate. Columbia University Press, New York.

WHITE, T. J., T. BRUNS, AND J. TAYLOR. 1990. Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. *In* M. A. Innis, D. H. Gelfand, J. J. Sinisky, and T. J. White (eds.), PCR protocols: a guide to methods and applications. Academic Press, Inc., New York.

WIGGINS, I. L. 1980. Flora of Baja California. Stanford University Press, Stanford, California.

WINSOR, M. P. 2009. Taxonomy Was the Foundation of Darwin's Evolution. Taxon 58(1):43–49.

WIT, E., E. V. D. HEUVEL, AND J. W. ROMEIJN. 2012. ‘All models are wrong...’: an introduction to model uncertainty. Statistica Neerlandica 66(3):217–236.

YAO, H., J. Y. SONG, C. LIU, K. LUO, J. P. HAN, Y. LI, X. H. PANG, H. X. XU, Y. J. ZHU, P. G. XIAO, AND S. L. CHEN. 2010. Use of ITS2 Region as the Universal DNA Barcode for Plants and Animals. PLoS ONE 5(10).

ZHAO, Z., AND B. L. TURNER. 1993. Documented chromosome numbers 1993: 3. Miscellaneous U.S.A. and Mexican species, mostly Asteraceae. SIDA: Contributions to Botany 15(4):649–653.

APPENDIX 3.01. MATERIAL INCLUDED FOR DNA STUDY: List of taxa sampled for molecular sampling in this study: *named taxon* (presented in alphabetical order, with bolded type and botanical authority given for first instance of taxon), name of collector(s) and collection number, acronym of herbarium where voucher specimen is deposited and herbarium accession number (if available), and GenBank accession numbers for nrITS. Taxa names follow recent treatments in the second edition of *The Jepson Manual* (Baldwin et al. 2012) and treatments in preparation for FNANM, botanical authorities follow *Authors of Plant Names* edited by R.K. Brummitt and C.E. Powell (1992), and herbarium acronyms follow Index Herbariorum (http://sweetgum.nybg.org/ih/).

PHACELIA CICUTARIA:
USA, California, Amador Co., 1 mi sw Plymouth, 17 April 1936, *G. T. Nordstrom 692* (UC1069326!); Calaveras Co., 2 mi ne Wheats (Plot 6), 17 April 1936, *P. L. Johannsen 862* (UC1069330!); Kern Co., Tehachapi Mountains, along State Hwy 58 three mi W of junction with State Hwy 223, 23 March 2001, *R. R. Halse 5949* (UC1779149!); Mariposa Co., 3/4 mi sw White Rock, 14 April 1935, *H. S. Yates 5130* (UC1069333!); Tulare Co., Lewis Creek, Lindsay, 21 March 1925, *P. A. Munz 9091* (UC310180!);

Material downloaded from GenBank for *PHACELIA CICUTARIA*:
USA, CA, Kern Co., 22 March 2004, *L. M. Garrison 02* (SFSU!), JX233431, not georeferenced; Kern Co., 6 May 2005, *L. M. Garrison 45* (SFSU!), JX233432, not georeferenced.

***PHACELIA CICUTARIA* VAR. *HISPIDA*:**
USA, CA, San Diego Co., Hellhole Canyon Open Space Preserve: east of Valley Center and northeast of Lake Wohlford, southwest side of preserve near Canal Road, 3 April 2008, *J. P. Rebman & M. Wall 14303* (SD184369); Santa Barbara Co., Gibraltar Rd, 19 June 1965, *J. Ammirati 314* (SFSU08452!); Santa Barbara Co., Santa Cruz Island, ca. 1/4 mi. from Stanton ranch h.q.'s, Canyon del Puerto, May 15 1962-May 17 1962, *M. A. Piehl 62159* (JEPS93239!).

México, Baja California, foothills below El Coyote Meling, 28 March 2009, *G. K. Walden 132* (SFSU!); Baja California, 9 miles S of Higuera on road from Bahia de los Angeles to San Borja, 17 February 1962, *I. L. Wiggins 16722* (UC1313717!); Baja California, under shrubs on rocky east slope, San Juan Mine, Sierra San Borjas, 24 March 1960, *Reid Moran 8019* (UC1179590!).

Material downloaded from GenBank for *PHACELIA CICUTARIA* VAR. *HISPIDA*:
USA, CA, Los Angeles Co., 6 May 2004, *L. M. Garrison 24* (SFSU), JX233433, not georeferenced.

***PHACELIA CILIATA*:**

PHACELIA CILIATA VAR. *CILIATA*:
USA, CA, Contra Costa Co., Brentwood, 26 March 1937, *Lewis S. Rose 37013* (UC881009!); Kern Co., 5 mi nw Lockern, McKittrick Quadrangle, 250 ft, April 01 1937, *H. S. Yates 6518* (UC1069290!); Monterey Co., Priest Valley, April 29 1957, *Lewis S. Rose 57067* (UC1176831!);

San Benito Co., Willow Creek Road, 15 April 2011, *G. K. Walden 358* (SFSU!); Stanislaus Co., 9 mi sw Patterson; Salada Canyon, April 11 1937, *Beryl O. Schreiber 2363* (UC615569!).

PHACELIA CILIATA VAR. *MEXICANA*
México, Baja California, 4.5 miles south of San Quintin cutoff, occasional in patches on baked red clay plain, 6 February 1952, *C. R. Bell & S. Carlquist 1224* (UC967361!).

PHACELIA CILIATA VAR. *OPACA*
USA, CA, Merced Co., near Le Grand, 28 February 1936, *R. F. Hoover 730* (UC765452!); Merced Co., Tuttle, 10 April 1937, *R. F. Hoover 1752* (UC767565!); Tulare Co., 3 mi e Ducor, 18 March 1939, *R. F. Hoover 3920* (UC767563!).

***PHACELIA CRYPTANTHA*:**
USA, CA, Inyo Co., Cottonwood Mts., Cottonwood Canyon, Death Valley,11 March 1940, *M. F. Gilman 4056* (JEPS2288!); Inyo Co., Alabama Hills, Lone Pine Creek, 26 May 1906, *H. M. Hall & H. P. Chandler 7182* (UC128902!); Inyo Co., Panamint Range, Johnson Canyon (main left-hand fork), 27 April 1940, *W. L. Jepson 19737* (JEPS2281!); San Bernardino Co., 7 mi wsw 29 Palms (stream bed of canyon), 22 March 1940, *A. M. Alexander & L. Kellogg 919* (UC922738!); Riverside and San Bernardino cos., Joshua Tree National Monument 27 April 1941, *A. M. Alexander & L. Kellogg 2098* (UC667340!).

Material downloaded from GenBank for *PHACELIA CRYPTANTHA*:
USA, CA, Riverside Co., 29 March 2004, *L. M. Garrison 20* (SFSU!), JX233453, not georeferenced.

Although an accession is identified as *Phacelia cryptantha* on GenBank (accession AY630281), this does not BLAST to other sequences of *Phacelia cryptantha,* but BLASTs to the *Phacelia distans* clade - and is included within those accessions in this study. The only specimen located at SFSU for *R. Peters 002* is determined as *Pholistoma membranaceum* [USA, CA, San Diego Co., scrambling annual, plant 3 dm., corolla white, occasional in desert/chaparral transition zone with *Rhus ovata*, *Lupinus* spp., *Ambrosia dumosa*, in shade of *Acacia greggii*, camp 0.5 mile off Culp Valley Road, elev. ca. 1000 m., 4 April 1993, *R. Peters 002* (SFSU!)]. Extraction and sequencing from *R. Peters 02* [*Pholistoma membranaceum* (Bentham) Constance] did not BLAST to AY630281, but to other sequences of *Pholistoma* Lilja. In the original lab notebooks for the Gilbert et al. study (Spicer personal communication) (Gilbert et al. 2005), the specimen associated with the *Phacelia cryptantha* sample is given as "SFSU Herbarium 1989". Specimens that match this description were not located in the SFSU herbarium. I included AY630281 within this study for *Phacelia distans* (see below).

***PHACELIA DISTANS*:**
USA, CA, Alameda Co., Berkeley Hills, 17 May 1903, *E. B Mulliken 67* (UC63894!); Kern Co., corolla blue, occasional on sandy compact soil in open flat Larrea scrub, US Hwy 395, 11.9 miles N of jct with Trona Rd. elevation 1000 m, 13 April 1990, *J. Dempcy 009* (SFSU!); Marin Co., near Burdell School, Novato, 23 April 1944, *H. Leschke s.n.* (SFSU08298!); Marin Co.,

Fairfax, Cascades, 26 April 1942, *H. Leschke s.n.* (SFSU08297!); Merced Co., Hopetown, 22 April 1967, *J. Ammirati 963* (SFSU08295!); Monterey Co., near intersection of Tasajara Rd and Cahuenga Rd, 20 March 1977, *M. A. Hewlett 420* (SFSU08443!); Monterey Co., Jolon Road, 15 April 2011, *G. K. Walden 361* (SFSU!); Riverside Co., Palm Springs, end of Racquet Club Road, 1/2 mile from Aerial Tramway, 18 February 1973, *B. Shervanick 648* (SFSU08281!); Riverside Co., Palm Springs, Palm Canyon Drive, 22 March 1967, *H. D. Thiers 18672* (SFSU08282!); Riverside Co., along Highway 74 between Palm Desert and Pinyon Flats Campground, 7 March 1970, *H. D. Thiers 24924* (SFSU08283!); Sonoma Co., Cavedale Road, foothill woodland burn, 28 March 1965, *J. Ammirati 69* (SFSU08296!); Stanislaus Co., common along roadside, serpentine area, Del Puerto Canyon Road, 10 miles West of Hwy 5, 23 April 1993, *C. Condos 20* (SFSU!); Stanislaus Co., common along roadside, non-serpentine area, Del Puerto Canyon Road, 10 miles West of Hwy 5, 23 April 1993, *C. Condos 25* (SFSU!); San Bernardino Co., glandular puberulent, many flowers in a dense cyme, Kelbaker Rd., 5 miles south of Kelbaker Station, elevation 1160 meters, *R. Skinner 10* (SFSU!); San Bernardino Co., Granite Mountain Research Station, 31 March 2010, *G. K. Walden 281* (SFSU!); San Diego Co., north San Diego County, intersection of W. Lilac and Wrightwood roads, off Hwy 15 (395), grassland, 5 May 1973, *E. J. Bynum 73-171* (SFSU08449!); San Diego Co., Anza Borrego State Park, Palm Canyon camp entrance, 7 April 2011, *G. K. Walden 345* (SFSU!); San Mateo Co., in in non-serpentine soil next to serpentine area along fence at San Francisco Watershed, 23 April 1977, *M. A. Hewlett 582mah* (SFSU08444!); San Francisco Co., Presidio, near Lobos Creek, 17 March 2010, *G. K. Walden 304* (SFSU!); San Francisco Co., San Francisco, Larsen Hill, 19 April 1942, *H. Leschke s.n.* (SFSU08286!); Santa Barbara Co., mesa near Lompoc, 22 March 1935, *B. O. Schreiber 1663* (UC615239!); Santa Clara Co., Frank Raines County Park, n.d., *H. D. Thiers 27191* (SFSU08448!).

México, Baja California, on one year old burned-over granitic hillsides, 16 miles southeast of Tecate, 14 May 1948, *I. L. Wiggins 11830A* (UC1093603!); Baja California, Cataviña, 24 March 2009, *G. K. Walden 110* (SFSU!); Baja California, Cataviña, 26 March 2009, *G. K. Walden 125* (SFSU!); Baja California, *Washingtonia* wash, 26 March 2009, *G. K. Walden 129* (SFSU!); Baja California, Canon de Guadalupe, E face of Sierra Juarez, rocky, dry slopes below springs and near our encampment, in microphyll woodland and mixed desert scrub, 18-20 February 1984, *R. F. Thorne, W. Wisura & A. Romspert 57790* (UC1531333!); Baja California, Desierto Viscaino Region, Cerro Tordillo and vicinity, 12 to 13 March 1947, *H. S. Gentry 7449* (UC753508!).

Material included as *Phacelia umbrosa*
San Diego Co., Descanso, June 20 1932, *C. Epling, M. Darsie, C. Knox, and Wm. Robison 251* (UC519856!).

Material downloaded from GenBank for *PHACELIA DISTANS*:
USA, CA, Kern Co., 22 Mar 2004, *L. M. Garrison 03* (SFSU!), FJ814654, – (*cited as *P. tanacetifolia* in Hansen et al. 2009) (Garrison 2007; Hansen et al. 2009; Walden et al. 2014), not georeferenced; Los Angeles Co., 6 May 2004, *L. M. Garrison 25* (SFSU), JX233479 (Garrison 2007; Walden et al. 2014), not georeferenced; Marin Co., 12 May 1991, *P. Wharton 24* (SFSU), AY630284 (Gilbert et al. 2005; Walden et al. 2014), not georeferenced; San Bernardino Co., 29 Mar 2004, *L. M. Garrison 21* (SFSU), JX233478 (Garrison 2007; Walden et al. 2014), not georeferenced; San Diego Co., n.d., *R. Peters 01* (SFSU), AY630280, (*cited as *P. crenulata*

var. *minutifolia* in Gilbert et al. 2005) (Gilbert et al. 2005; Walden et al. 2014), not georeferenced; San Diego Co. [putative locality], AY630281 (see discussion regarding this accessions at *Phacelia cryptantha*), not georeferenced.

JQ513452, associated with voucher *cmg138* on GenBank, and with *C. M. Guilliams, M. G. Simpson, & K. Hasenstab-Lehman 570* in publication (*cited as *P. crenulata* var. *minutiflora*) (Hasenstab-Lehman and Simpson 2012). Sequence annotated as " JQ513452 cmg138" in tree.

Sequence JQ513452 was placed in every analysis in the *Phacelia distans* clade, and sequence JQ513453 is placed in every analysis in the *Phacelia crenulata* clade in larger analyses of the family [not shown]. Only JQ513452 is included here for the *Phacelia* sect. *Ramosissimae* chapter. It is very likely that the taxonomic identifier for the sequences were switched at submission to GenBank, and that JQ513452 should be associated with *Guilliams et al. 692*, and JQ513453 should be associated with *Guilliams et al. 570*. This made no difference to the results of their particular study, which used two *Phacelia* taxa as outgroups, but has significant impacts for larger sampling within *Phacelia* clades and for other studies relating to biodiversity and radiations in the Boraginales and California Flora.

Full details for each sequence:
JQ513452 associated with voucher *cmg138* on GenBank, and with *Guilliams 570* in publication (*cited as *P. crenulata* var. *minutiflora*) (Hasenstab-Lehman and Simpson 2012), USA, California, San Diego Co., Anza Borrego Desert State Park, in mud hills surrounding Palm Spring, east of S-2, Highly erosive mud hills, largely devoid of vegetation. Area immediately surrounding spring a lushly vegetated mesquite bosque, 17 March 2008, *C. M. Guilliams, M. G. Simpson, & K. Hasenstab-Lehman 570* (SDSU19853).

JQ513453 associated with voucher *cmg139* on GenBank, and with *Guilliams 692* (*cited as *P. distans*) (Hasenstab-Lehman and Simpson 2012), USA, California, San Diego Co., Beauty Mountain region, south of Chihuahua Valley Road along Puerta De La Cruz Road, approximately 4 km from State Route 79 and 10 linear miles north-northwest of Warner Hot Springs, 7 May 2008, *C. M. Guilliams, B. Ogg, & W. Loeffler 692* (SDSU19859).

PHACELIA FLORIBUNDA SENSU STRICTO:
México, Baja California, Guadalupe Island, Islote Negro, off SW coast, 19 April 1957, *R. Moran 5986* (UC1083882!); Guadalupe Island, 1889, *E. Palmer 866* (UC24506!); Islote Negro, 28 April 1958, *R. Moran 6707* (UC1094548!); few in wash, Melpomene drainage, 29 April 1958, *R. Moran 6722* (UC1094549!).

"_PHACELIA FLORIBUNDA_ SAN CLEMENTE ISLAND "NALFSCIENSIS":
USA, CA, Los Angeles Co., San Clemente Island, middle portion of Norton Canyon, on canyon walls, 11 April 1973, *R. F. Thorne 42853* (UC1426004!); Los Angeles Co., San Clemente Island, local, on steep hillside near bottom of Horse Canyon, elev 1500 ft, large canyon W of Thirst, 10 May 1962, *P. H. Raven 17728* (UC1228878!); Los Angeles Co., San Clemente Island, SWAT, 9 April 2011, *G. K. Walden 353* (SFSU!).

***PHACELIA GENTRYI*:**
México, Sonora, a few miles northwest of Ures, granite highlands, March 1946, *C. O. Sauer 1* (UC1341989!); Sonora, District of Altar, 4 miles W of Caborca, 10 March 1936, *David D. Keck 4042* (UC628460!); Sonora, 1.5 km southwest of Santa Ana on road to Guadalupe Tayopa, 21 February 1997, *T. R. Van Devender, A. L. Reina-G & M. Kaib 97-205* (UC1619375!); Sonora, Cañon las Barajitas, Sierra el Aguaje, c 18 km NW of San Carlos, palm wash, main arroyo system, ca 0.1 km inland from shore, 17 February 1995, *R. S. Felger & M. F. Wilson 95-159* (UC1923900!).

USA, Arizona, Pinal Co., 8 miles E of Oracle on the unpaved road to San Manuel, 28 March 1994, *J. S. Miller and D. K. Harder 8176* (MO-002978).

Material downloaded from GenBank for *PHACELIA GENTRYI*:
USA, AZ, Pima Co., *L. M. Garrison 14* (SFSU), JX233454 (cited as *Phacelia distans* in Walden et al 2014), not georeferenced; Pima Co., 22 Mar 2005, *L. M. Garrison 34* (SFSU), JX233455 (cited as *Phacelia distans* in Walden et al. 2014), not georeferenced.

***PHACELIA HELIOPHILA*:**
USA, CA, San Benito Co., slopes above New Idria Mine; San Carlos Range, 2700 ft, 1 April 1935, *Gregory Lyon 966* (UC719480!); Elkhorn Hills, 17 April 1968, *R. F. Hoover 11050* (UC1392984!); 6.9 mi from Coalinga-Avenal road (33); Jacolitos Creek, 15 April 1950, *Freed W. Hoffman 3329* (UC923139!).

***PHACELIA HIRTUOSA*:**
México, Baja California, north slope, bank of Arroyo Largo, 10 miles east of mouth., 8 Feb 1973, *R. Moran & J. L. Reveal 19944* (UC1432927!).

***PHACELIA HUBBYI*:**
USA, CA, Los Angeles Co., Tujunga Canyon, San Gabriel Mountains, March 28 1920, *F. W. Peirson 2100* (JEPS2179!); Santa Barbara Co., in calcareous soil, Exeter Place at junction of steep unnamed road, Santa Barbara, Mission Canyon Heights Tract, 550 ft, June 6 1945, *C. F. Smith 1326* (UC764436!); 4 mi s Lompoc, Lompoc Quadrangle, 800 ft, April 30 1935, *G. E. Sindel 272* (UC1069335!).

PHACELIA IXODES: [varieties not recognized, treated as a synonym of *Phacelia ixodes* in taxonomic treatment, OTUs annotated with epithet 'var. ixodes' or 'var. plumosa' in tree figure]: México, Baja California, Cedros Island, petals almost white, near Bernstein Spring, 23 April 1948, *Reid Moran 2973* (UC753505! as 'var. ixodes'); common in pure stands on cobble berm at Cape Colonet, south of cape, Baja California Norte, 4 June 1973, *A. F. Johnson s.n.* (DAV93730! as 'var. ixodes', cited in Johnson 1973); Baja California, just above high tide line, South Todos Santos Island, Baja California, 7 April 1948, *Reid Moran 2825* (UC936005! as 'var. plumosa'); Lower California, San Quintin, lava rocks, 5 April 1936, *Carl Epling and Wm. Stewart s.n.* (UC604998! as 'var. plumosa'); viscid stinky shrubby perennial to 1 m tall, stems to 3 cm tall, corolla lavender, on lava rock, Hassler Cove, San Martin Island, elev 10 m, 10 April 1963, *Reid Moran 10504* (UC1247534! as 'var. plumosa').

***PHACELIA LOASIFOLIA*:**
USA, CA, Monterey Co., roadbanks on Nacimiento Rd 1.9 mi from State Highway 1, June 26 1957, *Peter H. Raven 10985* (UC1167738!); Monterey Co., San Lucas-Lockwood rd. Espinosa Canyon, June 4 1939, *R. F. Hoover 4116* (UC762386!); San Luis Obispo Co., ne flank Cypress Mountain, 3000 ft, May 10 1960, *Rimo Bacigalupi, F. Chisaki, L. Dempster, and C. Hardham] 7416* (JEPS27037!); San Luis Obispo Co., Pine Mountain Santa Lucia Range (nw slope), 3500 ft, June 21 1950, *L. Constance and R. F. Hoover 3352* (UC920173!);

***PHACELIA LYONII*:**
USA, CA, Los Angeles Co., San Clemente Island: just N of Gray, glandular, looks very different from form on other side of island, corollas very pale blue, nearly white, May 9 1962, *P. H. Raven 17690* (UC1228865!); San Clemente Island: second cyn S of Seal Cove, corollas very pale blue, 100 ft, May 8 1962, *Peter H. Raven 17602* (UC1228877!); Santa Catalina Island, road to East Mountain, S end of island, petals lavender, 457 m, June 22 1965, *R. F. Thorne and P. Everett 34886* (UC1348876!).

***PHACELIA MALVIFOLIA*:**
USA, CA, San Mateo Co., Moss Beach Distillery, 28 May 2009, *G. K. Walden 149* (SFSU!);
USA, CA, San Mateo Co., Bean Hollow Road, 15 March 2011, *G. K. Walden 340* (SFSU!);
USA, CA, San Mateo Co., Martins Beach Road, 15 March 2011, *G. K. Walden 342* (SFSU!).

PHACELIA PAUCIFLORA [taxon treated in an expanded synonymy, including *Phacelia cedrosensis* as a synonym in the taxonomic treatment, OTUs annotated with epithet 'pauciflora' in tree figure]:
México, Baja California, topotype, fairly common under shrubs, outwash slope near the village, Bahia de los Angeles, elevation 10 m, 21 February 1966, *Reid Moran 12297* (UC1345860!); Baja California, saddle between two valleys about 10 miles toward Cerro Blanco from the San Augustin-Laguna Chapala road, alt about 1700 feet, granitic rubble and large granitic boulders, 7 February 1962, *I. L. Wiggins and John H. Thomas 136* (UC1313725!); Baja California, Cataviña, 24 March 2009, *G. K. Walden 114* (SFSU!); Baja California, *Washingtonia* wash, 26 March 2009, *G. K. Walden 128* (SFSU!); in east facing ravine, hilly slopes W of Volcan Las Tres Virgenes, c. 200 m, 29 March 1989, *G. L. Webster 26155* (DAV133615!); Baja California, vicinity of Bahia de los Angeles about 4 miles south of Las Flores, sandy alluvial fan, 13 February 1962, *I. L. Wiggins & John H. Thomas 247* (UC1313730!); Baja California, few, under shrubs, El Terminal, 16 miles south of Bahia de los Angeles, elev 400 m, 14 January 1962, *Reid Moran 8523* (UC1116172!).

PHACELIA CEDROSENSIS: [taxon treated as a synonym of *Phacelia pauciflora* in the taxonomic treatment, OTU annotated with epithet 'cedrosensis' in tree figure]:
México, Baja California, Cedros Island, 1 April 1897, *T. S. Brandegee s.n.* (UC107528!).

***PHACELIA PHYLLOMANICA*:**
México, Baja California, Guadalupe Island, sprawling perennial up to 1.8 m long, seed collected 27 Jan 1960 by *R. Moran 7836*, "cliff of lower circus, 950 m", grown in greenhouse and field plot at UC Berkeley 1961, 1962, harvest date n.d., *L. R. Heckard C-271* (UC1228910 sheet 1), not georeferenced.

***PHACELIA RAMOSISSIMA*:**
USA, CA, Inyo Co., Wyman Creek, 13 June 2009, *G. K. Walden 200a* (SFSU!); Los Angeles Co., Freshwater marsh at Bear Flats about 1 1/2 miles from Baldy Village on Bear Flats Trail, granitic soil, 12 July 1973, *B. Shervanick 1023* (SFSU08431!); Mono Co., Valentine Eastern Sierra Reserve, 11 August 2008, *G. K. Walden 83* (SFSU!); Monterey Co., near Pacific Grove, Moss Beach, 9 June 1907, *Miss Patterson s.n.* (UC496337!); Monterey Co., sand dunes at ne corner of Carmel, 12 June 1950, *P. H. Raven 2564* (UC1176936!); Orange Co., Modjeska Peak, 26 June 2008, *G. K. Walden 76* (SFSU!); San Diego Co., Hellhole Canyon Open Space Preserve: east of Valley Center and northeast of Lake Wohlford; southwest portion of preserve, along Hellhole Creek west of the canal pipe in the waterfall area, 28 May 2008, *J. Rebman and M. R. Mulligan 15308* (SD186963); San Luis Obispo Co., about 5 mi s of Oceano (immediately back of ocean beach, nw of Oso Flaco Lake, 24 July 1953, *Rimo Bacigalupi, Dr. and Mrs. Robt. M. Page, R. S. Ferris, and R. W. Holm 4324* (JEPS16760!); Santa Barbara Co., Hollister Ranch, 2010, *G. K. Walden 298* (SFSU!); Santa Barbara Co., Jalama State Park, 24 June 2008, *G. K. Walden 67* (SFSU!); Santa Barbara Co., se Orcutt (w of Mt. Solomon), Graciosa Ridge, 14 June 1973, *C. W. Tilforth and J. Dourley 846* (UC1400329!); Santa Barbara Co., Santa Cruz Island, Smugglers Cove, 24 June 1939, *M. W. Williams 23* (UC1084192!);

México, Baja California, 21 May 1977, *R. Moran 24192* (UC1445255!) not georeferenced; Baja California, 28 March 1960, *R. Moran 8109* (UC1179587!) not georeferenced; Baja California, 20 July 1988, *Ross 2800* (UC1782286!) not georeferenced.

Material downloaded from GenBank for PHACELIA RAMOSISSIMA:
USA, CA, Mono Co., 18 Jun 1993, *D. M. Ferguson 10* (GH), AF091199 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005). USA, CA, Mono Co., n.d., *H. D. Thiers 17121* (SFSU), AY630327 (Gilbert et al. 2005).

Material excluded from study for PHACELIA RAMOSISSIMA:
USA, CA, Alpine Co., *Gilbert 100* (SFSU), AY630326 was excluded from analyses for this study (see Walden et al. 2014). I unable to determine source of material from available documentation and correspondence with study authors (Spicer, personal communication, Gilbert, personal communication),, no label information associated with unmounted voucher specimen

deposited at SFSU. Re-extraction and re-sequencing for the nrITS marker for this specimen did not match GenBank sequence.

***PHACELIA RATTANII*:**

USA, CA, San Benito CO., about 4 mi e Hernandez; South Coast Ranges, headwaters of San Benito River, May 10 1947, *Freed W. Hoffmann 1444* (UC1299140!); Santa Clara Co., e Fork Coyote Creek Bald Peak foothills (at foot of foothills), June 1, 1895, *W. R. Dudley 4194* (UC201607!); San Luis Obispo Co., Franklin Creek, west of Adelaida., 26 May 1961, *Clare B. Hardham 7134* (DAV55495!).

***PHACELIA TANACETIFOLIA*:**

USA, CA, Contra Costa Co., corolla blue, locally rampant on talus slope, EBPRD [East Bay Regional Parks District] Botanic Garden, possibly cultivated from horticultural seed source, 29 April 1991, *M. Ely 76* (SFSU!); Fresno Co., lower Monocline Ridge, 27 February 2013, *G. K. Walden 400a* (SFSU!); Fresno Co., Panoche Hills, 27 February 2013, *G. K. Walden 400b* (SFSU!); Fresno Co., Panoche Road towards Idria, 27 February 2013, *G. K. Walden 405* (SFSU!); Inyo Co., Hwy 395 east towards Manzanar, 13 April 2011, *G. K. Walden 354* (SFSU!); Kern Co., Poso Creek, 15 March 1940, *C. Smith 54* (JEPS1295!); Kern Co., Lerdo Highway near McKittrick, 6 April 2011, *G. K. Walden 343a* (SFSU!); Los Angeles Co., approximately 0.8 miles west from 150th Street along N-5, 8 April 1977, *M. A. Hewlett 560mah* (SFSU!); San Benito Co., Willow Creek School, 30 March 1932, *W. L. Jepson 16127* (JEPS1299!); San Francisco Co., likely cultivated from horticultural seed source, growing behind science building at San Francisco State University, 23 April 1977, *M. A. Hewlett s.n.* (SFSU08256!);

***PHACELIA THERMALIS*:**

USA, Oregon, Harney Co., clay flat 2 mile E of Stinking Water Mt., 1 June 1943, *Morton E. Peck 21649* (UC881272!); Malheur Co., abundant locally on vernal depression along both sides of East Steens Rd., 2.3 miles S of SR78 jct near culvert pipe in valley between Steens Mtns & Sheephead Mtns, 17 June 2012, *R. B. Kelley 2063* (SFSU!).

USA, CA, Modoc Co., on shore Snake Lake (dry), June 10 1946, *Annie M. Alexander and Louise Kellogg 4712* (UC748324!);

Material downloaded from GenBank for *PHACELIA THERMALIS*:
USA, OR, Lake Co., 10 Jun 1996, *D. M. Ferguson 125* (GH), AF091202 (Ferguson 1998, 1998 [1999]; Gilbert et al. 2005), not georeferenced.

***PHACELIA VALLIS-MORTAE*:**

USA, CA, Inyo Co., Marble Fork White Mountains, Black Canyon, 5700 ft, May 30 1930, *V. Duran 2657* (UC1297468!); Inyo Co., Bishop Creek east slope of Sierra Nevada, 7150 ft, June 16 1945, *A. M. Alexander and L. Kellogg 4255* (UC736051!); San Bernardino Co., Ord Mountain Rd Mojave Desert, 1 April 1937, *M. Beal 12* (JEPS3509!).

Material downloaded from GenBank for *Phacelia vallis-mortae*:
Inyo Co., *C. Gilbert 108* (SFSU), AY630332 (cited as *P. tanacetifolia* Benth. in Gilbert et al. 2005, no label, unmounted voucher at SFSU!) (Gilbert et al. 2005), not georeferenced.

APPENDIX 3.02. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA CICUTARIA*** [VAR. *CICUTARIA*]**.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES. **CALIFORNIA**. **ALAMEDA CO.**: (POM65582); **AMADOR CO.**: (UC131463!); (UC1069326!); (CAS799394!); (CDA13203); (UCD120321, UCR187300); (UCR230635); **BUTTE CO.,** (UC107479!); (POM73732); (UC175561!); (UC726927!); (CHSC10585); (CHSC31637); (CHSC45933); (CAS982346!); (CHSC38463); (CHSC39947, RSA325026); (CHSC51524); (CHSC83910, JEPS104201!); (CHSC103733, JEPS117223!); (CHSC110127); **CALAVERAS CO.,** (UCR136760, RSA427693B); (UC672400!); (RSA74193); (UC1069331!); (UC1069330!); (UC1377698!); (DS592143!); (JEPS77295!); (UCD120318); (SJSU6737!); (CDA16495); (UCR218170, BRYV0003099-3860277); CONTRA COSTA CO., (JEPS2178!); **EL DORADO CO.,** (UC726926!); (UC1537528!); (UC735028!, UC735027!, POM298613); (UC1368753!, SEINET3158085); (CDA11109); (UCR207652, RSA755433); (UCR237057, RSA789529); **FRESNO CO.,** (POM225456); (JEPS2204!); (UC419056!); (UC419040!); (POM306585); (UC767519!, JEPS2196!); (UC709344!); (RSA24020); (RSA96468); (RSA107910); (RSA131772); (JEPS28188!); (SDSU6645, SD53291); (OBI40891!); (UCR16831); (HSC13629); (POM318291); (UCD120328); (JEPS85778); (UCR100415, UCD120323); (JEPS118769, CAS1119713); (LEA-VP-15049); (WWB16640-WWB-VP-16463); **INYO CO.,** (UC440320); (RSA427721); (UC1004916); (RSA274243); (RSA678901); (RSA274244); (RSA678902); KERN CO., (UC107472); (UC107473); (POM73401); (UC144630); (JEPS2202); (JEPS2203); (JEPS2197); (POM17627); (UC881144, POM145894); (UC881143); (RSA74183); (RSA428282A); (RSA74184); (SBBG41371); (UC457194); (RSA427692); (UC511252, POM291107); (UC511283, POM291104); (POM291105); (UC505656); (JEPS2198); (JEPS2200); (SBBG11774); (UC718061, RSA12814); (UC1069328); (UCD120313); (SBBG16173); (SBBG11766); (UC598543); (UC765502); (JEPS3121, SD58175); (UC881139); (UC657589); (UC650704); (UC666592!, n = 11 Cave and Constance 1944); (UC666585! n = 11 Cave and Constance 1944); (UC754265, RSA45152); (SD45364); (UC901873); (RSA60386); (UC984893, RSA60397); (UC923141); (UCD120314); (UCSB5348); (UCR4573); (RSA428205); (RSA348942); (RSA773008); (UC1523542, RSA342249); (UCD120331); (SBBG108641); (UCSC1226); (RSA428285A); (UCR141223); (RSA257596); (SBBG34875, OBI8215); (SJSU8628); (UCR28997, OBI33855); (UCR115442); (UCSB46532 not georeferenced); (UCR115441); (UC1562749, SD131876); (JEPS83659); (UCR112637); (UCR130959); (UC1779149); (UCR130233, RSA667360, UCD120325); (UCR160730); (UCR122433); (OBI72648); (UCD55692); (UCR186045); (UCR184253); (UCR184449); (UCR184701); (SFSU08252); (SFSU); (SFSU08251); (SFSU); **LAKE CO.,** (HSC66586); **MADERA CO.,** (POM225457, POM225455); (UC672397); (POM291106); (UC511141, POM291102); (UC565343); (UC104580, JEPS16397); (JEPS17683); (UC1302901, RSA161179); (CAS983638, CAS824397); (CAS1148150); **MARIPOSA CO.,** (UC1041062); (UC881146); (UC702986, POM299000, RSA112680); (UC702980, POM298999); (RSA428300); (UC1069327); (UC1069333!); (UC572480, RSA129724); (UC1278081); (UC881140); (SJSU11230); (UC750539); (UCR136721, RSA40280); (UC1250175); (UC1046493, JEPS8368, RSA114094);

(SJSU1777); (SJSU14328); (UCD80361); (RSA782333); (UTC00249384-255521, CHSC99465, GH403607, RSA730224, SEINET255521, ID144194-ID111398, SRP34287-SRP-VP-34031); (SFSU08253); (SFSU08255); (UC1375612); **MERCED CO.,** (SBBG45094); (CDA20817); **MONTEREY CO.,** (DS8251); (SBBG108878); **NEVADA CO.,** (CDA21256); **SACRAMENTO CO.,** (CDA12676); (UCD46312); **SAN JOAQUIN CO.,** (UC24367); **SAN LUIS OBISPO CO.,** (OBI77806); **SANTA BARBARA CO.,** (OBI52019); **SOLANO CO.,** (DS10313!); (UCD47995); **STANISLAUS CO.,** (UC24369); (UC767518); (JEPS45202); (JEPS77097, JEPS77096); **SUTTER CO.,** (DS207237); (SD122565); **TEHAMA CO.,** (CHSC48467); **TULARE CO.,** (UC131695); (JEPS2199); (UC73684); (JEPS2201); (UC310180); (UC403368); (UC881008); (UC881007); (UC683365); (UC1540270); (UCSB11692); (UCSB28875); (RSA818322); (UCSB41602); (RSA791710, CAS1145508); (UC1562026); (RSA804764); (UCR140559, UCR140201); (UCD54643); (RSA804765); (MWI00056138-3479042, SEINET3479042); (UTC00224727-273108, SEINET273108, UCR106715); **TUOLUMNE CO.,** (UC1069376); (UC765503); (UC735026); (UCD120324); (SJSU14635); **YUBA CO.,** (UC1069332); (UCD120315); (JEPS94319, CHSC68480); (JEPS107366, CHSC90348);

NEVADA, CLARK CO.: (SJNM49741-6061501).

APPENDIX 3.03. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA CICUTARIA* VAR. *HISPIDA*.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES. **CALIFORNIA**. **FRESNO CO.:** (JEPS2176!); (UCSB27307); (CHSC70130); (CHSC55125); (CHSC69769); (CHSC55126); (UCD102337); (UCD77214); **INYO CO.,** (RSA618971); (RSA626452); **KERN CO.,** (SBBG11808); (UC1733848); (UC1516020); (OBI19541); (CHSC37338); (UC1562747); (CAS1127128, RSA808617); (UC1561967); (SBBG93091); (RSA554460); (UC1927333, CHSC98209, RSA721267, UCR192712); **LOS ANGELES CO.,** (RSA428273A); (UC107380); (RSA427661); (UC24363); (RSA427351A); (UC55302); (UC55307); (DS136329); (POM49688); (DS134571); (UC57027); (POM73400); (RSA74186); (UC126041); (UC131468, POM3508); (POM3671); (RSA427649A); (UC147666, POM3747); (POM127646); (RSA427657); (UC1211050); (JEPS2194); (POM3283); (POM6433); (POM6740); (RSA74191); (POM9841); (RSA8636); (POM50250); (POM8082); (RSA346640); (RSA74187); (POM78164); (POM17283); (RSA427654); (RSA427662); (UCD120312); (POM19040, UC284840); (RSA427649B); (LA38555); (POM123377); (RSA427637, RSA427640); (RSA11007); (RSA427667); (SBBG95231, POM155787); (UCR124359, POM199537, UC881136); (RSA427635); (SBBG95418, RSA427628); (POM427627); (LA209997); (JEPS1311); (LA38554); (RSA427660); (RSA427647); (RSA602438); (RSA427655); (RSA427658); (RSA427645); (UC440325); (RSA607003); (RSA428307A); (POM175366); (RSA427659); (RSA628031); (RSA427625); (RSA427624); (UC450888); (RSA427626); (RSA427646); (UC457250); (LA38556); (SD38325); (RSA427639); (RSA427636); (RSA427641); (SBBG64964); (RSA3535, SD28037, UC729584); (RSA427638); (UC881135, RSA3742); (RSA582644); (RSA11776); (RSA582641); (UC575006); (LA38558); (LA38559); (LA209998); (RSA611770); (LA38552, RSA427630); (LA38553, RSA427629); (LA38564, UC1002528); (UC1069325); (RSA427852); (RSA582243); (LA38551); (LA38560, LA38574, LA38561); (RSA427650); (LA81954); (RSA427631); (SD44542); (UC697771); (UC702028); (LA85582); (POM293600); (LA38557); (RSA658859); (SDSU6635); (RSA650552); (RSA427634); (RSA427633); (RSA427648); (RSA650548); (SDSU6641); (UC934014); (LA26125); (SFV3016); (DS572614); (RSA160527); (CHSC8397); (LA33997); (RSA133408); (LA33796, RSA126667); (RSA650550); (LA38795); (UC1181203, RSA131238); (RSA134849); (UC1183058, RSA136784); (LA40165); (LA40164); (LA40167); (LA40168); (RSA650557); (UCSB11633); (UC1234777, RSA156044, SBBG13582); (RSA210959); (LA200564); (UC1302892, RSA167644); (RSA177779); (SBBG45493); (RSA188122); (RSA188121); (SBBG31473); (UC1349370, RSA187967); (RSA187966); (SD69508, RSA187968); (UC1348866, RSA188260, SD69694); (RSA190967); (RSA618682); (RSA598379); (HSC79408); (CHSC34465); (UCR138534); (RSA609280); (RSA650554); (LA200563); (RSA346645); (UC1426023, RSA250701); (RSA226211, UC1375391); (RSA427642); (UC1400328); (UC1400395, RSA427666); (UC1426008); (CHSC35485); (CHSC23591); (UC1424875); (SFV6661); (VVC265); (UCD120316); (RSA657165); (UCD120317, SFV12406); (UCSB42348); (RSA650555); (RSA653340); (LA105059); (LA105114); (RSA700296);

(RSA596371); (RSA517135); (UC1584256, RSA524203); (UC1595361); (RSA547802, UC1595235); (UC1584866, RSA529300); (UC1587644, RSA433468); (RSA587748); (RSA570031); (RSA786325); (RSA552589); (UCR85811, RSA527702, SBBG98575, UC1584715); (RSA785819); (RSA660094); (RSA748447); (RSA590527); (SFV16028); (RSA643156); (RSA579467); (RSA580195); (RSA579542); (RSA596017); (UCR88701); (RSA594986); (RSA599569); (SEINET3301342); (RSA600482); (RSA599882); (RSA599832); (UCR150622, RSA602473, UCR144089); (RSA616272); (UCR190285, RSA730281); (UCR150848); (UCR150895, RSA632938); (UCR197207, RSA653464, SFV22135, UC1922307); (RSA654348); (RSA700379); (CHSC95846, SFV21105, RSA647800); (UCR190522, RSA732776); (CHSC95348, SFV21404, RSA669697); (UCR200031, RSA710709); (OBI69240); (UCR126724, IRVC28571); (UCR126579); (UCR125610, RSA714985); (CHSC98105, SFV21420, RSA682647); (UCR126818, IRVC26212, RSA714685); (RSA701180); (RSA703620); (UCR199827, RSA735252); (RSA703518); (UCR152878, RSA713792, SD186241); (UCR153468); (UCR153982, IRVC27801); (UCR155394); (RSA716218); (RSA774881); (UCR205082, RSA747225); (UCR192949); (UCR210534, RSA762729); (UCR220381); (UCR219912); (RSA752478); (UCR209285); (RSA752576); (UCR216378); (UCR252727); (RSA802833); (RSA802559); (UCR239615); (UCR251886); (SRP3249-SRP-VP-14722); (SRP3248-SRP-VP-14723); (ID86370-ID111399); (WWB17020-WWB-VP-16464); (SFSU08254); (UC881145); (SD6820); (UC55303); (RSA14229 not georeferenced); (POM11768); (UBC-V165743-UBC-VP-67025); (SFSU08258); (UNM100448-4044550); **MERCED CO.,** (DS192796!, POM192873, UC419043! not georeferenced); (CHSC55127); **MONTEREY CO.,** (SBBG16169); (SBBG21377); (RSA150728); (SBBG107541, RSA163711); (UCSB7940, RSA185471); (UCSC1235); (UCSB34133); (UCSB32832); (UCSB34143); (UCSB42995); (PGM2192, CAS742025); (PGM2191); (PGM2291); (PGM2717); **ORANGE CO.,** (POM49689, POM49687); (POM49691); (JEPS2193); (POM7744); (RSA595); (RSA594); (POM147493); (RSA497761); (RSA697797); (UC1280311, SBBG6171); (RSA650551); (RSA221010); (RSA769612, RSA263669, RSA769030); (OBI30179); (RSA810128); (UCSB34159); (UCSB47622); (RSA553116); (RSA647938); (SD152828, RSA562740); (RSA631397); (RSA638969); (RSA632934); (RSA679097); (UCR192455, RSA734814); (UCR209379, RSA749315); (UCR191362, RSA734285); (UCR191020, RSA732146); (UCR192068); (RSA794334); (UCR228808); (UCR239653); **RIVERSIDE CO.,** (JEPS2191); (UC73692); (UC73671); (UC284681); (JEPS2192); (DS140180); (UC672399); (DS184102); (DS184079); (RSA427686B); (JEPS2182); (DS234326); (UC718114); (UC881077); (UCD120320); (SJSU11233); (UC1087288, SD48483); (RSA650556); (SJSU11234); (UCSB42177); (CSUSB130); (UC1287099, HSC13709); (SBBG37427); (CHSC35502); (UCR90049); (UCR3163); (CLARK-A1045-183); (UCR20788); (UCR50515); (SDSU12935); (UCR96887); (UCR84655); (UCR91405); (UCR90750); (UCR89879); (UCR91350); (UCR97708); (UCR101787); (UCR139026, RSA613405); (UCR117619); (UCR113167); (UCR102916); (UCR132487); (UCR100824); (UCR241243); (UCR172786, SD234423); (UCR112405); (UCR239210); (UCR116856); (UCR116661); (UCR121091); (UCR121338); (UCR144754, RSA680847); (UCR215510); (UCR162839); (UCR180136); (UCR180597); (UCR135854); (UCR135985, RSA713801, SBBG33693, UCD120322); (UCR165415); (UCR174964); (SEINET1906693, SD185237, UCR158728); (UCR207633); (UCR172184); (UCR174034); (UCR177512); (UCR174174); (UCR187468); (SDSU18751); (SDSU18727, SDSU18405); (RSA788442, RSA764120); (UCR228253); (UCR213444); (UCR214569); (RSA777275);

(UCR213624); (UCR214308); (UCR225598); (UCR225710); (UCR251941); (UCR228836); (UCR230929); (UCR241935); (UCR241819); (UCR250124); (UCR250120); (UCR250565); (ARIZ395708-1906693); **SAN BENITO CO.,** (UCR192972, RSA734591, SD236312); **SAN BERNARDINO CO.,** (UC191995); (JEPS2184); (UC24364); (POM3674); (UC24365); (UC64050); (UC24366); (POM49690); (POM4491); (UC167085); (POM3800); (JEPS1339); (JEPS2187); (JEPS2188); (UC284676); (POM6741); (RSA74190); (RSA428299A); (RSA427671A); (RSA427676); (POM308457); (RSA602427); (POM305401); (RSA604155); (RSA650549); (POM3734); (JEPS45651); (UC1090413); (UCSB5399); (SJSU12286); (UCR6113); (UC1349306, UC1348987); (UC1349303); (CSUSB131); (RSA233434); (UC1375361); (RSA221486); (UC1375357, RSA222996); (RSA228947); (RSA632856); (UCR90048); (UCR90051); (UCR16829); (RSA427672B); (RSA427723B); (RSA656799); (UC1549325); (UCR50894); (RSA651738); (RSA554096); (UCR78390, RSA563832); (UCR75504); (UCR78780, RSA583828); (UCR82738); (UCR157627); (RSA575239); (UCR181291); (UCR88488); (UCR88483); (UCR96009); (UCR96010, RSA595853); (UCR94366, RSA596691); (UCR94010, POM592701); (RSA604659); (UCR127043); (UCR125845); (VVC1492, RSA682274, UCR127912); (UCR139562, CAS1123984, UCD120330); (UCR154553); (UCR188667); (SD236311); (UCR199025); (RSA747948); (UCR238677, RSA765852); (VVC2201); **SAN DIEGO CO.,** (SD6825); (SD6858); (SD7192); (SD6849); (SD6811); (RSA14227); (POM73552); (UC107478); (UC131479); (UC24370); (SD6839); (POM127611); (UC57024); (POM156124); (POM48791); (JEPS2189); (POM46985); (JEPS2183); (POM9408); (SD4062); (JEPS2185); (POM49055); (POM98172); (UC310849); (RSA427678); (UC310393, POM97958); (UC310910, POM97279); (POM88434); (UC1001608); (UC1001626, SD48652); (UC1001630, SD48706); (SD4067); (SD21964); (UC1001627, SD48707); (UC1001607); (UC488981, JEPS2195); (UC1539576); (UCD120326); (UC527631, RSA1688); (SDSU6084); (RSA612047); (RSA602191); (RSA603110); (SDSU6090); (SD38342); (RSA12295); (RSA602436); (RSA602435); (SD38315); (SD10605); (UC1537524); (SD10808); (SD38314); (SD10964); (SD11194); (SD11277); (SD11319); (SD14720); (SD113321); (SD15740); (RSA602193); (RSA21363); (SD21039); (SD17153); (SD17207); (SD17341); (SD17847); (SD17981); (SD20589); (SD20911); (RSA603572); (UC881276, JEPS14950); (POM307053); (JEPS2186); (POM305705); (SD24731); (SD26462); (UC660038); (SD27003); (SD27072); (SD28420); (RSA29281); (UC916696, RSA60727); (SD33054); (UC1539732, SD133767); (RSA427675); (RSA427668); (RSA427677); (RSA427680A); (RSA427679); (SDSU6097); (SDSU6108); (SDSU6121); (UCSB10797); (HSC13630); (CSUSB129); (SJSU11232); (SDSU313); (SD70973); (SD67520); (SDSU6102); (UC1384366, SD79425); (SD85524); (SD80461); (SD85696); (SD85815); (SD86060); (SDSU17858); (CHSC35194); (HSC24975); (UCR107210, SD128340); (UCR90050); (UCR90046); (UCR90052); (RSA598427); (UCR90045); (RSA656909); (UCR90065); (UCSB56322); (UCR132196); (UCSB40919); (RSA427681B); (SD106837, POM3676); (SD124530, RSA363926); (UCR73655); (UCR49736); (UCR48019); (SDSU6114); (SD128608); (RSA557791); (UC1871286, RSA571499); (RSA700919); (SD138859); (RSA587320); (RSA587690); (SDSU12100); (UCR96791); (SD215564); (RSA645926); (UCR147480, SD152193); (SD155168, RSA696078, UCR147159); (SD164453); (UCR153604, SD155167); (SDSU14112); (UCR156448, SD158979); (RSA701317); (SD162211); (SD160589); (SDSU16169); (SD185722, CDA10263, RSA732864); (SD153267); (UCR144463, SD160588); (SDSU16003, SD162492); (SD159905); (IRVC27274, UCR127807, SD233862, RSA682111); (IRVC28447, RSA696143, UCR128521, SD234887); (UCR128638, IRVC28014,

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(UC1334163, SBBG6153); (SBBG95333, RSA535869); (UCSB5357); (UC753511); (UC753520); (SBBG96387); (UC794428); (SBBG82378, UC1563246); (RSA94220); (SBBG82384); (SBBG82292); (SBBG107048); (SBBG85690); (SBBG10717, RSA135676); (SBBG39437, RSA134472, RSA624380); (SBBG107182); (RSA142141, RSA141771); (SBBG15504); (UCSB14722); (RSA624418, JEPS93239, SBBG14213); (SBBG20271, RSA427674); (SBBG80466); (SBBG40875); (SBBG40894); (UC1563247, SBBG82379); (SBBG82291); (UCSB24293); (UC1349326, RSA190802); (UCSB21974); (UCSB51835); (HSC13632); (UCSB26106); (SBBG50322); (OBI26692); (UCR20945); (UCSB32747); (UCSB45167); (SBBG82022); (UCSB38908); (UCSB38925); (UCSB38927); (UCSB34130); (UCSB33184); (UCSB32831); (UCSB34004); (RSA760768); (UCSB41873); (SBBG89971); (UCSB54479); (UCSB45620); (UCSB43401); (SBBG91436); (UCSB43002); (UCSB42924); (UCSB42923); (SBBG91733); (RSA332414); (SBBG97142); (SBBG90860); (SBBG90848, RSA516246); (UCSB53933); (SBBG97740); (UCSB54206); (UCSB60134); (SBBG97279); (RSA535503); (SBBG97371, RSA535247, UC1586781); (SBBG97453, RSA534104, UC1586785); (RSA535923); (UC1586768, SBBG97590); (SBBG97765); (RSA535501); (SBBG108880); (SD133070, RSA528083); (SBBG101386, SD138601); (RSA588252); (OBI70440); (SBBG105252); (RSA601037); (SBBG105242, OBI77848, SD171847); (UCSB68253); (SBBG109534); (UCD120329); (CDA16703); (UCR140347); (UCR140978); (UCR161971); (CDA21434); (CDA29812); (OBI73363); (OBI73635); (UCSB5400); (SFSU08260, SFSU08259); (SFSU08261); (SFSU); (SFSU); **TULARE CO.,** (UC1349287); (CAS912771); **VENTURA CO.,** (JEPS2190, UCSB31489); (RSA599); (SBBG79940); (RSA427683A); (RSA427682A); (UC1069323); (UC718109, RSA15984); (UCR95736, UC718243, RSA16290); (POM308224); (UC671730! n = 11 Cave and Constance 1942, RSA42294); (UCSC1517); (RSA59989); (UC967385!); (UCD120319); (LA38797); (HSC13707); (RSA140791); (LA40169); (RSA165512, SBBG18782); (SBBG13124); (SFV2997); (SBBG18368); (SBBG22311); (SBBG25261); (SBBG24308); (SBBG24832); (SBBG32892); (RSA549451); (JEPS57323); (JEPS60181); (RSA427685B); (SBBG41359); (SFV9348); (OBI19538!); (SBBG39916); (UCR64800); (RSA427684B); (SBBG45385); (UCD120327); (UCSB34157); (UCSB34158); (SBBG95000, SD143513); (SBBG91827); (UCSB71928); (RSA786326); (SBBG111668); (SD202274, RSA641665, SBBG112111); (SBBG112086); (UCR158356); (UCR114678); (UCSB70605); (LA201583); (SBBG114517); (SBBG121347, SBBG114265); (SBBG36729); (SBBG116392); (UCR127232, IRVC29134, SD186242); (UCR126791); (IRVC27912); (RSA725891); (SBBG116810); (UCR127265, IRVC28398); (UCR128263); (SBBG116523); (UCR200757, RSA727217, SD231327, UC1928504); (UCR148509, RSA702058, SBBG118900); (RSA723241); (RSA723505); (SFSU13713!);

CALIFORNIA, UNKNOWN CO., (SDSU6096 not georeferenced); (UC107476! not georeferenced).

MÉXICO, **BAJA CALIFORNIA:** (SD11779, SD11778); (TEX224036); (SD43152); (SD47245); (SD60605); (TEX224035); (SD60763); (SD64914); (SBBG80486); (SD73036); (SD74998); (SD83329); (SD92832); (SD87969); (SD88933); (SD91285); (SD91123); (SD100738); (SD101709); (SD102596); (SD102983); (SD102341); (SD106055); (SD105349); (SD105436); (SD107257); (SD110340); (SD110506); (SD110899); (SD111094); (SD111049); (SD111215); (SD111142); (BCMEX3792); (BCMEX3949); (DES00030652-3091890, UCR-

43037-393577); (BCMEX2508); (BCMEX3429); (BCMEX3357); (SD130181); (UCR106239); (UCR112255, BCMEX10922, SD144740); (SD144825); (HCIB12633, BCMEX10261); (SD222900, UCR-239761-4541246); (SD228889).

APPENDIX 3.04. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA CILIATA*** **(VAR. *CILIATA*).** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES. **CALIFORNIA**. **ALAMEDA CO.,** (UC63895!, SEINET3158086, NMC41626-3158086, POM64824); *M. Ely 27* (SFSU!); (UC1746029!); (POM196287, UCR136759); (POM182661, RSA3278B); (UC571718!); (UC571719!); (JEPS21994!, OBI13839!); (UC144635!, UC144635, RENO34613-NESH 10568); (RSA152137); (JEPS2246!); (RSA760008, SD211616, UC1950241); (UC70196!); (RSA181608); **COLUSA CO.,** (POM65807); (UC71625!, UC736911); (JEPS2272!); **CONTRA COSTA CO.,** (CHSC21610); (UC24322!); (JEPS68958!); (CHSC23115); (UC767564!); (POM65595, UC75117!); (UC2022567!); (UC672410!); (JEPS18324!); (JEPS18382!); (UC1950229!, RSA755524); (POM204460); (UC881009!, SEINET3158089, NMC51531-3158089); (RSA44378); (UC35531!, POM89836); **FRESNO CO.,** (UC1069301!); (CHSC41948); (UCD77217); (UC596130!, JEPS2261!); (RSA74164); (UC984898!, RSA97716); (JEPS2255!); (JEPS2256!); (JEPS2253!); (JEPS2265!); (UCD120346); (RSA427694B); (UCR121002); (UCD120347); (UC107433!); (UC107432!); **GLENN CO.,** (JEPS2259!); (JEPS2258!); **HUMBOLDT CO.,** (UC1239734!); (UC24323!); (BLMAR632); (BLMAR698); **INYO CO.,** (UCR133205); **KERN CO.,** *M. Ely 24* (SFSU!); (UCSB47431); (JEPS2269!, SD29281); (OBI54543!); (OBI7133!); (UC1069296!); (SBBG108639); (SBBG17376); (POM264136); (RSA303852); (JEPS91359!); (UC1069297!); (UC1069287!); (UCD120356); (CAS1119714, JEPS118779!); (LA88427); (LA88426); (UCD120355); (POM289607, UC511240!); (RSA112767, RSA112770); (UC881012!); (UCR101654); (POM289608); (POM289609); (RSA745086, POM289609); (RSA745236); (RSA745013); (RSA745088); (POM97248); (RSA749407); (POM289610); (RSA761412); (RSA761351); (RSA562318, RSA560921); (UCR83666); (SJSU1141!); (UCR82059); (RSA667217, UCR121712); (UC1069290!); (UCD120341, SD148139, UCR123945); (RSA746600); (RSA746615); (RSA746610); (RSA746607); (RSA747640); (RSA746933); (RSA757605); (UC144633!); (UCR98810, RSA599576); (CAS1170806!); (UCD120345); (SBBG23557); (OBI39129!); (OBI28627!); (POM213000, UC569057!); (RSA59385); (SFSU08263!); (UCR130768); (UCR183628); (UCR214206); (UCR214186); (UCR214180); (UCR213290); (JEPS2275!); (SD178145); (UCR140942); (UC126031!); (POM127612); (POM73713); (VVC592); (UCR7731); (SBBG15872); (POM17629); **KINGS CO.,** (UC671718!); (UC767562!); **LOS ANGELES CO.,** (UC1537520!); (RSA716616); (SBBG65309); (UC73685!); (RSA74168); (RSA483581, UCR52404); (RSA203068); (SBBG34764, RSA667600); (SEINET3158087, RSA60282); (CAS936); (SBBG29814); (UC672411!); **MERCED CO.,** (CHSC41949); (JEPS2270!, UC765520!); **MONTEREY CO.,** (UC1069286!); (POM125885); (UC1614502!); (PGM5935); (JEPS85821!); (PGM5936); (CHSC28611); (PGM5937); (SBBG11806); (UC672413!); (RSA170415); (RSA127079); (UCD120338, UCD33780); (UC310187!, POM97462); (UC984910!, RSA98361); (JEPS2249!); (RSA128699); (UC1176831!, RSA118865, OBI13841!); (SBBG65308); (POM127742); (PGM1463); (PGM1464); **ORANGE CO.,** (UCR239654); (JEPS89037!); (RSA738989); (RSA738988); **RIVERSIDE CO.,** (UCR120812); (RSA658905); (UC64056!); (SDSU18365); (UCR85569); (UCR85577); (RSA614227,

UCR104644, SD143849); (RSA615568, UCR103479); (UCD120334, UCR104628); (UCR104637); (UCR104639); (HSC95252, UCR123602); (UCR95332); (RSA593695); (RSA593692); (RSA666588, UCR121106, SD148138); (SD134446); (UCR6374); (UCR18538); (UCR37441); **SAN BENITO CO.,** (SFSU08262); (UC1137253!); (UC519000!, SBBG29883); (UCSB15344); (JEPS2248!); (RSA42019); (JEPS78304!); (RSA26572); (SBBG93310, SD131875, RSA517024, UCR71461, UC1562510!); (LA205641); (JEPS91357!); (JEPS112732!); (JEPS2250!); (JEPS2254!); (UCR193088); (UC107434!); (UCD120336); **SAN BERNARDINO CO.,** (UCSB34142); **SAN DIEGO CO.,** (POM156477); **SAN FRANCISCO CO.,** (UC133058!); (UC168668!); **SAN JOAQUIN CO.,** (UC702962!, POM299077, SBBG29816); (UC672412!); (JEPS27271!); (RSA21263); (JEPS2260!); (JEPS2245!); (CDA16212); (JEPS2262!); (JEPS2268!); **SAN LUIS OBISPO CO.,** *S. R. Hubbard 16* (SFSU!); *K. Whitney 35* (SFSU!); (UC55312!); (UCR26113); (OBI2190!, UC1321300!, OBI13835!); (OBI8552!, SFV19348); (OBI64934!); (UC1069298!); (UCD147068); (UCD147160); (SFV16119); (UC1069293!); (UCD120342); (SBBG118421); (OBI65068!); (SBBG12287); (UC1069295!); (CAS1090132); (UC1069289!); (UC1069294!); (UC1069292!); (RSA427698B); (UCR104787); (UCR97539); (UCD40566); (UCD40589); (RSA603238); (UC1069291!); (UC671726!, n = 11, Cave and Constance 1942, POM298625, RSA42311); (UCSB17242); (UCSB14980); (UCSB17636); (UC671721!, HSC13633, POM298663, RSA42319); (RSA354853, SBBG81019, UCR41871, OBI39392!, SD125574, UC1541097!, UCD120350); (SBBG97523); (UC575294!, RSA607294); (RSA614980, UCR101026); (RSA112769); (JEPS7465!); (JEPS7763!); (UC511214!, POM289611); (UCD78280); (UC524055!, RSA8260); (UC524069!, POM203591, RSA8326); (SD148137, UCR122490); (OBI30160!); (OBI13838!); (UC580868!); (OBI13837!); (UC1285310!, OBI13833!); (JEPS2247!); (UC564184!); (OBI13836!, OBI13834!); (RSA74169, POM97366); (CAS1126769, RSA789124, RSA790158); (UCD120344); (CDA14182); (CDA15626); (UC1426016!, RSA246177); (CDA13598); (OBI28860!); (OBI28752!); (JEPS2251!); (JEPS2252!); (UC1228851!, RSA151027); (OBI39028!); (OBI77621!); (UC1523527!, HSC82800, RSA342257); (RSA427699B); (PGM5934); (UCD120335); (SBBG103411); (UC1501863!); (UC1501864!); (UCSC587); (UC55311!); (JEPS2266! excluding plant on left [*Phacelia divaricata*]); (UCD120340); (SBBG27020); (OBI4029!); (OBI77449!); (SFV16343); (JEPS86728!); (UC338244!); *R. Peters 28A* (SFSU!); (OBI13840!, UC1285034!); **SAN MATEO CO.,** (UC24324!); (JEPS2263!); (JEPS2271!); **SANTA BARBARA CO.,** (SBBG101228); (POM165975); (UC1069300!); (SBBG12288, JEPS29399!, RSA151511); (SBBG85688); (SBBG65307); **SANTA CLARA CO.,** (UCSB44905); *J. Dempcy 47* (SFSU!); (UC75118!, POM65576); (UC535102!, POM210221, SBBG44995, SD143511, SD143512); (RSA26553); (UC1206491!); (DS749993!); (POM265229); (RSA149205); (UC1301151!); (DS580570!); (UC1219882!, RSA159456, UCD120353); (RSA195723); (SJSU69!); (SJSU11239!); (UCD120354); (RSA128861); **SANTA CRUZ CO.,** (UC187874!); **SOLANO CO.,** (JEPS2257!); (UCD120339); **SONOMA CO.,** (UC73702!); **STANISLAUS CO.,** (JEPS2274!); (UC615569!, JEPS21732!); (UC702955!, RSA26590); **SUTTER CO.,** (UC881011!); **VENTURA CO.,** (UCSB27810); (UCSB27811); (RSA427697A); (SBBG19812); (SBBG121429); (UC1018425!, UC791053!); (SBBG121125); (RSA427696A); (SBBG23010); (SBBG114736); (SD116574); (UCR129518); (SBBG124236); (UC69148!); (UC718240!, RSA16272); (RSA13138); (SEINET3158088, RSA60372); (SBBG116539); (POM181828); (RSA17001); (LA205642); **YOLO CO.,** (UCD120349); (HSC13634); (UCD120333); (UCD120337); (POM261894); (UCD149396).

APPENDIX 3.05. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA CILIATA* VAR. *MEXICANA*.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

MÉXICO: BAJA CALIFORNIA, (UC107431!); (UC917049!); (UC660914!); (UC131472!); (SD6853); (UC511782!); (UC956708!, UC967361!, SD45287, LL248679); (DES00024732, SD110488).

APPENDIX 3.06. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA CILIATA* VAR. *OPACA*.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES. **CALIFORNIA**. **KERN CO.:** (POM305115); (RSA602433); (RSA112767, RSA112770); (LA205638, RSA12867, UC718100!); **MERCED CO.:** (UC1069299!; (DS129465!); (UC765452!, CAS240044!); (JEPS2264!, UC596126!, UC767565!, DS254302!); (UC765444!); (GH402965, POM224489, CAS188194!, DS170869!, RSA74165); (GH402966, UC583377!, UC765504!, CAS188199!, RSA604725, RSA74163, GH402966); (GH402967, CAS473861!, UCD120343); (DS254302!); (UC1422531!); (UC455959!); **TULARE CO.:** (JEPS2276!); (CAS370478!); (UC767563!, JEPS2277!); (UCR254197, RSA808609, CAS1170808!); (JEPS2267!); (JEPS2273!); (UC881010!).

APPENDIX 3.07. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA CRYPTANTHA*.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES, **ARIZONA**, **COCHISE CO.**, (ARIZ5565743); **COCONINO CO.,** (DES00030844-3091662); (GCNP1864886); (DES00044439-3091696, GCNP3201137, ASU239483-704200); (GCNP1868736); (GCNP1867755); (BRYV0108550-4682051, GCNP3201714, DES00070178-3218695, ASC92610-GRCA 96020 (acc. GRCA-05522)); (MNAB.24212-GRCA 87374); (MNAB.24188-GRCA 87375); (MNAB.27115-GRCA 87373); (ARIZ5565746); (ASU150663-704232); (DES00042726-3091687, ASU239863-704202); (DES00048246-1077687); (DES00051854-1074284); (DES00052013-1074486); (DES00057795-2051918, ASC80229-GRCA-05445 cat# : 90832, GCNP1868032); (DES00059558-1093083); (ASC92644-GRCA 96052 (acc. GRCA-05522), GCNP3201749); (DES00068382-3124324); (ARIZ5565748); **GILA CO.,** (US 1624964!); (RM491894-1573179, RM491894-1252741, ASU32315-704244, ARIZ5565741); (DES00074124-3426727); (RM138792-1223422); (RM172517-1231784); (ARIZ5565732); (ASU217609-706128, ASU167626-652037); (ASU190901-704194); (ASU190939-706129); (ASU216184-658108, ARIZ5565751); **GRAHAM CO.,** (ASU123071-704245); (ASU43381-704227); (ASU168639-704205); (ASU226950-652893, DES00046065-3091713, ASC76499-1025628); (ASU-706722); **LA PAZ CO.,** (ASU123071-704245); (ASU43381-704227); (ASU168639-704205); (ASU226950-652893, DES00046065-3091713, ASC76499-1025628); (ASU-706722); MARICOPA CO., (ASU32313-704239, ASU32311-704237); (ASU223766-770541); (ASU32312-704238); (ASU32314-704229); (ASU49837-704243); (ASU214666-704233); (ASU189918-704246); (BRYV0108539-4682034); (ASU236895-659959); (ASU289603-4536050); (UCR-144874-422337, UTC00234319-241974); (RM172505-1230998); (ARIZ5565742); (ARIZ5565734); (DES00049392-2040674); (DES00046976-2045569, ASU660155); (DES00055845-2048332); (DES00072661-3382325, ARIZ417380-4561099); (DES00067673-2164065); (ARIZ5565733); **MOHAVE CO.,** (US2057265! P03861875! cited by Coville 1893); (*Palmer 3341* US, cited by Coville 1893); (*Palmer 3342* US, cited by Coville 1893); (GCNP1863608); (RM364263-1576723, BRYV0108538-4682038, RM364263-1378740); (DES00040729-3091678); (UCR-98087-320906, UTC00223778-272161); (BRYV0108640-4682021); (BRYV0108540-4682032); (RM742626-1576348, BRYV0108541-4682040, RM742626-1375434); (RM741395-1360330, BRYV0108641-4682023); (BRYV0108542-4682042); (UTC00232983-240597); (RENO34838-5759810); (UTC00233436-240543, BRYV0108581-4682030); (RENO34836-5759808, BRYV0108642-4682025); (BRYV0108544-4682047, NY1057949-2886356); (BRYV0108546-4682055, NY1057950-2882771); (SUUSUU000651-LAKE 18370); (UCR-169131-443756, ID137597-ID111437); (SRP45019-SRP-VP-50288, BRYV0108547-2443185, UCR-234084-4538188); (BRY:V:0613574613574-2441504); (BRY:V:0613783613783-2441636); (BRY:V:0613618613618-2444947, BRY:V:0613617613617-2441646); (SRP45020-SRP-VP-50289, BRYV0108548-2443330); (DES00014876-3091622); (MNAB.35851-6171079); (ARIZ5565735); (ARIZ5565729); (ARIZ5565740); (ARIZ5565730); (ARIZ5565744);

(ARIZ5565731); (ARIZ5565736); (ARIZ5565753); (ARIZ5565739); (ARIZ5565745); (ASC35228-2086583, ARIZ5565754, ASU97922-704223); (ASU100812-704236); (ASU100644-704241); (ASU100621-704242); (ASU101542-704234); (ASU133831-704192); (ASU126309-704213, DES00020327-3091637); (DES00040695-3091677); (ASC62953-2077219); (ASC64237-2109611); (NY1057951-2881089, BRYV0108639-4682019); (ASU238435-704211); (ASU238634-704209); (NY1057952-2885021, UTC00233364-240617, RM741549-1376447, RM741549-1576463, ASU240047-704207); (ARIZ375155-853046, BRYV0108582-4682028); (NY1057953-2881093, BRYV0108543-4682049); (NY1057954-2884437, BRYV0108545-4682046, UTC00233073-240811); (ASU253801-721703); (ASC82541-2115906); (ASC79862-2103511); (ASC79870-2103506); (ASC79937-2110790); (DBG39995-3292284); (NY1057955-2881094); (ASC96637-2118210); (ASC96696-2118063); (ASC94290-2118190); (DES00063544-1093084, ASC92448-GRCA 96172 (acc. GRCA-05522), BRYV0108549-4682052, GCNP3201875); (ASC96483-2126523); (DES00014840-3091621); **PIMA CO.,** (RM172512-1228103); (ID62223-ID111438); (BRYV0108628-4682003); (SJNM33194-6042356); (RM172504-1228855); (RENO33159-NESH 63253); (ASU158622-704235); (ARIZ218516-921671); (ARIZ5567138, ARIZ5565749); (ARIZ5565757, ARIZ5565747); (ARIZ5565737); (ARIZ5565738); (ARIZ385098-921672); (ARIZ388193-953899); (SJNM19063-6057132); **PINAL CO.,** (US 1634451!); (SJNM32483-6044711); (ARIZ5565756); (ASU190676-704247); (DES00044590-3091698); (DES00049347-1072485); (TEUI-274689); **YAVAPAI CO.,** (*Rusby s.n.,* US cited by Coville 1893); (US 855609!); (US856940!); (ASC103865-3409253); (SEINet6166221); (RM1168281); (RM1168304); (ASC94954-2124200); (DES00073859-3854467); (DES00073493-3439268); (ASC8306-2111596); (ARIZ5565755); (MNAB.9877-1926042); (ASU84940-704225); (COC-AZ997-5424054, ASC33262-2111627); (ASU221680-704231); (ASU195443-704189); (ASC67374-2077218); (DES00052780-1076499, ASU276085-1003362); (ASC76309-1025627); (DES00053014-1076375, ASU275886-1124080, ASU275886-783354); (DES00052833-1076421); (ASC74413-1036055); (DES00052741-1076703, ASU282026-2038529); (DES00052816-1076293, ASU279956-2035577); (ASC83919-2114195); (ASC81030-2104324); (ASU287731-3371242); **YUMA CO.,** (BRYV0108631-4682007); (MISSA31989-6744432, ID16608-ID111439); (ASU32310-704224); (ARIZ5565750); (ASU86489-704240); (ASU105157-704221); (ASU68477-704228, ARIZ5565752).

CALIFORNIA. **IMPERIAL CO.,** (UCSB33424, UCSB72102); (SD242848); (UCR108040!, SD144371); (UC1790151!, RSA706305, SD162626); (RSA787302); (RSA787480); **INYO CO.,** (*F. Funston and F. V. Coville 835* US, cited by Coville 1893); (POM73398); (UC128902!); (JEPS2278!); (SD40626); (SD40510); (UC697998!); (UC938986!, US1600046!, cited by Voss 1934); (SBBG11365); (JEPS2288!); (UC657587!); (JEPS2282!, RSA114171); (JEPS89040!); (JEPS2283!, US2308205!); (JEPS2281!); (JEPS2280!); (JEPS2292!, SD46077); (RSA112686); (UC693732!); (UCR208073); (SFV7492); (RSA552081); (RSA620945); (RSA678899); (RSA678772); (UC1445355!, RSA622350); (CAS738522!); (RSA625042); (SEINET4682005, BRYV0108630-4682005); (SEINET4682004, BRYV0108629-4682004); (RSA426015); (UCR97226); (UCR88788); (UCR89228); (UCR235182); **KERN CO.,** (POM96611); (RSA620333); (UCSB32687); (RSA517007); (RSA621293); (RSA727563); (RSA720851); (UC1922029!, RSA727589); (OBI13827!, OBI13826!); **LOS ANGELES CO.,** (RSA74179, JEPS2294!); (POM18109); (JEPS2289!, SBBG29808); (RSA592352); (RSA628873); (RSA632447); (RSA348930); (RSA587339); (RSA586986); (UCR141357, RSA659946);

(RSA746565); (RSA587154); (UCR189282, RSA727732); (RSA674784); (UCR190364, RSA733281); (UCR177456, CHSC95500, RSA709682, SBBG71496, SD181481, SFV20833, UC1870170); (UCR197755, RSA725085, SD231329); (RSA716896); (RSA756876); (RSA755961); (RSA756955); (RSA757661); (RSA756796); (RSA756131); (RSA756127); (RSA756013); (UCR206276); (UCR220056); (UCR223390, RSA771776, SEINET3245999, ARIZ409661-3245999); (SBBG126051, RSA763228); (RSA765195, ASC91190-GRCA-05507 Cat. # 94617, GCNP3200971); (UCR252878, RSA823746); (RSA775874); (RSA778875); (RSA809053); **MONO CO.,** (UCR60039, BRYV0108634-4682013, HSC86006, SEINET4682013, UC1545595!); **ORANGE CO.,** (SEINET4682011, BRYV0108633-4682011); **RIVERSIDE CO.,** (RSA428301B); (UC922689!); (UC668397!); (UC667340!); (UC663066!); (UC666575!, *n* = 11, Cave and Constance 1944); (UCSC1207); (UC1262269!); (UCR16830); (UCR30056); (UC1518622!, RSA315551); (UCR41355); (UCR88426); (UCR88543); (UCR97479); (JOTR34007); (JOTR30997); (JOTR31059); (JOTR34085); (JOTR33951); (JOTR32435, JOTR32041); (UCR243510); (JOTR32186); (JOTR35475); **SAN BERNARDINO CO.,** (POM73406); (POM8013); (POM145307); (POM96846); (POM188255); (RSA15828); (JEPS2279!); (JEPS2290!); (JEPS2285!); (JEPS2291!); (POM259353); (JEPS2293!); (JEPS2286!); (UC922738!); (POM254932); (UC666353!); (RSA112688); (RSA24976); (JEPS2284!); (UC774918!, RSA24489); (RSA24569); (UC774965!, RSA24504); (JEPS3124!); (JOTR1168); (JEPS8547!, RSA151956); (RSA595251); (RSA426020); (UCR13995); (RSA270726); (UC1606939!, RSA348926, UCR60507); (RSA270734); (RSA270721); (RSA247050); (UC1400326!); (RSA270722); (UCR145565, IRVC15784); (RSA344271); (RSA344272); (UC1536005!, RSA254947); (SD99378); (RSA426019); (RSA284538, GMDRC0144); (UCR15865); (UC1531151!, RSA349047); (UCR33439, RSA278616); (RSA348916); (UCR33282, SD100144); (RSA278401); (RSA278747); (UC1590360!); (RSA296625); (RSA296604); (UCR38798); (SDSU18192); (GMDRC0145); (UCR51013); (RSA488919); (RSA492901); (RSA479823); (UCR128590); (RSA709430); (UCR88254, SD232702); (UCR86813, SEINET269345, UTC00220919-269345, VVC942); (UCR86671); (UCR86977); (UCR86156); (UCR87125); (UCR88176); (RSA664985); (UCR88487); (RSA645667); (UCR117293); (UCR101502); (SEINET2077217, UC2015722!, ASC2077217); (SBBG111933); (UCR119760, RSA627291); (UCR106319, RSA619324); (GMDRC0990); (GMDRC0925); (GMDRC1441); (UCR126123, HSC95400, IRVC26387, RSA680937, RSA714213); (CAS1122270!, RSA706152); (GMDRC1135); (VVC1928, UCR209070); (VVC1585, RSA682336, UCR127509); (UCR152958, IRVC26867); (UCR164648); (UCR164647); (UCR164596, GMDRC1526); (UCR154476, IRVC27386); (GMDRC3698); (GMDRC1837); (UCR160913); (UCR175590, RSA815807); (UCR214748, RSA757162); (UCR198988); (VVC1748); (VVC1731); (GMDRC3086); (UCR216289, GMDRC3560, ASU50902-704226); (JOTR31206); (UCR228514, RSA772143); (JOTR33913); (UCR218387); (UCR218937); (RSA763113); (SEINET2124718, ASC96858-2124718); (UCR227169); (JOTR32002); (UCR225894); (RSA809805); (RSA777672); (RSA777301); (RSA774652); (RSA825146); (GMDRC6088); (SDSU18192-3540567); **SAN DIEGO CO.,** (POM183813); (SD14519); (SD24561); (UCSB30492); (HSC49201); (SD155448); (SD155447); (UCR144449, SD160587, UC1790100!); (SD159910); (UCR137265); (SD172431); (SD171432); (SD215083); (SD218739); (SD212256); (SD197370); (SD197371); (SD219893); (SD213196); (RSA787644); **VENTURA CO.,** (POM346642).

NEVADA, CLARK CO., (DES00042582-3091937); (RENO34840-5759813); (UTC00233593-240398); (RENO34837-5759809); (RENO34833-5759804); (RENO34831-5759800); (BRY:V:0613562613562-2441491); (RENO34835-5759807, DES00047407-2044628); **LINCOLN CO.,** (RENO34839-5759811, BRYV0108636-4682015, RENO34834-RENO 49223, NY1057960-2881856); (UTC00189005-229012, BRYV0108632-4682009); (RENO34832-5759802, UTC00256116-2475001, NY1057961-2884439); (RENO34830-5759798, NY1112313-2972383); **NYE CO.,** (NTS16177-5514809); (NTS16679-5515300); (NTS16441-5515063); (NTS16464-5515085); **MOHAVE CO.,** (RM49576-1369684, US1417532! cited by Coville 1893), (US 856942!); (US 1739200!); (US 1739195!).

NEW MEXICO, HIDALGO CO., (UNM109340-4106028, NMC76592-147387).

UTAH, WASHINGTON CO., (BRYV0108533-4681972); (BRYV0108522-4681990, US 2724385!); (BRYV0108527-4681982); (BRYV0108525-4681985); (BRYV0108524-4681987, NY1057958-2882157); (BRYV0108511-4682002); (BRYV0108534-4681971); (BRYV0108521-4681991); (BRYV0108519-4681993, NY1057956-2882030); (BRYV0108532-4681974); (BRYV0108514-4681999); (BRYV0108530-4681977); (RENO33115-NESH 66812, BRYV0108526-4681983); (BRYV0108512-4682001); (BRYV0108531-4681976); (BRYV0108529-4681979); (BRYV0108637-4682016); (BRYV0108515-4681998); (BRYV0108523-4681988); (BRYV0108516-4681997); (UVSC8905-2155056); (BRYV0108517-4681995); (UVSC8401-2154770); (SRP33989-SRP-VP-33736); (BRYV0108537-4681966); (NY1057957-2882236, BRYV0108528-4681980); (NY1057959-2881934, BRYV0108535-4681969).

MÉXICO, SONORA, (USON4572-286242); (UCR-41139-393694); (UCR-56252-393695); (ASU76028-1918085); **BAJA CALIFORNIA**, (SD97129, UC1445247!); (SD111274); (SD170148); (UC124522!).

APPENDIX 3.08. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA DISTANS*****.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are <u>underlined</u>, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES, ARIZONA, LA PAZ CO., (RM491924-1318648); (DES00024566-3091646); (MISSA32038-6744420, ID117587-ID111457); (NMC70086-3141247); (UCR-203854-471224); (ASU49935-704694); (ASU49934-704703); (ARIZ5565840); (ASC63948-2077221); (DES00059908-1093118, ASC91845-2125255); (DES00059911-1093117, ASC91876-2125774); (ASU253603-721696); (ASU61301-704278); (ASC63539-2077223); (SJNM18751-6042848); Mohave Co., (DES00014794-3091741); (DES00020259-3091636); (RM49472-1367561); (RM284489-1220695, ID62173-ID111452); (UCR-90243-378223); (MNAB.35760-4341415); (ASC96474-2126305); (ASC96673-2124666); (ASC73489-2081638); (DES00076207-4670335, MNAB.35775-88-3); (ASC94306-2118173); (ASC96664-2126468); (ARIZ5565802); (ASU200499-704260); (ASC33518-2086584); (ASU114603-704764); (DES00019800-3091754, ASU113353-704846); (ARIZ5565764); (ASC82244-1066022); (ASU85227-705223); (ARIZ5565800); (ARIZ5565876); (ARIZ5565776); (ARIZ5565798); (ASU32287-704851); (ASC21076-2086440); (ASC21075-2111514); (ARIZ5565883); (ARIZ5565827); (MNAB.29872-LAME 5638); (ASU91508-704700); (ARIZ-5566367); (ARIZ5565772); (ASC62956-2077224); (ASC2086439); (ASC62957-2077225); (ASC25812-2086438); (ASU217131-704676); (ASC63537-2077222); (ARIZ5565760); (MNAB.21129-1935407); (MNAB.28778-1941726); (MNAB.11815-1927847); (MNAB.11865-1927897); (MNAB.14534-1929358);

CALIFORNIA. **ALAMEDA CO.,** (UC63894!); (CDA9528); (UCD120420); (UC63893); (UC129653); (UC403305, POM194601); (UC521528); (UC24480); (UC1614388); (UC407050, POM161103, DS177527); (UC571790); (POM304181); (UC671680, n = 11, RSA42307); (POM298636); (UC672422); (JEPS2315); (UC1576847); (UC672415); (JEPS107005); (UC1949204, SRP34293-SRP-VP-34037, RSA756243, SD211617); (POM298992); (UC131691); (UC24348); (UC24343); (UCSC589); **BUTTE CO.,** (CHSC42159); (CHSC27844); (CHSC31964); (UCD120383); (CHSC52345); (CHSC83956, JEPS104191); **COLUSA CO.,** (HSC35373); (CHSC108152, RSA794842, RSA794842); (JEPS95504, CHSC62845); **CONTRA COSTA CO.,** (JEPS111838); (JEPS111841); (JEPS111829); (UC1084393); (JEPS2385); (UC1084500); (UC24341); (UC56706); (UC762051, JEPS2399); (CAS953531, POM65421, ECON93123, UC131485); (UC762423); (UC672416); (UC881083); (UC672425); (UC672426); (RSA74783); (RSA83075); (UC1607636); (JEPS2024); (UC727775); (JEPS73329); (UC107400); (JEPS2366); (UC107374); (UC107401); (RSA276851); (UCD120388); (UCD120412); (LEA-VP-15055); **FRESNO CO.,** (UC709327, ID35101-ID111448); (RSA124637); (UC1069242); (UC881286!, DS132493!); (UC719479); (RSA681331); (CHSC41933); (CHSC47107); (UCD77220); (UC1069249, RSA122617); (JEPS2006); (UCR102077); (JEPS2374); (UC762417); (UCD120422); (UC107465); (UC178358); (UC107377); (CHSC55128); (CHSC69770); (CHSC70264); (PGM4081); (PGM7161); (POM299072); (POM88547); (UC107562); Glenn Co., (CHSC77590);

(CHSC67795); (CHSC53957); (CHSC109581); Imperial Co., (UCR16834); (SD73544); (SDSU6586); (UC669323); (UC669315); (RSA787782); (RSA787867); (ID116991-ID111459); (POM289806); (RSA803861); (DS194548); (UCR249856); (RSA292434); (RSA681359); (UC1790224, SD162625, UCR156500); (UC665821, RSA27490); (JEPS2372); (NMC6414-3131238, SEINET3131238); (RSA176844, DS508556); (HSC13682); (UCR241614); (POM197428); (SD10719); (RSA426063); (RENO34893-RENO 56315); Inyo Co., (UCSB10878); (UCSB32688); (JEPS2387); (JEPS2388); (RSA612649); (UCR51874); (UCD120418); (UTC00255385-3123863, RSA352620); (RSA352623); (RSA274235); (RSA274236); (RSA274240, RSA274239); (RSA274241); (UC1069263); (RSA614797); (RSA274246); (UCR119624); (RSA552046); (RSA552109); (UC939147); (RSA621973, RSA124392); (SBBG11715); (UC764458); (RSA615625); (ASC91061-2117481, SEINET2117481); (VVC1909); (RSA428318A); (RSA618051); (UC696010); (RSA30748); (UC694505); (UC131696); (UCR88802); (POM247265); (POM247264); (POM247122); (RSA788142); (WS378144-WS-VP-170868); (RSA794650); (UCR26049); (UC881078, RSA27855); (UC1236239, RSA105043); (NMC41630-3158138, SEINET3158138, UC128905); (JEPS2008); (UC1542721); (UC128904); (UCR183213); (UCR208960, POM289808A); (UCR200472); (RSA621040); (UCR221869); (UC597730); (UCR226677); (POM255207, UC1004995); (UCR226495); (RSA272429); (UCR234683); (UCR235244, RSA785098); (RSA798085); (UCR234824, RSA785960, OBI75927); (CHSC35443); (SD108793, RSA291981); (JEPS2000); (RSA795125); (SFSU08291); (RSA426069); (JEPS2375); (ID10088-ID111447); (RSA759825, CHSC106534); (RSA758911); (RSA118826); (SBBG32306, MISS29714-6225236, OBI13803, RSA189399, UCD120426); (RSA291994); (RSA291982); (RSA291993); (RSA310824); (SBBG64908); (SBBG64904); (SBBG64907); (SBBG64912); (SBBG64905); (SBBG64875); (UCR251335); (UCR133869); (POM73557); (POM73458); (UC107561); (SBBG64876); (SBBG64901); (JEPS2390); (POM232065); (POM244839); (RSA678771); (RSA678898); (RSA678900); (SD40521); (SD40625); (UC440321); (UC440322); (UC440324); (UC881074); (UCD120437); (MWI00056626-3840103); **KERN CO.,** (J. Dempcy 9 SFSU!); (UCR16835); (RSA105909); (UC1314989, OBI13819); (UCSB49284); (UCSB47434); (JEPS3255, UCD120431, SD58180); (POM311272); (RSA718633); (JEPS2362); (OBI54544); (RSA720988); (UCR246699, RSA799111); (SFSU); (UCSC3560); (JEPS2403); (POM311269); (UC1927576, RSA720578); (UCD83168); (UCD83171); (UCD84302, UCD83173); (UCSB69621); (UCR98996); (UC661062); (UCR12041); (RSA721196, UC1927501, UCR200048); (UCD109535); (SD70814); (CHSC98762, UCR200065, RSA720539, UC1927378, CHSC98074); (JEPS3253); (POM346641); (HSC66746); (UCR99004); (JEPS3238); (JEPS3196); (RSA720415); (RSA428283A); (RSA426089); (RSA727577); (CAS1121870); (CHSC108380, UCR196695, RSA729156, UC1921991); (RSA602238); (UC608482); (UC1069265); (RSA730056, UCR196594); (UC1928494, RSA728907); (SBBG11792); (UCD40556); (JEPS57244); (UC762054); (UC762052); (UC1078182); (UCR115911); (UCR120361); (SBBG107031); (RSA707606); (RSA707605); (UCR177480, RSA711203, CHSC95716); (UCR186499); (UCR91496, SEINET269536, UTC00221111-269536); (UCSB10581, SBBG64874, UC665595, UCD120384, POM264518, RSA28629); (UC671725); (RSA426087); (UCSB46491); (UCR186001); (UCR100792); (UCR101061, SD143846); (UCR100931); (UC923138); (POM291103); (MWI00056196-3479076, SEINET3479076); (RSA745053); (RSA619936); (RSA620343); (RSA745260); (RSA26563, POM299067); (RSA751058); (RSA799832); (RSA749405); (RSA761216); (RSA525309); (RSA761533); (RSA761512); (JEPS76525);

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(OBI31437); (OBI78763); (UC1069250); (OBI77448); (UC54863); (UC1069244); (CAS1091224); (UC1069238); (OBI29027); (UC1069259); (OBI28879); (UC615382); (UC1069258); (UC1069255); (OBI53176); (UC1069251); (SBBG107037); (SBBG107034); (RSA115614); (SD72105); (SBBG97431); (UC1541103, RSA344392); (RSA396526); (SBBG82540); (RSA17818); (RSA18233); (RSA296367); (SBBG6161, RSA140123); (SBBG107424); (SD41349); (UCR122159); (UC524047, POM203613, RSA8264); (UTC00125388-3121758); (OBI5386, OBI5022); (UC762348); (UCR122518, SD148136); (RSA48491); (UCR140993); (UC1562610, RSA518636); (RSA83107); (UCR161907, RSA150743, SBBG25618); (UC564122); (UCR190648); (UCR159226); (UCD120408); (UC310639, POM96346); (OBI13809); (OBI13807); (CDA11469); (CDA11470); (CDA11484); (UCD120409, CDA11485); (UCD120410, CDA11496); (SBBG28698); (UC410481); (OBI30659); (SBBG55567, OBI32142); (RSA67559); (OBI42224); (OBI72928); (RSA43309, OBI13806); (OBI54151); (OBI58193); (OBI58211); (OBI58334); (UCR231136, CHSC108874, RSA773014); (RSA426084); (RSA355858); (OBI23893); (SBBG32297, SJSU7528, RSA155481); (SBBG107033); (UTC00221094-269519); (SEINET269519); (UCD147165); (UCD147201); (UCD147261); (SBBG82624); (SBBG104280); (HSC91855); (UC24482); (UC338229); (OBI13810); (UCR131480); (JEPS2392); (OBI19535); (OBI34069); (POM202647); (SBBG21329); (UC24478); (UC338217); (UC56407); **SAN MATEO CO.,** (SFSU08294); (UC881081); (UC131512, POM65579); (RSA10261); (JROH2758); (UC75119); (POM128434); (UC306570, POM65454, SRP20214-SRP-VP-14732); (RSA149147); (UC881073, NMC21750-3158140, OBI48680, RSA426083, SEINET3158140); (UCD120425, SJSU7544); (SFSU08444); (SBBG32291); **SANTA BARBARA CO.,** (UC615239!); (UCSB44935); (UCSB50123); (CHSC24444); (UCSB40926); (SBBG108885); (UCSB38926); (UCSB38928); (OBI52016); (UCSB44300); (UCSB47293); (UC1069246); (UCD120433, RSA262589); (CDA29818); (UC130815); (RSA426184, UCSB31201); (SBBG96390, RSA535355); (UC129641); (UC1069261); (UC1069239); (UC1069262); (UC483266); (UCSB59363 sheet 1 of 2, UCSB59380 sheet 2 of 2); (SBBG47043); (UC577904); (UC1042534, RSA88318); (UC1042535, RSA88317); (UCSB39630, UCSB39629); (SBBG18492, RSA166520); (RSA165972); (UCSB43408, UCSB43409); (UCR107646); (UCSB39587); (UCSB54509); (SBBG37802, DS219929, RSA213125, RSA576182, SD75489, UCR65232, JEPS93308, UNM60973-4081448); (UC666542); (UCSB60069); (JEPS85760); (RSA602243); (SBBG35574); (SBBG15668); (SBBG11790); (UCR103793); (SBBG15578); (SBBG11997); (UC753499); (SFV3004, SBBG6162, SBBG64880); (SBBG64873, SBBG6166); (SBBG6167); (UCSB5371); (UCSB39138, RSA795816); (SBBG107040); (SBBG107039); (UCSB39662); (UCSB52838, RSA786484); (UCSB14564); (SBBG11788); (UC733689); (UC733690); (RSA4717); (SBBG12271); (SD194401, RSA131649, RSA624379, SBBG9207); (UC57026); (JEPS93303); (RSA737668); (UC809789); (RSA395868); (JEPS29398, SBBG11036, RSA145560); (UC901872); (POM262051); (RSA15744); (RSA173838); (POM262095); (SBBG29434, RSA426091); (RSA166958, SFV3005); (SBBG82524); (RSA395836); (SBBG11312, JEPS93306, JEPS93305, OBI60224, RSA624382); (SD194399, SBBG11311); (JEPS93238, RSA624415, SBBG11388); (SBBG107030); (SBBG82623, OBI45811, SD125575, UCR46648); (UC753512); (SD41348); (SBBG82538); (SD194402, UCR107624, OBI60228, RSA624419, SBBG13135); (SBBG82537); (SBBG82386); (SBBG82377, SD130596, UC1563245); (SBBG18457); (SBBG18458); (SBBG17705, RSA624416); (SD202275, RSA639681, SBBG112298); (UC1069245); (SBBG82535); (SBBG82536); (SBBG82137); (UCR122281); (SBBG37823, RSA213287, RSA426182);

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(UC671731!, n = 11, Cave and Constance 1942); (UC794423); (UC762050); (UC1562024); (RSA517316); (UC564156, RSA14187); (UCD120423); (SFSU08448!); **SUTTER CO.,** (UC1745675); (CHSC43313); (UC921151); (CHSC45934); (CHSC45935); (POM163449); (JEPS105859, CHSC87398); (CHSC87395); (JEPS105855); **TEHAMA CO.,** (CHSC77589); (UC1586540, CHSC53956); (CHSC70891, JEPS94155); (UC1010405); (JEPS2010); (CHSC78852); (JEPS2395); (JEPS2371); **TULARE CO.,** (JEPS2382); (UC131694); (UC881076, SD40788); (UC1561974, SD129722); (UC1872991, OBI68316); (UC24476); (UC185305); **VENTURA CO.,** (CAS317860!); (UNM60846, SD132626, SD75539, SEINET4081460, CAS317859!, DS728208!); (SBBG78952); (SBBG30955); (SBBG80662); (RSA519224); (UC24497); (UC1069264); (UCSB72371); (UC1069248); (RSA213201, UNM60817-4081450, RSA426189, SBBG37824, SD75540); (RSA166308); (SBBG121124); (UCSB14663); (RSA426097); (UCSB15156); (RSA723245); (SBBG39439); (SBBG39438); (SBBG121174); (UCR238149); (RSA4256); (SBBG30088, OBI4060, RSA426100); (JEPS73912); (UC702982, RSA112684, SBBG29819); (UC702989); (RSA810616); (SBBG114513); (SBBG114592); (SBBG114530); (SBBG114525); (OBI60222, JEPS93304); (SBBG13660); (RSA772436); (SBBG82385); (SBBG17893); (POM289812); (POM289810); (POM289811); (UC69144); (RSA749800); (UC77026); (RSA692592); (POM98472, UC310813); (SBBG82279); (SBBG21501); (SBBG21484); (SBBG21485); (RSA426101); (SD194398, SRP20212-SRP-VP-14734, OBI60227); (RSA624414, OBI60226); (SBBG91416); (RSA549450, SBBG91414); (SBBG91415); (SBBG55883); (SBBG91904); (SBBG91910); (SBBG112017, RSA640486); (SBBG78941); (SBBG78942); (SBBG79941); (SD143510); (SBBG43173); (SBBG43186); (SBBG32882); (SBBG39021); (SBBG64897); (SBBG21627); (SBBG41372); (SBBG64892); (RSA426096); (SBBG23328); (RSA31813); (SBBG64872); (SBBG41373); (RSA44097); (SBBG6168); (SBBG64903); (SBBG64902); (POM14186); (RSA426099); (SBBG94753); (SBBG111661); **YOLO CO.,** (UCD33194); **UNKNOWN CO.,** (UC24479); (RSA804762); (UC973558); (UC335457); (SBBG94754);

NEVADA, CLARK CO., (RENO34888-5760577); (RENO34895-RENO 15232); (RENO34886-RENO 15233); (RENO34885-RENO 15231); (UCR-103926-323723); (UCR-97354-320873); (SRP34294-SRP-VP-34038, UTC00231239-239274); (WCW4536-WCW-VP-8563); (ASC96756-2124630); **ESMERALDA CO.,** (UCR-241444-4542567); (UCR-241310-4542434); (RENO34892-NESH 55798); **LINCOLN CO.,** (RENO34891-NESH 63357); Nye Co., (ASC97383-3004494); (ASC97427-3004538); (ASC97473-3004562);

MÉXICO, **BAJA CALIFORNIA**, (SD227958); (SD133631); (ASU0041080-218052-1918144); (UCR51131); (BCMEX4578); (UCR52491); (UCR26110); (DES00027485-3091874); (WCW9461-WCW-VP-15833); (SD145574); (UCR38454); (SBBG23720); (SBBG25676); (SBBG25665); (SD87970); (SD38324); (SD41326); (SD42880, DES00034790-3091920); (SD60601); (SD60597); (ASU66317-1918090); (DES00009304-3091814, ASU128471-1918095, SD86436); (SD54530); (SD53808); (SD53819); (SD60770); (SD64905); (SD64906); (SD64904); (SD64913); (SD63011); (SD64657); (ASU261261-1918088); (SD64656); (SD67287); (SD72344); (ASU23252-1918089, SD72268); (SD77159); (SD77166); (SD77167); (SD194588); (SD77158); (SD195618); (RSA661344); (SD84342); (SD67025); (SD87294); (SD88914); (SD83920); (SD91239); (SD91280); (SD91857); (SD222901); (SD222902); (SD222903); (SBBG53577, SD95639, UCR44807); (SD95728); (SD97300); (SD97130); (SD100708); (USON19203-4908452, ARIZ408779-3245234, SD218153, UCR-

226033-2465077); (SD228890); (SD102592); (SD102988); (SD102470); (SD103707); (SD110471); (SD110803); (SD111122); (DES00024895-3091867, SD111160); (SD111247); (SD111298); (SD111299); (SD170149); (BCMEX1388); (SD168087, BCMEX13733); (BCMEX13705); (SD41607); (SD121242); (SD124118); (BCMEX4141); (SD235621); (SD162731); (TEX248735); (BCMEX2544); (SD41866); (SD41738); (LL248734); (SD182736); (SD49765); (TEX248741); (SD41550); (BCMEX3461); (BCMEX2545); (LL248747); (SD182737); (LL248738); (BCMEX13892); (TEX248730); (LL248739); (SD14993); (SD14921); (SD43143); (TEX248742); (SD44191); (BCMEX2177); (SD41336, SD41333); (SD41339); (SD44415); (SD63990); (LL248732); (SD47248, TEX248745, UC1093603!); (SBBG104326); (RSA762986, RSA761054); (LL248731); (LL248737); TEX248740); (UCR-51131-393587); (UCR-38454-393586); (UCR-238822-4540540); (UCR-44807-393584); (DES00018834-3091848); (RSA576757); (SD208193); (UC1531333!); (UC753508!).

ADDITIONAL SPECIMENS EXAMINED FOR *PHACELIA UMBROSA* [included as a synonym of *Phacelia distans*]
USA, CALIFORNIA, SAN DIEGO CO., (SD221156); (SD155604); (SD215097); (UC519856!).

APPENDIX 3.09. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA FLORIBUNDA*** **SENSU STRICTO.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

MÉXICO: **Baja California**, **Guadalupe Island,** (UC24506!, CAS35020!); (UC107295!); (CAS212201!); (UC1177970!); (UC1112225!, n = 11, Cave and Constance 1959); (SD47005); (SD46989); (DS402131!); (DS402125!); (UC1174462!, DS402123!); (UC1094548!, DS440150!, SD48225); (UC1094550!, DS440140!, CAS436983!, SD48261); (UC1174463!, DS402124!); (UC1094549!, SD48227); (UC1094547!, DS440141!, CAS436990!, SD48262); (SD74839); (SD74831); (SD119433); (BCMEX2296); (SD155032); (SD230858); (SD230859); (UC1251641!, DS498745!); (UC1251639!); (UC107308!); (UC107311!); (UC107313!); (JEPS1991!, UC24507!, DS8383!); (DS140709!); (UC35537!, DS8391!, CAS301456!, CAS415782!, UCR-64358, SD4096); (DS8382!, CAS415779!); (CAS191046!); MÉXICO: **Baja California**, **Islote Negro,** (UC1083873!); (UC1083882!, DS392385!, SD47435); (SD48226); MÉXICO: **Baja California**, **Islote Toro,** (HCIB19551); (SD154558); MÉXICO: **Baja California**, **Outer Islet,** (UC1057263!); (UC1083883!, n = 11, Cave and Constance 1959, CAS436818!, DS392384!, SD47486).

APPENDIX 3.10. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR **"*PHACELIA FLORIBUNDA* SAN CLEMENTE ISLAND "NALFSCIENSIS".** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES. **CALIFORNIA**. **LOS ANGELES CO., San Clemente Island**: (GH402973!); (GH402970!, POM19226, UC284964!); (CAS317857!, RSA213384); (DS572634!); (SD90548); (CAS951140!, SBBG109013); (UC1426004!, RSA251527); (RSA74486); (UC284786!, POM19211); (UC1426034!, RSA251389); (UC1228866!, GH402969, GH402972, RSA151248, SBBG12264, CAS454092!, SD51899); (SBBG108908); (UC1228878!, RSA151211 cited by Carlquist 1984, GH402971, SBBG11599, CAS454093!, SD51859); (RSA533936); (RSA643836); (SBBG109015); (SBBG108997); (SBBG108996); (SCI254!, SCI256!, SCI257!, SCI258!, SCI259!, SCI260!, SBBG105342); (UC557756!);

APPENDIX 3.11. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA GENTRYI***. Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES, ARIZONA, APACHE CO., (CS79881-519151, SJNM19041-6081604); COCHISE CO., (CCH713-156182); (ARIZ5565845); (ARIZ390217-959116); COCONINO CO., (ASU123866-704807); (ASC42892-2086217); **GILA CO.,** (RM132378-1235278); (RM491923-1283710, ASU32286-704850); (RM491922-1327361); (DES00004270-3091579); (ASU219435-778608); (WCW4455-WCW-VP-8564); (UNM87895-4013049); (DES00017627-3091746); (UCR-199252-467406); (ASU269780-777765); (ASU281008-2025467); (ASU32277-705219); (ARIZ5565846); (ASU112189-704683); (ASC2337-2086585); (ASC17318-2086218); (ASU34844-704848); (ASU32290-704833); (ASU32292-704835); (ASU32291-704834); (ASU158439-704524); (ASU24956-704844); (ASU143709-704830); (ASU95761-704859); (ASU32276-704266); (ASU164579-704539); (ASU120775-704804); (ASC26160-2086216); (ASU84836-704858); (ASU172374-704854); (ASU172383-705211); (ASU172355-705212); (ASC58675-1011212); (ASC58676-1011213); (ASC58692-1011214); (ASU190954-705202); (ASU216183-704264); (ASU216178-704262); (ASU216179-704263); (ASU190933-704269); (ASU216180-704265); (DES00048748-2045572); (DBG45310-3290897); GRAHAM CO., (UNM35191-4081454); (DES00006947-3091586, DES00006581-3091584); (ARIZ5565804); (ARIZ5565767); (ARIZ5565887); (ASU42342-705214); (DES00011184-3091611); (ASU151319-704542); (ASU103410-704277); (ASU142422-704281); (ASU226909-652910, ASC76500-1025637); (ASU226848-652978); (ASU230711-653475); (ASU230715-653500); GREENLEE CO., (DES00076320-4690973); (DES00076662-4891433); MARICOPA CO., (DES00022376-3091640); (RM138021-1224819); (RM491925-1327645, DES00045777-3092036); (ASU223802-756341); (ASU32245-704280); (ASU34959-704675); (ASU211861-756340); (DES00006152-3091580); (ASU32295-704819); (DES00006180-3091581); (DES00006410-3091582); (UCR-108299-378226); (ASU32248-704856); (ASU32289-704816); (ASU34784-704855); (ASU32297-704815); (ASU139788-704767); (ASU32281-704838); (ASU32243-704820); (ASU32239-704814); (ASU32240-704813, ARIZ5565774); (ASU32246-704823); (ASU9163-704825); (UCR-40997-378222); (ASU158211-704689); (ASU47043-704826); (ASU143701-704839); (DES00003365-3091576); (ASU164509-704646); (ASU139801-704669); (ASU139843-658176); (UNM46326-4081438); (ASU23495-704686); (ASU117576-704818); (ASU137220-704662); (ASU38430-704827); (ASU22284-704685); (ASU28748-704693); (DES00002458-3091573); (DES00002638-3091574); (ASU69375-704672); (ASU84522-704840); (ASU158567-704526); (ASU165585-704682); (ASU69368-704821); (DES00010912-3091603); (ASU87068-704841); (ASU87067-704828); (ASU83408-704822); (ASU105961-704695); (ASU105962-704684); (DES00017636-3091628); (ASU100155-704544); (ASU105027-704696); (ASU133649-704257); (DES00018260-3091749); (ASU145415-704812); (ASU119066-704805); (DES00019250-3091635); (ASU116268-704699); (ASU240097-657784); (DES00023187-3091642); (DES00023212-3091643); (ASU214534-704678); (DES00024429-3091645); (WCW15725-WCW-VP-8562); (ASU154311-704768); (ASU154260-704681); (ASU166784-651995); (ASC91263-2122337);

(ASU165922-704250); (ASU165907-704251); (ASU167083-704817); (ASU193467-652019); (UCR-78617-378227, DES00036012-3091978); (ASU190698-705186); (ASU189947-705199); (ASU200484-704261); (ASU243842-704687); (ASU212405-704688); (ASU215521-704668); (ASU248594-704517); (ASU227441-704842); (ASU236250-655386); (ASU655424); (ASU233009-705197); (ASU660116); (ASU660119); (ASU236476-704519); (UCR-212176-2454738); (ASU240143-655537); (ASU285306-660154); (ASU274208-1003229); (ASU266990-776521, ASU254229-753504, ARIZ368610-853215, ARIZ365360-853213); (ASU246701-662531); (ASU254385-747873); (ASU251120-662618, UCR-157162-433246); (ASU243694-704665); (ASU251887-707380); (ASU251884-707395); (ASU250640-709177); (ASU249670-710044); (ASU263258-712101); (ASU748080); (ASU748107); (ASU759914); (ASU748350); (ASU759908); (ASU759907); (ASU761898); (ASU759904); (ASU759905); (ASU761270); (ASU766787); (ASU781209); (ASU268260-780360); (ASU781315); (ASU778781); (ASU269408-777574); (ASU279555-782377); (ASU279556-782379); (ASU782397); (ASU279848-1121970); (ASU279906-1121977); (ASU279911-1121982); (SRP45017-SRP-VP-50286); (ASU282321-2038577); (ASU285280-3223614); (DES5771020); (DES5770712); (DES5770813); (DES5356458); (DES3385864); (DES3385889); (DES5770889); (DES5770894); (ASU287941-4535853); (CLEMS89253-3761842); (DES-5771111); (DES5527494); (DES5771137); (ASU242033-704521); (ASU194743-652389); (ASU267897-782477, ASU259444-2429232); (ASU32288-704256); (ASU32278-704861); (ARIZ5565766); (ARIZ5565769); (ASC13073-2086434); (ASC10568-2086433); (ASC12885-2086428); (ARIZ5565834); (ASC21570-2086437); (ASC18845-2086436); (ASC19000-2086430); (DES00008181-3091591); (ASC30525-2111495); (ASC24287-2111485); (ASC25492-2086431); (MNAB.31849-1944367); (ASC34172-2086427); (MNAB.27251-1940214); (ASC34152-2086432); (ASC50385-2086435); (ARIZ5565803, ASU129710-704259, DES00026991-3091774); (ARIZ5565770, ASU129562-704258); (DES00019160-3091634); (ASC36578-2086429); (ASC48613-2086426); (ARIZ5565763); (DES00048453-2045578); (DES00048395-2045577); (DES00048774-2045576); (ASC76501-2081637); (DES00050331-2040539); (ARIZ5575610); (DES00049138-2040363); (DES00049222-2040371); (DES00060040-2056794, UCR-203792-471259); (ARIZ5575612); (DES00057209-2051044); (ARIZ363010-853211); (ARIZ369791-853214); (DES00054740-2047963, ASU243677-704691); (ARIZ365617-853217); (DES00056571-2050055); (ARIZ374509-853223); (DES00057403-2051380); (DES00061431-2061570); (DES00072660-3382338, ARIZ417250-4561100); (DES00072650-4561101, ARIZ417251-4558698, DES00072650-3382346); (DES00061401-2061762); (DES00072659-3382349, ARIZ417383-4561102); (TEUI5425-1916459); (DES00067752-2430096); (ASU274127-781551); (ASU777488); (ASU1957083); (ASU32298-704837); PIMA CO., (USON3362-284898); (RM491915-1393574); (RM172511-1226443); (UNM23379-4081436); (UCR-57957-378228); (ID62217-ID111453); (UTC00261437-5501958); (UCR-8829B-378221); (ID63337-ID111454); (DES00010322-3091732); (UNM66817-4081442); (SJNM28167-6041260); (SJNM28162-6093953); (SJNM28163-6057808); (UCR-112055B-378208); (DES00075864-4565791, ARIZ415170-3831056); (ARIZ415205-3830951); (MABAson-trv-27705-6328200); (MABAson-trv-28543-6642405); (UNM12668-4081443); (UNM12685-4081452); (ARIZ5565779); (ARIZ5565886, ASU210246-704642); (ARIZ5565790); (ARIZ5565813); (ARIZ5565885); (ARIZ5565814); (ARIZ5565816); (ARIZ5565849); (ARIZ5565815); (ARIZ5565768); (ARIZ5565792, ASC25935-2113293); (ARIZ5565793); (ASU32285-704857); (ARIZ5565844); (ARIZ5565881); (ARIZ5565882); (ARIZ5565897); (ARIZ5565821); (ARIZ5565820); (ARIZ5565829);

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704527); (ASU228320-704535); (ASU228284-704530); (ASU219634-754039); (ASU220207-754040); (DES00060168-2060201, ARIZ352912-853193, ASC66290-2077220); (ASU220208-754038); (DES00048964-2045579); (DES00046658-1079745); (DES00046691-2045571, RENO31891-4924793); (DES2045580); (DES00045633-2045581); (DES00045624-2045582); (DES00053779-2044822); (DES00071222-3096151); (DES00071815-3522781); (DES00048673-2045574); (DES00048660-2045575); (DES00048726-2045573); (ARIZ367467-921679); (ARIZ358771-853197); (ASU262763-729247); (ASU729248); (ASU662512); (DES00057901-2051889, ASC91836-2125643, ARIZ383153-853224); (ARIZ384996-921681); (DES00057223-2051144); (ASU243934-662673); (ASU251914-707799); (ASU258970-768936); (DES00060603-2067437, CS91836-3014486, ASU270229-777666, ARIZ391155-960133); (TEUI274725); (DES00070850-3225056); (DES00074077-4182714); (DES3405203); (DES00072430-3405168); (DES00076292-4690049); (DES00075831-4404321); (ARIZ5565808); **SANTA CRUZ CO.,** (ARIZ418548-4560041); (UC131736!); (ARIZ5565870); (ARIZ5565867); (ARIZ5565877); (ARIZ5565868); (ARIZ5575611); (ARIZ366394-853202); (ARIZ370762-853200); (ARIZ5575608); **YAVAPAI CO.,** (UTC00255384-3123862); (WWB21654-WWB-VP-16483); (UNM73766-4081433, UNM72470-4081440); (UCR-27645-378229); (DES00035221-3091792); (ASU288741-5524684); (ASU288747-5524690); (ASU288745-5524688); (ASU288742-5524685); (ASC90859-2117353); (ASC94946-2124192); (ASC95008-2123832); (DES00075174-3426697); (DES00075268-4173620); (MNAB.2512-1920762); (ARIZ5565871); (ASC1046-2086587); (ARIZ5565809); (MNAB.4912-1922513); (ARIZ5565873); (ARIZ5565902); (ARIZ5565879); (ASC7609-2086594); (ASC8239-2086593); (MNAB.7816-1925024); (ARIZ5565893); (MNAB.7883-1925091); (MNAB.9849-1926014); (MNAB.9854-1926019); (ASC15323-2086591); (ASC54153-2077226); (MNAB.14617-1929440); (ASC15321-2086592); (ASC17269-2086595); (MNAB.20503-1934787); (MNAB.21563-1935850); (ASC27747-2086588); (ASC35636-2125087); (ASC38749-2086589); (COC-AZ998-5424056); (ARIZ5565810); (ASU116158-704759); (ASU117259-704806); (ASC51860-2111635); (ASC48096-2086590); (ASC64699-2086219); (DES00054849-2048081, ASC69772-2073340); (ASC73163-2081656); (ASC73109-2081639); (DES00053752-1076619); (DES00052989-1076646, ASC91815-2125342); (ARIZ372694-921680); (ASC74410-1018015); (ASU283137-3195724); (DES00054828-2048219); (DES00055008-2048055); (ASC83920-2114196); (DES00055021-2048245); (ASU778740); (DES00069238-3101831); (DES00069008-3095987, MNAB.33285-3237357); (DES00074694-4153162, ASC101992-3409303, MNAB.33085-3237284); (DES00074227-3816396); **YUMA CO.,** (ASU1956989); (MABAson-trv-23404-4173139); (ARIZ5565853); (ASU70082-704831); (ASU117665-704275); (ASU116538-704809); (ASU116520-704808); (ASU130011-704271); (ARIZ5565888); (ARIZ5565890);

MÉXICO, SONORA: (UC1923900!); (WCW9399-WCW-VP-8565); (TEX248746); (TEX248736); (TEX248733); (ASU195251-1918091); (USON1475-287652); (ASU194989-1918094, UCR-79188-393699); (TEX248744); (ASU194898-1918092); (TEX248743); (ASU202175-1918086); (ID117526-ID111458); (ARIZ391880-960820); (USON851-281994); (USON13860-4909482); (USON13803-4909481); (ARIZ397779-1908909); (UC1508843!, UCR-28242); (UCR-37432); (UCR-79564, TEX248752); (TEX248754); (UCR-79610, TEX248754); (UCR-80092, UC1931663!); (UCR-80177); (USON1637-277941); (USON4339); (USON4015, TEX248751); (MABAson-trv-12299); (MABAson-trv-11198); (USON2034); (USON6165-282570); (UCR-30111-393700); (USON20330-4910801); (MABAson-trv-27948-

6328443); (MABAsar-trv-074); (MABAsar-trv-217); (MABAson-trv-6312); (MABAson-trv-6313); (MABAson-trv-11410); (UCR-80181); (MABAson-trv-29239-6643101); (MABAson-trv-21000-3384806); (MABAson-trv-20999-3384805); (MABAson-trv-20997-3384803); (MABAson-trv-20998-3384804); (MABAson-trv-21001-3384807); (MABAson-trv-21002-3384808); (MABAson-trv-21003-3384809); (MABAson-trv-21004-3384810); (MABAson-trv-21005-3384811); (MABAson-trv-21007-3384813); (MABAson-trv-21006-3384812); (MABAson-trv-21008-3384814); (MABAson-trv-11199); (USON3813-285190); (USON547-280206); (USON3386); (USON8331-284400); (USON12724-280043); (ARIZ392677-853196); (ARIZ392666-853199); (USON8210-281219); (USON8888-278480); (USON8207-281216); (USON8209-281218); (USON8208-281217); (USON5827-278367); (ARIZ370299-853218); (MABAson-trv-11601); (NMC71776-3142499); (USON13975-4913196); (USON16762-4913202); (USON14999-4913198); (USON17552-4913203); (USON18191-4913204); (USON18604-4913205); (USON15799-4913200); (USON15569-4913199); (USON16381-4913201); (USON14531-4913197); (USON10189-280761); (MABAson-trv-12049); (ARIZ416581); (MABAson-trv-11868); (MABAson-trv-10891); (MABAson-trv-11931); (MISSA32227-6751355); (MABAson-trv-23684-4174726); (USON10190-280762); (USON14193-4914504); (USON16204-4914505); (MABA4151781, MABA4151270); (ARIZ88546-ARIZ-BOT-0005123, ARIZ273972-ARIZ-BOT-0005117, MO 1089147-156572, UC 646330!, GH, MEXU); (ARIZ5566779); (ARIZ5579818, TEX248753); (ARIZ5579821); (ARIZ5579816); (ARIZ5579819); (ARIZ5579817); (ARIZ5579820); (ARIZ5566778); (USON551-280210); (UCR-78525); (MABAson-trv-4711); (ARIZ408928); (MABAson-trv-12199); (MABAson-trv-12256); (MABAson-trv-29799-6736795); (ARIZ417612-4557081); (TEX248755); (MABAson-trv-28309); (MABAson-trv-28370); (UCR-50610-393697); (MABAson-trv-27840-6328335); (USON18462); (USON18461); (USON18463); (USON19926); (MABA4151012, MABA4151523); (MABAson-trv-28181); (USON14213-4916179); (UCR-6953); (MABAson-trv-28403); (MABAson-trv-12514); (USON5716); (UCR-28227); (NMC70108); (US); (UC576456!); (UC576441); (MEXU, MO, K!); (UC6660005!); (UC628460!); (UC666004!); (UC881071!); (UC881072); (UC1341989!); (UC753594!); (UC1093600!); (DES00003498-3091806); (ASU39708-1918087); (UC1549333!); (UC1549332!); (DES00034290-3091914, UCR-54726-393696); (UC1595803!); (UC1595804!); (UCR-86114-393698); (ARIZ319140-6632444); (ASU0031605-211340, UC1619374!, TEX248750); (UC1619375!); (ARIZ5575613); (ASU252226-1918093); (ASU283032-2146339); (*E. A. Goldman 306*, US); (UC131514!), (UC1923900!).

APPENDIX 3.12. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA HELIOPHILA*****.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES, CALIFORNIA, **FRESNO CO.**, (UC107471!);, (UC718098!, RSA12891);, (UC762418!);, (UCD120701); (UC1299135!);, (UC923139!);, (RSA74249);, (SBBG23561, RSA180002);, (UCD77223); **KERN CO.,** (POM187123); (UC1539578!); (RSA745019); **MERCED CO.,** (DS319868!);, (UC671722! *n* = 11, Cave and Constance 1942, RSA42318, POM298661);, (UC762416!, JEPS2175!); **SAN BENITO CO.,** (POM161780);, (UC719480!);, (UC1279956!);, (RSA132667); **SAN LUIS OBISPO CO.**, (OBI13822!);, (OBI13823!);, (RSA140118);, (OBI13828!);, (OBI77737!, UC1314929!);, (OBI13825!, OBI13824!, UC1392984!, SBBG40306);, (RSA304480);, (OBI47630!);, (SBBG95285, OBI47708!);, (OBI77452!);, (OBI78090!).

APPENDIX 3.13. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA HIRTUOSA*.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

MÉXICO, BAJA CALIFORNIA: (UC107525!); *E. Palmer 692* (K!, P03846576!, likely duplicates of UC107525); (BCMEX3791, UC1523621!); (SD100944, UCR40769, UC1445242!); (UC1462362!); (UC10087209!); (SD92484, UC1432927!); (UC774145! *n* = 11 Cave and Constance 1950, K!); (UC127324!, cited at *hirtuosa* by Brand 1913); (UC10095217!, *n* = 11 Cave and Constance 1950); (ASU0031607-261253); (BCMEX6295, ASU0031608); (BCMEX6295, ASU0031608); (SD222904); (SD96869); (SD228891); (SD41829); (TEX248787); (SD92568); (UC1432927!, SD92569); (ASU207400-1918084, BCMEX6318).

APPENDIX 3.14. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA HUBBYI*.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES. CALIFORNIA. LOS ANGELES CO., (CAS477477!, GH402943, LA33996); (UCD120526); (GH402951); (UCR209589); (UCR205119, RSA746776); (UCR208929, RSA427632); (RSA426238); (UCR126763, IRVC27958, SD234424, SEINET1004984, ARIZ394143-1004984); (HSC13631); (UCR192946); (RSA602431); (LA210024); (LA35886); (LA81950); (SBBG64978); (RSA427663); (HSC13741); (UCR213314); (UC56892!, UC56893!); (JEPS2179!, RSA74161); (POM310392); (RSA654563); (RSA616282); (UCR88515); (UC73683!); (RSA650553); (LA39236); (RSA582236); (UCR215793, SBBG122694); (UCR131371); (LA38545, LA38547, UC1002527!); (RSA44893, UCR19173); (RSA625159); (UC107477!); (UC206192!); ORANGE CO., (UCR191235); (RSA733877, UCR191321); (RSA741728); (RSA741721); (RSA741474); (RSA741475); (RSA699147); **SANTA BARBARA CO., mainland**, (CAS389439!, RSA94203); (CAS411916!); (UCSB50680); (UCSB45617); (UCSB60021); (UCSB71639); (UCSB69727); (UC794429!, *n* = 11, Cave and Constance 1947); (SBBG82021); (UC1069335!); (SBBG64977); (SBBG88812); (CAS861963!, SBBG82380, UC1563248!); (SBBG82436); (SBBG82290); (UC1563249!, OBI56243!); (SBBG51925); (SBBG82267, SD130597); (SBBG64976); (GH402942, UC764436!); (SBBG6155); (SBBG82382, SD130598); (SBBG65312, SFV2998, CAS381938!, OBI56245!, CAS474300!); (RSA166563, RSA427687, CAS455788!); (SBBG17392); (SBBG29656, RSA427690A); (SBBG64974); (CAS381908!, UCD120529); **Santa Cruz Island,** (CAS474256!); (SBBG89876, RSA516644); (SBBG89874, RSA516645); (SBBG80488); (SBBG78946); **VENTURA CO.,** (GH402948); (GH402950); (CAS213557!); (CAS343947!); (CAS352159!); (CAS474299!); (CAS474261!); (CAS540732!); (CAS562128!); (UCSB55416); (UCSB53583); (UCSB64073); (UCSB53429); (UCSB53799); (CAS1099808!, UCR127259, IRVC28389, RSA713274, SD186243); (UCD120527); (UCD120528); (GH93350); (GH402946); (GH402945); (GH402944); (SBBG15121, RSA166579); (LA210023); (SBBG41370); (SBBG64975); (UCR13527); (UCR213736, RSA748387, SD232701); (UC1069334!); (SBBG121081); (SBBG39009); (SBBG41369); (SBBG45501, RSA427691A); (UCR13506); (SBBG35645, RSA427688A, CAS540795!, UCR136657); (SBBG65313).

CALIFORNIA, ALAMEDA CO. grown in lath house at the University of California Berkeley Botanic Garden, (UC764437!, not georeferenced).

APPENDIX 3.15. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA IXODES*.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

PHACELIA IXODES VAR. *IXODES* [varieties not recognized, taxon treated as a synonym of *Phacelia ixodes* in taxonomic treatment].

MÉXICO, BAJA CALIFORNIA, (RSA576911); (CAS703150-371719!); (SD94219, UC1445258!); (TEX248795); **Cedros Island**, (CAS35101-371721!); (DS168470-371676!, CAS146946-371677!, CAS146947-371678!); (UC702979!, DS296394-371680!, CAS301273-371681!); (CAS301222-371682!); (UC971552!, DS356553-371724!, CAS384574-371725!); (UC753503!, UC753505!, UC936026!); (SD43111); (UC1001724!, CAS401981-371689!, DS363304-371690!); (SD51512, SBBG12281); (SD53941); (SD67884, UC1359525!, DS624766-371688!); (LL248796); (SD127734, SBBG92083); (BCMEX3061); (BCMEX3256, UC1776635!); (ASU0031618-202658, BCMEX6835, HCIB6228); (DS129582-371687!); (CAS35102-371722!); (UC107387!, CAS35104-371679!); (SBBG91231); (SBBG91236); (UC107386!, DS8437-371685!, SD87508); (SBBG51973); (SBBG47637); (SBBG47555); (SBBG47636); (SBBG43895); (SBBG43884, SBBG43889); (UC107480!, cited by Brand as var. *typica* 1913, CAS301455-371683!, CAS415741-371684!, DS8440-371686!, SD4095); (UC107486!, [mounted on same sheet with isotype UC107485, excluding type material of three fragments to the left]); (DAV93730!); **Isla San Benito Oeste,** (SD80384, UC1432904!, SBBG50382); (UC1015237!); (UC107389!); (SD43825); (SD80370); (SD86958); (SD102436); **Isla Natividad**, (SD67846, UC1359526!, RSA cited by Carlquist 1984); (SBBG48247); (SBBG91234).

PHACELIA IXODES VAR. PLUMOSA [varieties not recognized, taxon treated as a synonym of *Phacelia ixodes* in taxonomic treatment].

MÉXICO, BAJA CALIFORNIA, (CAS188310-371660!); (CAS179687-371657!, DS203051-371658!, CAS188309-371659!); (JEPS2093!); (UC604998!, DS254477-371661!); (SD40409); (UC753506!, UC936005!); (UC901896!); (SD113338, SD113339); (SD50852, UC1242669!); (SD50868, UC1225645!, DS467135-371691!); (UCR141294); (SD96660, UC1445240!); (SD95646); (UC1445241!, ASU0031616-109763, DES00018839, SD97885); (SD101286); (SD102386); (UCR29725); (SD117076); (SD110359); (SD111056); (BCMEX3995); (UCR75890); (SD145541, UCR105845, HCIB13175, BCMEX9556, BCMEX9555); (ASU0031615-26157); (ASU0031617-261260); (SD148133, UCR116568); (SD222905); (UC107484!); (UC107481!); (NY 00083866); (UC107487!); **San Martin Island**, (CAS35103-371698!); (SBBG31767); (BCMEX3811); (SD107376); (UC35535!, NMC21799, CAS415748-371720!, DS134250-371694!, DS8441-371695!, CAS301454-371696!, SD194128); (SD95738); (SD4081); (SD74924); (CAS146831-371699!, DS168439-371700!); (SBBG31783); (SD54249, UC1247534!, DS501913-371693!); (UC753407! n = 11 Cave and Constance 1950, UC936000!); (SBBG39441); (SBBG49566); (SD77669); (UC107388!, DS8438-371697!); (SBBG31789);

(UC702948!, DS295703-371652!, CAS296866-371653!); **South Todos Santos Island,** (UC753506!, UC936005!); (SBBG31980); (UC107483!); (SBBG32003); (CAS620405-371651!); (SD71963); (SD194404, SBBG32006); (DES00055097, UC901901!, SD43984); (SBBG31979); (SD61777, SBBG23755, SD194403); (SD61769, SBBG23756); **Coronados Island** (UC639139!); (SD95646);

ALAMEDA CO., grown in lath house at Berkeley, California, 1949 [harvest date], (UC794426!, CAS353429-371692!); grown in lath house at Berkeley, California, 1949 [harvest date], (UC916627!, UC967167!, DS356649-371654!, CAS381741-371655!, CAS419833-371656, SD47983, not georeferenced);

APPENDIX 3.16. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA LOASIFOLIA*****.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES, CALIFORNIA, MONTEREY CO., (UCSB40419); (POM231573, UC597708!); (PGM5953); (UCSC1233); (DS18050!); (RSA428266); (RSA428265); (JEPS1196!); (JEPS99370!, SBBG13414); (RSA75943); (JEPS1198!, UC762386!); (RSA604726, POM221169); (JEPS99209!, SBBG109762, SBBG15413); (UC1167738!); (JEPS72884!); (UC131123!, UC185353!); (UC172667!); (UC229930!); (UC24427!); (UCSC1729); (UCSC1732); (PGM5954); (UCSB34136); (PGM5955); (UCSB34156); (PGM5956); (SBBG11367); (SBBG20357); (PGM5957); (UC671734!, POM298654, RSA42296); (SBBG107061); (RSA26581); (PGM5958); (SBBG107124, SBBG107062); (RSA170423); (RSA598280); (POM203927); (POM203928); (SBBG107193); (RSA60750, POM261895, UC58410!); (POM289345); (POM289346); (UC610622!); (RSA75938); (SBBG109288); (RSA116093); (OBI60849!); (RSA88506); (OBI59153!); (JEPS105546!); (PGM2372); (PGM3407); (PGM5952); (RSA602); (RSA6889); (SBBG64995); **SAN LUIS OBISPO CO.,** (OBI17764!); (OBI35448!); (OBI72085!); (SBBG118430); (OBI65859!); (SBBG48491); (UC920173!, POM311045); (SBBG6181); (UC762347!); (JEPS27037!); (OBI13754!); (UCR29000, OBI32140!); (OBI42771!); (OBI39684!); (UC1583753!, OBI45293!); (OBI37984!); (OBI39352!); (OBI58208!); (OBI58335!); (OBI39866!); (OBI48264!); (SFV3022); (UC455965!); **SANTA BARBARA CO.,** (RSA659289).

APPENDIX 3.17. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA LYONII*.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES, CALIFORNIA, LOS ANGELES CO., San Clemente Island: (SBBG13134, RSA239488, SD85034); (UC557750!); (RSA150838); (SBBG12265, RSA150669, SD51910, UC1228877!); (UC1228865!, SBBG11615, SD51855); (SD86347); (SD92009); (RSA139587, SBBG10984, SD48929, UC1177566!); (UC1177563!, SD48925); (UC1432905!); (UC1426037!, RSA232816); (SBBG108998); (SBBG110501); (SBBG108990); (UCR68901, SBBG96756, RSA526539); **Santa Catalina Island:** (RSA428056); (UC1375364!); (UC881190!); (SD72782, RSA428055); (RSA75940); (UC124484!, cited by Brand as *lyonii* 1913); (UC455952!); (JEPS64035!); (UC881189!); (SBBG93598, POM158286); (SBBG95265, POM155773); (SBBG47534, RSA428054); (SBBG96530); (SBBG50409); (POM147455); (UC1234627!, RSA155911, SBBG13581, SD53031); (UC1234794!, RSA155830, SBBG13693, SD53045); (RSA187963); (RSA187965, UC1349371!); (RSA187957); (RSA190921); (RSA190934); (RSA187964, SD69516); (SBBG31466); (RSA177773); (UC1348973!, RSA198818, SD69865); (UC1349037!, RSA177774); (UC1348876!, RSA188123, cited by Carlquist 1984); (F495875); (UC107482!, cited by Brand as *lyonii* 1913); **SAN DIEGO CO.,** (SD212759).

ALAMEDA CO., grown in lath house of the University of California Berkeley Botanic Garden, in 1959, as No. C 33, (UC1181164!, not georeferenced); grown in lath house of the University of California Berkeley Botanic Garden, in 1959, as No. C 34, (UC1181165!, not georeferenced).

APPENDIX 3.18. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA MALVIFOLIA*****.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES, CALIFORNIA, ALAMEDA CO., (RSA666392, UC1607673!); (UC1819068!); (CAS27415!); (UC24430!); **HUMBOLDT CO.,** (JEPS1201!, UC562581!); (JEPS1200!, UC562580!); **MARIN CO.,** *John Dempcy 34* (SFSU!); (SFSU08385!); (SFSU08380!, SFSU08379!); (UC336389!); (SFSU08383!); (RSA15431); (JEPS1197!); (UC589572!); (POM127619); (SFSU08382!); (UC1594178!); (UC671735!, n = 11 Cave and Constance 1942); (UC24428!); (UC1301155!); (RSA220033); (UC750513!); (DS10685!); (SFSU08384!); (UC168670!); (UC35533!); **MENDOCINO CO.,** (UC881193!); (POM299076); (SD64339, SDSU6636); (UC131558!); **MONTEREY CO.,** (UCSC2114); (UCSC2115); (UCSC2116, UCSC2117); (UCSC2118); (UCSC2119); (OBI67056!); (UC881186!); (UC672347!); (UC306568!, POM65467); (JEPS1199!); (RSA75936); (UCSC584); (UC131098!); (UC54869!); (UC206189!); **SAN MATEO CO.,** (CDA929); (SFSU08381!); (RSA101024); (UC24429!); (RSA51310); (UC202785!, POM65348); (POM289344); (RSA152046); (UC881192!, RSA21847); (RSA184848, OBI13755!); (SFSU08378!); (UC206190!); **SAN FRANCISCO CO.,** (UC672722!); (UC1602034!); (UC163948!, CHSC76199, POM65404); (UC702958!, RSA75939); (RSA317497); (POM261888); (UC1295789!); (POM65584); (POM261887); (UC107550!); (UC191766!); (UC24431!); (UC85567!); **SONOMA CO.,** (UCD120562); **SANTA CRUZ CO.,** (OBI45364!); (UC794459!); (RSA149201); (UC572554!, JEPS21163!); (JEPS84927!, RSA516369, UC1561850!); (UC1236504!, RSA131971); (RSA181330).

APPENDIX 3.19. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA PAUCIFLORA*.** Taxon treated in an expanded synonymy, including *Phacelia cedrosensis* as a synonym in the taxonomic treatment, OTUs annotated with epithet 'pauciflora' in tree figure. Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES, CALIFORNIA, IMPERIAL CO.: (CAS188059-371667!).

MÉXICO, BAJA CALIFORNIA, (UC131734!); (UC131735!); (UC 753507!; UC 756962!, DES00034617, DS318654-371666!, SD42891, RSA459206); (UC1179584!, DS561541-371671!, SD60606); (UC1179585!, DS561542-371672!, SD60607); (UC1116172! *n* = 11 Constance 1963, DS560703-371668!, SD60594); (UC 791048!, ASU0041058-79588, DES00009388, SD86421); (UC1351186!, SD63225); (UC1351179!, SD63226); (UC1345860! *n* = 11 Constance 1963, DS598792-371669!, SD64899); (UC1345861! *n* = 11 Constance 1963, SD64901); (UC1345862! *n* = 11 Constance 1963, SD64901); (UC1345863! *n* = 11 Constance 1963, K!, UCR-58539, SD64911); (SD64911); (UC1345846! *n* = 11 Constance 1963, SD64909); (UC1345890!, SD64910); (SD64903); (UC1345906!, SD64907); (UC1345906!, SD64908); (SD92568); (SD92569); (UC1437988!); (JEPS70829); (UC1313725!, DS616661-371664!); (UC1313730!, DS616683-371663!); (UC1087201!, CAS474314-371662!); (UC 648451!, DS263725-371665!); (UC107530!); (UC1432906!, SD87255); (SD87255); (HCIB2970); (SD182739); (HCIB16691); (SD175873); (BCMEX13704); (SD157348); (ARIZ408830, UCR-226042, SD218155); (SD53812), (DAV133615!); **Isla Angel de la Guarda,** (UC1242666! *n* = 11 Constance 1963, CAS494911-371670!, SD61567); (SD61538); (DS515316!); **San Esteban** (UC107531!, cited by Brand as *pauciflora* 1913).

PHACELIA CEDROSENSIS [taxon treated as a synonym of ***PHACELIA PAUCIFLORA*** in the taxonomic treatment, OTU annotated with epithet 'cedrosensis' in tree figure].

MÉXICO, BAJA CALIFORNIA: San Benito Island, (UC107530! cited by Brand as *pauciflora* 1913); **Cedros Island**, (UC107527! cited by Brand as *cedrosensis* 1913, K!, DS24384-371752!, DS135856-371753!, SD87516, NESH 7367-34609); (UC107528!); (UC107526!); (SD45250); (UC1001699! *n* = 11 Cave and Constance 1959, CAS401872-371754!, DS363303-371755!); (UC10247531!, DS498138-371756!, SD53928); (SBBG45314); (SBBG91239); (SBBG91230); (UC1432897!, SD86920); (SBBG91671); (SBBG91670); (SD127733, SD86920); (SBBG55649); **Isla Natividad**, (UC107529! cited by Brand as *cedrosensis* 1913, POM65552); (SBBG91235); (SBBG91233); (SBBG91232); (SBBG110462).

APPENDIX 3.20. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA PHYLLOMANICA*.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

MÉXICO, Guadalupe Island: (UC107309!); (UC24447! cited by Brand 1913, DS134421-371675!, POM cited by Carlquist 1984); (UC107310!); (UC107296!); (UC1179597! *n* = 11, DS440173-371673!, SD50067, SD50068); (SD51840, SD51841 [these are the wild-collected vouchers for *R. Moran 7836*]); (UC1345792!, SBBG31556, SD64584); (SD230860).

UNITED STATES, CALIFORNIA, ALAMEDA Co.: from *R. Moran 7836*, grown in greenhouse and field plot at UC Berkeley 1961 and 1962, harvest date n.d., *L. R. Heckard C-271* (UC1228910! sheet 1, UC1228911! sheet 2, UC1116779! sheet 3 [4 photographs of greenhouse inflorescences], DS501701-371674!, not georeferenced). This collection is noted in Moran's *Guadalupe Island Flora*, and shown in Fig. 63 (p. 114) (Moran 1996).

APPENDIX 3.21. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA PLATYLOBA*****.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES. **CALIFORNIA, FRESNO CO.:** (UC56701!); (POM225454); (POM225453); (UC880990!); (CAS474359!, RSA6820, SD40828, UC881212!); (UC1069375!); (UC617677!); (CAS370430!, JEPS1101!, UC762384!); (CAS869069!); (CAS370906!, UC764462!); (CAS370907!, UC764459! wild collected vouchers for chromosome counts, $n = 11$ Cave and Constance 1950); (CAS795906!, UCR95798); (CAS399024!, CAS869070!, JEPS13200!); (CAS408502!); (CAS532349!); (CAS1133980-24980!); (CAS1133747-25183!); (UC1442625!); (JEPS25457!); **MADERA CO.,** (CAS27473!, DS129587!, DS8525!, collection cited by Brand 1913); (UC186164!); (CAS128019!, CAS128020!); (CAS188083!, JEPS1099!); (UC1613506!); (UC1537533!); (CAS256761!, RSA21996, UC881213!); (CAS256760!); (CAS256698!); (CAS869091!, JEPS8366!, RSA114095, UC1046495!); (CAS408462!); (JEPS28020!); (CAS879262!); (OBI13746!, RSA184867); (RSA766883, UCSB29050); (RSA710035, UCR122403); **MARIPOSA CO.,** (UC107307! cited by Brand 1913); (DS134417!); (UC191767!); (CAS322422!, DS8528!); (UC107299! cited by Brand 1913); (CAS322422!); (DS8527!); (UC24448!); (UC185358!); (UC107306!, UC107312!, collection cited by Brand 1913); (CAS27474!); (CAS27470!); (CAS27471!, UC881214!); (CAS27472!); (CAS188308!); (YM-YOSE65491); (CAS474361!, RSA7055, SD40875, UC881211!); (CAS370428!, DS319926!, JEPS1100!, UC596136!, UC762387!); (HSC89390); (SJSU15129!); **TULARE CO.:** (RSA7008).

ALAMEDA CO.: from seeds of UC764459, raised in a lath house for chromosome counts at Berkeley $n = 11$ Cave and Constance 1950 (UC764460!, UC764461!, K!, not georeferenced).

APPENDIX 3.22. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA RAMOSISSIMA*****.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

CANADA, BRITISH COLUMBIA, THOMPSON-OKANAGAN: (V179603-V-VP-64064); (V172516-V-VP-57121); (V171253-V-VP-55855); (V176165-V-VP-60693); (V158011-V-VP-42680, UBCV223815-UBC-VP-137026); (UBCV208135-UBC-VP-170622); (UBCV218056-UBC-VP-114204, V179601-V-VP-64062); (V157363-V-VP-42038); (V161053-V-VP-45703);

UNITED STATES, ARIZONA, COCHISE CO., (ASU130314-706654); **COCONINO CO.,** (ASU32432-706631, ASU32546-704174); **GILA CO.,** (DES00011515-3091829); (ASU32433-706646); (ASU32435-706651); (ASC57243-1025806, DES00088048-3091949); **GREENLEE CO.,** (ASU227399-706661); **MARICOPA CO.,** (ARIZ87626-931168); (UNM46168-4080505); (UTC00223509-271896); (ASU282184-2038623); (DES00055844-2048331); (DES00054342-2045074, ASU282202-2038371); (DES00056017-2048852); (DES00057699-2051569); **MOHAVE CO.,** (ARIZ7698-931160); (ASU109217-706641); (ASC34733-1025444); (ASC2077241); (ASC84723-1063893, BRY608619-2440565); (ASC89012-2116114); **PIMA CO.,** (UNM69396-4080503); (ARIZ29835-931161); (ARIZ29829-931166); (ARIZ29830-853767); (ARIZ5566331); (ARIZ29844-931167); (ARIZ90081-931162); (ARIZ90080-931163); (ARIZ90079-931170); (ARIZ5566334); (ARIZ5566337); (ARIZ90078-931155); (ARIZ87624-921742); (ARIZ93577-931172); (ARIZ39833-931169); (ARIZ106926-931164); (ARIZ178061-931171); (ARIZ5566332, ARIZ414238-3830143); (ARIZ233314-931159); (ASU138371-706648, ARIZ276923-931157, DES00030201-3091885); (ARIZ248192-931165); (ASU214477-706645, ARIZ5566336); (ARIZ5566333); (ARIZ5566335); (NY19970-2803788); (ASU260543-771776, ARIZ375007-853768); (ARIZ383795-921743); (ARIZ397157-1908293); (NY1260090-2974031); **PINAL CO.,** (ARIZ90082-931154); (ASU284030-3000441); **SANTA CRUZ CO.,** (DES00030514-3091888, ASU153946-706637); **TOHONO O'ODHAM NATION RESERVATION,** (ARIZ87625-931156); **YAVAPAI CO.,** (DES00036545-3091924); (ASU126115-706633); (DES00053268-2044199); (DES00052958-1076417, ASU278101-1850451); (DES00052762-1076793, ASU281864-2166114); (DES00052934-2043893, ASU278499-1903863); (DES00052815-1076295, ASU279958-2035576); (DES00052664-1076137, ASU280374-1956897); (ASU280370-1956899);

CALIFORNIA, ALAMEDA CO., (CAS473900); (DS266762, RSA23162); (RSA813554); **ALPINE CO.,** (DS8249); (JEPS1348, CAS188086); (UC1069386); (RSA74779); (UC614673! *n* = 11 Cave and Constance 1942); (SBBG34697); (JEPS15697); (CAS868688); (JEPS26696); (CAS912793); (CAS879286); (CAS868697); (CAS865866); (JEPS86189, JEPS81431); (UCR196808, SD236314); (UCR196813); (UTC00259817-3260241, SD197804, SEINET3260241, UCR202556); **AMADOR CO.,** (DS181045); (RSA428178); **BUTTE CO.,** (POM73731); (DS146691, CAS27503); (UC196274, CAS27522, DS17836, GH401038); (CHSC38465); **COLUSA CO.,** (GH401037); **EL DORADO CO.,** (CAS27515); (CAS27524); (DS24448); (UC881100, DS67535); (GH401055, CAS188409); (UC1069383); (UC1069380); (UC1614026); (UC632740, CAS868683, DS298606, POM256519); (CAS866395); (UC747478,

GH401016, CAS866396, UC700286); (GH401023, CAS866394, UC700313, UC747466); (JEPS71505); (JEPS71502); (JEPS71504); (CAS868701); (UCR248480); (WCW6854-WCW-VP-8635); (RENO33446-5505476); **FRESNO CO.,** (UC24458, DS8533); (UC24459, DS24450); (JEPS1340); (CAS27507); (JEPS1023, DS85528, POM215560); (RSA428272B); (CAS188410); (RSA74759); (CAS280429); (CAS868680); (UC709345); (UC1565066); (UC1565158); (DS395182, CAS868689); (CAS913217); (CAS879267); (CAS868694); (SBBG109945); (CAS602848); (CAS780971); (CHSC39918); (CAS1097288); (UCD130758); **GLENN CO.,** (UC672694, CAS302778); (DS331248, CAS312224); **IMPERIAL CO.,** (RSA603564); **INYO CO.,** (DS8545); (UC131494); (JEPS1025); (CAS188408); (CAS188407); (CAS188411, RSA74784, DS295482, GH401063, POM298998); (RSA603573); (UC670009, DS300955, GH401045); (UC694383); (UC694382); (UC694407, DS317632, GH401043); (UC694507, DS336730, GH401044); (UC697244); (UC736049, DS341366, GH401017); (CAS341928, RSA44186); (SD70774); (CAS357793); (CAS362012); (RSA58651); (CAS362792); (CAS409130); (CAS868686); (UCR84527, CAS912794, GH401065); (RSA618125, RSA206052); (RSA632062); (CAS889028, RSA619151); (RSA619228, CAS890673); (RSA517670); (UC1478644, RSA290766); (CAS868550); (SBBG111879); (NY1058164); (RSA627004); (UCR99897, SD225002); (GMDRC3481); (GMDRC4008); (UCR230793, RSA777992, GMDRC4829); (VVC2040); (GMDRC4793); (UCR232862); (ARIZ417647-4559087, UCR250817, RSA796649, SEINET4559087); (UCR244002); (UCR251894); **KERN CO.,** (DS24351); (UC131678); (UC107409); (UC107410); (UC204619, DS8295); (UC204670, DS8314); (UC204650, DS8262); (UC204630, DS8261); (UC204420, DS8260); (UC511220, DS218795, POM289528); (CAS188405, RSA74778); (CAS175432, RSA9305, DS207723, GH401031); (POM289529); (JEPS1030, RSA114174); (CAS291313); (UC666580); (UC967171); (CAS610550, CAS473881); (CAS628713); (CAS628711, CAS473882); (UCSB11889); (CAS610656, SBBG15325, SD135594); (CAS868690, CAS608716); (CAS868687); (CAS912792); (DS494814, CAS473913); (CAS473911, CAS626459); (CAS473912, CAS608717); (CAS473880, CAS628715); (CAS473885, RSA180888, CAS628722); (CAS879266); (UCR102163); (UCR47092); (UCR102164); (CAS1170680, RSA788064); (CAS1099289, RSA750474); (CAS1098568, RSA750472); (UC1561280); (UCR103494); (RSA563468); (RSA560948); (UCR82063); (UCR157817); (RSA720666); (OBI72605); (UCR196674, RSA727546); (UCR186209, SBBG122693); (UCR185985); (UCR184636); (UCD83009); (UCR207711, RSA748518); (RSA777221); **LAKE CO.,** (GH401051); (UC24456); (UC24460); (JEPS1342); (JEPS1341); (POM289525); (CAS473902, CAS473901); (CAS326282); (UC909759); **LASSEN CO.,** (UC107339); (UC107342); (UC24457); (GH401042, DS230204, CAS217229, POM203780); (CAS311452); (CAS868552); (CHSC23109); (CHSC27604); (CHSC29886); (UC1483880); (NY1058138); (CHSC59552); (UC1609295, CHSC60749); (RSA722687); **LOS ANGELES CO.,** (DS134877); (POM2704); (DS8544); (UC55299); (DS136327); (DS8301); (POM73280); (POM49700, DS8341); (DS129486); (UC57033); (DS8338, POM156351); (DS129487); (SEINET3158316); (DS129483); (UC131498, POM3702); (DS8538); (RSA184358); (CAS300323); (CAS27508); (UC284698, RSA428280, DS109102, POM3704); (UC881244, DS109100, POM3706, RSA428160, UC284697); (DS87155); (UC284694); (UC212515, DS87871); (POM3700); (CAS27505); (JEPS1355, RSA74785); (CAS200857); (CAS27501); (GH401062, DS295483, CAS188412, CAS473919); (SBBG65017); (RSA428159); (RSA428275B); (CAS188095); (JEPS1028); (RSA74780); (POM220255); (RSA428166); (RSA428278A); (RSA428170); (RSA428276A); (RSA670721); (UC450796, GH401030); (RSA428167); (RSA428163);

(RSA428168); (RSA428161); (CAS205126); (LA38565); (UC1002525); (SD38350); (RSA582642); (RSA428279A); (UC1069391); (SD41338); (CAS473892); (DS390031); (RSA17077); (UC1069417); (RSA306271); (RSA427665); (RSA428164); (UC697614 $n = 10$ Cave and Constance 1947); (LA81949); (LA81948); (UCSC3638, UCSC3636); (CAS354223); (LA38566); (UCSB5426); (CAS477615, RSA127920, LA33797); (RSA202454); (RSA188489, UC1348914); (RSA601127); (UC1348977, RSA191367); (UCR95249, RSA594571); (UC1400330); (RSA233419); (UC1375311, RSA230709); (HSC12498); (UC1375333, RSA226122); (RSA428171); (UCR60508); (VVC279); (RSA656256); (UC1424845, RSA287991); (CHSC35454); (RSA428169); (RSA660335); (RSA319219); (UCD120672); (UCR45024); (UCR50875, RSA495100); (LA105577); (RSA597010); (RSA567175); (RSA522336); (CAS964600, RSA584494); (UCR146466, RSA660095); (RSA642687); (UCR160094, RSA648047); (RSA584860); (RSA578524); (RSA642099); (UCR180005, RSA719768); (UCR179681, RSA717949); (UCR149526, RSA726058); (UCR189699, RSA729235); (RSA638860); (RSA647874); (RSA653921); (UCR125125, IRVC28676); (RSA669279); (LA201878); (CHSC99447, RSA697062); (UCR127160); (UCR136838); (UCR126706, IRVC27352, RSA709745); (RSA703519); (RSA762286); (UCR193643); (UCR209145); (UCR205539, CAS1121292); (UCR205979); (RSA751108); (UCR223708, RSA773610); (UCR256462); (UCR227620, RSA778569); (UCR218006); (RSA781094); (RSA780694); (CAS1128536); (UCR228737); (UCR231079); (RSA809055); (RSA808765); (UCR255503); (LA30866); (SFSU08431!); (DES00069290-3100967, ASC100371-3200277, SEINET3100967, SEINET3200277); (RSA428162); (RSA428165); (SDSU21058-6174802); **MADERA CO.,** (UC563052, DS229758); (CAS372116); **MARIN CO.,** (CAS1170484, POM216808); (UCR168320); **MARIPOSA CO.,** (UC201632, DS8421, JEPS1346); (UC164584); (YM-YOSE65494); (YM-YOSE65495); (YM-YOSE65496, SJSU13501); (UC770927); (CAS868698); (YM-YOSE116534); (DS24383); (YM-YOSE1672); **MODOC CO.,** (JEPS1024); (CAS280649, POM260898); (GH401029); (UC660147, CAS313435, DS310842, GH401050, POM301682, SRP20175-SRP-VP-14879); (DS338459, UC748439, GH401018, POM275214); (GH401020, UC748437); (DS339455, UC748445, GH401019); (GH401022, DS338321, UC748116); (CAS479309, SBBG22537, RSA165575, CAS479909); (RSA165580); (CAS839364, RSA531328); **MONO CO.,** (UC35534, POM89840); (JEPS1347); (RSA74777); (CAS188128); (UC698023); (RSA74781); (SBBG65036); (CAS188167); (CAS188165); (POM171628); (UC697997); (UC511898, DS236495, RSA74789); (RSA74788, CAS228564); (UC646497); (DS242575, DS695822); (UC1069389); (CAS234083); (RSA77719); (CAS473897); (CAS473879); (UC1069379); (CAS868684); (CAS866399); (CAS912790); (UC702319); (UC703350, GH401046, JEPS1351); (UC1575300); (UC736048, GH401021, DS341880); (UC733159, CAS866393, DS318292); (UC727240, CAS331186, DS314910, RSA32216); (SD44003); (UC942885); (UC967195); (JEPS13865, RSA151994); (RSA116014); (CAS868693); (CAS868692); (UC1299819); (CAS866392); (SD75832); (HSC12300); (RSA619036); (UCSB35681, UCR243272); (HSC77406); (HSC77407, CAS1008898); (SD147536, CAS879269); (CDA14884); (CAS911137); (CAS910617); (UC1549854, NY1058165, RSA463763); (GH288827); (GH401040); (HSC94448); (HSC94458); (JEPS101544); (RSA685316); (RSA700749); (UC1787102, NY1058160, RSA682807); (RSA718883); (UC1973773, CAS1120820); (UCR244341, RSA791513); (RSA795215); (RENO33491-NESH 51116); (RENO33481-NESH 51113); (RENO33444-NESH 51112); (RENO33482-NESH 51115); (NY1058137-2888763, CAS868681); (NY1058136-2888443, RSA113572, UC1075780); (SDSU6637-3529519); (NY1058135-2888495,

UC1399895); **MONTEREY CO.,** (UC107414); (DS8535); (DS8323); (JEPS1345); (UC184270, DS8339); (UC306567, SRP20176-SRP-VP-14878, DS65078); (UC58411, DS129484, DS8342); (GH401026); (UC496337); (DS8546); (RSA6888); (DS17862); (DS8537); (DS13352); (UCSC590); (DS8534); (GH401027, CAS27502); (DS85227); (UC284695, POM63741); (JEPS1356); (DS132504); (UCD120670); (UC672348); (GH401064, CAS188425, POM299079, RSA26545); (JEPS1021); (GH401053); (GH401024, POM289526); (SD41350, RSA428270B); (CAS234064); (UC597684, DS695841, POM229042); (POM289524); (CAS315906); (CAS389123); (UC708748! n = 11 Cave and Constance 1947); (DS572314); (UC1176936); (CAS473876); (CAS473877, PGM5959); (SBBG107029); (RSA201154, CAS473899); (SBBG107054, CAS473883, RSA140117); (CAS473917, PGM5960); (UCSB17606, RSA164359, SBBG18873); (CAS473875); (RSA165496); (CAS473908); (UCSC1234); (UCSC1237); (JEPS72882); (JEPS72883); (PGM2015); (PGM1971); (UCD120678); (SD116562); (UCD120679); (UCSB46630); (UCSB46490); (PGM2453); (SEINET3878754, BRYV0018887-3878754); (UCD120671); **NAPA CO.,** (UC146180); **NEVADA CO.,** (CAS156463, GH401025, POM73587); (DS134402); (UC24461); (JEPS1343); (UC58523, DS24451); (GH401032); (CAS312961); (CHSC23110); (CAS868695); (CAS868699); (CAS868700); **ORANGE CO.,** (RSA428288A); (RSA632); (UC702949, CAS188397, GH401056); (CAS473894, CAS188394); (CAS188396); (GH401058, CAS188402); (RSA630); (CAS188400, GH401059); (SD72766, GH401049, RSA428287A); (UC537166, JEPS1031, POM202028); (UC729652, DS278119, RSA6064); (RSA582643); (RSA7465, CAS473887); (UCR16840); (UCSB48216); (RSA657746); (SD152824, RSA562749); (UCR124020); (RSA678724); (SEINET998493, IRVC26742); (RSA773554); (UCR193556, RSA739553); (UCR239645); (RSA812630); (JEPS1357); (POM3701); **PLACER CO.,** (JEPS71503); (UCD22018); (JEPS86486); (JEPS111161); **PLUMAS CO.,** (CAS868696); **RIVERSIDE CO.,** (UC107413); (UC73694); (UC56712); (UC63812); (UC63813); (UC64049); (POM10401); (JEPS1349); (POM11517); (POM122256); (CAS188145); (POM122264); (DS154106); (POM158430); (GH401060, CAS188398, DS295484); (UC729536, RSA6102); (LA205627); (UC666584); (UC697613! n = 10 Cave and Constance 1947); (UCR18872); (CAS473893); (RSA180470); (CSUSB151); (CSUSB150); (RSA650562); (SDSU13608); (UCR1457); (VVC280); (UCR22110); (UCR160975); (UCR41322, HSC82952); (RSA494633); (SEINET3091923); (UCR98690); (UCR131795); (UCR241638); (UCR151063, RSA632472); (UCR176895); (SD178221); (UCR137359); (UCR159771, RSA645684, SD181476); (UCR172769); (UCR123875); (UCR164294); (UCR137031); (UCR140658); (UCR140562); (UCR199571, RSA736854); (UCR207553); (UCR156365); (UCR193876); (UCR241000); (GMDRC6544); (UNM61424-4080506, RSA428289B, SEINET4080506); (SDSU13608-3537340); (ARIZ393966-1004522, SEINET1004522, UCR181345); **SAN BENITO CO.,** (DS87364); (CAS27504); (CAS213518); **SAN BERNARDINO CO.,** (UC172762); (UC107411, POM48583); (JEPS1352, UC24462); (DS134401); (JEPS1354); (JEPS1353, CAS27509); (DS8539); (JEPS1359); (DS136307); (POM4493); (UC284696); (UC284693); (UC219574, POM12452); (RSA428190); (GH401057, CAS188401, DS295481); (RSA628); (PASA1331); (RSA74787); (GH401048); (RSA428192); (RSA428191); (RSA428277A); (DS397735, RSA132550); (RSA603253); (RSA603250); (POM298662, UC671724, DS350094); (DS324484); (CAS473886); (CAS909843); (UCSB42180); (RSA659189); (RSA425018); (RSA609262); (UCR108672); (RSA250372); (RSA225931); (RSA637645); (UCR90055); (UCR90058); (UCR90056); (JEPS34134); (RSA302515); (IRVC19306); (UC1518447); (UCR40782); (RSA482208); (RSA562156); (UCR147629); (RSA553950); (UCR79947);

(RSA554440); (UCR91266); (UCR101946); (UCR78778, RSA584470); (GH401041); (UCR157900); (UCR87586, RSA574597); (UCR105751, RSA597348); (UCR180194, RSA664840); (UCR180269, RSA597676); (UCR96041, RSA596597); (UCR96040, RSA645779); (UCR94394); (UCR179992); (UCR103842); (UCR100019); (UCR114448); (UCR115871); (UCR120843); (UCR136220); (UCR183084); (UCR177436, RSA683773); (RSA684309); (UCR140587); (UCR137571); (UCR137317); (UCR163945); (UCR174584); (UCR174581); (RSA741322); (UCR201059, RSA737199); (UCR238279, RSA748109); (RSA752193); (RSA748245); (RSA764398); (RSA767028); (RSA763640); (UCR238501, RSA765714); (RSA768253); (UCR232594); (RSA796424); (RENO33440-NESH 8413); (ASC64504-2077242, SEINET2077242); (ARIZ417861-4559360, RSA797339, SEINET4559360, UCR251086); **SAN DIEGO CO.,** (UC173245, CAS300321); (UC107343); (POM3703); (RSA14230); (SD6802); (SD4093); (UC24469); (UC107406); (UC107407); (DS8540); (UC107416); (UC107415); (JEPS1358); (DS8529, DS180747); (DS8257); (DS113004); (UC472918); (POM9411); (POM47982); (SD48714); (POM122963); (SDSU6152); (UC488983, JEPS1027); (UC1001651, DS366026, SD48711); (CAS473906); (CAS473905); (SD112822); (SD17411); (SD17645); (SD17838); (SD18088); (SD21747); (SD21783); (SD22098); (UC660036); (SD27591); (SD29125); (SD50405); (SDSU6656); (CAS514391); (SD85660); (SD85702); (SD85279); (UCR90059); (UCR90057); (HSC79858, CHSC34586); (UCSB34132); (SD106724, CAS1008040, LA101859); (SEINET3091877, DES00027825-3091877); (UCR48077); (CAS984702, RENO33488-5506801); (SBBG89549); (SD137421); (SD137728, RSA587951); (SD140559); (SD142852); (SD217311, RSA619630); (SD222212); (UCR147488, SD148633); (SDSU16511); (SDSU16539, SD156314); (SD153128, RSA700666, UC1787848); (SD164221); (UC1787824, RSA703853, SD153132); (CHSC89925); (UCR156665, SD166229); (UCR159577, SD166230); (SD157145); (SD161494); (UCR137289, RSA714233, SD178222); (UCR137543, SD173486); (SD158691); (SD158112); (SD172417); (UCR171470, SD171427); (SD172418); (SD185729); (UCR202156, SD174698); (UCR163822, SD185240); (UCR202173, SD174697); (UCR171636, SD176698); (SD175487); (SD178514); (SD176697); (SD177732); (SD208922); (SD184799); (SD184801); (SD185728); (SD183602); (SD184800); (SD185727); (SD199249); (SD201777); (SD201775); (SD193861); (SD179642); (SD186966); (SD186964); (UCR203064, SD186963); (SD187271); (SD186967); (SD190508); (SD215095); (SD207931); (SD186965); (SD188931); (SD190509); (SD208921); (SD207932); (SD190507); (UCR210765, SD190506); (SD218759); (SD195871); (SD201778); (SD201776); (SD197378); (SD218758); (SD218757); (SD215094); (SD215096); (SD199248); (SD206780); (SD221155); (SD210272); (SD209701); (SD206778); (RSA766705); (SD221154); (SD206779); (SD209700); (UCR237123, SD209699); (SD226504); (SD212383); (SD226505); (SD219521); (SD226506); (UCR236851, SD219522); (UCR240206, SD225599, SDSU20168); (SD223459); (UCR245375, SD229987); (SD228213, UCR116418); (SD225600); (UCR244937, SD228212); (UCR238914, SD230570); (UCR254331, SD229902); (UCR245008, SD231662); (SD231661); (SD238202); (SDSU6152-3529516); (ARIZ5578757, SEINET5578757); (ARIZ420670-5586298, SEINET5586298, SD235382); **SAN FRANCISCO CO.,** (GH401034); (POM83849); (OBI48667); (RSA428179); (GH401052); **SAN JOAQUIN CO.,** (WWB16667-WWB-VP-16474); **SAN LUIS OBISPO CO.,** (RSA428673); (DS86090); (JEPS1026); (JEPS1350); (RSA428174); (SD41334); (SD41346); (POM186373); (SD41335); (RSA699776); (CAS380068); (UC774476, RSA25665); (OBI13741, CAS456123, DS510249); (SD112821); (SBBG82040); (SBBG83114); (JEPS16760); (CAS473916); (CAS473914); (JEPS18492); (CAS473915); (SBBG6187, RSA140119); (SBBG6188); (SBBG83110);

(SBBG107032); (SBBG107425); (SDSU6625, SD53096); (DS500714); (RSA342260, HSC82797); (DS500968); (SBBG109248, CAS217640); (OBI13744, CAS458341); (DS510329, CAS458322, OBI13743, UC1285031); (SBBG82282); (OBI13745, CAS536107); (SD79851); (RSA232063); (OBI36154); (OBI28432); (OBI28509); (OBI43519); (OBI34327); (OBI60483); (UC1928025, OBI59257, RSA749095); (HSC91854); (OBI72930); (OBI58027); (OBI53897); (SBBG104954, JEPS97111, RSA586563); (UCD120676); (UCD120677); (CDA11655); (UCR109062); (OBI58205); (UCR123176); (UCR121536); (UCR132761); (UCR134428, IRVC28944); (UCR131834, IRVC29051); (UCR158564); (UCR160146); (UCR159851); **SAN MATEO CO.,** (SD38340); (DS298099); **SANTA BARBARA CO.,** (UC107408); (DS16879); (POM73564); (DS8340, DS144861); (POM155911, DS8541); (DS180738); (UC881245, CAS27516); (UC881246, CAS27511); (CAS27514); (CAS27512); (CAS27513); (UC129643); (POM48135); (DS8337, CAS27526); (CAS27506); (JEPS1029); (CAS168316); (SBBG78989); (SBBG78988); (RSA629); (RSA26561, CAS188403); (DS677611); (POM172762); (SBBG78987); (POM163428 cited by Carlquist 1984); (SBBG78983); (SBBG78991, SBBG78990); (SBBG78984); (CAS188153); (SBBG78986); (RSA428172); (CAS200346); (UC483400, CAS199467, DS211488); (SD41332); (UC675756); (LA200571); (SD41345); (UC1069387); (UC615239); (SBBG11797); (POM258790); (SBBG78985); (CAS473878); (UC1084192, POM250302); (SBBG95690); (RSA428176, CAS317861); (RSA428177); (UC1280310); (UCSB5423); (UC753518); (UCSB5422); (SBBG96389, RSA535354, UC1586826); (SBBG96388, RSA535353); (UCD120682); (SBBG83049); (SBBG83056, OBI45805, SD125578); (SBBG83115); (SBBG83111); (SBBG83106); (SBBG83109); (CAS416658); (CAS417589); (SBBG83112); (UCSB8457); (UCSB14718); (SBBG18495, OBI56237); (UCSB17247); (UCR46660, OBI45556, SBBG82263, SD125579); (SBBG39005); (SBBG39010); (LA96261); (UCSB21933); (SBBG82283); (UCSB28562); (UCSB36368); (UC1400329, RSA246200); (UCSB40917); (RSA286966); (UCR141316, RSA641051); (UCSB32680); (UCSB33829); (UCSB41891); (UCSB37542); (SBBG53938); (UCSB54508); (UCSB54507); (UCSB50367); (UCSB38441); (UCSB41351); (UCSB39479); (UCSB39481); (UCSB47665); (UCSB46554); (UCSB55246); (OBI47649); (UCSB56901, RSA786988); (UCSB61090); (SBBG108869); (SBBG108870); (OBI54693); (UCSB63551); (OBI65582); (UCSB61308); (UCSB61309); (UCSB61494, RSA786474); (OBI53396); (SBBG111532); (SBBG60356, CAS979505, SD202277, RSA640605); (RSA680338); (UCSB67677); (OBI77909); (UCSB5424); (SFSU); **SANTA CLARA CO.,** (DS391973); (UC571785, CAS232371); (UC571784, CAS232370); (UC1613424); **SANTA CRUZ CO.,** (GH401035); (DS156008, POM73540); (GH401054, CAS212586, POM299071, RSA26547); (CAS473890); (UC579354, JEPS21164); (UC735067! n = 11 Cave and Constance 1947); (RSA149203, DS391971); (DS391972); (UCD120674); (JEPS82890, JEPS82889); (UCSC5448); (UCSC5571); (JEPS105009); **SHASTA CO.,** (POM127628); Sierra Co., (UC572462, JEPS21165); (CAS868685); (CAS912796); (CHSC67115); (CAS1164679); (RENO33465-RENO 72345, CAS978406); **SISKIYOU CO.,** (GH401039); (CAS27521); (DS207417); (DS243807, RSA17695); (DS243753); (CAS280988); (CAS473891); (UC666546! n = 11 Cave and Constance 1944); (HSC13679); (UCD120681); (CHSC93535, RSA715804, JEPS107962, JEPS107317); **SONOMA CO.,** (RSA428197); **STANISLAUS CO.,** (GH401033); **TEHAMA CO.,** (UC923099); **TRINITY CO.,** (UC922465, DS371005); (UCD120675); **TULARE CO.,** (UC107338); (DS8316); (DS8305); (UC107405); (DS24449); (DS8320); (JEPS1344); (DS136328, DS136324); (UC63349); (UC185365); (UC126027); (RSA631); (CAS473918, CAS188404); (DS295467); (CAS159861); (DS250857); (SBBG11803); (CAS868682);

(POM296824); (UC676702, DS288465, RSA30525); (UC702981, CAS300847); (CAS329112); (RSA75537); (CAS372122); (RSA137573); (CAS626792); (CAS912769); (GH401047, CAS628712); (LA39337); (CAS628714); (SBBG15206, RSA563225); (UCR88926, CAS912770); (CAS868545); (CAS912773); (CAS868546); (CAS912772); (CAS610548, RSA195225, SD135593); (CAS610546); (SBBG103647, CAS610547, RSA220297, RSA563340); (UCR79436, CAS631233, RSA220251); (CAS868549); (CAS879285); (CAS571879); (CAS912782); (CAS912774); (UCSB32689); (UC1523570, RSA341453); (CAS1170838, RSA808602); (UCSB42938); (RSA790563, CAS1145297, RSA789427); (RSA750473, CAS1099291); (OBI42460); (UC1562868, RSA739894, UC1562700); (RSA750476, CAS1099280, CAS1099281); (UC1562752, RSA516830); (SFV17027); (RSA804757); (UC1929455, RSA683348); (RSA804755); (VVC2054); (RSA792499); (LEA-LEA-VP-15136 not georeferenced); (SFSU08429); (RENO33441-NESH 7311); (SDSU6643-3529520, SDSU6643); **TUOLUMNE CO.,** (CAS27523, GH401028); (JEPS1022); (CAS913218); (CAS866397); (UC762373); (UC1069385); (UC1178995, CAS868691); (YM-YOSE65493); (CAS866398); (DS298073); (RSA112689, CAS298366); (UC1523543, RSA342252); (YM-YOSE118654, UC1949615, YM-YOSE118655); (YM-YOSE118428); **VENTURA CO.,** (CAS345811); (UC463182, DS8280); (UC69205); (UC69153); (DS8542); (DS8543); (POM48665); (GH401061, CAS188399, CAS473896); (CAS188413); (RSA598); (CAS200337); (UC527202, DS231122, POM212363, RSA1989); (CAS473904, CAS473903); (RSA427656); (UC1069384); (CAS332789); (CAS332788); (RSA31810); (UCSB10394); (RSA116525, CAS399310, CAS628721); (CAS473884); (CAS473874); (CAS473907); (SD72080); (UCD120680); (SBBG41374); (LA33795, CAS477573, RSA127940); (CAS473898); (SBBG41376); (CAS473872); (SBBG18592); (SBBG83113); (SBBG83108); (CAS479006); (CAS479010); (RSA428173); (SBBG35836); (CAS478391); (SBBG27433, OBI4061, RSA428196); (CAS540727); (SBBG36312); (SBBG39917); (RSA428195); (CAS540797); (SBBG39301); (SBBG45392); (UCR13497); (SDSU6631, SD98900); (SBBG52534); (RSA678590); (RSA678589); (RSA428175); (UCSB70064); (UCSB70383); (RSA552604); (UCR119736); (SBBG103495); (SBBG121329); (SBBG121178); (UCR127464, CAS969858); (SBBG121091); (SBBG121412); (SBBG121078); (SBBG114496); (SBBG125647); (UCR149491, RSA702547); (UCR148510, RSA702057); (UCR197115, CHSC108522, RSA723327); **YOLO CO.,** (UCD120673); (UCD41086); **UNKNOWN CO.,** (GH401036, UC24455).

IDAHO, BOISE CO., (CIC12075-CIC-VP-35225); (OSC153871-OSC-VP-86830); (SRP10687-SRP-VP-14875); (SRP46524-SRP-VP-54744); (CIC44569-CIC-VP-44008); (CIC43588-CIC-VP-26123); **OWYHEE CO.,** (WTU303563-WTU-VP-131897, ID112287-ID-VP-119587); (CIC12074-CIC-VP-35224); (CIC19958-CIC-VP-38289); (BBLM4481-BBLM-VP-4041); **VALLEY CO.,** (SRP10397-SRP-VP-14876, ID112289-ID-VP-119585); **WASHINGTON CO.,** (SRP23407-SRP-VP-14909, ID112288-ID-VP-119586); (RM1253338, RM-RM-VP-213814).

MONTANA, SILVER BOW CO., (MONTU26777-MONTU-VP-40795).

NEVADA, CARSON CITY, (RENO33449-RENO 6578); (SRP23408-SRP-VP-14910); **DOUGLAS CO.,** (NY1058167-2889080, RENO33460-NESH 68128); (NY1058149-2896736, RENO33445-NESH 70365); **ELKO CO.,** (MWI00056636-3479312); (RENO33477-RENO

15124); (RENO33466-RENO 15483); (RENO33487-NESH 4235); (NY1058139-2888764, ID112472-ID-VP-119597); (NY1058148-2888882); (NY1058153-2892951); (NY1058141-2968204, DES00010302-3091824); (NY1058157-2902423, RENO33471-RENO 48876); (NY1058155-2966951, CIC17277-CIC-VP-37205); (NY1058158-2894449); (NY1058159-2889087); (NY1109896-2898513, CIC35740-CIC-VP-7821); **ESMERALDA CO.,** (NY1058166-2896629); **EUREKA CO.,** (RENO33501-NESH 4234 not georeferenced); **HUMBOLDT CO.,** (RENO33467-NESH 60246); (RENO33497-5506810); (NY1058154-2888517, RENO33478-NESH 14457, RENO33486-NESH 13206); (NY1058151-2888702, RENO33475-RENO 15527); (NY1058143-2967394); (NY1058142-2888542); (NY1058147-2888454, RENO33474-RENO 42258); (NY1153855-2972442, CIC38278-CIC-VP-41765, RENO33496-5506809, UCR-212086-2454046, DES00065961-2069871); (BRY610461-2441247, RENO33495-5506808, NY1112316-2972389); **LANDER CO.,** (RENO33469-RENO 15123); (RENO33483-RENO 15484); (RENO33489-RENO 40542); (NY1058156-2897575); (NY1058163-2888869); (NY703203-2857117, UTC00242981-249943); **LYON CO.,** (ID112471-ID-VP-119596); (RENO33480-NESH 51114); **ORMSBY CO.,** (RENO33450-RENO 15528); (NY1058145-2888452); (RENO33492-NESH 15526); **STOREY CO.,** (RENO33458-NESH 6508); (NY1058169-2888519, RENO33463-NESH 63449); (NY1058168-2896419, RENO33462-NESH 66923); **WASHOE CO.,** (RENO33485-NESH 6507); (RENO33457-NESH 9616); (RENO33472-RENO 15128); (RENO33464-RENO 15480); (RENO33468-RENO 15125); (RENO33451-RENO 15482); (RENO33448-RENO 15481); (RENO33470-RENO 15126); (RENO33461-RENO 9115); (RENO33494-RENO 30827); (RENO33493-RENO 30839); (RENO33473-RENO 29190); (RENO33499-RENO 32034); (RENO33459-RENO 30078); (RENO33484-RENO 34244); (RENO33479-NESH 53848); (RENO33498-5506811); (RENO33500-NESH 56968); (NY1058140-2978268); (RENO33447-NESH 4233 not georeferenced); (RENO33455-NESH 14698); (RENO33490-NESH 4267); (RENO33452-RENO 15526); (NY1058146-2902362, NMC75146-3158315, RENO33453-NESH 6505); (NY1058152-2888703, RENO33454-NESH 12892); (RENO33476-RENO 15127, ID112468-ID-VP-119593); (NY1058144-2888451); (NY1058150-2895925, ID112466-ID-VP-119591); (NY1058162-2897435, ID112391-ID-VP-119588, RENO33456-5505486, UTC00247737-253843).

NEW MEXICO, GRANT CO., (SNM5455-115379).

OREGON, BAKER CO., (WS56139-WS-VP-130979); **CROOK CO.,** (WILLU16203-OSC-VP-175987); (ORE12328-OSC-VP-12385); (OSC68259-OSC-VP-141414); (WTU169175-WTU-VP-131899, ID112469-ID-VP-119594, WS199876-WS-VP-130977); (ORE103852-OSC-VP-1265); **DESCHUTES CO.,** (OSC15062-OSC-VP-84794); (WILLU11130-OSC-VP-171017); (WILLU10193-OSC-VP-170024); (WILLU13060-OSC-VP-172548); (WTU154562-WTU-VP-131884); (HPSU15132-HPSU-VP-13474); **GILLIAM CO.,** (WTU132300-WTU-VP-131892); **GRANT CO.,** (ORE75356-OSC-VP-51251); (WTU217223-WTU-VP-131896, WS256891-WS-VP-131010, WCW6614-WCW-VP-8636); **HARNEY CO.,** (ORE75373-OSC-VP-51263); (ORE75372-OSC-VP-51262); (OSC35036-OSC-VP-128740); (OSC63431-OSC-VP-139329, CIC27244-CIC-VP-40278); (WTU-V-000836-WTU-VP-158376); (WILLU18823-OSC-VP-178811); (WILLU27269-OSC-VP-187877); (NY1058134-NY-VP-1203051); (WTU211903-WTU-VP-131878); (NY1058161-NY-VP-1203325); (OSC163553-OSC-VP-91878); (CIC27621-CIC-VP-40354); (NY1058134-6478079); (NY1058161-6508722);

JACKSON CO., (OSC229163-OSC-VP-120412); (BLMMD2941-BLMMD-VP-1293); (WTU14668-WTU-VP-131817); (ORE75363-OSC-VP-51257); (ORE75357-OSC-VP-51252); (OSC8635-OSC-VP-149852); (ORE75362-OSC-VP-51256); **JEFFERSON CO.,** (ORE114636-OSC-VP-7910); **JOSEPHINE CO.,** (OSC119101-OSC-VP-74383); **KLAMATH CO.,** (WILLU20147-OSC-VP-180248); (WS105824-WS-VP-130975); (WTU-V-000844-WTU-VP-158386, ORE95924-OSC-VP-63914); (WS71762-WS-VP-130984); (WILLU20146-OSC-VP-180247); (ORE75374-OSC-VP-51264); (WTU14035JWT-WTU-VP-131883); (ORE75369-OSC-VP-51260); (OSC29729-OSC-VP-125623); (WILLU16200-OSC-VP-175984); (WTU171641-WTU-VP-131891, WS169707-WS-VP-130993); (SOC6586-SOC-VP-6357); (ORE75361-OSC-VP-51255); (BLMMD226-BLMMD-VP-1292); **LAKE CO., (**WTU-V-000845-WTU-VP-158387, ORE95925-OSC-VP-63915, WILLU14659-OSC-VP-174318); (WILLU21483-OSC-VP-181689); (WILLU24222-OSC-VP-184613 not georeferenced); (OSC151055-OSC-VP-85111); (OSC174927-OSC-VP-98202); (WTU368409-WTU-VP-172429, RENO33513-5506826, WTU365734-WTU-VP-116543); (WTU70906-WTU-VP-131895, ORE75375-OSC-VP-51265); **MALHEUR CO.,** (OSC152413-OSC-VP-86034, CIC12072-CIC-VP-35222); (CIC12073-CIC-VP-35223); (CIC30116-CIC-VP-7824); (OSC200871-OSC-VP-111968); (CIC31168-CIC-VP-7822); (CIC40044-CIC-VP-42144); Union Co., (ORE75378-OSC-VP-51267); **WALLOWA CO.,** (ORE75366-OSC-VP-51258); Wasco CO., (ID112467-ID-VP-119592, RENO33442-5505472); (WILLU28091-OSC-VP-188768); (WTU14099JWT-WTU-VP-131880); (ORE75377-OSC-VP-51266); **WHEELER CO.,** (WILLU10936-OSC-VP-170820); (ORE75367-OSC-VP-51259); (ORE75371-OSC-VP-51261); (WILLU24003-OSC-VP-184371); (WTU154543-WTU-VP-131887, OSC86050-OSC-VP-149632).

WASHINGTON, ADAMS CO., (WS162832-WS-VP-130996); **BENTON CO.,** (WS272991-WS-VP-131001, WTU260308-WTU-VP-19260); (DES00025548-3091870); **CHELAN CO.,** (REED3860-REED-VP-3921); (WTU14275JWT-WTU-VP-131821, OSC28280-OSC-VP-124920); (WTU125297-WTU-VP-131820, ID112470-ID-VP-119595); (WTU321229-WTU-VP-19261); (WTU370876-WTU-VP-163276); (WS21978-WS-VP-130991, OSC117021-OSC-VP-73466); **DOUGLAS CO.,** (WS64465-WS-VP-130978); (WWB5105-WWB-VP-16475); (WTU372627-WTU-VP-176941); (WTU380959-WTU-VP-176820); **FRANKLIN CO.,** (OSC117019-OSC-VP-73463, WS21980-WS-VP-130992); **GRANT CO.,** (WTU108007-WTU-VP-131825, WS129045-WS-VP-130973); (WTU14144JWT-WTU-VP-131829); (WTU34393-WTU-VP-131827, WTU13925JWT-WTU-VP-131830); (WTU83138-WTU-VP-131832, ORE6187-OSC-VP-43674); (WTU104880-WTU-VP-131826); (WS192027-WS-VP-130986); (WS203977-WS-VP-130997); (WTU143235-WTU-VP-19262, WS203945-WS-VP-130985); (WS204118-WS-VP-130987); (WTU397575-WTU-VP-187948); (WS21981-WS-VP-130982); (WS21979-WS-VP-131000, RENO33443-NESH 13042); (ORE75358-OSC-VP-51253); (WS21800-WS-VP-130983); **KITTITAS CO.,** (WS84450-WS-VP-130988); (WTU35506-WTU-VP-19263); (ID112465-ID-VP-119590, ID112392-ID-VP-119589); (WTU370489-WTU-VP-174370); **LINCOLN CO.,** (WTU381506-WTU-VP-178410); **SPOKANE CO.,** (WS57265-WS-VP-130999); (UCR-129634-401627); **WHITMAN CO.,** (WS47361-WS-VP-130998, WS129044-WS-VP-131007); **YAKIMA CO.,** (WS64091-WS-VP-130980); (WTU213354-WTU-VP-19264, OSC118522-OSC-VP-74140); (PSM5145-PSM-VP-7744); (WTU14655-WTU-VP-114167).

MÉXICO, **BAJA CALIFORNIA**, (SDSU6602-3529598); (SD21810); (SD47247); (UCR6373); (SD68136); (SD75363); (SD77160); (SD75198); (SD76595); (SD88932); (ASU67688-1918136); (SD91364); (SD91134); (SD95108); (SD100249); (BCMEX2905); (SD144641, BCMEX10655, HCIB13700); (UCR105590); (SD148815, HCIB5013); (SD157608, BCMEX12799); (SD59711); **SONORA,** (MABA2144007).

APPENDIX 3.23. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA RATTANII*.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES. **CALIFORNIA, ALAMEDA CO.,** (DS520131!); **CONTRA COSTA CO.,** (UC691717!); (JEPS99530!); (JEPS99583!); **FRESNO CO.,** (SBBG109225); **HUMBOLDT CO.,** (JEPS1045!, UC562579!); **LAKE CO.,** (UC107549!); (UC107551!); (UC146178!); (RSA2667); (POM289347); (UC353814!); (UC353809!, JEPS1046!); (UCSC582); (POM215771); (UC588130!, RSA74699, UC1540448!); (UC762383!); (JEPS1043!); (JEPS13701!, OBI13739!); **MENDOCINO CO.,** (JEPS1044!); (JEPS1047!); (RSA47160); **MONTEREY CO.,** (PGM5961); (PGM0735, PGM0726); (PGM2412); (OBI70338!, JEPS98189!); **SAN BENITO CO.,** (JEPS16433!); (UC1299140!); (JEPS16908!); (PGM4131); (UC1004423!); (DS673651!); (DS720288!); (UC881185!); (UC1392822!, OBI13740!); **SAN LUIS OBISPO CO.,** (UC716206!, POM258755); (OBI13737!, RSA201661); (OBI13738!); (SBBG107057); (SBBG107056); (SBBG107058); (UCD120683, DAV55495!, RSA201164, SD71248, LEA-VP-15137); (OBI38071!); (SBBG95574, OBI42194!); (OBI55646!); (RSA680188); (OBI69957!); (UCD83706); **SAN MATEO CO.,** (JROH2764, JROH2763); (JROH2765); (JROH2766); **SANTA CLARA CO.,** (UC201607!); (RSA128859); (UC571779!); (UC724474!); (SBBG29815); (UC881248!, POM230337); (SJSU1231!); (RSA149200); (RSA181332); (SJSU11201!); **SANTA CRUZ CO.,** (UC375453!, POM127640, UC130489!); (POM202468); (JEPS2962!); (SBBG29809); (UC710447!); (UC735116! n = 11 Cave and Constance 1947, POM298622, RSA42345); (UC1179135!, RSA127727); (JEPS82887!); (UCSC4943); **SHASTA CO.,** (UC73697!); (UC70448!); **SISKIYOU CO.,** (UC107552!); **VENTURA CO.,** (SBBG18365, RSA165497, UCSB16693).

IDAHO, **OWYHEE CO.,** (WTU142379, WS203191, UC943315!); (WTU14666, ID4457-ID112292, WS299100, NY-1057962); (CIC43395); (CIC45469); (ID115055-ID112473); (CIC12077).

NEVADA, **ELKO CO.,** (UC1492521!, NY1057963); HUMBOLDT CO., (RENO33424-NESH69126); WASHOE CO., (ID87908-ID112293, NY1057964).

OREGON, **HARNEY CO.,** (OSC172073, OSC153190); (NY-1057967); (UC660146!, WS122037, ORE75347, SRP20174, NY1057967); (WTU74481); **JACKSON CO.,** (ORE75352); (SRP20173); (OSC8636, UC192005!); (ORE75349); (ORE75351); (WTU14665); (WILLU419); **JOSEPHINE CO.,** (WS105710); (WTU13914JWT, K!); **MALHEUR CO.,** (NY-1057966); (NY-1057968); (CIC30115); (OSC233206, NY1057966, CIC30115); (OSC197103, CIC28044); (NY-1057969); (OSC167249, NY1057969); (OSC209589, CIC30117); (OSC159463, CIC12076); (OSC96690); (WILLU24328); (NY-1057965); (OSC204249, CIC31682, NY1057965); (NY1057968); WASCO CO., (WILLU21557, UC693816!).

APPENDIX 3.24. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA TANACETIFOLIA*.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are <u>underlined</u>, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES. **CALIFORNIA, ALAMEDA CO.,** (UC57163); (DS135107!); (UC672351!); (POM289800); (RSA97190); (RSA128921); (RSA292908); (JEPS84837!); (UC1606449!); (JEPS96235!, BRY607456-2441198, RSA691923, SEINET2441198, UC1618346!); (RENO33166-NESH 10574-5499599); (NMC41638-3158351, SEINET3158351); (LEA-VP-15185); **BUTTE CO.,** (POM73395); (CHSC730); (CHSC28761); (CHSC38467); (CHSC48476); **COLUSA CO.,** (DS179927!); (POM163459); (POM289798); (JEPS1305!); (UC765521!); (HSC69910); (HSC45512); (HSC44464); (HSC45748); (HSC62807); (RSA428207); (UCD82733); (RSA799178); (UCR233441); **CONTRA COSTA CO.,** (UC35529!); (UC107559!); (UC126023!); (UC881269!); (JEPS1284!); (UC881270!); (PASA1329); (UC672349!); (UC691701!); (RSA29642); (JEPS68952!); (UC691700!, POM300967); (CHSC21625); (CHSC69643); (JEPS99570!); (JEPS101085); (UCD102384); (JEPS111840!); (JEPS108346!); (CDA31462); (CDA28836); (NMC21833-3158353, SEINET3158353); (UC1618258!, JEPS87899!); (UC306173!); **FRESNO CO.,** (UC107378!); (UC126004!); (UC107466!); (DS8274!); (UC660992!, RSA122632); (UC719496!); (JEPS1302!); (RSA12878); (UC666578!, LA210026); (UC796721!, RSA52286); (RSA74206); (RSA74209); (RSA120204); (UCD120728); (UCD120716); (HSC13684); (UC1349286!); (DS749717!); (UCR120987); (RSA325130); (CHSC41952, HSC87294); (CHSC41954, UCD120727); (CHSC70451, HSC94302); (CHSC41951); (CDA14207); (UTC00237174-244649, MWI00062087-5321005, RENO33168-5499601, CHSC85648, SEINET244649); **GLENN CO.,** (CHSC53958); (CHSC90676); (CHSC89867); **IMPERIAL CO.,** (RSA603565); (RSA428208); (SD143839); **INYO CO.,** (DS194811!); (CAS474582!, RSA428223); (UC440323!); (UC881267!, SEINET3479313, MWI00056637-3479313); (POM228853); (RSA428209); (POM288846, POM228846); (SBBG108868); (SD26475, RSA29253); **KERN CO.,** (POM297933); (UC131443! right plant on sheet); (UC144193!); (UC144196!); (UC185362!); (UC185277!); (POM9268); (POM14200); (RSA74149); (UC310391!, POM99072); (SBBG54350); (UC311257!, POM96086); (POM97073); (SBBG65043); (UC672329!); (POM147945); (POM145717); (RSA428200); (SBBG65042); (SBBG65049); (SBBG65050); (RSA428199); (RSA74158); (POM289791); (UC511193!, POM289793); (RSA289795); (UC511105!, POM289794); (POM289802); (UC672350!); (RSA428206); (RSA602200); (UC505657!); (SBBG16281); (JEPS1292!); (JEPS1288!); (JEPS1289!); (UC579285!, RSA122645); (UC576464!, SD38349); (UC767520!); (UC564159!); (RSA602199); (RSA602423); (UC1069404!); (RSA602239); (UC718085!, RSA13048); (UC580071!); (JEPS2177!); (JEPS1280!); (UC718092!, RSA13188); (SBBG16264); (UC1069401!); (POM264137); (UC1069396!); (UC1069395!); (POM289801); (UC614678! n = 11 Cave and Constance 1942); (POM307874); (UC765450!); (RSA426085); (<u>JEPS1295</u>!, JEPS1296!, SD29282); (UC1733947!); (JEPS1293!, JEPS1294!, SD46085); (JEPS1282!); (UC726936!); (UC1278079!); (UC666594!, UTC00255428-3123893); (UC666598!); (UC666579!); (UCSB5433); (UCSB5432); (RSA49676); (POM428304); (RSA60442);

(RSA67620); (UCD120713); (RSA612643); (RSA293031); (JEPS18321!); (SJSU1847!); (UCR136605); (JEPS22995!); (CHSC26342); (UC1516021!); (SBBG16836); (SBBG15327); (SBBG16405); (SBBG15194); (HSC13737); (UC1523529!, HSC82788, RSA342259); (UCR55473); (RSA428203); (RSA428204); (SBBG30114); (UCSC1224); (RSA620337, RSA257595); (CAS865873!); (JEPS76450!); (UCD120715); (OBI39127!); (UCSB32669); (CAS911140!); (CAS910372!); (CAS911378!); (RSA750479); (UCSB42928); (UCSB47432); (UCSB47436); (SFV13483); (UC1562748!, RSA517006, SD131871); (RSA517005); (CAS1170867!); (RSA407609); (RSA395966); (UCSB59456); (RSA555352); (RSA557851); (UCD120722); (UCD120724); (UCR82055); (UCR90549); (UCR97535, VVC938, SD143838, RSA599056); (UCR101473); (UCR112638); (UCR99365, RSA600596); (RSA611341); (RSA614974); (SBBG110117, JEPS99406!); (RSA620027); (UCR157827); (CDA18886); (UCR130744); (UC1779147!); (UCR130234); (UCR122560, RSA667124); (RSA710032); (UCR122898, SD148132); (RSA707777); (UCD40561); (UCD40938); (UCR183901); (UCR183672); (UCR186028); (UCR184031); (UCR184294); (UCR184685); (UCR184345); (UCD78263); (CHSC101501); (UCD83211); (RSA744467); (RSA745042); (RSA745113); (RSA746058); (RSA745093); (UCR207957, RSA747482); (UCR207958, RSA746940); (UCR242736, RSA761408); (RSA761348); (RSA757847); (RSA761210); (RSA777222); (SBBG126003); (RSA761584); (SBBG125930); (RSA769558); (UCR237504, RSA778707, RSA778707); (UCR237611, RSA778053); (RSA778361); (UCR234711); (SD72081, RSA201421); (UNM61419-4080653, SEINET3306070, RSA428201); (ID-ID112604-ID-VP-119748, RENO33167-NESH 58779-5499600); (SD133066); (ID-ID112603-ID-VP-119747); (*R. Peters 28* SFSU!); (*K. Whitney 37* SFSU!); (*M. Ely 135* SFSU!); (RSA777227); (RSA777129); **KINGS CO.,** (UCD120736); (UC671733! n = 11 Cave and Constance 1942, HSC13685, RSA42297, UTCUTC00255427-3123892); (SBBG14741); (UCD120730); LAKE CO., (RSA2668); (POM289790); (UC424804!); (UC583155!, POM224479, RSA604723); (UC663076!); (UC914089!, RSA63329, RSA63368, RSA74337); (HSC30757, RSA258850); (CHSC24143); (CHSC24779); (CHSC27538); (CHSC27540); (UC1552834!); (UCSB63999); (CHSC88959); (CDA24960); (WWB17022B-WWB-VP-16477, WWB17022-WWB-VP-16476); (LEA-VP-15183); (LEA-VP-15184); (SRP34347-SRP-VP-34093, RENO33164-5499597); **LOS ANGELES CO.,** (UC55313!); (DS143757!); (DS8256!); (SD112820); (SBBG18905); (RSA74150); (JEPS1287!, RSA74162); (LA38548); (SBBG65048); (LA38549); (LA38546); (RSA426194); (RSA670722); (UC881134!, JEPS1286!); (SBBG16276); (PASA1328); (RSA607086); (RSA74159); (SBBG16184); (UC1069408!); (RSA74160, POM213280); (SBBG15752); (JEPS1298!); (LA34691); (RSA428210); (CHSC731); (LA81955); (RSA428213); (UCSC3068, UCSC3067); (UCSB10395 not georeferenced); (UCSB5436); (SBBG12273); (LA38794); (UCSB5446); (HSC13681); (RSA160867, RSA106837); (RSA207704); (RSA254375); (RSA738063); (RSA738064); (RSA738065); (CHSC3690); (UC1426033!, RSA250587); (RSA640243); (SBBG41183, RSA428212); (UCR90063); (UCR90062); (UCR141024); (SFV6221); (RSA763657); (HSC31662); (RSA650530); (SFV6451, UCD120717); (SBBG51754); (UCD120729); (RSA428214); (CHSC35453); (RSA339700); (RSA343353); (SFV13269); (RSA518030, UC1563061!); (RSA555357); (RSA660460); (RSA589339); (RSA599338, OBI70595!); (RSA682580); (RSA726017); (RSA717378); (RSA799680); (UCSB5428); (WCW12622-WCW-VP-8641); (SD108870); (SFSU!); (SD73409); MARIPOSA CO., (RSA648493); MERCED CO., (POM147015); (UC765639!); (UC671717!, RSA42316); (UC934001!); (CHSC41953, UCD120726); (UCD54615); **MONTEREY CO.,** (POM65586); (UC185292!); (POM125935); (POM127846);

(RSA13314); (RSA10460); (UC463288!); (JEPS1301!); (PGM5962); (RSA140135); (SBBG107053); (PGM0103); (UCSB13311); (UC1518746!, RSA313083); (UC1392690!, OBI13732!); (SJSU12136!); (UCD33777); (UC1561953!, RSA516376); (OBI70370!); (RSA665737); (SBBG110819); (SBBG123777); (CDA14998, SBBG111258); (OBI67163!, SBBG119088); (*J. R. Sweeney s.n.* SFSU!); **NAPA CO.,** (UC963880!); (UCD120738); (JEPS110799!); (JEPS110798!); (UCD48042); (UCD48041); (UCD81820); ORANGE CO., (JEPS110797!); (RSA697796); (UC537058!, POM202123); (DS234338!); (RSA650512); (UCR241066); **RIVERSIDE CO.,** (UC64051!); (POM3783); (POM3757); (POM7721); (RSA428217); (UCSB5434); (CSUSB153); (UC1286986!, UCD120719); (HSC79409); (SBBG35568); (SBBG37504); (UCR162053); (RSA776282); (WCW5931-WCW-VP-8642); (SD225003); **SAN BENITO CO.,** (POM128609); (RSA13267); (JEPS1299!); (UCD18658); (UCD120734); (UC1097051!); (UCD13105); (UCD13107); (UCR193582); (SFSU08445!); **SAN BERNARDINO CO.,** (JEPS1297!); (JEPS1300!); (DS136320!); (UC284699!); (UC881282!, RSA13943); (POM13184); (POM47426); (POM145531); (RSA428224); (POM126322); (UC440319!); (UC494423!, POM184065); (UC495195!, POM184257); (RSA428222); (RSA12383 not georeferenced); (UC569150!); (UCR124867, UC881266!, RSA428220, POM250355, RENO33165-RENO 15529-5499598); (RSA16436 not georeferenced); (POM307176); (POM308229); (UC718117!, RSA21339); (UC718116!, RSA21349); (POM247725); (DS264948!); (POM247711); (UC1733906!); (JEPS3527!); (UCD120718); (JEPS1281!); (UC774661!, RSA24715, SD42415); (UC774656!, RSA24737, SD42446); (JEPS3247!); (UC923106!); (UCSB5437); (UCSB5435); (SFV3032, SBBG17011); (RSA650517 not georeferenced); (UCD120735); (OBI13735!); (UCD120732); (HSC75359); (RSA765387); (CLARK-A1045-662); (RSA650529); (UCR33288, RSA272440); (UC1424832!, RSA271163); (RSA271420); (CHSC31103); (RSA625020); (RSA395991); (UCR53739); (RSA396001); (UC1549329!); (RSA649957); (UCR147823); (UC1719457!, HSC92359); (HSC92306); (UCR166302); (UCR87048); (RSA627365); (RSA705025); (RSA707200, SBBG118852); (CHSC99681, RSA709786); (RSA710584); (UCR196040); (CHSC100729); (UCR203491, SD197805, RSA747001); (UCR211344, RSA752129); (RSA752468); (SEINET3004617); (SEINET3004646); (UCR226875); (UCR226625); (RSA785958); (UCR225945); (UCR225927); (RSA776377); (UCR227102); (UCR226972, RSA786720); (RSA795058); (SD27766, RSA3759); (WCW11702-WCW-VP-8643); (WCW11699-WCW-VP-8644); (WCW11703-WCW-VP-8645); (SD70812); (ID-ID112605-ID-VP-119749); (SD100123); (SJNM66726-6425808); (SFSU08301!); (SFSU!); (SFSU08453!); (SFSU08451!); (SFSU08450!); (LSU00087023-5731150); (ASC97559-3004617); (ASC97598-3004646); SAN DIEGO CO., (UC1001653!); (UC486422!); (UC486351!); (RSA699629, RSA699777); (RSA428226); (UCD120720); (CHSC35347, HSC79405); (UCSB40921); (UCSB46318); (SD113326); (SD28506); (DES00010295-3091817, SEINET3091817); (SJNM18959-6055735, SEINET1984179); (UCSB34155); (NY83872-2803790); SAN FRANCISCO CO., (ARIZ-5566360); **SAN JOAQUIN CO.,** (UC107558!); (UC24484!); (UC75125!, POM65418); (DS67022!); (JEPS1290!); (JEPS1291!); (UC702960!, RSA26580); (RSA428228); (RSA21452); (ID-ID112608-ID-VP-119753); (ID-ID112607-ID-VP-119751); **SAN LUIS OBISPO CO.,** (OBI13731!); (UC52174!); (OBI48668!); (UC338218!); (UC24471!); (UC57366!); (POM97372); (POM147154); (UC524071!, POM203589, SD67648); (UC575329!, POM220947, RSA605960); (UC1069397!); (UC1069410!); (UC1069400!, JEPS21162!); (UC1069403!); (UC881268!, RSA428229); (UC1069399!); (UC1069402!); (RSA603567); (OBI13734!); (OBI40274!); (RSA115467); (PGM5963); (SBBG107052, RSA140137);

(SBBG107186); (SJSU3373!); (UCD120737); (RSA348910); (POM307954); (UCR6732); (OBI13730!); (OBI13733!); (OBI19537!); (SBBG48297, OBI26335!); (SBBG49061); (OBI17759!); (OBI31236!, OBI31235!); (OBI47514!); (JEPS86547!); (UCD120725); (RSA585892); (UCD120733); (OBI54276!); (CDA15089); (OBI58213!); (OBI57033!, CDA15116); (OBI58209!); (OBI58199!); (CDA16333, OBI71020!); (OBI64523!); (UCR122479); (UCD40580); (UC1872972!, OBI77628!); (RSA719904); (OBI65117!); (SD50993, SDSU6655!); (SRP44999-SRP-VP-50268); **SANTA BARBARA CO.,** (CDA20905, CDA20903); (OBI47943!); (POM114246); (SBBG65047); (SBBG75976); (POM216204); (UC569070!, POM213010, UC569061!); (UC1069409!); (UCSB5427); (SBBG16280); (SBBG65045); (SBBG85653); (UC1563241!, RSA554005, UCR67841, SD130593); (SBBG85668); (UCSB5429); (UCSB5430); (UCSB5431); (SBBG13117, RSA145555); (SBBG12292); (UCSB10985); (SBBG17413); (RSA165994); (SBBG85670); (SBBG23037); (SJSU11236!); (SBBG29524, RSA428230); (RSA648473); (UCSB44128); (OBI69612!, CDA17889); (SBBG122885); (SBBG122624); **SANTA CLARA CO.,** (DS572306!); (JEPS1285!, POM65352); (UC203059!, POM65355, SRP20168-SRP-VP-14889); (UC596680!); (POM127636); (CHSC732); (UCSC2559); **SHASTA CO.,** (HSC49117); (HSC49133); (RSA428232); (HSC46255); **SOLANO CO.,** (JEPS78803!); (UCD48001); (CDA31230); SONOMA CO., (HSC49397); **STANISLAUS CO.,** (UC24483!); (DS85650!); (RSA26573); (JEPS1303!); (UC564174!); (UC571778!); (UC571776!); (RSA428233); (JEPS18459!); (JEPS45482!); (UC1594180!); (JEPS100950!); SUTTER CO., (JEPS1304!); (UC24477!); (UC1069398!); (JEPS21185!); (UC1069407!); (UC1069406!); (CHSC12055); (CHSC43310); (CDA12467); **TEHAMA CO.,** (RSA153473); (CHSC68699, JEPS94375!); (CHSC105996); (CHSC92778); **TULARE CO.,** (JEPS1283!); (RSA602424); (POM88223); (POM289799); (POM308214); (POM306549); (SDSU6649); (SJSU1761!); (RSA303843); (UCD120731); (UCSB41576); (CAS1145735!, RSA806916); (UC1930163!, RSA683365); **VENTURA CO.,** (SBBG65046); (RSA16111); (SBBG65044); (RSA31809); (SEINET3158352, RSA60256); (SBBG85652); (RSA428231); (SBBG24445); (SBBG52535); (RSA678588); (SBBG94996, RSA534448); (UCSB70351); (UCSB65390); (UCSB70408); (UCSB53804); (UCSB53576); (UCSB71183); (UCSB70898); (SBBG121321); (SBBG121058); (SBBG124231); **YOLO CO.,** (UC107379!); (UCD120712); (POM181664); (UCD120714); (UCD120721, CDA12020); (UCD73634); **UNKNOWN CO.,** (UC24474! not georeferenced); (RSA102504 not georeferenced).

APPENDIX 3.25. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA THERMALIS*.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are underlined, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES. **CALIFORNIA, LASSEN CO.,** (NY1057982-2887874, NY1057983-2880318); (NY1057984-2880321, RSA38633); (CAS473845!, RSA128306); (SJSU14072!); (NY1057981-2885118, RSA337279); (SEINET3091880, RSA324193, RSA334843, DES00028610-3091880); (CHSC64879, JEPS97248!); (JEPS79143!); (UC1187649!, RSA152190); (UC526141!, RSA74152, UCR-80230-331593); (JEPS25530!); (JEPS109642!); (POM73715); (RSA40730, POM266079, UC710908!); (HSC29510); (UC1567390!); **MODOC CO.,** (CAS217648!); (CAS280989!); (CAS280647!, POM261000); (CAS473846!, UC726937!); (DS338449!, UC748324!); (SJSU9586!); (SJSU9668!); (CAS753953!); (CAS865937!); (CAS937!, UC56441!, POM63285); (JEPS101028!); (UC764435!); (UC881274!, OBI48669!); (UC791037! n = 11 Cave and Constance 1950); (UC1304164!); (UC526142!, POM203781, CAS217230!, DS230206!); (JEPS83791!, RSA502344); (UC107435!); (UC1586865!); **SHASTA CO.,** (UC73698!); (JEPS91089!, RSA530024); (UC57528!); **SISKIYOU CO.,** (JEPS101029!); (HSC13647).

NEVADA, WASHOE CO., (NY1057971-2877560); (NY1057972-2887373, RENO33108-5498656, ID122409-ID112601-ID-VP-119768, UC1778998!); (NY1057973-2884515, RENO33107-5498655, ID123039-ID112600-ID-VP-119767).

OREGON, HARNEY CO., (ORE75395-OSC-VP-51279); (ORE75394-OSC-VP-51277, OSC8594-OSC-VP-149565); (ORE75394B-OSC-VP-51278); (ORE75392-OSC-VP-51275); (ORE75391B-OSC-VP-51274); (NY-1057977-NY-VP-1199667); (OSC35330-OSC-VP-128990); (WILLU18827-OSC-VP-178815, WTU8077JWT-WTU-VP-130791, UC881271!); (OSC34210-OSC-VP-128359); (NY-1057979-NY-VP-1199674); (WILLU24873-OSC-VP-185294); (NY-1057978-NY-VP-1199669); (OSC108601-OSC-VP-70413, NY1057978-6554332, CIC27250-CIC-VP-40280, ID43879-ID112602-ID-VP-119769, WTU180184-WTU-VP-130795); (NY1057977-6569666, WTU14093JWT-WTU-VP-130807); (NY1057979-6535589, WILLU24856-OSC-VP-185276, WILLU24874-OSC-VP-185295, WTU110422-WTU-VP-130793, UC881272!); (NY1057976-6547459, CIC18980-CIC-VP-37927, WTU285705-WTU-VP-130804, NY-1057976-NY-VP-1199663); (NY1057975-6512852, CIC19220-CIC-VP-38019, WTU286673-WTU-VP-130802, NY-1057975-NY-VP-1199661); (ORE75393-OSC-VP-51276); LAKE CO., (OSC164049-OSC-VP-92256, UC1508735!); MALHEUR CO., (ORE75397-OSC-VP-51281); (ORE75396-OSC-VP-51280, ORE75390-OSC-VP-51272, UC179881!); (WS114414-WS-VP-131055); (WS21983-WS-VP-131054, UC24499!, UC107436! mounted with UC107435); (ORE75391-OSC-VP-51273); (NY-1057974-NY-VP-1199660); (WILLU16198-OSC-VP-175980, NY1057974-6544550, WTU14098JWT-WTU-VP-130790); (WILLU16215-OSC-VP-176000); (WILLU21960-OSC-VP-182191); (WILLU21405-OSC-VP-181603, UC693778!); (WILLU21967-OSC-VP-182198, UC693843!); (WILLU24314-

OSC-VP-184701); (OSC197130-OSC-VP-109822, CIC28051-CIC-VP-40445); (OSC209697-OSC-VP-115495, CIC31169-CIC-VP-7831); (CIC34117-CIC-VP-41044, NY1057980-6468068, OSC211087-OSC-VP-115822, NY-1057980-NY-VP-1199676); **MULTNOMAH CO.,** (WS100567-WS-VP-131053).

IDAHO, GOODING CO., (ID66329-ID112834-ID-VP-119763, SRP7303-SRP-VP-14893, CIC12082-CIC-VP-35232, ID66364-ID112833-ID-VP-119761); (CIC21095-CIC-VP-38633); LINCOLN CO., (NY1057970-2885178, NY-1057970-NY-VP-1199626, OSC164225-OSC-VP-92356, RENO33109-NESH59954, CIC17536-CIC-VP-37277, ID76953-ID112832-ID-VP-119765, WTU285275-WTU-VP-130799); **OWYHEE CO.,** (UC1039187!, ID31996-ID112835-ID-VP-119764).

MONTANA, GARFIELD CO., (MONTU81943-MONTU-VP-311); **PHILLIPS CO.,** (MONT69509-MONT-VP-38127, MONT76872-MONT-VP-38128, MONTU81944-MONTU-VP-26046); (MONT68539-MONT-VP-38126, MONT68540-MONT-VP-38125).

APPENDIX 3.26. ACCESSION NUMBERS OF SPECIMENS EXAMINED AND GEOREFERENCED FOR ***PHACELIA VALLIS-MORTAE*.** Specimens morphologically determined indicated with exclamation mark (!), accessions included in molecular study (see Apppendix 3.01) are <u>underlined</u>, specimens not georeferenced indicated parenthetically (see discussion in Methods section), specimens cited in other revisions noted.

UNITED STATES. ARIZONA, MOHAVE CO., (GCNP-1864246, GCNP-1864245); (DES00040727-3092001); (RM741465-1360795); (RM741351-1360860, UTC00233490-241191); (RM741513-1576446, RM741513-1376349); (RENO33124-5498820); (RM741525-1576485, RM741525-1376625, UTC00233346-241063); (RM741517-1376793, RM741517-1576504, UTC00233317-240374); (UVSC13346-3379366, SRP34350-SRP-VP-34096); (SUU000629-3365895); (UCR-167142-442361, RENO33123-5498815, RM785584-1337545); (SUU000883-3369429); (SUU000898-3371334); (BRY613573-2441503); (BRY613682-2441727); (ASC97531-2141928); (ASC-3101615); (UC10183080!); (UC711695!); (RENO33118-NESH 64464); (RENO33126-5499354); (RENO33127-5499357); (ARIZ-5566364); (ARIZ-5566365); (ARIZ-5566366); (ASU-706720); (ASU-706718); (ASU-706721); (ASU-706719); (ASU-706717); (ASC47308-1025815, ASU-706716); (ASU-706715); (ASU-706714); (SUU000711-3368521); (ASC97506-2126398); (MNAB.21615-1935902);

CALIFORNIA, INYO CO., (P03892447!); (UC162498!, RENO33129-NESH 7232, GH, cited Voss 1934, P03861925!); (UC128903!); (POM75565); (POM160122, cited Voss 1934); (RSA160199, cited Voss 1934); (POM145551, cited Voss 1934); (RSA426066); (RSA74153); (UC494597!, POM182283, cited Voss 1934, B!); (RSA74154); (POM187405, GH93501); (POM289813); (JEPS1269!); (RSA15888, HSC84071, UC718093!); (SEINET3479314); (JEPS15422!, UC569605!); (UC569602!); (POM229599); (POM247191); (POM243654); (RSA243557); (SD26386); (SD26111); (POM250055); (POM255199); (UC1004918!, POM255196); (POM255206); (JEPS68690!, UC696086!); (UC696077!); (JEPS1275!, RSA114178); (JEPS1265!); (UC775051!, RSA24147); (RSA26588); (RSA112691); (UC693685!); (<u>UC736051</u>!, POM275358); (UC753387!, $n = 11$ Cave and Constance 1950); (UC903418!); (RSA426065); (RSA426064); (RSA49149, UC809738!); (RSA50658); (SD71350); (JEPS17058!); (SD46635, RSA109895); (UC1087295!, RSA74155, UCD120703); (SDSU6590, SD51413); (CAS479308!); (UCR208071, RSA195927); (RSA211962); (NY1058020); (UCR90042); (UCR90041); (CHSC12908); (UC1426015!, RSA246203); (RSA244113); (UCR90044); (RSA621489); (RSA624359); (UCR77243); (RSA426068); (RSA428236); (RSA428235); (RSA426067); (JEPS78793!); (CLARK-A1045-22); (RSA678767); (RSA625639); (UCR134209); (UC1445354!, RSA623441); (UCR133907); (RSA274237); (RSA678763); (CHSC35426); (RSA428237); (UCD120705); (NY1058023); (NY1058022); (RSA351970); (RSA428234); (UCR222270); (UCR41780); (SEINET3091887); (UC1535047!, UCR47776, HSC84995, RSA387457, NY1058024); (UCR42782); (UCR43249); (UC1562746!, NY1058026, RSA517008, SD131870); (UCR60921, RSA515466); (RSA485366); (RSA485360); (UC1542720!); (UC1542770!); (RSA509909); (RSA475192); (OBI72073!, ARIZ398861-1909956, RSA756840, SEINET1909956); (RSA562309); (RSA620092); (SEINET853798, ARIZ376097-853798); (UCR165614); (UCR165375); (UCR165378); (RSA737640); (UCR225677, RSA802954); (UCR232935); (UCR236203);

(UCR243522); (MWI00056638-3479314); (UTC00255429-3123894, POM275357, UC736050!); (RENO33136-RENO 23171); (UCR-134209-409629); (UCR-133907-409243); (DES00030364-3091887); (UCR-42782-316619); (UCR-165614-441064); (UCR-165375-440806); (UCR-165378-440772); **KERN CO.,** (POM73555, cited by Voss 1934); (RSA74194); (SD45363); (UCSB42930); (UCR102162); (UCSB46538); (RSA562246); (SEINET235062, UTC00226978-235062); (UCR234897); (RENO33142-NESH 58780, SEINET3091855, DES00021783-3091855, ID76292-ID112623); MONO CO., (JEPS1273!); (DS296438!); (UC698000!, NY1058021, SD62312, UC1297468!); (UC698022!); (JEPS1272!); (RSA59946); (UC1287807!); (UC1287806!); (UC1299846!, JEPS74333!); (CLARK-A1045-1047); (RSA299528); (UC1545572!, NY1058025, RSA443003, UCR60182); (JEPS101538!); (JEPS112694!); (UC1787073!, RSA685483); (RSA682745); (RSA687470); (RSA696677); (RSA687457); (RSA700693); (RSA700577); (RSA685052); (UCR232897); **RIVERSIDE CO.,** (POM301821); (RSA80989); (UCSB16950); (UCR101584); (RSA613708); (UCR-101584-322834); (RENO33158-NESH 4265); **SAN BERNARDINO CO.,** (28 April 1937 *Lester Rowntree s.n.* B!); (P03861911!); (UC107382!); (UC107300!); (JEPS1268!); (JEPS1271!); (UC184740); (POM6714, cited Voss 1934, DS107325!); (UC284683!); (POM8600, cited Voss 1934); (POM8207, cited Voss 1934); (POM47736, cited Voss 1934); (JEPS1274!); (JEPS1267!); (POM187744, cited Voss 1934); (RSA13063); (UC569169!, POM213270); (UC718110!, RSA16041); (JEPS3509!); (JEPS3511!); (JEPS3490!); (JEPS3496!); (SBBG11782); (JEPS3525!); (JEPS3517!); (JEPS4043!); (UC718119!, RSA18627); (UC1753858!, JEPS97708!); (JEPS1270!); (RSA18621); (POM254376); (RSA24752); (UC774666!, RSA24761); (RSA112681); (RSA24776); (UC774648!, RSA24811); (RSA25100B); (RSA24524); (RSA24606); (UC774734!, RSA24598, SD42319); (UC666442!); (UC1003709!, SD47990, POM325052); (SD93015); (UC1278086!); (JEPS22604!); (UC1087298!, UCD120702, RSA124515); (RSA269953); (UC1478722!); (UC1417539!); (JEPS70902!); (RSA269696); (UCR60506, RSA348927); (RSA269697); (RSA271135); (RSA270740); (RSA270723); (UCR90043); (RSA344270); (UCR26114, UCR26114); (UC1483342!); (CLARK-A1045-897); (CLARK-A1045-720); (RSA275532); (RSA278692); (UC1606938!, RSA348919); (UCSB71642, RSA348918); (UC1531181!, RSA334573); (RSA718170); (RSA296634); (RSA296632); (RSA295912); (RSA296635); (OBI43688!); (OBI48760!); (UCR117292); (RSA673738); (UCR122576); (UCR183087); (UCR116253); (UCR240677); (SBBG118877, RSA707288); (SBBG118841, RSA707115); (UCR200455); (UCR192520); (UCR219075); (UCR213928); (UCR236314); (UCR232113); (RSA778347); (UCR243551); (UCR237475, RSA774435); (RSA788156); (UCR-219075-2459921).

NEVADA, CLARK CO., (16 April 1904 *M. E. Jones s.n.* POM, cited Voss 1934); (28 May 1930 *E. C. Jaeger s.n.* POM, cited Voss 1934); (RENO33114-RENO 42482); (RENO33140-5499524); (UCR-57231-371823, UTC00217156-265847); (UTC00255431-3123896, RENO33139-NESH 62655); (UCR-89736-371821); (UCR-104492-371819); (UTC00227683-235831, UCR-105676-333923); (MISS-6261231); (BRY613561-2441490); (UC158831!); (UC1005205052!); (UC900395!, RENO33133-RENO 15530); (UC1532305!); (UC900399!); (UC900397!, JEPS1266!); (UC206188!); (UC900398!, RENO33148-RENO 8549); (UC900396!); (RENO33121-5498812); **ESMERALDA CO.,** (17 June 1927 *M.E. Jones s.n.* POM, cited Voss 1934); (ID95310-ID112622, DES00032636-3091903); (UTC00248882-255145, RENO33120-5498810, ID137096-ID112619); (RENO33132-5499516); (RENO33113-NESH 7352); LINCOLN CO., (UTC00272638-5500233, UTC-4343406); (RENO33116-RENO

71893); (RENO33141-RENO 71818); (ENLC00992-3270644); (RENO33117-NESH 6506); (RENO33112-5498795); (ENLC02609-6729633); **MINERAL CO.,** (UTC00227122-235223, ID122412-ID112620); (UTC00226107-234304, ID122544-ID112621); **NYE CO.,** (NTS1929-5511638); (NTS1964-5511671); (NTS1957-5511664); (NTS1961-5511668); (NTS1963-5511670); (NTS1959-5511666); (NTS1962-5511669); (NTS1960-5511667); (NTS1967-5511674); (NTS1966-5511673); (NTS1968-5511675); (NTS1958-5511665); (NTS1965-5511672); (NTS1970-5511676); (NTS7532-5513749 not georeferenced); (NTS3008-5512314); (RENO33145-RENO 20301); (RENO33138-RENO 20300); (RENO33137-RENO 20293); (UCR-5355-301603); (RENO33134-RENO 21649); (RENO33153-RENO 22460); (UTC00255430-3123895); (RENO33143-RENO 24699); (NTS10083-5514143); (NTS12135-5514536); (RENO33144-RENO 30858); (RENO33135-RENO 30761); (NTS17155-5515769); (RENO33155-RENO 45875); (NTS16993-5515609); (NTS17373-5515985, NTS17376-5515987); (RENO33154-RENO 47723); (NTS17220-5515834); (NTS17992-5516220); (NTS18180-5516406); (SEINet-6167629); (UTC00246380-252982, RENO33122-5498814, SRP29523-SRP-VP-15092, CIC34896-CIC-VP-41128, ID137724-ID112618); (UCR-220831-2461269); (UCR-220828-2461272); (UC10228859!); (UC10228860!); (UC1374617!); (UC1950287!); (RENO33157-NESH 12018, RENO33156-NESH 12139, RENO33130-NESH 11968).

UTAH, WASHINGTON CO., (UTC00180195-226009); (SJNM29648-6039743); (SJNM29733-6061916); (UVSC3652-2148606); (UVSC5890-2151705); (UVSC13176-3377970); (SRP34349-SRP-VP-34095); (UC1409783!); (UC528710!), (P03861929!, GH, cited by Voss 1934).

UNKNOWN, (UC124727!, not georeferenced).

TABLE 3.1. LIST OF MAJOR DATA PORTALS ACCESSED FOR THIS STUDY. Presented in alphabetical order by title of database, with URL and access (table shown over two pages).

Data Portal	URL	Access
Collections Search Center of the Smithsonian Institution	http://collections.si.edu/search/	public
CollectionSpace public portal to UC & JEPS specimens	https://webapps.cspace.berkeley.edu/ucjeps/publicsearch/publicsearch/	public
CollectionSpace user login	http://demo.collectionspace.org/collectionspace/ui/core/html/index.html	user login, permission required by admin
Harvard University Herbaria & Libraries Index of Botanical Specimens	http://kiki.huh.harvard.edu/databases/specimen_index.html	public
Herbarium Hamburgense Virtual Herbarium	http://www.herbariumhamburgense.de	public
JStor Global Plants	http://plants.jstor.org/	access provided by the UC Berkeley Libraries subscription via a proxy server and VPN (Cisco AnyConnect Secure Mobility Client v3.0.11042, Cisco Systems, Inc., San Jose, CA) and by UC/JEPS as a participating institution
Muséum National d'Histoire Naturelle	http://science.mnhn.fr/institution/mnhn/item/search/form	public
Muséum National d'Histoire Naturelle Plantes vasculaires	https://science.mnhn.fr/institution/mnhn/collection/p/item/search/form	public
The Botanic Garden Meise Herbarium Catalogue	http://www.br.fgov.be/RESEARCH/COLLECTIONS/HERBARIUM/advancedsearch.php	public
The Botanical database at the Swedish Museum of Natural History Krypto-S	http://www.nrm.se/forskningochsamlingar/samlingar/databaser/kryptos.8598.html	public
The C. V. Starr Virtual Herbarium of the New York Botanical Garden	http://sciweb.nybg.org/science2/vii2.asp.html	public
The California Academy of Sciences Botany Collection Database	http://researcharchive.calacademy.org/research/botany/coll_db/index.asp	public
The California Academy of Sciences Institute for Biodiversity Science and Sustainability Botany Collection Beta release SilverCollection v1.2.0 portal	http://collections.calacademy.org/bot/	public
The Collections Database of the Philadelphia Herbarium (PH) at the Academy of Natural Sciences	http://ph.ansp.org/sheets.php	public
The Conservatoire et Jardin botaniques de la Ville de Genève Herbaria Catalogue	http://www.ville-ge.ch/musinfo/bd/cjb/chg/advanced.php?lang=en	public
The Consortium of California Herbaria [CCH]	http://ucjeps.berkeley.edu/consortium/	public
The Consortium of Pacific Northwest Herbaria [CPNWH]	http://www.pnwherbaria.org/data/search.php	public
The Field Museum of Natural History Botany Collections Database	http://emuweb.fieldmuseum.org/botany/Query.php	public
The Field Museum of Natural History Botany Collections vTypes Database	http://emuweb.fieldmuseum.org/botany/search_vtype.php	public
The Kew Herbarium Catalogue	http://apps.kew.org/herbcat/gotoSearchPage.do	public
The Missouri Botanic Garden TROPICOS Specimen Search	http://www.tropicos.org/SpecimenSearch.aspx	public
The Natural History Museum Specimen Collection Data Portal beta	http://data.nhm.ac.uk/	public
The Natural History Museum Specimen Collection Dataset: Collections	http://data.nhm.ac.uk/dataset/collection-specimens	public

The Oregon State University Herbarium Type Specimens Collection	http://oregondigital.org/cdm4/search.php?CISOROOT=/herbarium	public
The Rocky Mountain Herbarium Specimen Database	http://rmh.uwyo.edu/data/search.php	public
The Royal Botanic Garden Edinburgh Herbarium Catalogue	http://elmer.rbge.org.uk/bgbase/vherb/bgbasevherb.php	public
The Southwest Environmental Information Network [SEINet]	http://swbiodiversity.org/seinet/collections/index.php	public
The UC & JEPS New Specimen Images	http://ucjeps.berkeley.edu/db/types/imaged_types.html	public, all links broken in 2015, redirected to search page on CollectionSpace
The UC & JEPS Specimen Images Table	http://ucjeps.berkeley.edu/db/types/types_table.html	public, all links broken in 2015, redirected to search page on CollectionSpace
The University of Colorado Museum Herbarium's Specimen Database of Colorado Vascular Plant Type Specimens	http://cumuseum.colorado.edu/Research/Botany/Databases/typeSpecimens	public
The University of Colorado Museum Herbarium's Specimen Database of Colorado Vascular Plants	http://cumuseum-archive.colorado.edu/Research/Botany/Databases/	public
The University of Michigan Herbarium Vascular Plant Type Collection with Specimen Images	http://quod.lib.umich.edu/h/herb2ic?page=search	public
The Washington State University Herbaria	http://herbaria.wsu.edu/web/advanceSearch2.aspx	public
The Yale Peabody Museum of Natural History Botany Online Catalog	http://peabody.yale.edu/collections/search-collections?bot	public
BajaFlora	http://bajaflora.org/	user login, permission required by admin
La Red Mundial de Información sobre Biodiversidad [REMIB]	http://www.conabio.gob.mx/remib_ingles/doctos/remibnodosdb.html	public
The Berkeley Natural History Museums	http://bnhm.berkeley.edu/query/index.php	all links broken in 2015, redirected to individual museum search pages
Arctos	http://arctos.database.museum/	public

Fig. 3.01. The strict consensus of 9600 best trees for maximum parsimony (MP) [tree length 450 steps]. Support values are at nodes for MP bootstrap values / maximum likelihood (ML) bootstrap values / Bayesian posterior probabilities for nodes supported at ≥95% posterior probability. An asterisk (*) indicates clade with <75% support in the 0.5 majority-rule MP bootstrap tree or in the 0.5 majority-rule ML bootstrap tree. (scale bar = mean number of nucleotide substitutions per site).

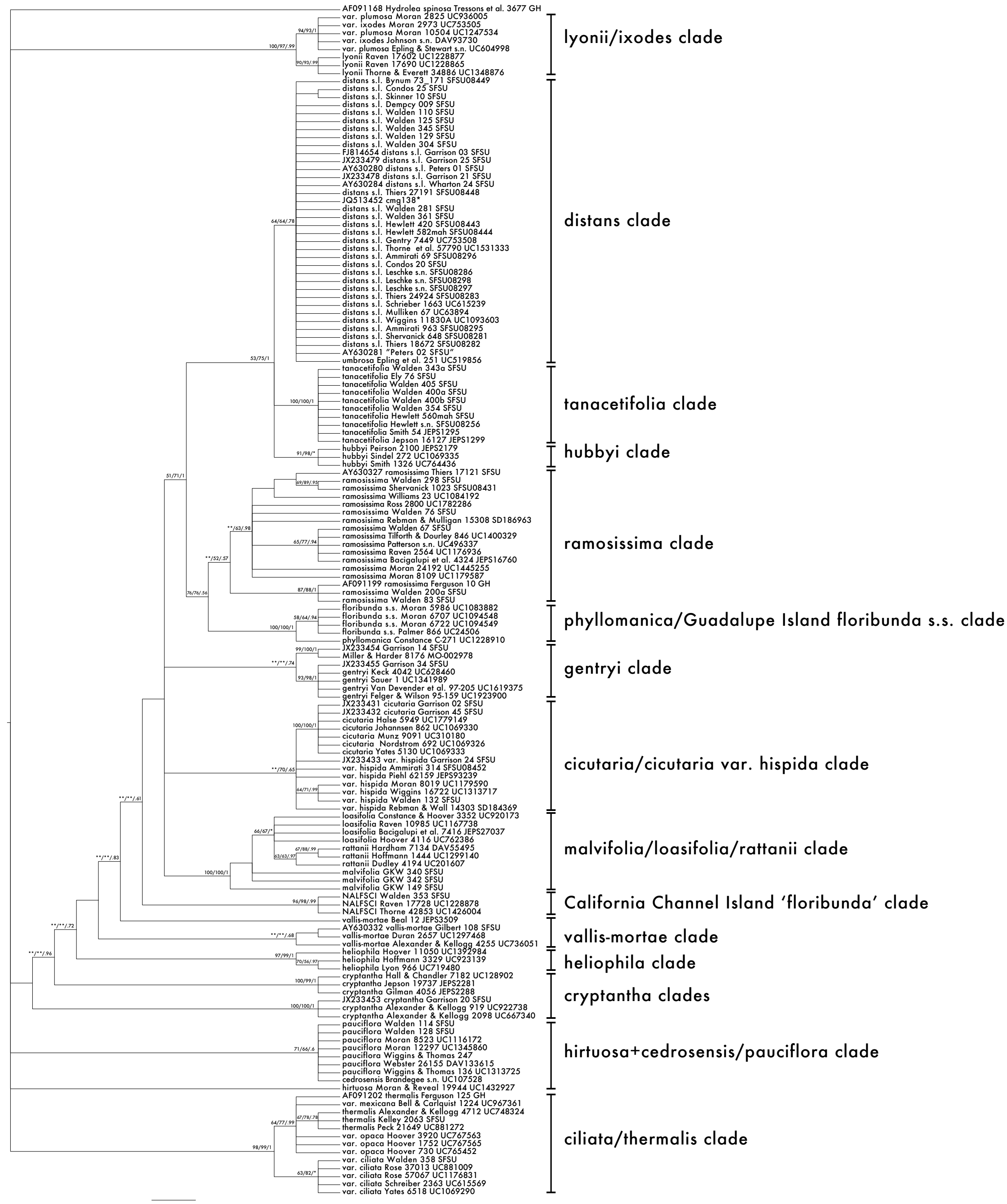

AF091168 Hydrolea spinosa Tressons et al. 3677 GH
var. plumosa Moran 2825 UC936005
var. ixodes Moran 2973 UC753505
var. plumosa Moran 10504 UC1247534
var. ixodes Johnson s.n. DAV93730
var. plumosa Epling & Stewart s.n. UC604998
lyonii Raven 17602 UC1228877
lyonii Raven 17690 UC1228865
lyonii Thorne & Everett 34886 UC1348876
distans s.l. Bynum 73_171 SFSU08449
distans s.l. Condos 25 SFSU
distans s.l. Skinner 10 SFSU
distans s.l. Dempcy 009 SFSU
distans s.l. Walden 110 SFSU
distans s.l. Walden 125 SFSU
distans s.l. Walden 345 SFSU
distans s.l. Walden 129 SFSU
distans s.l. Walden 304 SFSU
FJ814654 distans s.l. Garrison 03 SFSU
JX233479 distans s.l. Garrison 25 SFSU
AY630280 distans s.l. Peters 01 SFSU
JX233478 distans s.l. Garrison 21 SFSU
AY630284 distans s.l. Wharton 24 SFSU
distans s.l. Thiers 27191 SFSU08448
JQ513452 cmg138*
distans s.l. Walden 281 SFSU
distans s.l. Walden 361 SFSU
distans s.l. Hewlett 420 SFSU08443
distans s.l. Hewlett 582mah SFSU08444
distans s.l. Gentry 7449 UC753508
distans s.l. Thorne et al. 57790 UC1531333
distans s.l. Ammirati 69 SFSU08296
distans s.l. Condos 20 SFSU
distans s.l. Leschke s.n. SFSU08286
distans s.l. Leschke s.n. SFSU08298
distans s.l. Leschke s.n. SFSU08297
distans s.l. Thiers 24924 SFSU08283
distans s.l. Schrieber 1663 UC615239
distans s.l. Mulliken 67 UC63894
distans s.l. Wiggins 11830A UC1093603
distans s.l. Ammirati 963 SFSU08295
distans s.l. Shervanick 648 SFSU08281
distans s.l. Thiers 18672 SFSU08282
AY630281 "Peters 02 SFSU"
umbrosa Epling et al. 251 UC519856
tanacetifolia Walden 343a SFSU
tanacetifolia Ely 76 SFSU
tanacetifolia Walden 405 SFSU
tanacetifolia Walden 400a SFSU
tanacetifolia Walden 400b SFSU
tanacetifolia Walden 354 SFSU
tanacetifolia Hewlett 560mah SFSU
tanacetifolia Hewlett s.n. SFSU08256
tanacetifolia Smith 54 JEPS1295
tanacetifolia Jepson 16127 JEPS1299
hubbyi Peirson 2100 JEPS2179
hubbyi Sindel 272 UC1069335
hubbyi Smith 1326 UC764436
AY630327 ramosissima Thiers 17121 SFSU
ramosissima Walden 298 SFSU
ramosissima Shervanick 1023 SFSU08431
ramosissima Williams 23 UC1084192
ramosissima Ross 2800 UC1782286
ramosissima Walden 76 SFSU
ramosissima Rebman & Mulligan 15308 SD186963
ramosissima Walden 67 SFSU
ramosissima Tilforth & Dourley 846 UC1400329
ramosissima Patterson s.n. UC496337
ramosissima Raven 2564 UC1176936
ramosissima Bacigalupi et al. 4324 JEPS16760
ramosissima Moran 24192 UC1445255
ramosissima Moran 8109 UC1179587
AF091199 ramosissima Ferguson 10 GH
ramosissima Walden 200a SFSU
ramosissima Walden 83 SFSU
floribunda s.s. Moran 5986 UC1083882
floribunda s.s. Moran 6707 UC1094548
floribunda s.s. Moran 6722 UC1094549
floribunda s.s. Palmer 866 UC24506
phyllomanica Constance C-271 UC1228910
JX233454 Garrison 14 SFSU
Miller & Harder 8176 MO-002978
JX233455 Garrison 34 SFSU
gentryi Keck 4042 UC628460
gentryi Sauer 1 UC1341989
gentryi Van Devender et al. 97-205 UC1619375
gentryi Felger & Wilson 95-159 UC1923900
JX233431 cicutaria Garrison 02 SFSU
JX233432 cicutaria Garrison 45 SFSU
cicutaria Halse 5949 UC1779149
cicutaria Johannsen 862 UC1069330
cicutaria Munz 9091 UC310180
cicutaria Nordstrom 692 UC1069326
cicutaria Yates 5130 UC1069333
JX233433 var. hispida Garrison 24 SFSU
var. hispida Ammirati 314 SFSU08452
var. hispida Piehl 62159 JEPS93239
var. hispida Moran 8019 UC1179590
var. hispida Wiggins 16722 UC1313717
var. hispida Walden 132 SFSU
var. hispida Rebman & Wall 14303 SD184369
loasifolia Constance & Hoover 3352 UC920173
loasifolia Raven 10985 UC1167738
loasifolia Bacigalupi et al. 7416 JEPS27037
loasifolia Hoover 4116 UC762386
rattanii Hardham 7134 DAV55495
rattanii Hoffmann 1444 UC1299140
rattanii Dudley 4194 UC201607
malvifolia GKW 340 SFSU
malvifolia GKW 342 SFSU
malvifolia GKW 149 SFSU
NALFSCI Walden 353 SFSU
NALFSCI Raven 17728 UC1228878
NALFSCI Thorne 42853 UC1426004
vallis-mortae Beal 12 JEPS3509
AY630332 vallis-mortae Gilbert 108 SFSU
vallis-mortae Duran 2657 UC1297468
vallis-mortae Alexander & Kellogg 4255 UC736051
heliophila Hoover 11050 UC1392984
heliophila Hoffmann 3329 UC923139
heliophila Lyon 966 UC719480
cryptantha Hall & Chandler 7182 UC128902
cryptantha Jepson 19737 JEPS2281
cryptantha Gilman 4056 JEPS2288
JX233453 cryptantha Garrison 20 SFSU
cryptantha Alexander & Kellogg 919 UC922738
cryptantha Alexander & Kellogg 2098 UC667340
pauciflora Walden 114 SFSU
pauciflora Walden 128 SFSU
pauciflora Moran 8523 UC1116172
pauciflora Moran 12297 UC1345860
pauciflora Wiggins & Thomas 247
pauciflora Webster 26155 DAV133615
pauciflora Wiggins & Thomas 136 UC1313725
cedrosensis Brandegee s.n. UC107528
hirtuosa Moran & Reveal 19944 UC1432927
AF091202 thermalis Ferguson 125 GH
var. mexicana Bell & Carlquist 1224 UC967361
thermalis Alexander & Kellogg 4712 UC748324
thermalis Kelley 2063 SFSU
thermalis Peck 21649 UC881272
var. opaca Hoover 3920 UC767563
var. opaca Hoover 1752 UC767565
var. opaca Hoover 730 UC765452
var. ciliata Walden 358 SFSU
var. ciliata Rose 37013 UC881009
var. ciliata Rose 57067 UC1176831
var. ciliata Schreiber 2363 UC615569
var. ciliata Yates 6518 UC1069290
lyonii/ixodes clade
distans clade
tanacetifolia clade
hubbyi clade
ramosissima clade
phyllomanica/Guadalupe Island floribunda s.s. clade
gentryi clade
cicutaria/cicutaria var. hispida clade
malvifolia/loasifolia/rattanii clade
California Channel Island 'floribunda' clade
vallis-mortae clade
heliophila clade
cryptantha clades
hirtuosa+cedrosensis/pauciflora clade
ciliata/thermalis clade
2.0

Fig. 3.02. Distribution of georeferenced *Phacelia* sect. *Ramosissimae* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, GEBCO, and U.S. Department of State Geographer. Scale bar 1000 miles.

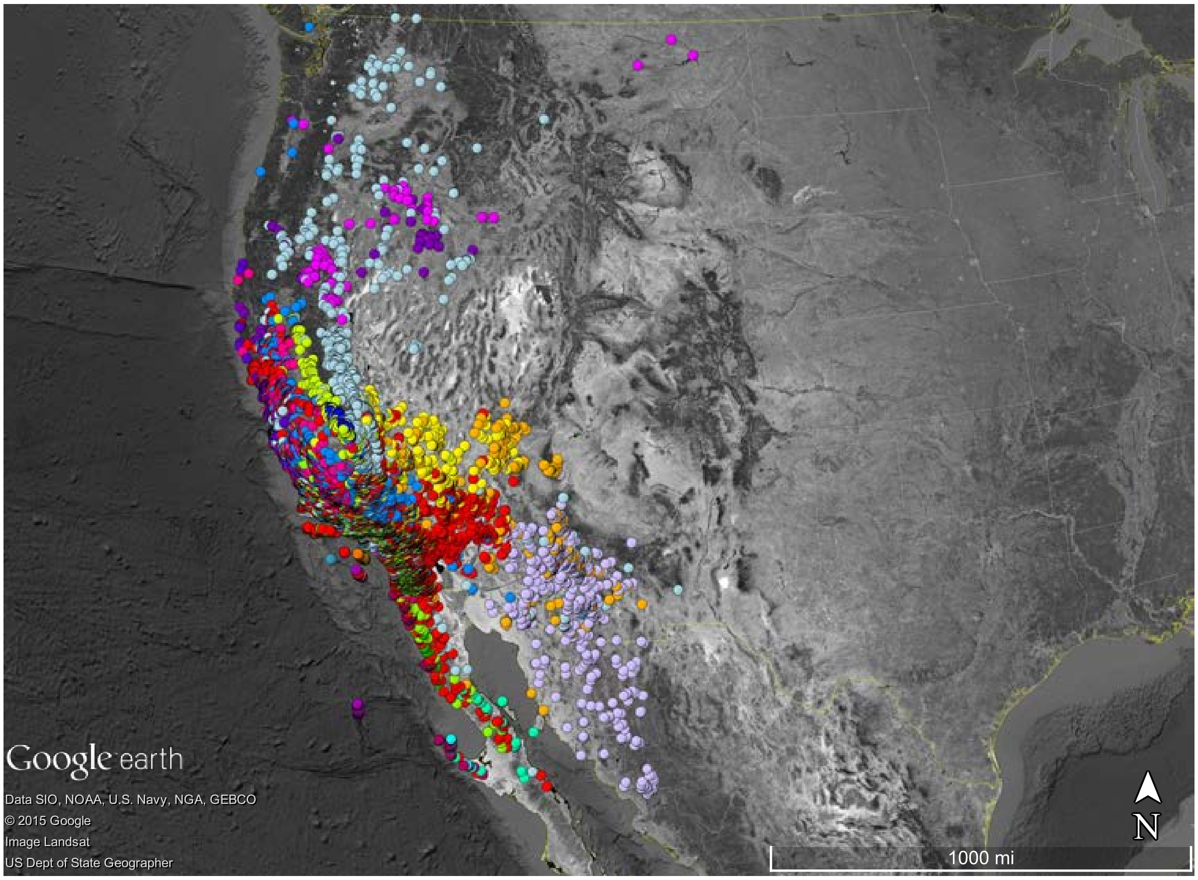

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
US Dept of State Geographer
1000 mi
N

Fig. 3.03. Distribution of georeferenced *Phacelia cicutaria* [var. *cicutaria*] specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google and U.S. Department of State Geographer, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.

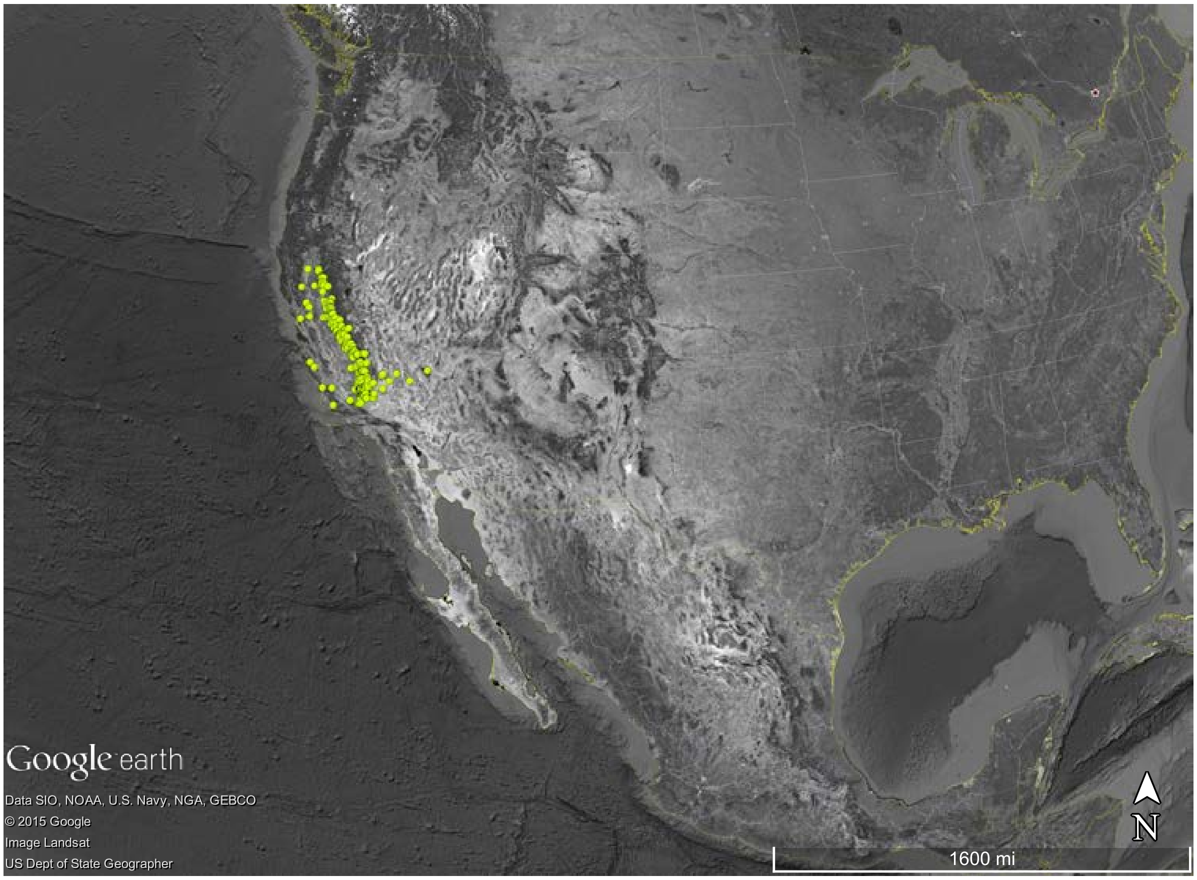

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
US Dept of State Geographer
1600 mi
N

Fig. 3.04. Distribution of georeferenced *Phacelia cicutaria* [var. *cicutaria*] specimens in California and Nevada. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google and INEGI, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 200 miles.

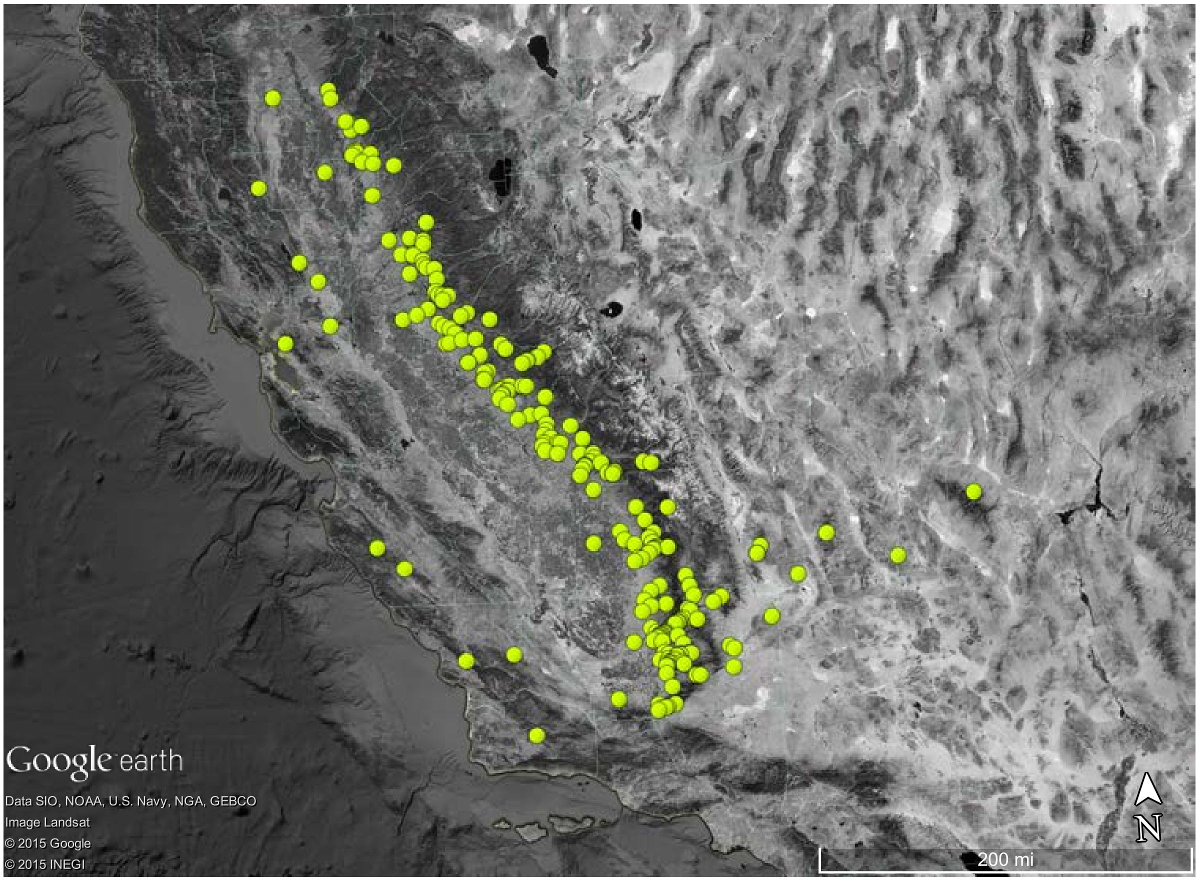
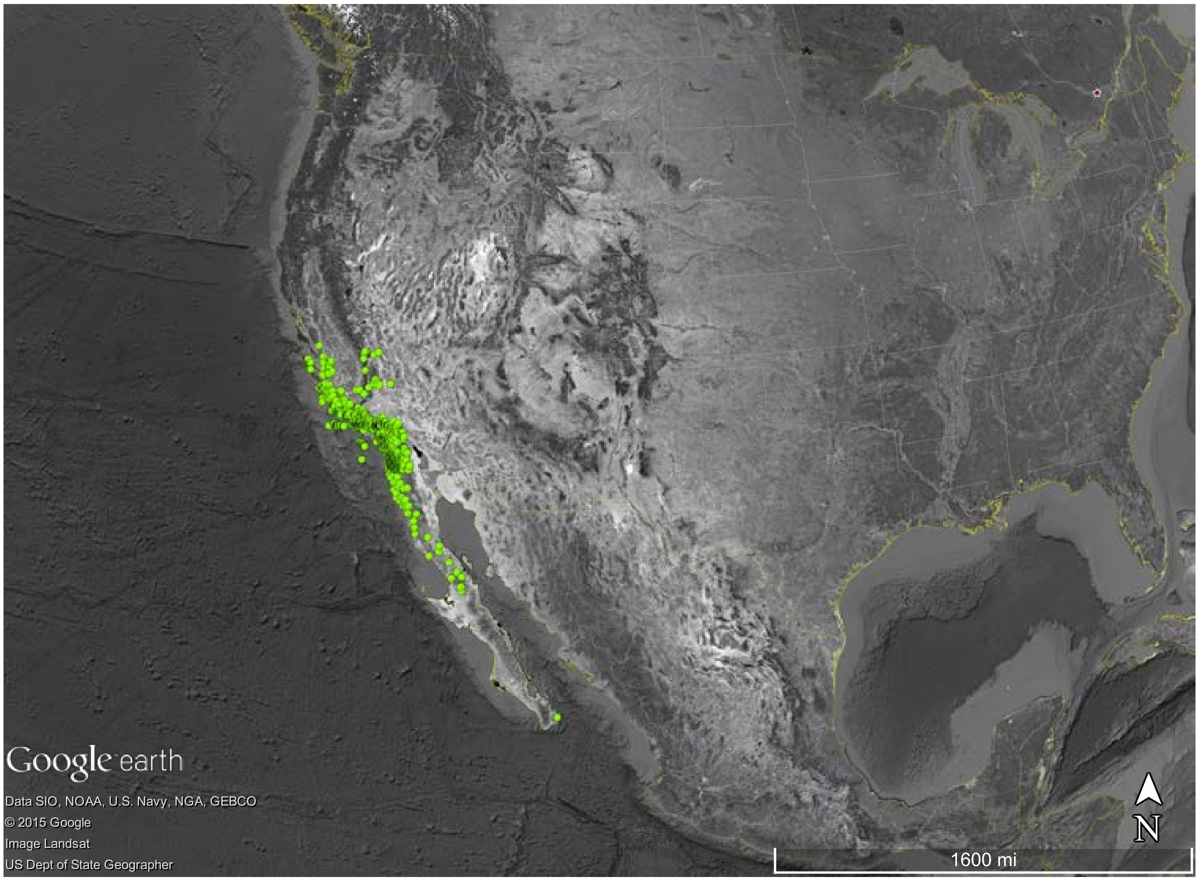

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
© 2015 Google
© 2015 INEGI
200 mi
N

Fig. 3.05. Distribution of georeferenced *Phacelia cicutaria* var. *hispida* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google adn the U.S. Department of State Geographer, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.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Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
US Dept of State Geographer
1600 mi
N

Fig. 3.06. Distribution of georeferenced *Phacelia cicutaria* var. *hispida* specimens in California and Baja California. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google and INEGI, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 300 miles.

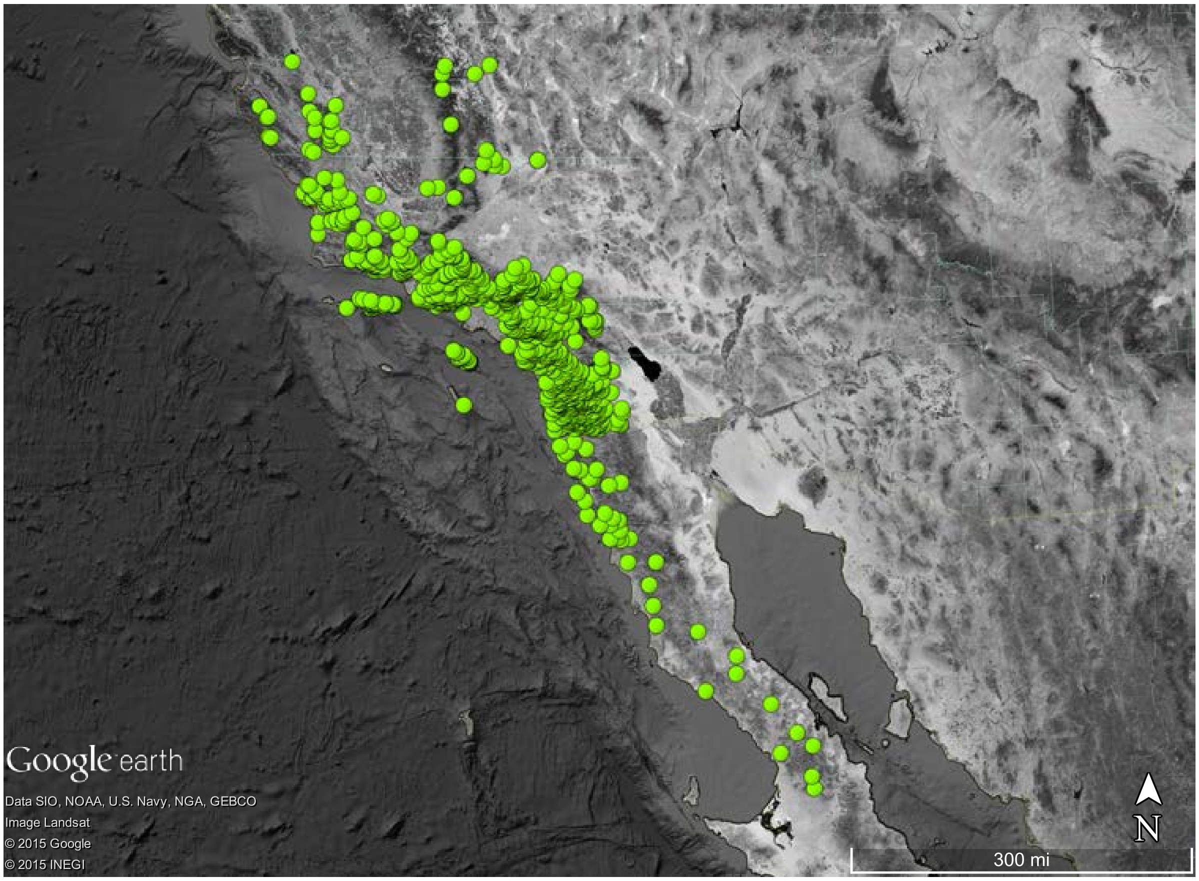

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
© 2015 Google
© 2015 INEGI
300 mi
N

Fig. 3.07. Distribution of georeferenced *Phacelia ciliata* var. *ciliata* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.

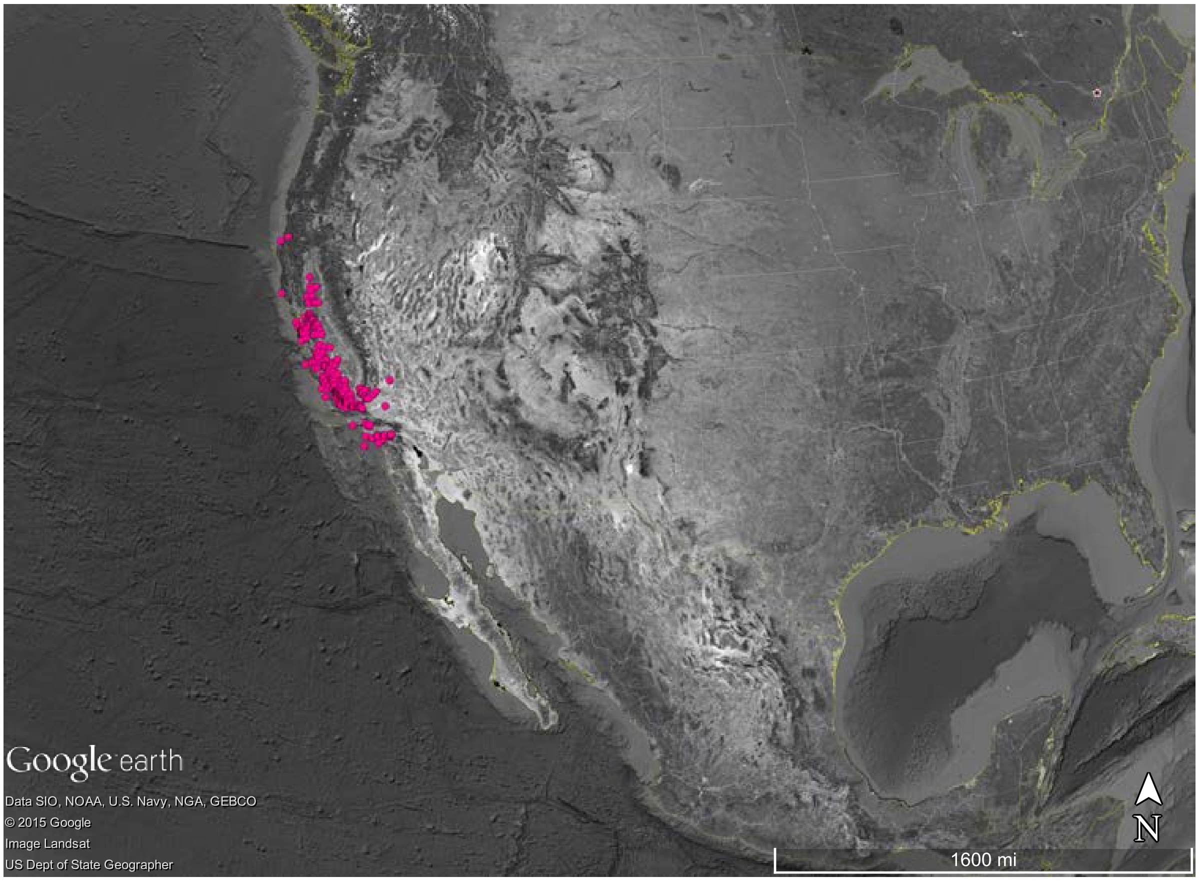

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
US Dept of State Geographer
1600 mi
N

Fig. 3.08. Distribution of georeferenced *Phacelia ciliata* var. *ciliata* specimens in California. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 300 miles.

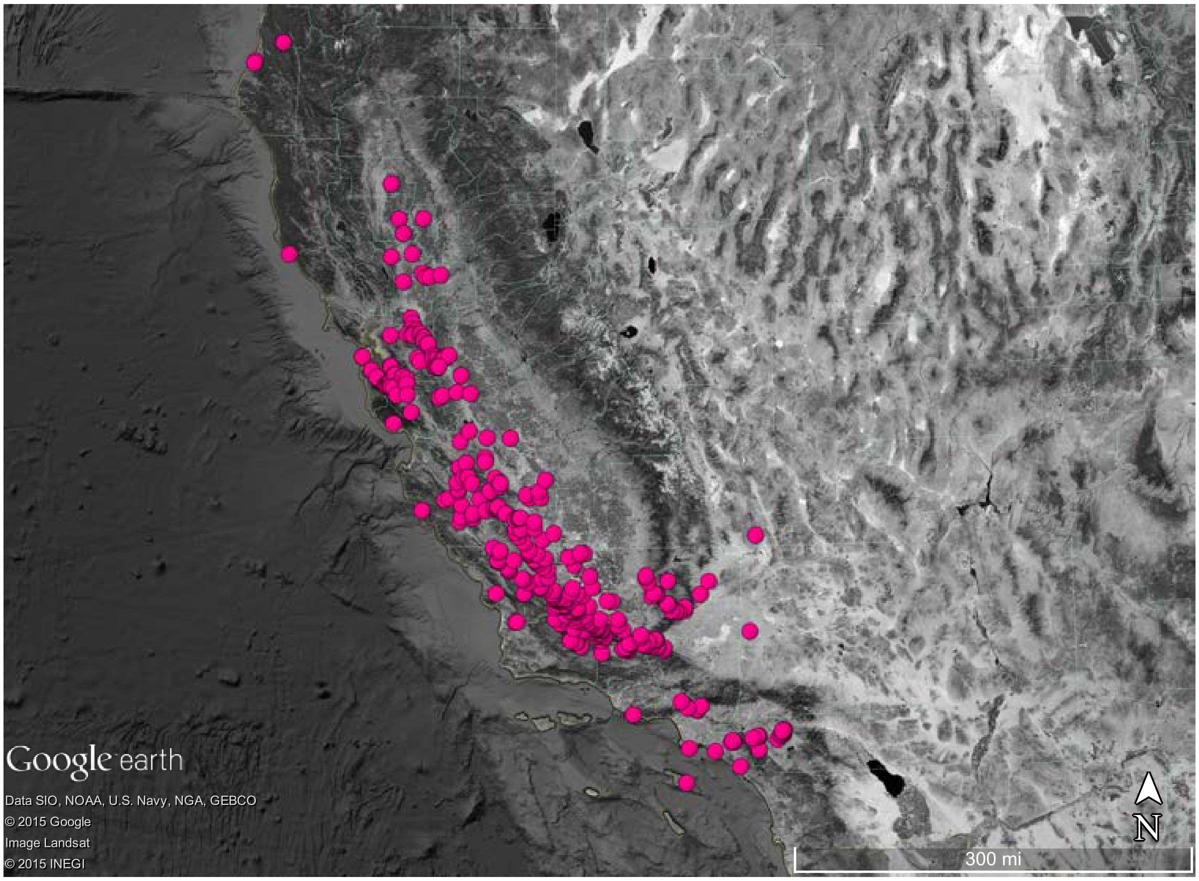
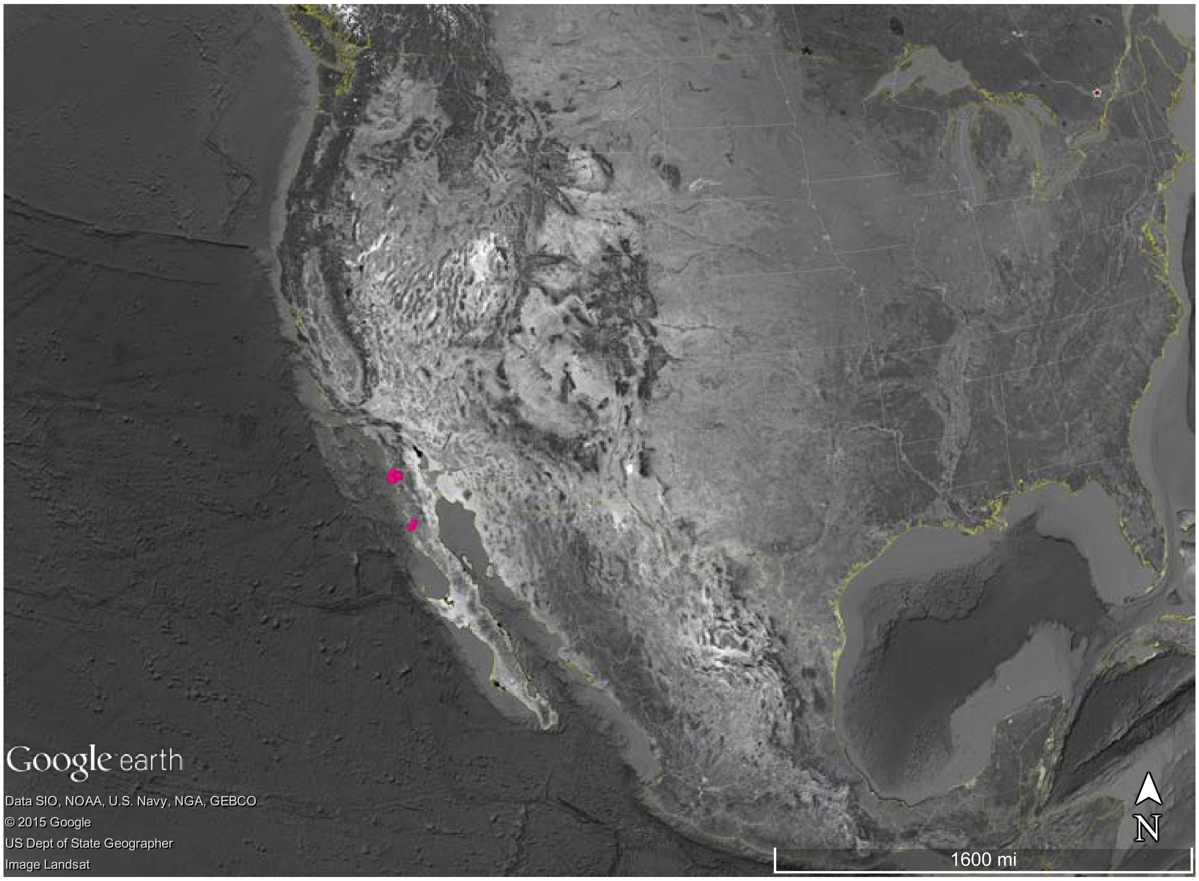

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
© 2015 INEGI
300 mi
N

Fig. 3.09. Distribution of georeferenced *Phacelia ciliata* var. *mexicana* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.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Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
US Dept of State Geographer
Image Landsat
1600 mi
N

Fig. 3.10. Distribution of georeferenced *Phacelia ciliata* var. *mexicana* specimens in Baja California. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 200 miles.

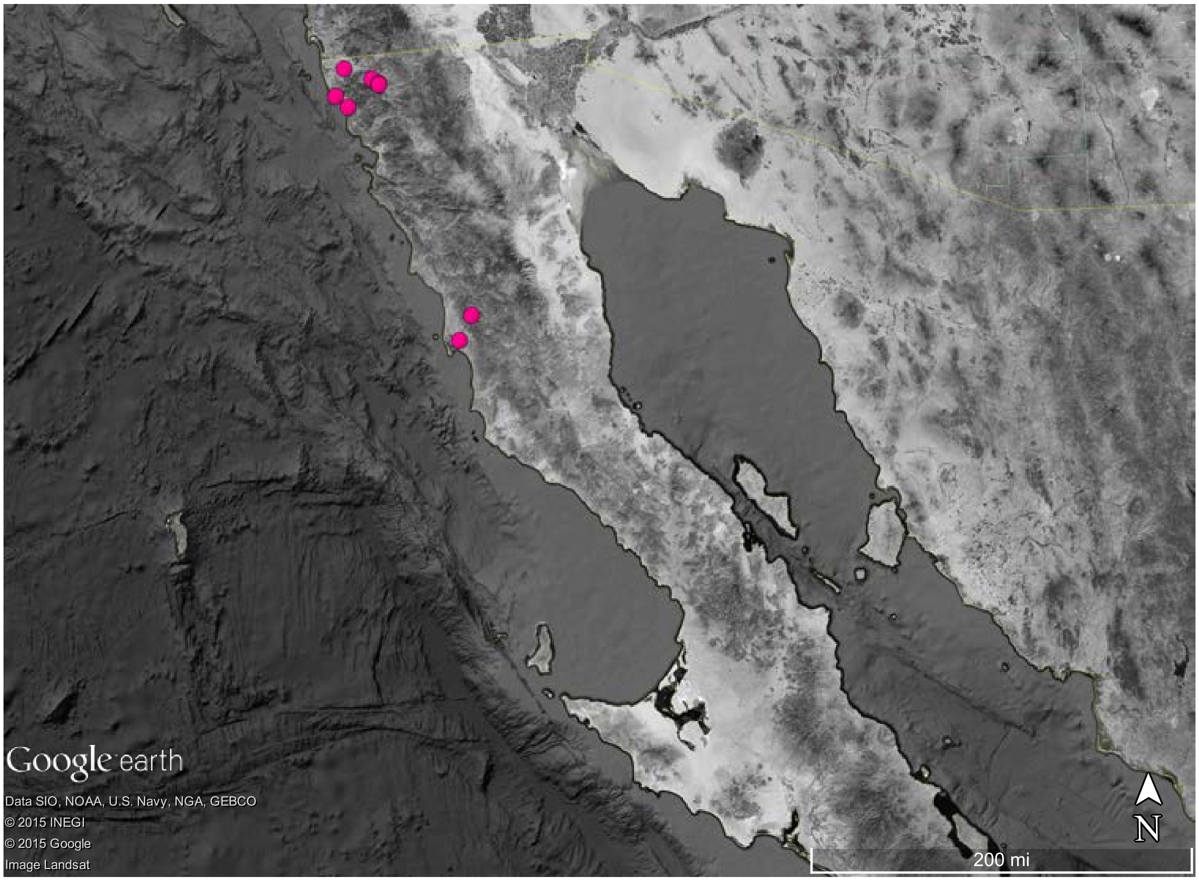

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 INEGI
© 2015 Google
Image Landsat
200 mi
N

Fig. 3.11. Distribution of georeferenced *Phacelia ciliata* var. *opaca* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.

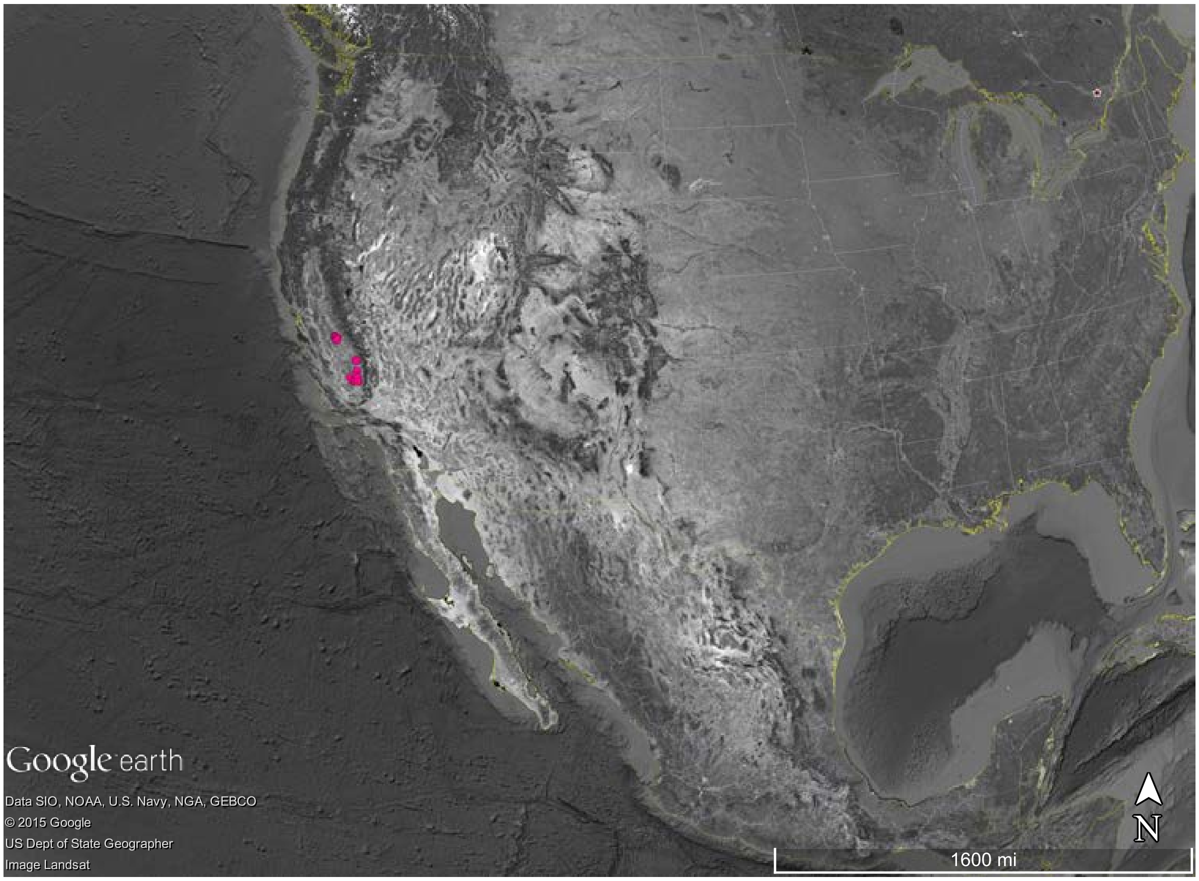

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
US Dept of State Geographer
Image Landsat
1600 mi
N

Fig. 3.12. Distribution of georeferenced *Phacelia ciliata* var. *opaca* specimens in California. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 70 miles.

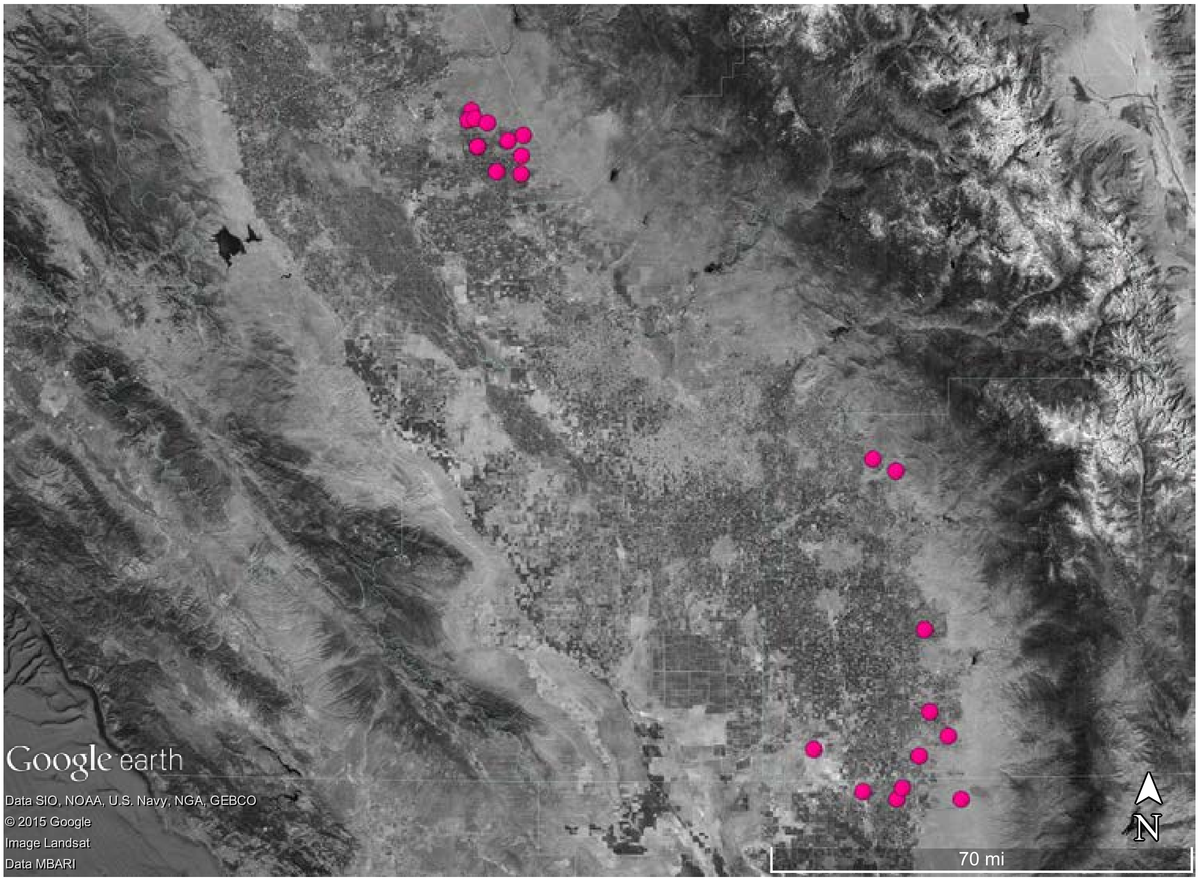

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
Data MBARI
70 mi
N

Fig. 3.13. Distribution of georeferenced *Phacelia cinerea* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.

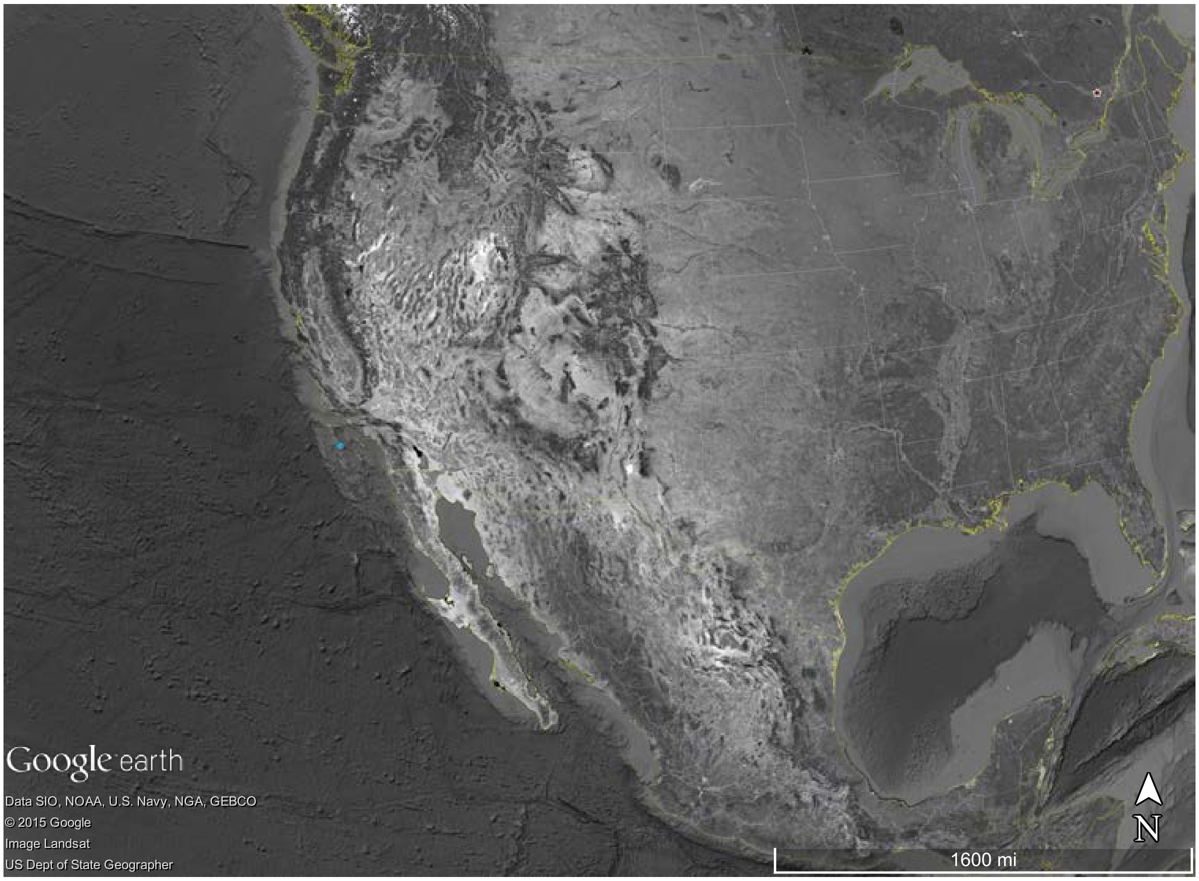
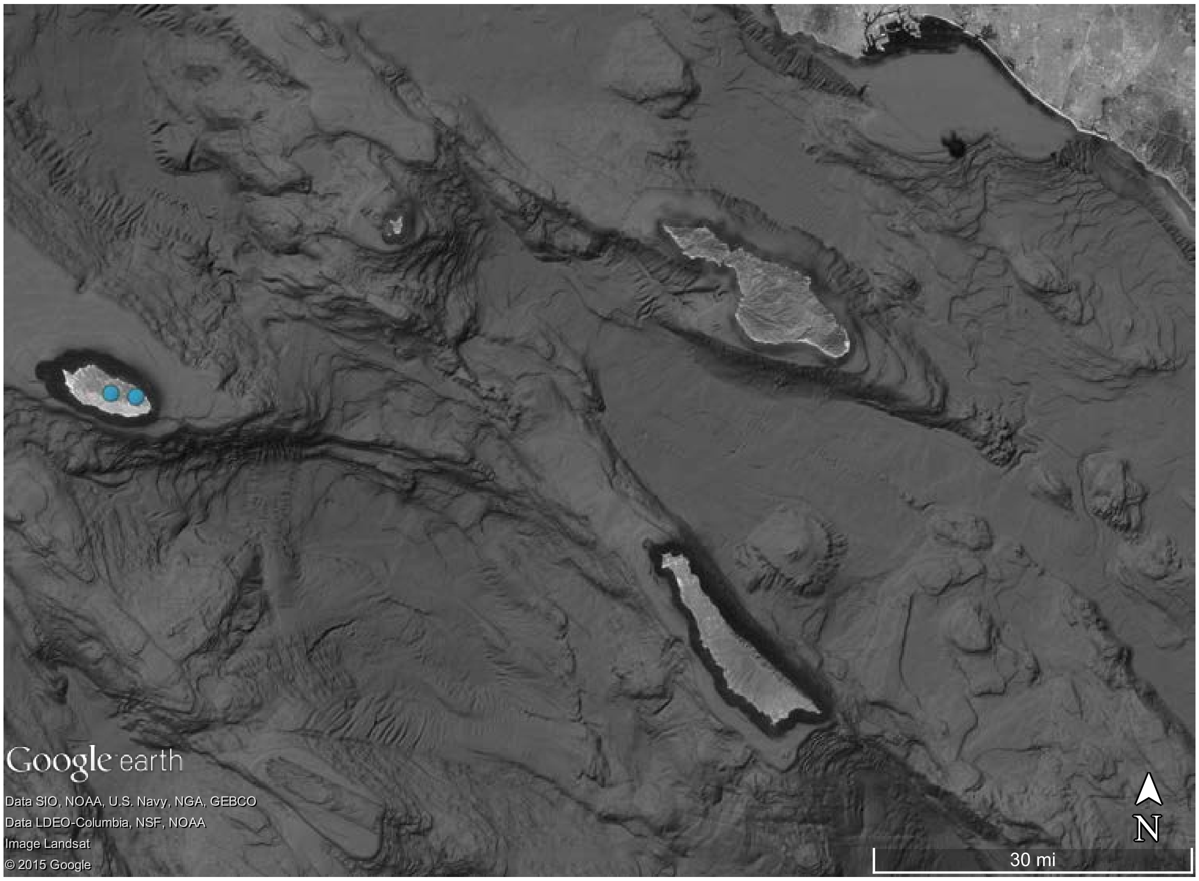

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
US Dept of State Geographer
1600 mi
N

Fig. 3.14. Distribution of georeferenced *Phacelia cinerea* specimens from California, Ventura County, San Nicolas Island . Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 30 miles. Only two collections are known for this taxon, both collections discussed in the taxonomic treatment. No additional appendices.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Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Data LDEO-Columbia, NSF, NOAA
Image Landsat
© 2015 Google
N
30 mi

Fig. 3.15. Distribution of georeferenced *Phacelia cryptantha* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.

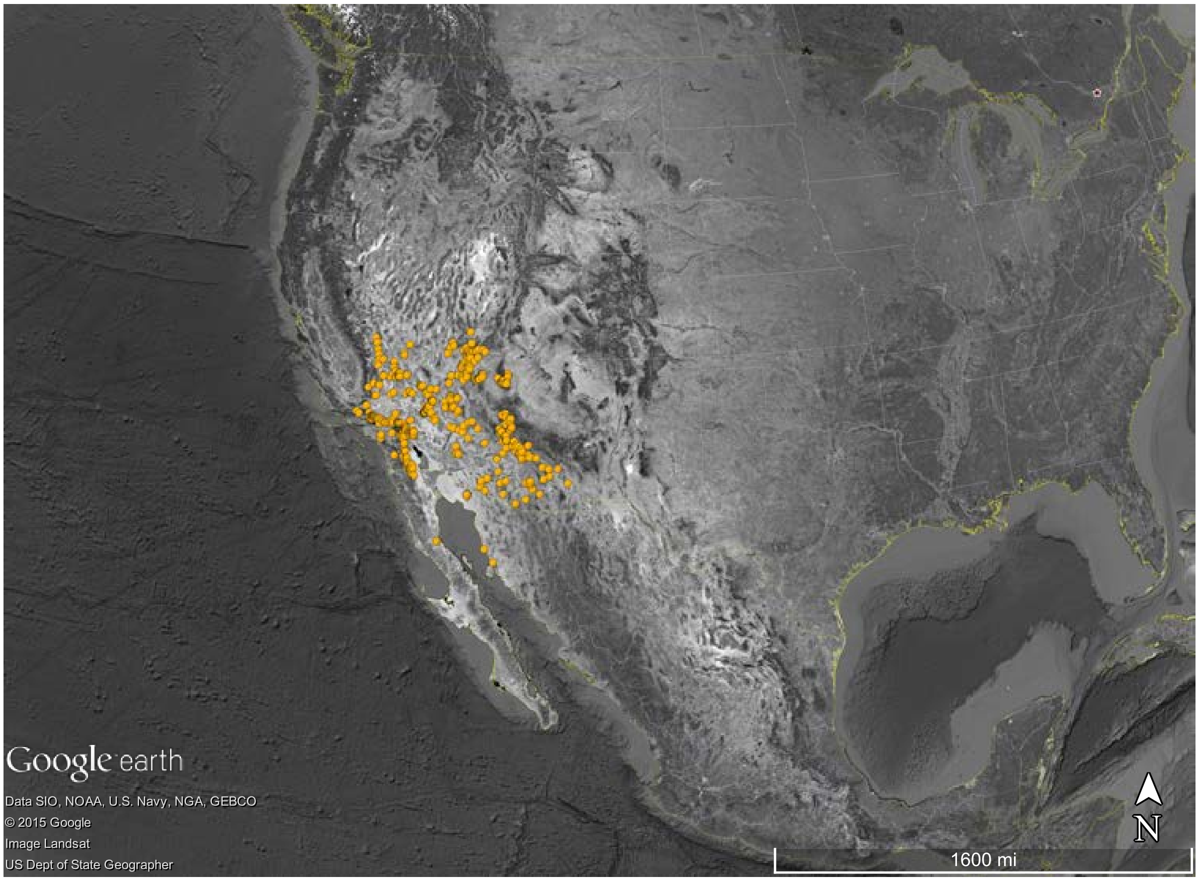
Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
US Dept of State Geographer
1600 mi
N

Fig. 3.16. Distribution of georeferenced *Phacelia cryptantha* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 300 miles.

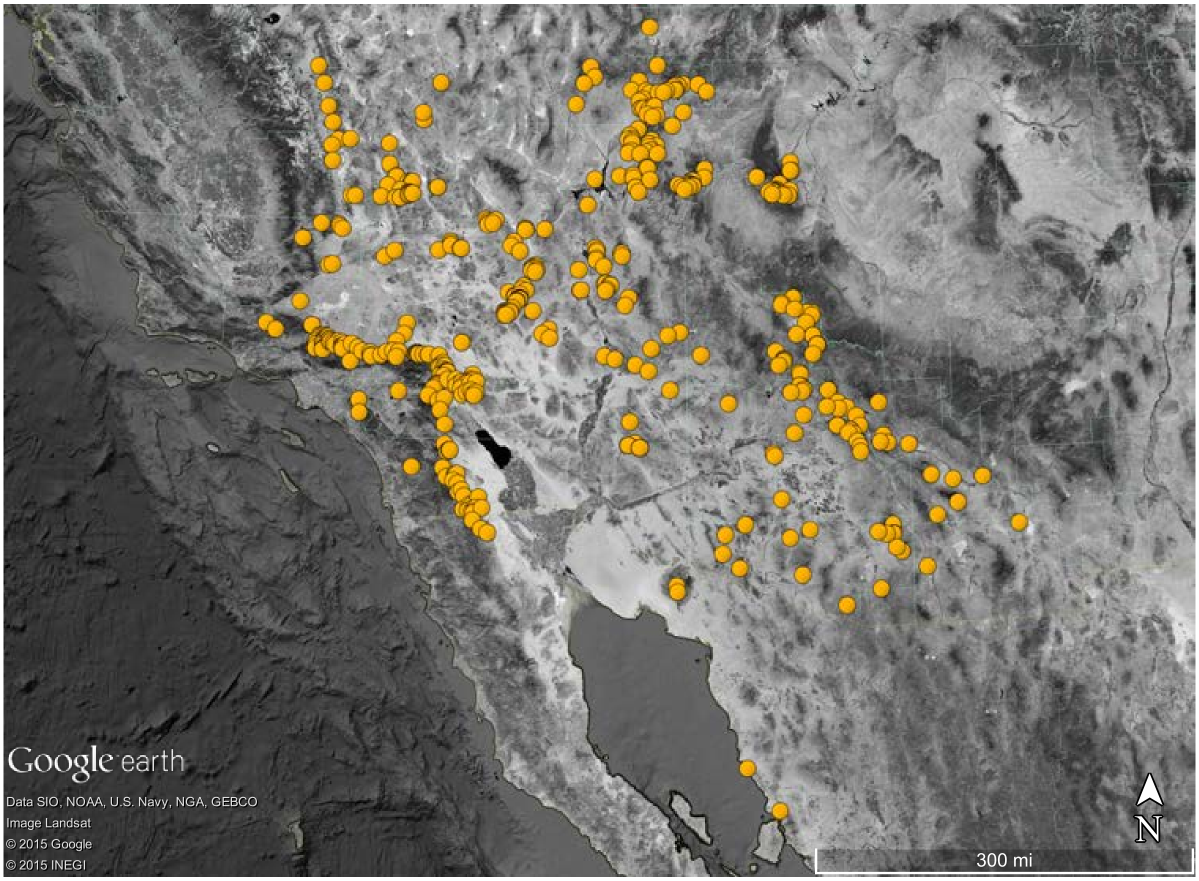
Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
© 2015 Google
© 2015 INEGI
300 mi
N

Fig. 3.17. Distribution of georeferenced *Phacelia distans* sensu lato specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.

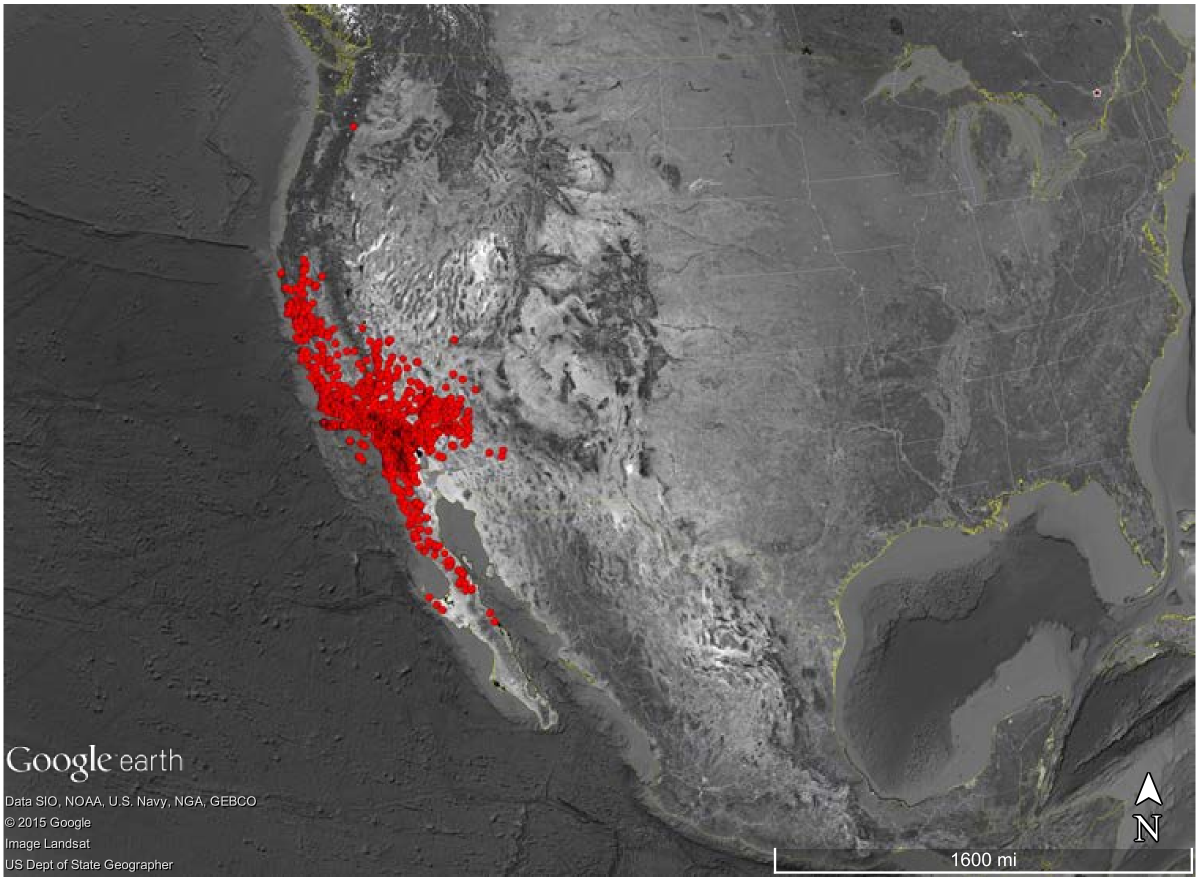
Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
US Dept of State Geographer
1600 mi
N

Fig. 3.18. Distribution of georeferenced *Phacelia umbrosa* [included in the synonymy of *Phacelia distans* sensu lato in the taxonomic treatement] specimens in California, San Diego County. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 50 miles.

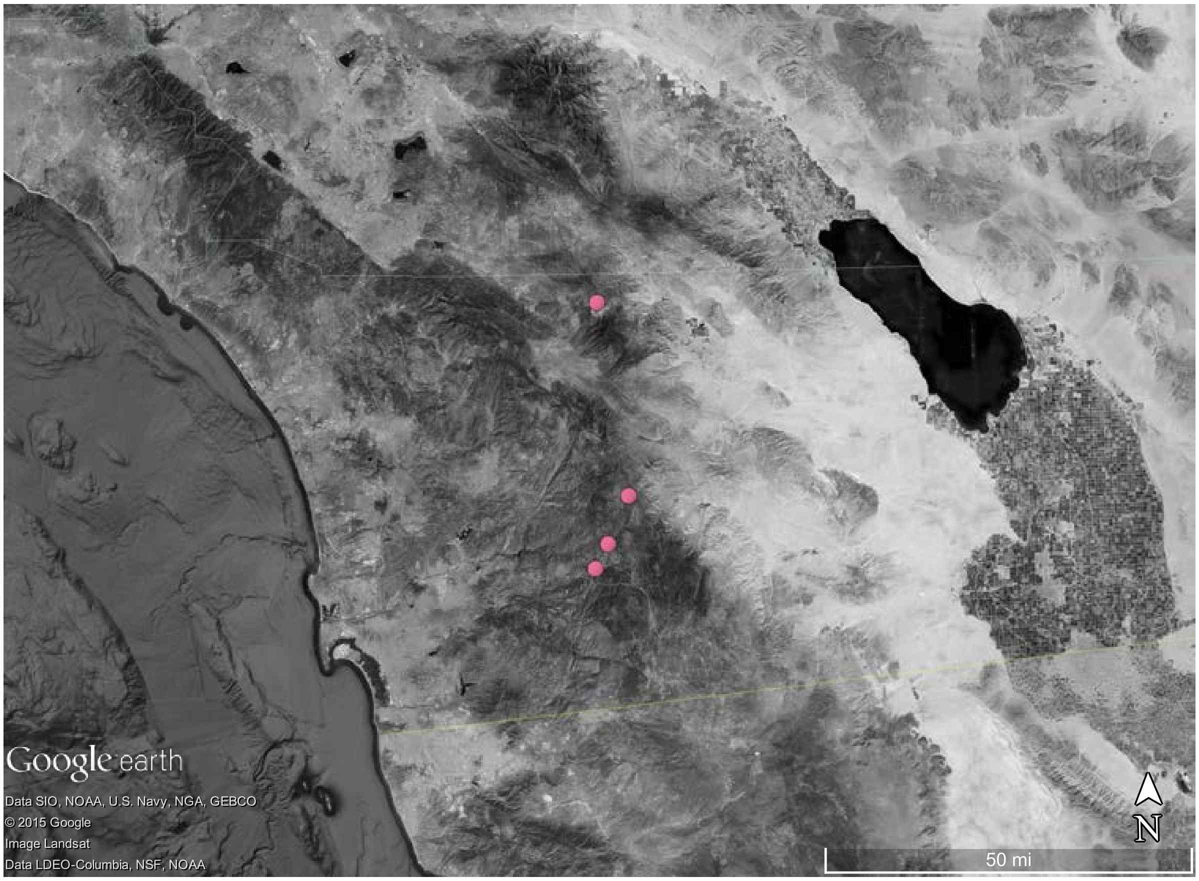
Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
Data LDEO-Columbia, NSF, NOAA
50 mi
N

Fig. 3.19. Distribution of georeferenced *Phacelia floribunda* sensu stricto specimens from Guadalupe Island (México). Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 10 miles.

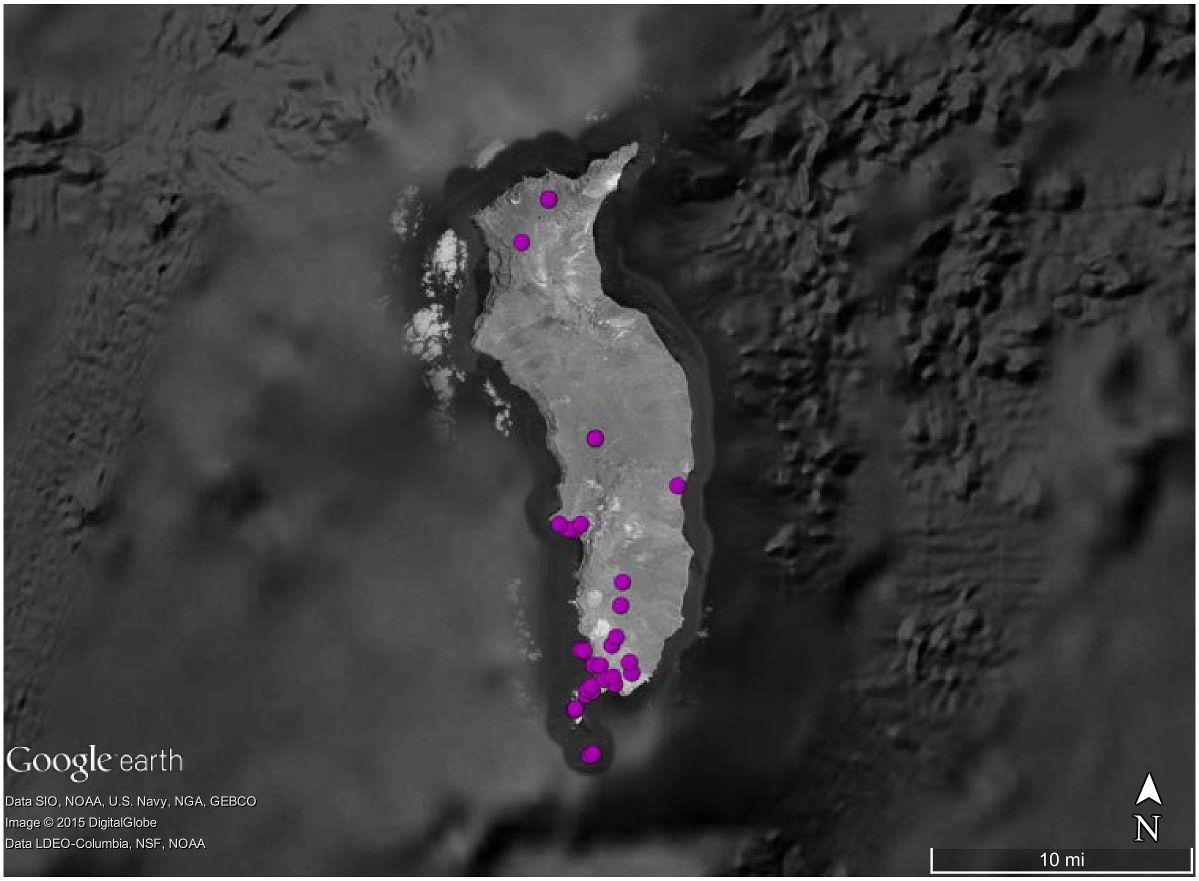
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Image © 2015 DigitalGlobe
Data LDEO-Columbia, NSF, NOAA
N
10 mi

Fig. 3.20. Distribution of georeferenced "*Phacelia floribunda* San Clemente Island, NALFSCI-ensis" specimens in the Channel Islands of California (San Clemente Island). Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 50 miles.

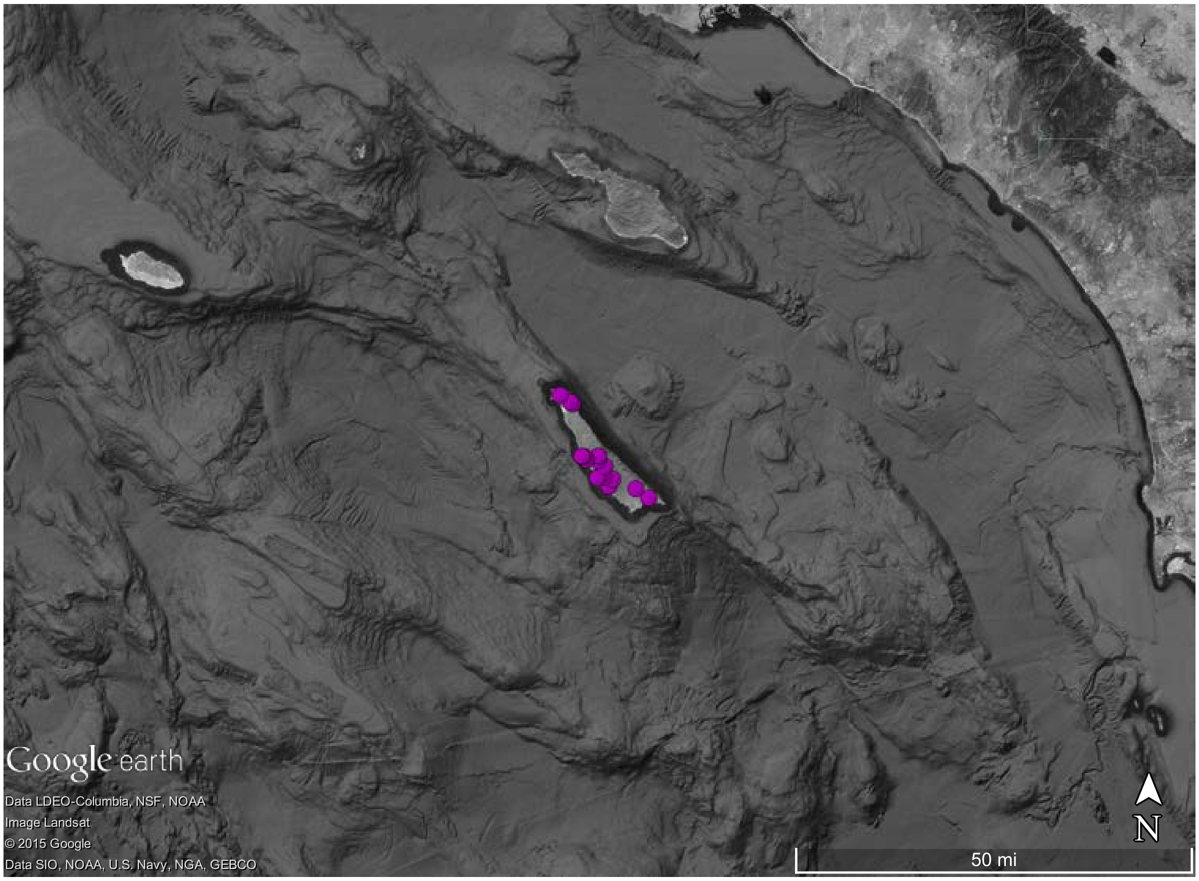

Google earth
Data LDEO-Columbia, NSF, NOAA
Image Landsat
© 2015 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
N
50 mi

Fig. 3.21. Distribution of georeferenced *Phacelia gentryi* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.

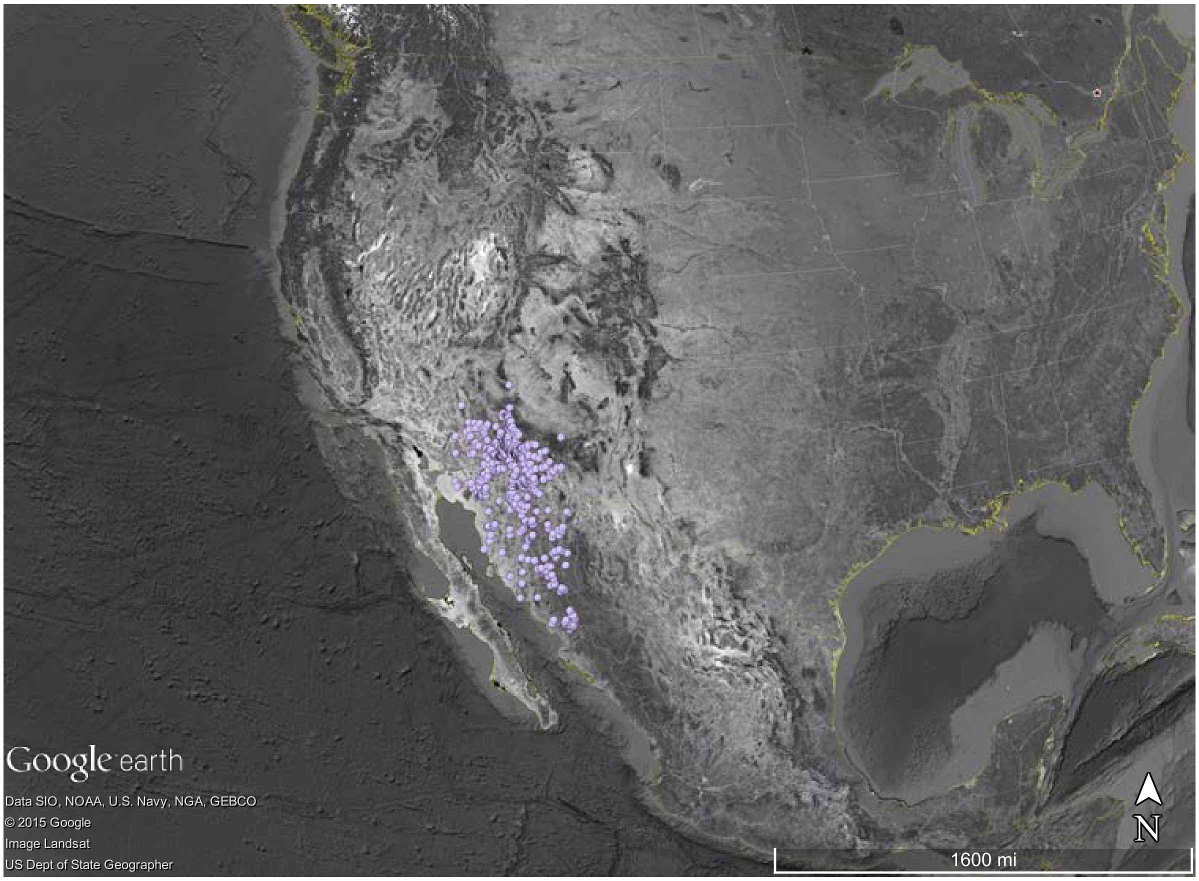

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
US Dept of State Geographer
1600 mi
N

Fig. 3.22. Distribution of georeferenced *Phacelia gentryi* specimens in Arizona and Sonora. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 300 miles.

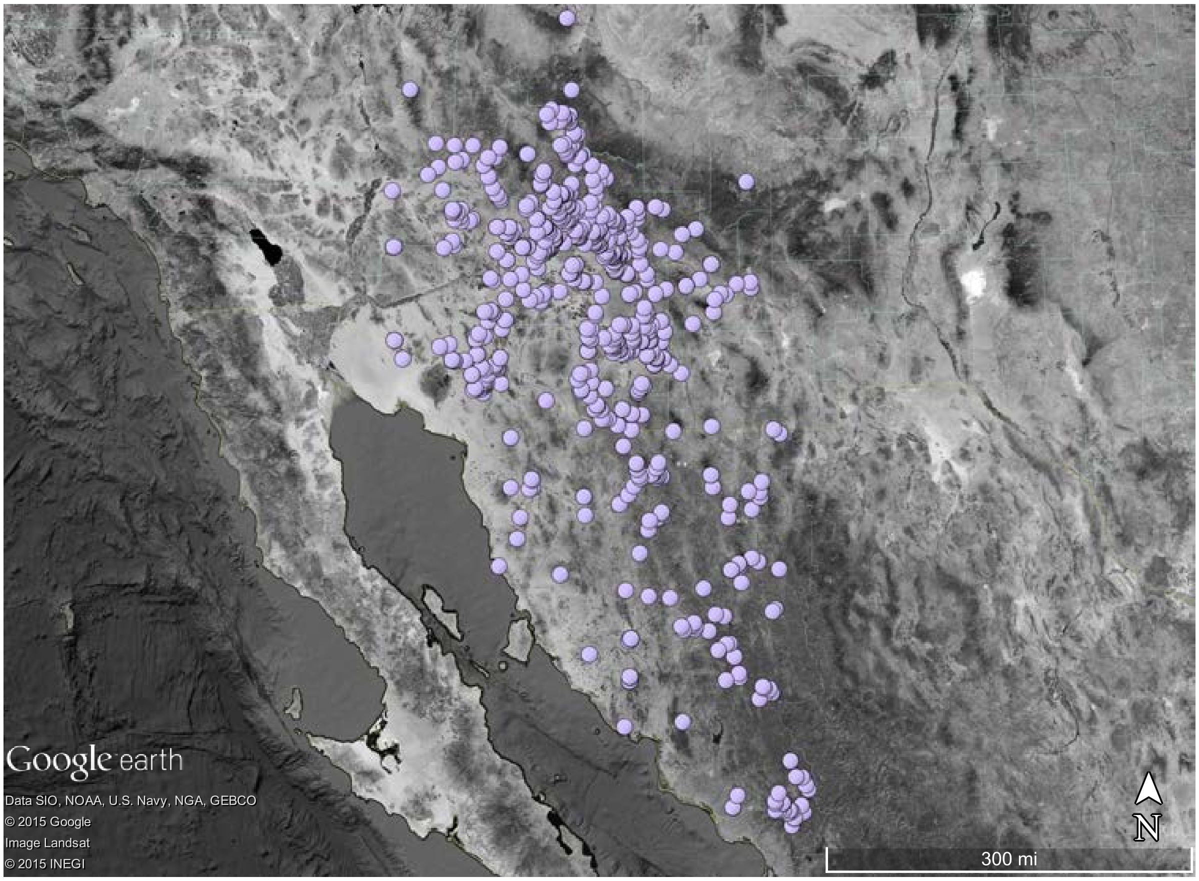
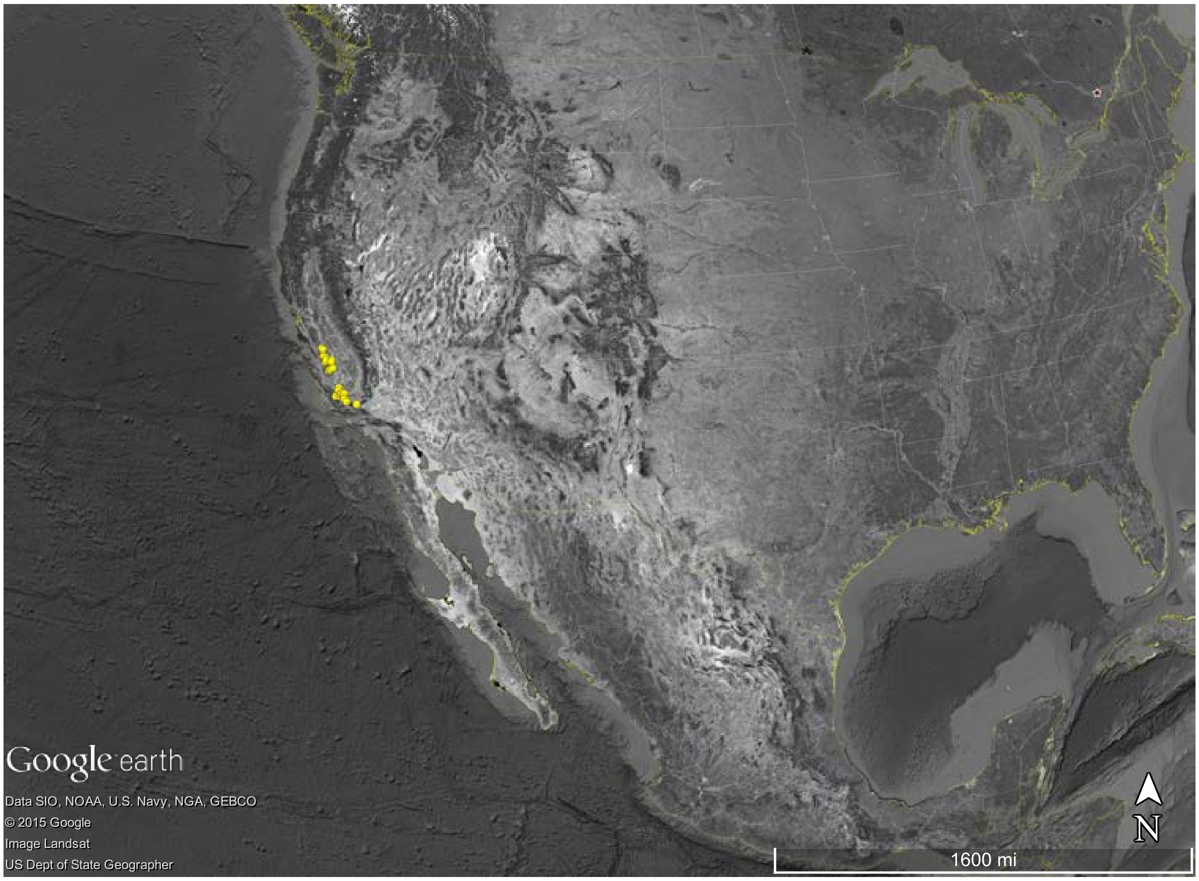

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
© 2015 INEGI
N
300 mi

Fig. 3.23. Distribution of georeferenced *Phacelia heliophila* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.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Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
US Dept of State Geographer
N
1600 mi

Fig. 3.24. Distribution of georeferenced *Phacelia heliophila* specimens in California. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 100 miles.

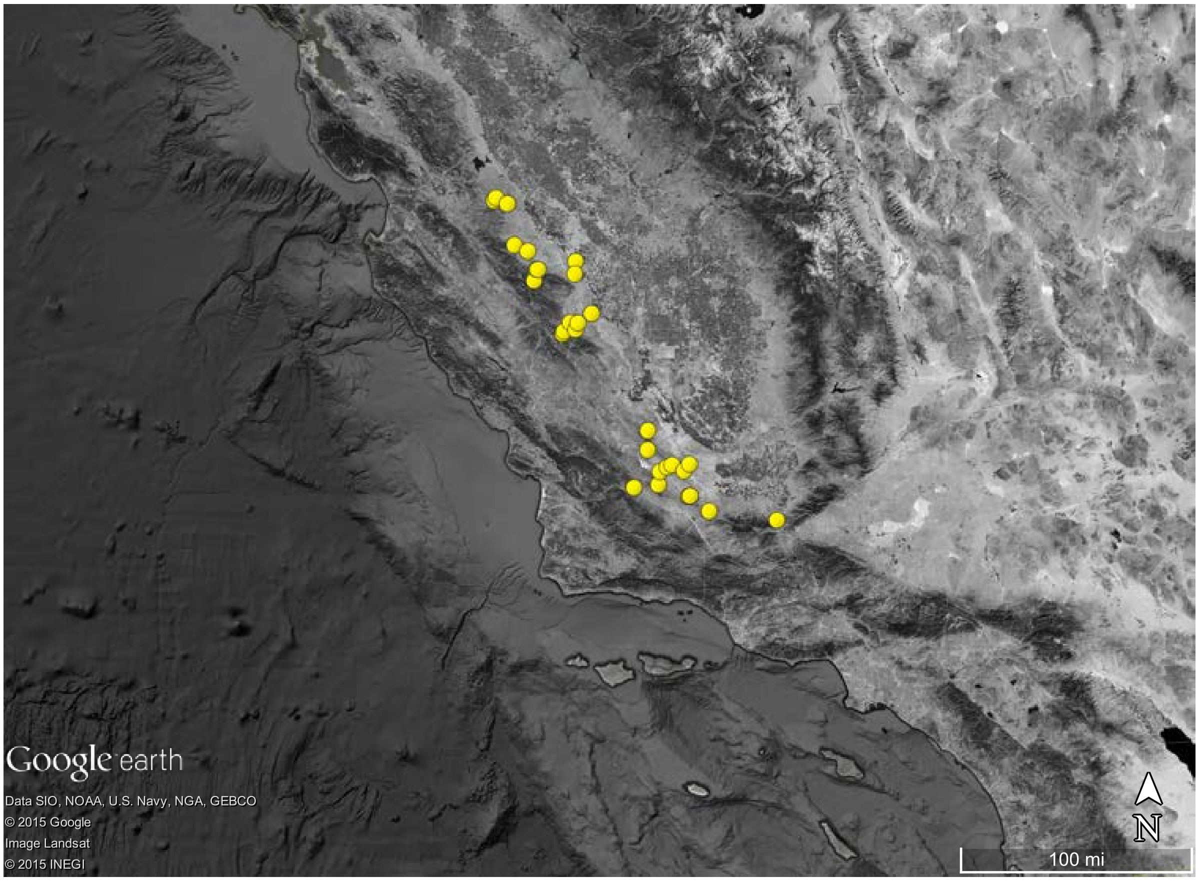
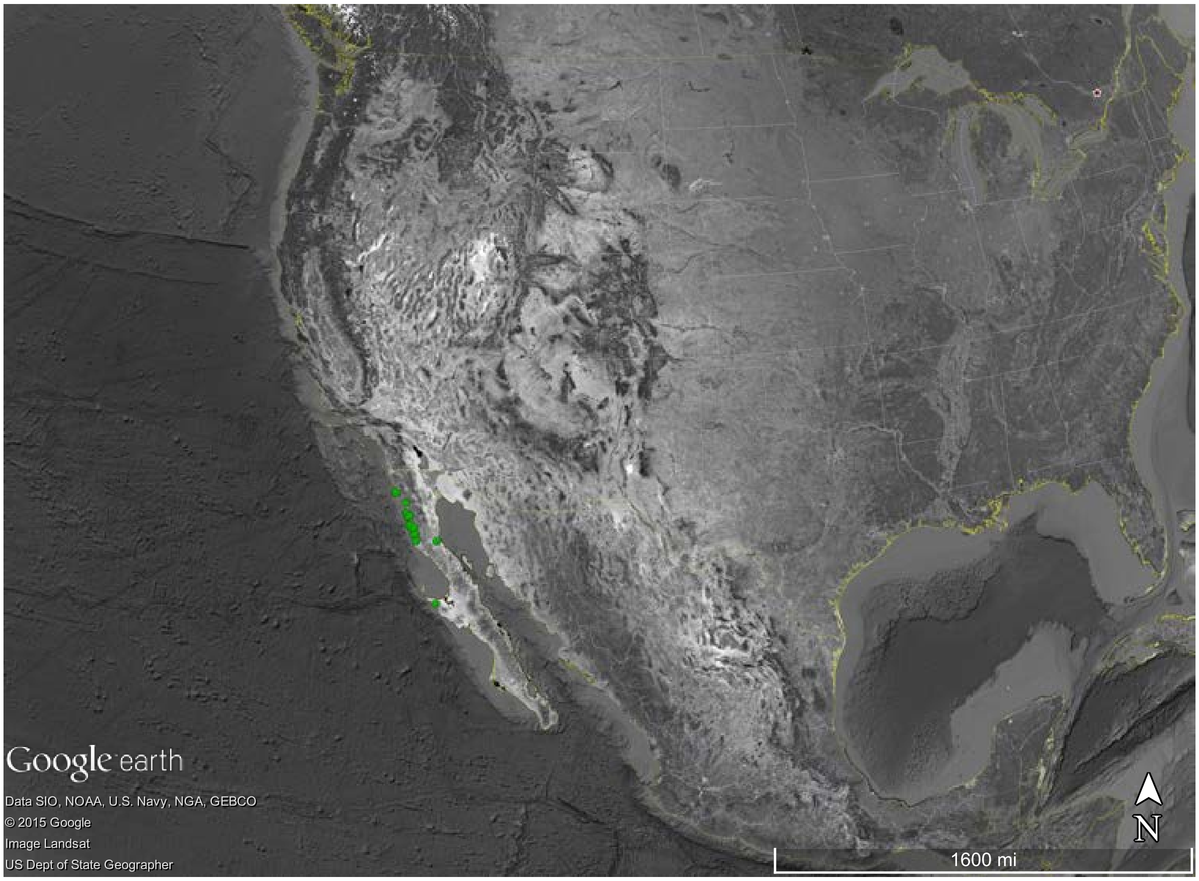

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
© 2015 INEGI
N
100 mi

Fig. 3.25. Distribution of georeferenced *Phacelia hirtuosa* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.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Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
US Dept of State Geographer
1600 mi
N

Fig. 3.26. Distribution of georeferenced *Phacelia hirtuosa* specimens in México, Baja California. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 100 miles.

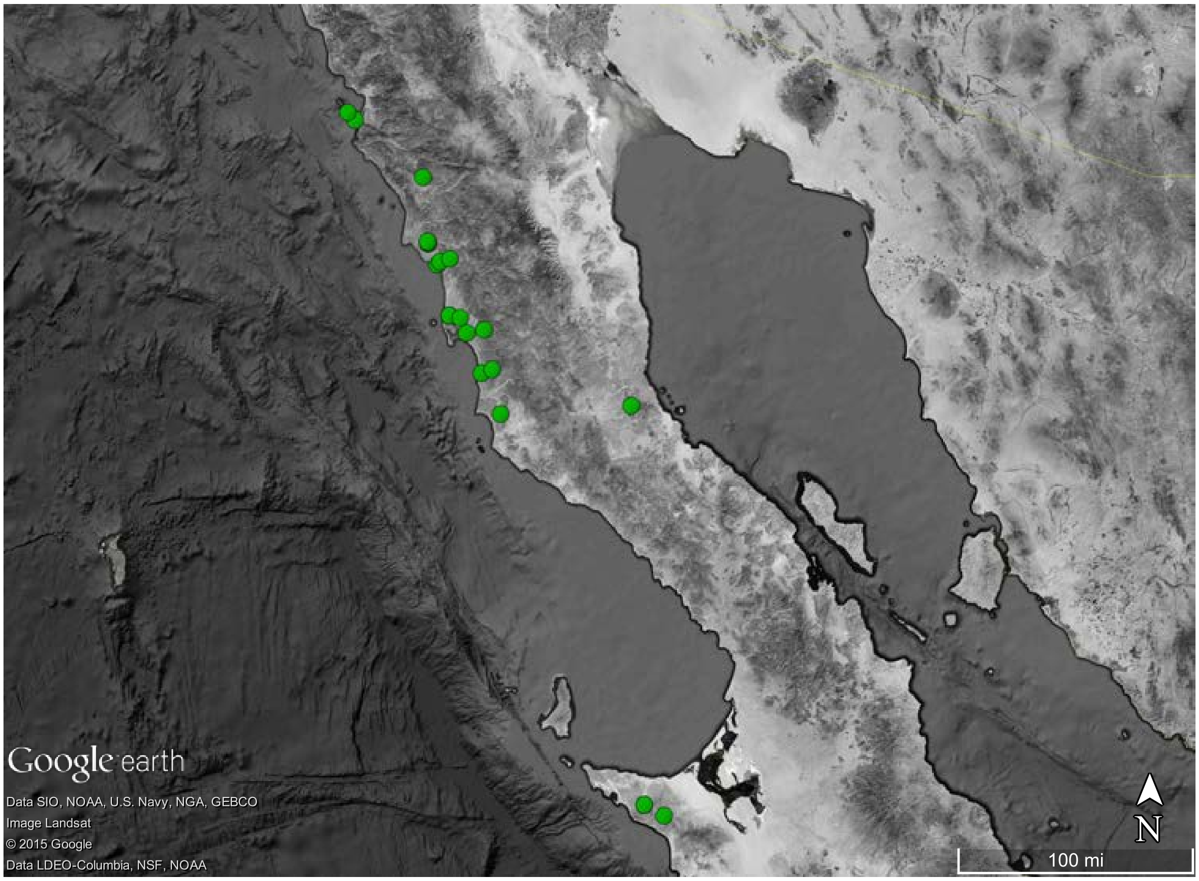
Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
© 2015 Google
Data LDEO-Columbia, NSF, NOAA
N
100 mi

Fig. 3.27. Distribution of georeferenced *Phacelia hubbyi* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.

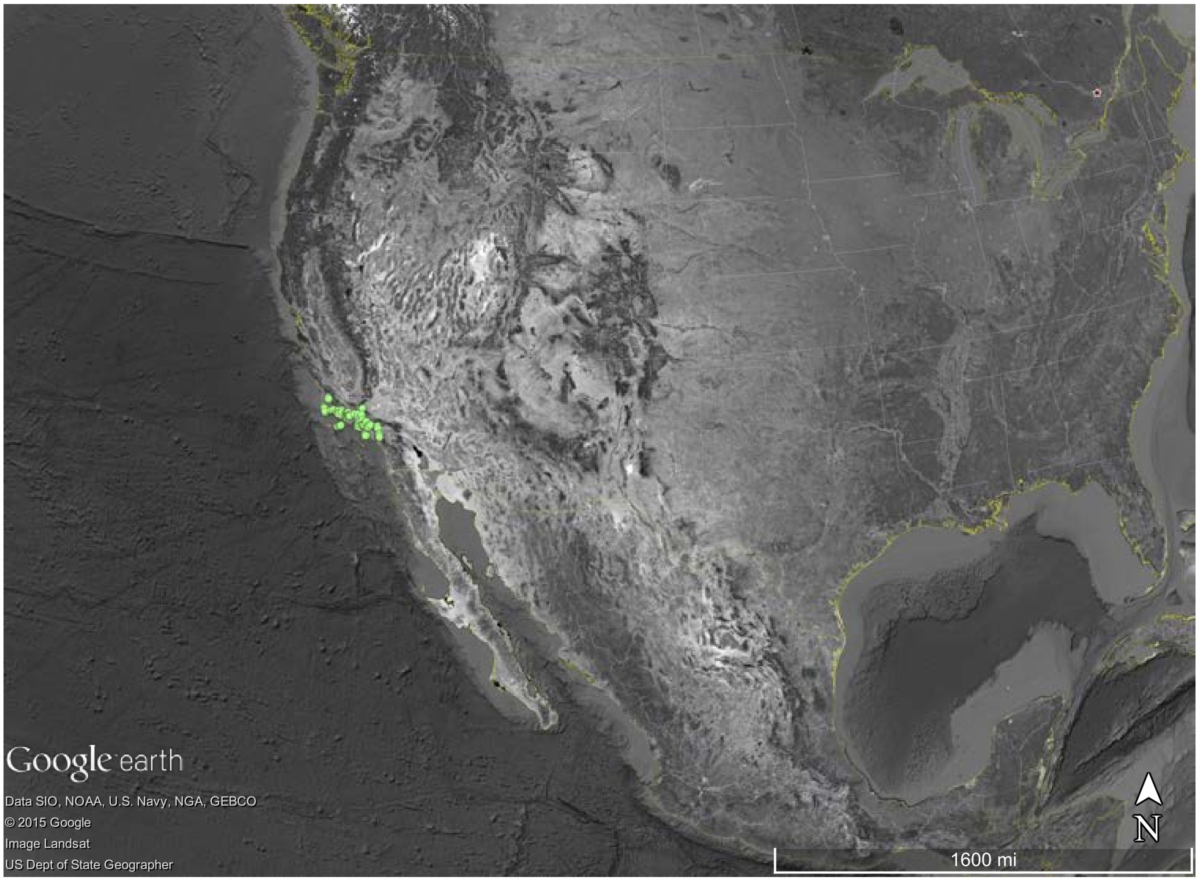
Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
US Dept of State Geographer
N
1600 mi

Fig. 3.28. Distribution of georeferenced *Phacelia hubbyi* specimens in southern California and Santa Cruz Island. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 60 miles.

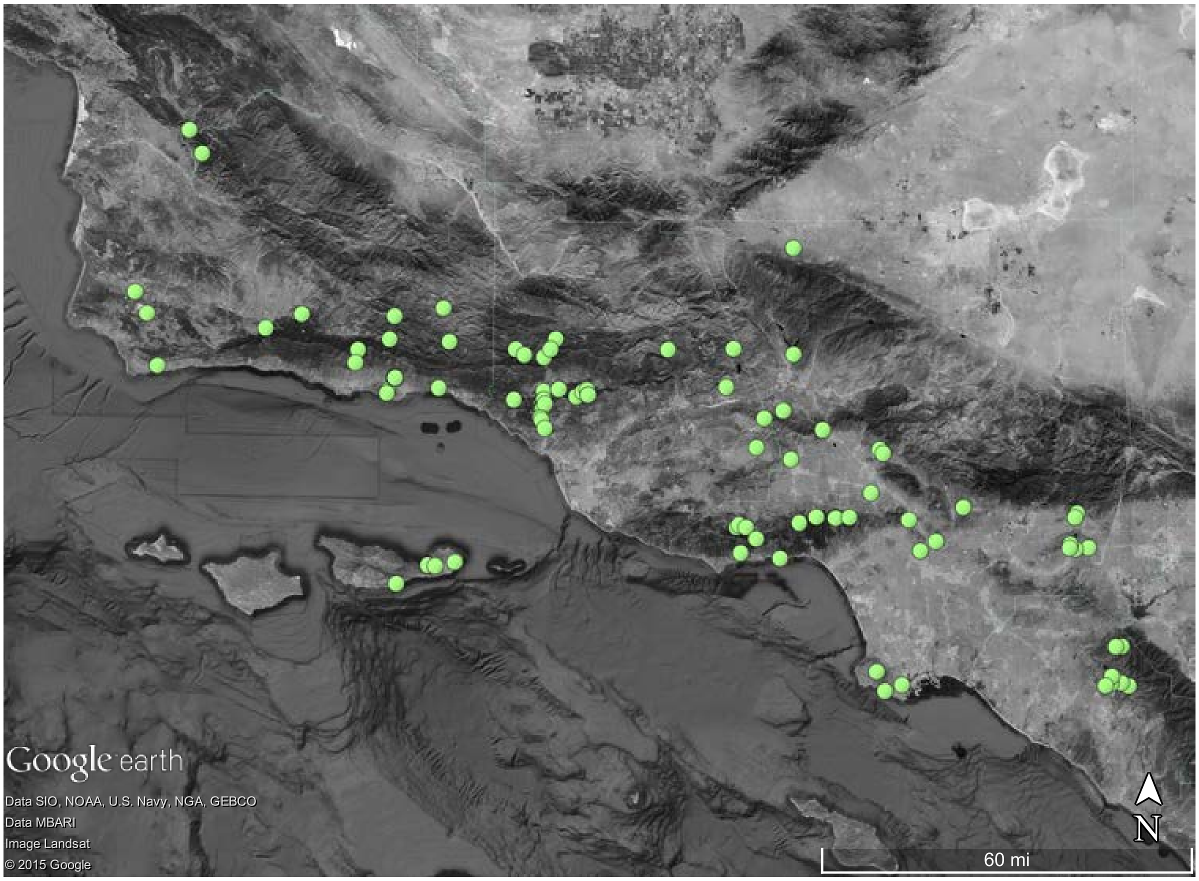
Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Data MBARI
Image Landsat
© 2015 Google
N
60 mi

Fig. 3.29. Screen grab from BerkeleyMapper 2.0 georeferencing of *P. hubbyi* accession (UC794429), Mission Canyon, Santa Barbara County, California. Plants are scattered on slope, and plants in flower are visible near the curb and beneath the floating direction guide. Old inflorescences from previous year are visible as grey skeletons on the foreground slope. Map layer imagery from Google Street View (Google Earth Pro 2015) via BerkeleyMapper 2.0 portal (Deck 2015).


Berkeley Mapper
BerkeleyMapper Information
Toggle map controls | Print
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Show Error Radius
Jepson Ecoregions (California) (zoom)
Marker Colors
Default record
Discrepant record
Unspecified
Download All (tab-delimited with XLS extension)
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Open in Google Earth
2851 Exeter Pl, Mission Canyon, California
Address is approximate
Exeter Pl
Exeter Pl
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Report a problem
Click on MarkerClusters or draw a polygon to query points

Fig. 3.30. Distribution of georeferenced *Phacelia ixodes* (*Phacelia ixodes* var. *ixodes* and *Phacelia ixodes* var. *plumosa*) specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1200 miles.

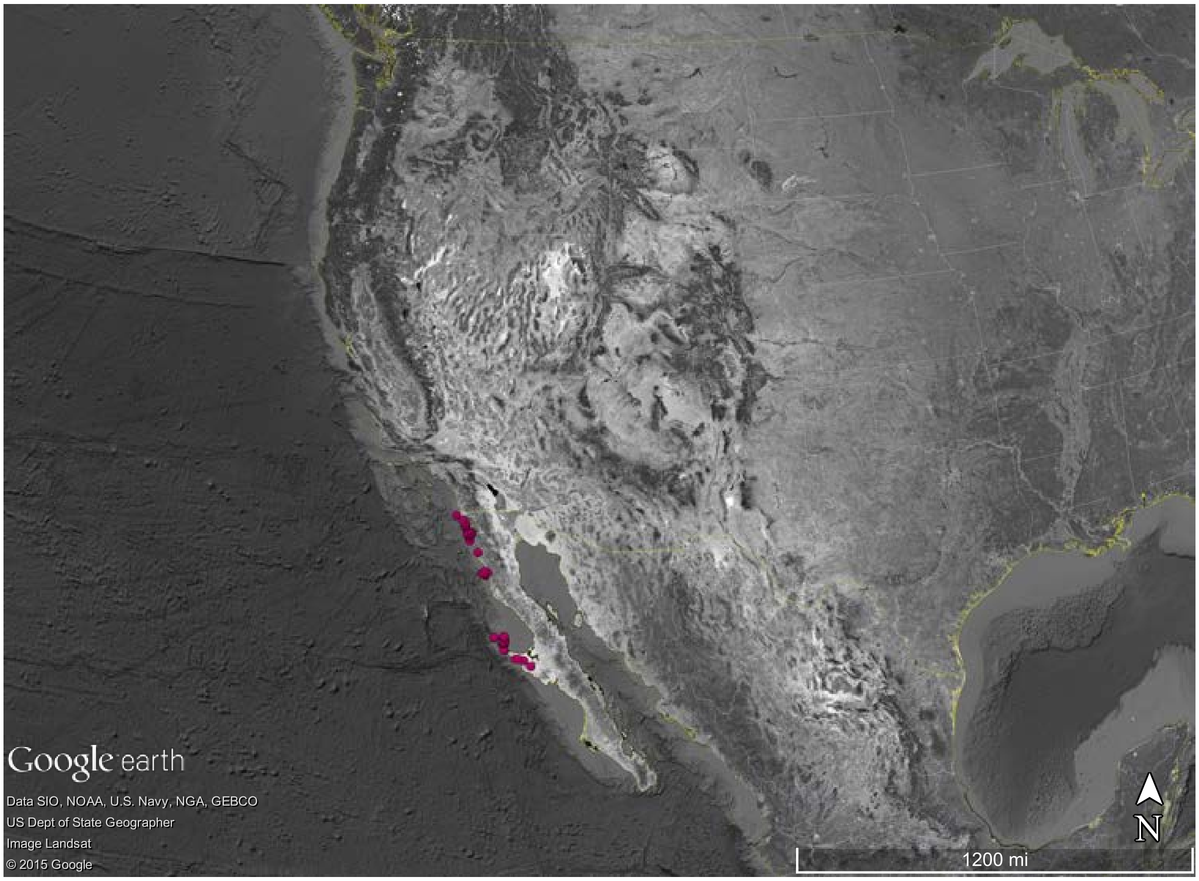

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
US Dept of State Geographer
Image Landsat
© 2015 Google
1200 mi
N

Fig. 3.31. Distribution of georeferenced *Phacelia ixodes* (*Phacelia ixodes* var. *ixodes* and *Phacelia ixodes* var. *plumosa*) specimens in Baja California, México. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 200 miles.

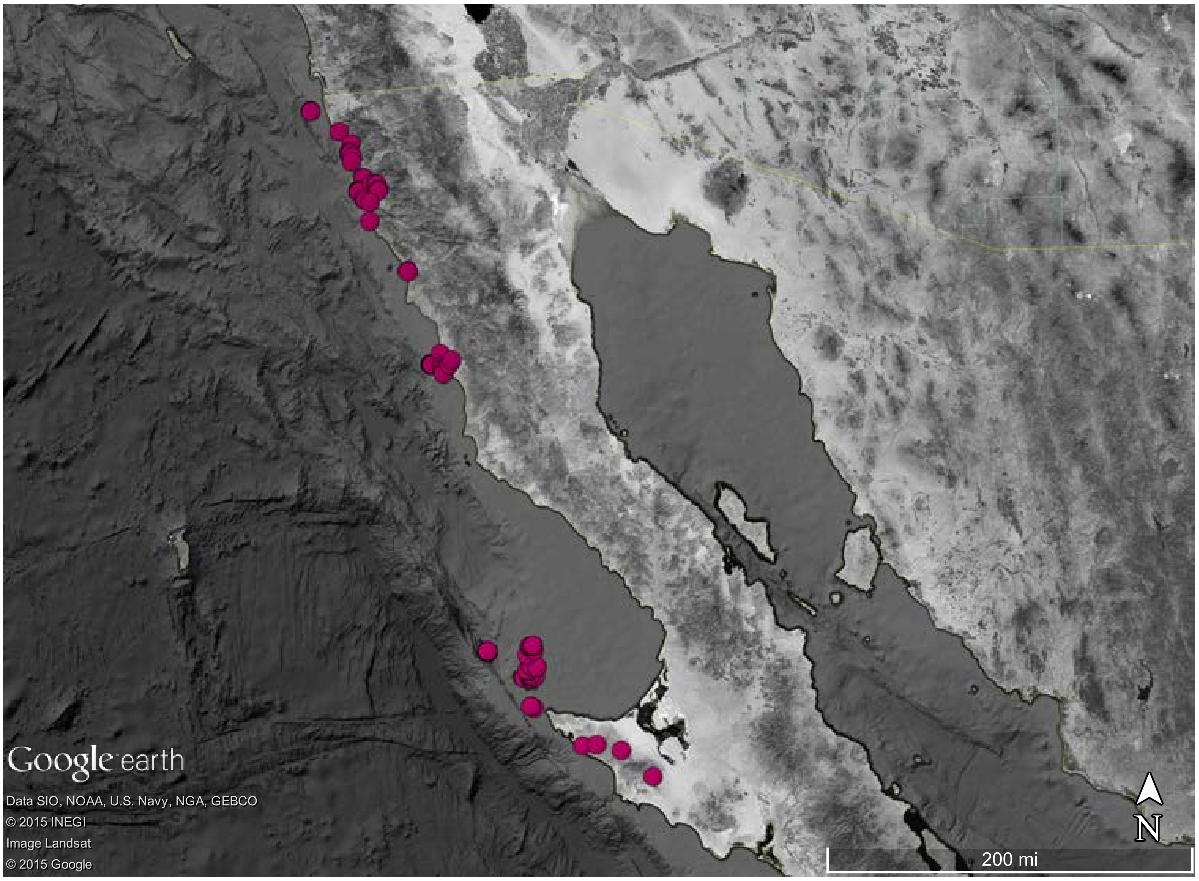

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 INEGI
Image Landsat
© 2015 Google
200 mi
N

Fig. 3.32. Distribution of georeferenced *Phacelia loasifolia* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.

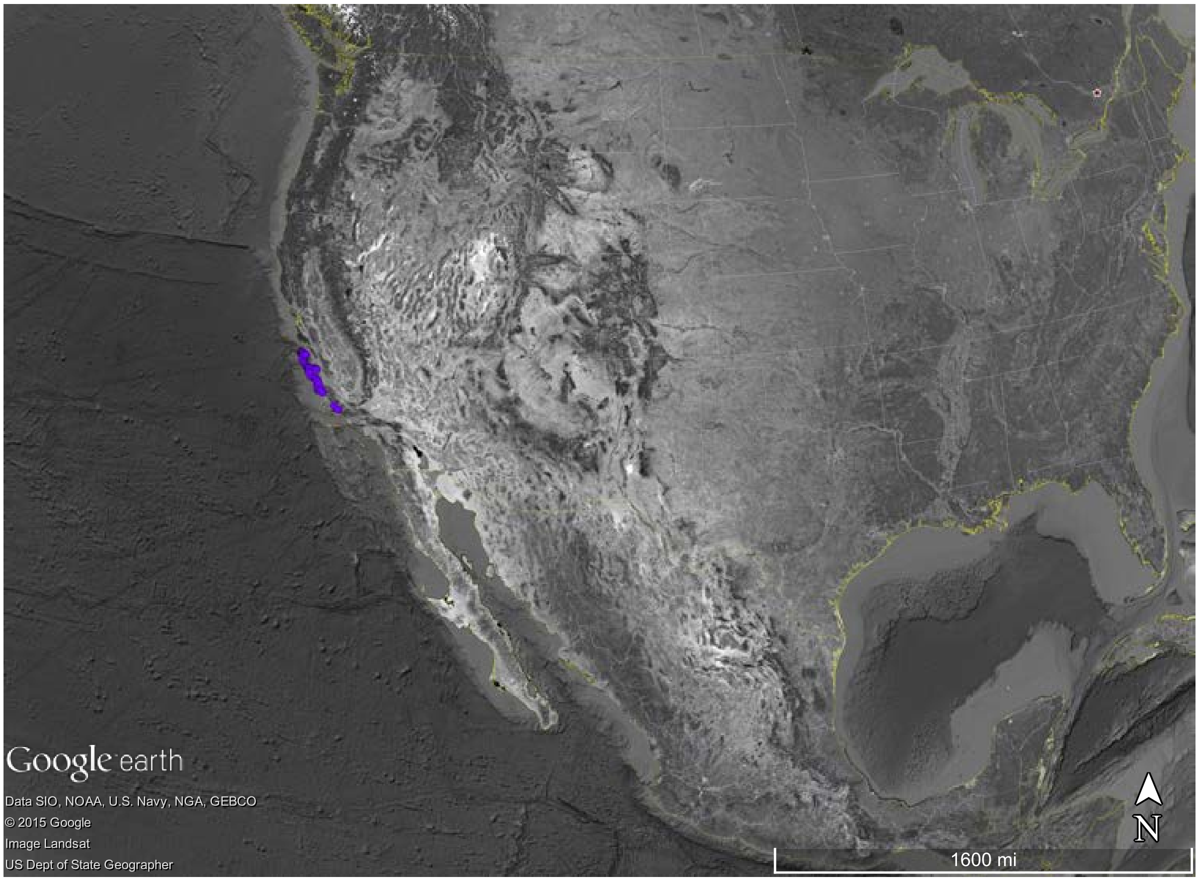

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
US Dept of State Geographer
1600 mi
N

Fig. 3.33. Distribution of georeferenced *Phacelia loasifolia* specimens in California. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 90 miles.

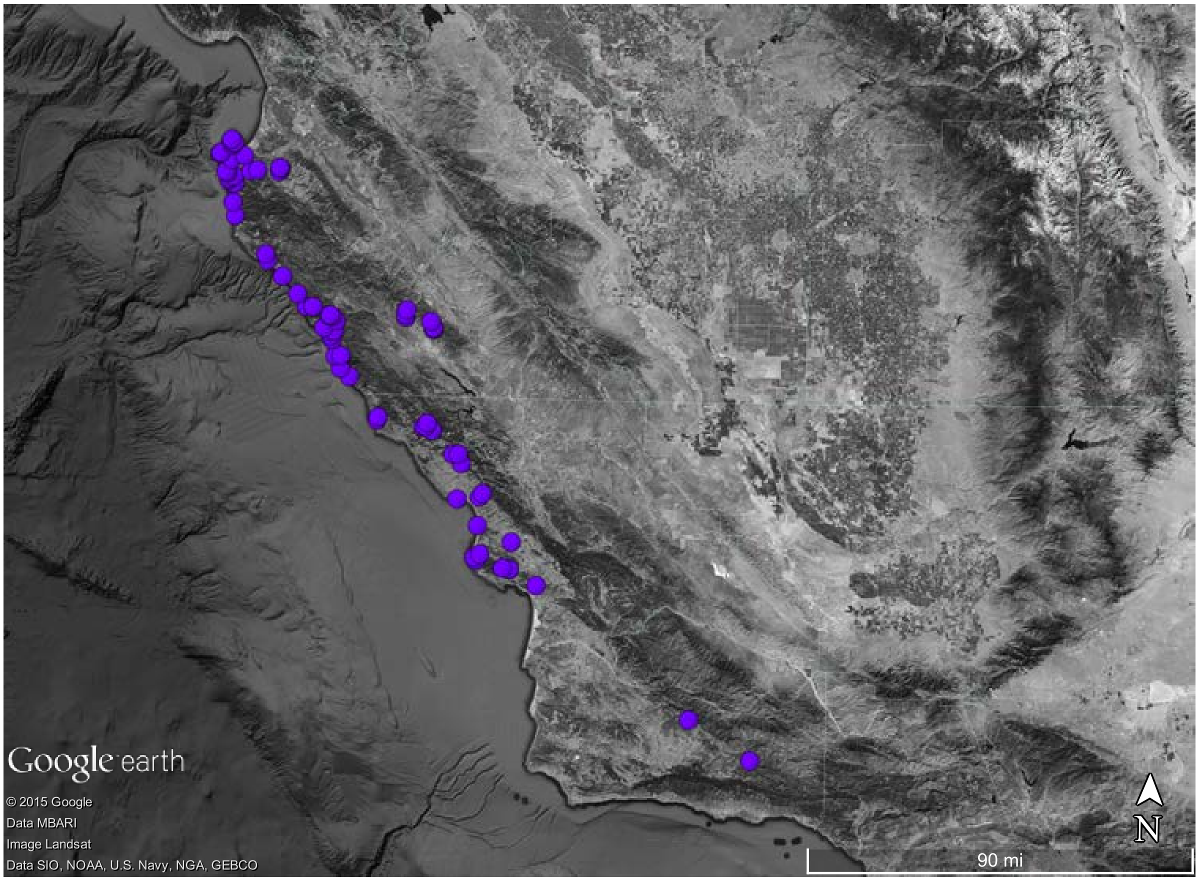

Google earth
© 2015 Google
Data MBARI
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
N
90 mi

Fig. 3.34. Distribution of georeferenced *Phacelia lyonii* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.

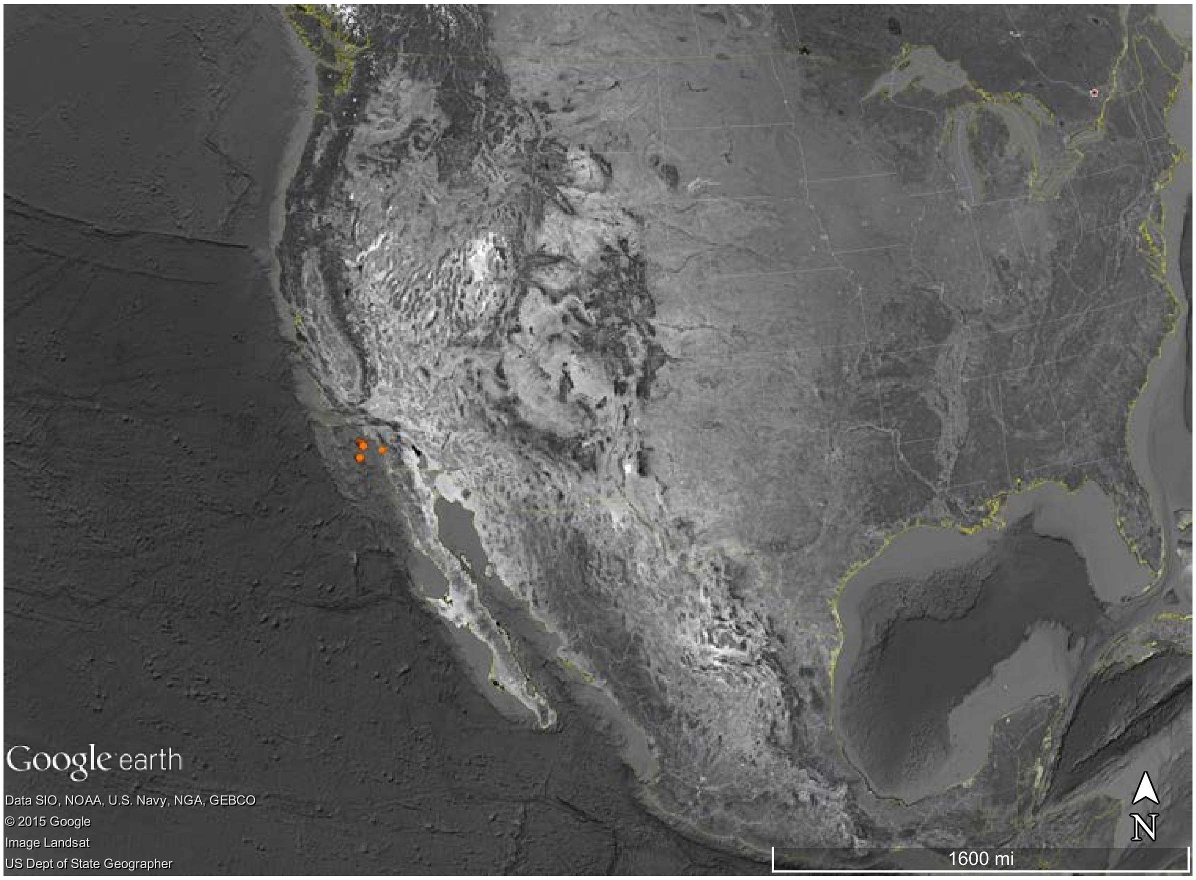
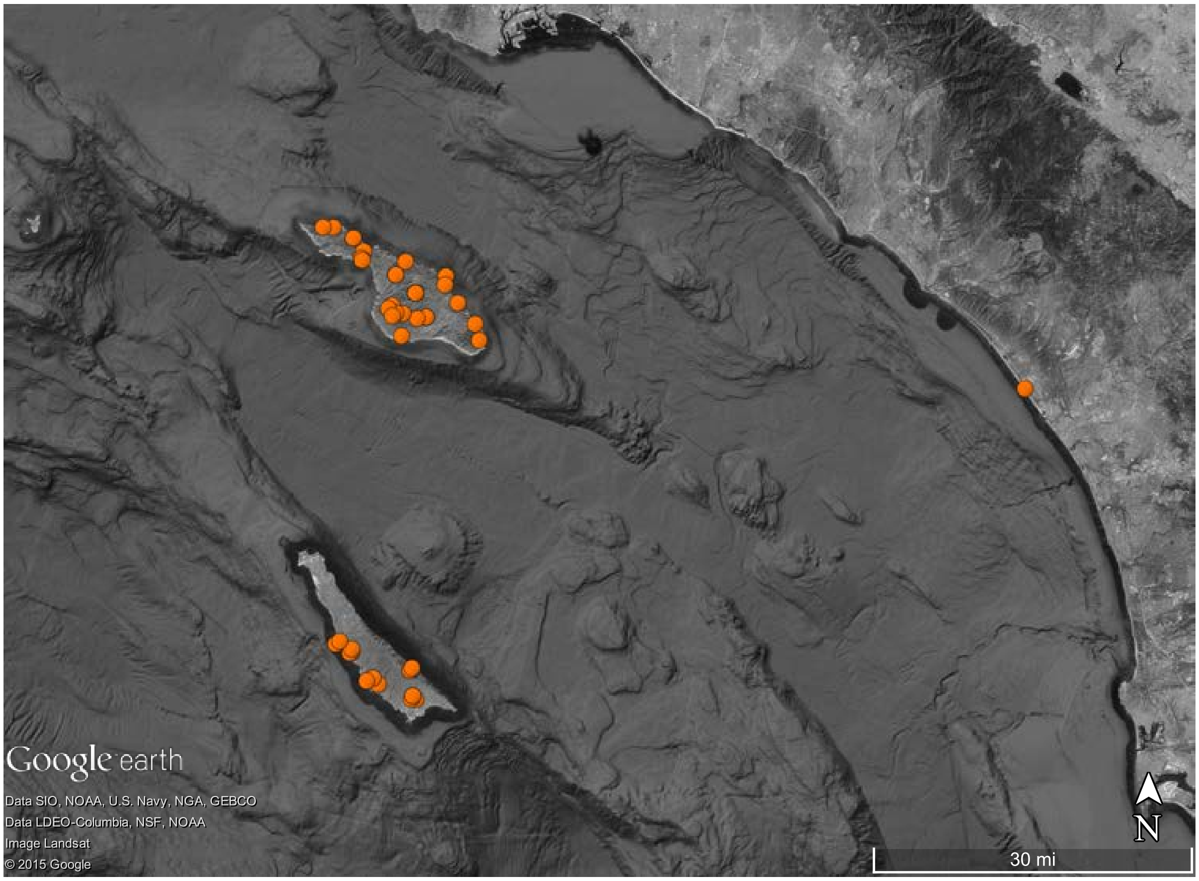

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
US Dept of State Geographer
N
1600 mi

Fig. 3.35. Distribution of georeferenced *Phacelia lyonii* specimens in California. Occurrences are in San Clemente Island, Santa Catalina Island, and at Camp Pendleton on the mainland. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 30 miles.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Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Data LDEO-Columbia, NSF, NOAA
Image Landsat
© 2015 Google
N
30 mi

Fig. 3.36. Distribution of georeferenced *Phacelia malvifolia* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.

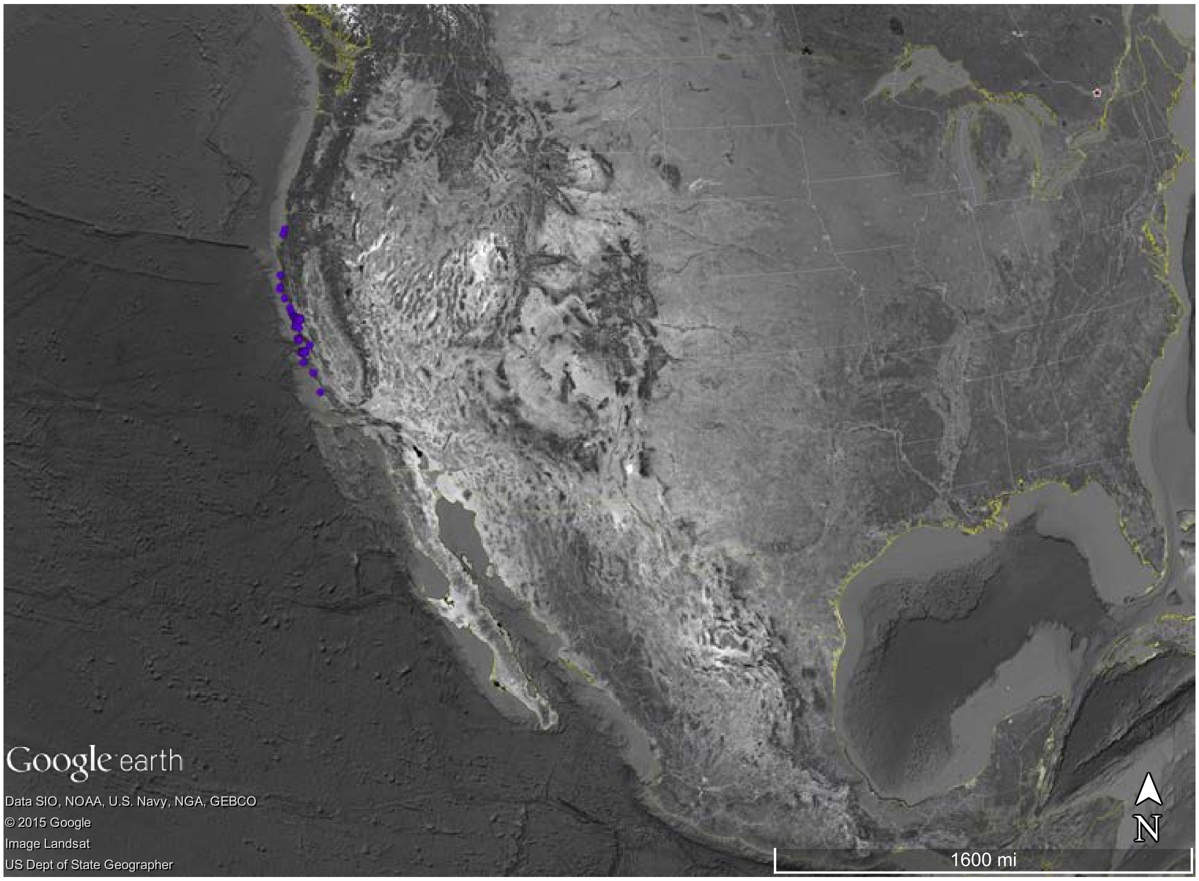

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
US Dept of State Geographer
N
1600 mi

Fig. 3.37. Distribution of georeferenced *Phacelia malvifolia* specimens in California. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 200 miles.

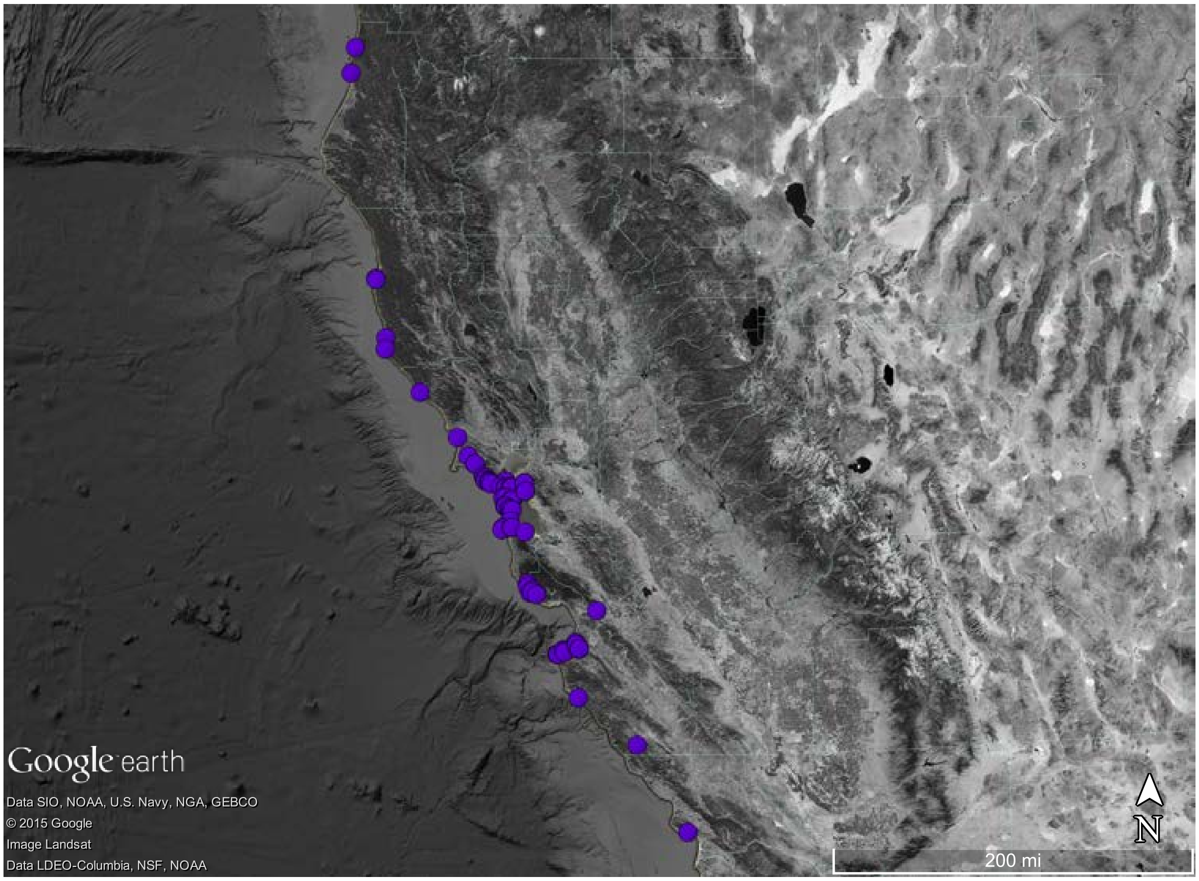

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
Data LDEO-Columbia, NSF, NOAA
N
200 mi

Fig. 3.38. Distribution of georeferenced *P. pauciflora* (combined distribution of georeferenced *Phacelia cedrosensis* and *Phacelia pauciflora* specimens) in North America. *Phacelia cedrosensis* is included as a synonym of *Phacelia pauciflora* in the taxonomic treatment (see conclusions section). Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 200 miles.

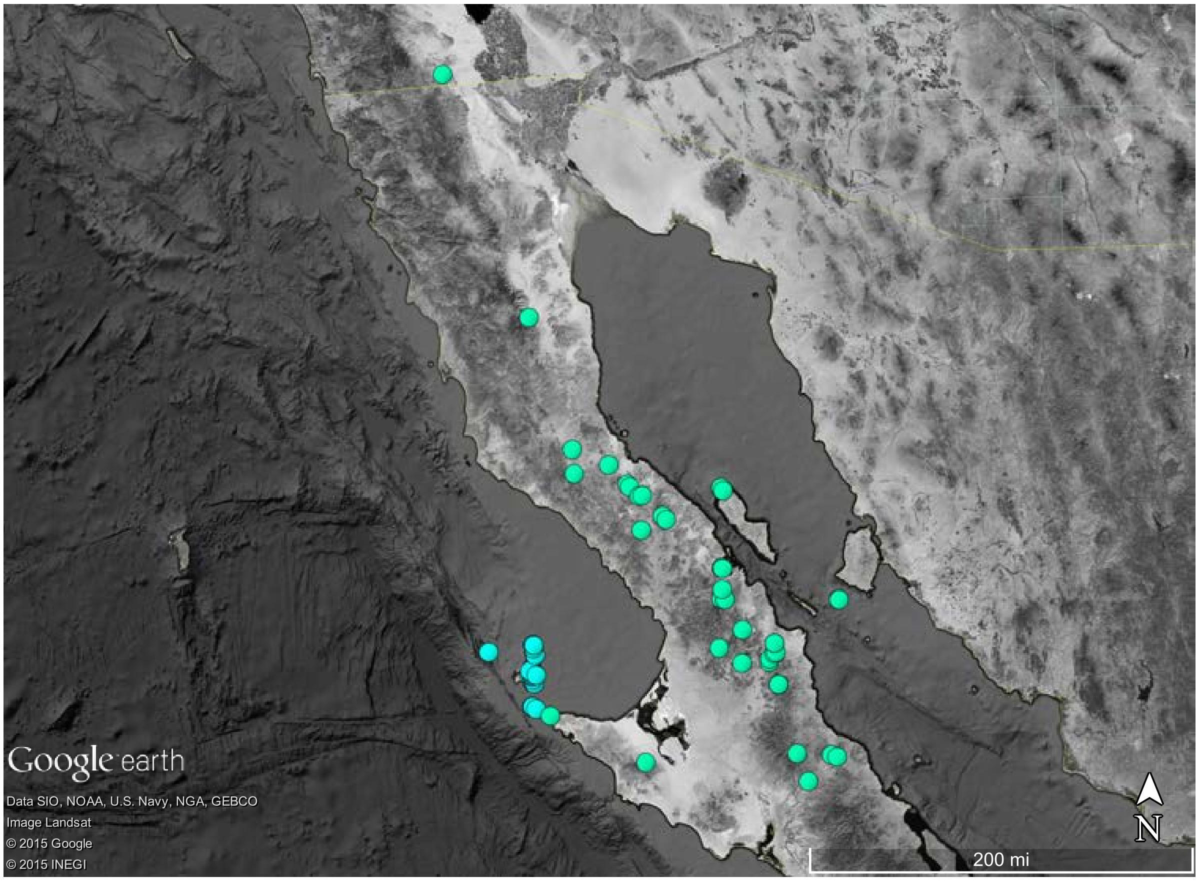

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
© 2015 Google
© 2015 INEGI
200 mi
N

Fig. 3.39. Distribution of georeferenced *Phacelia pauciflora* (traditional circumscription) specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 200 miles.

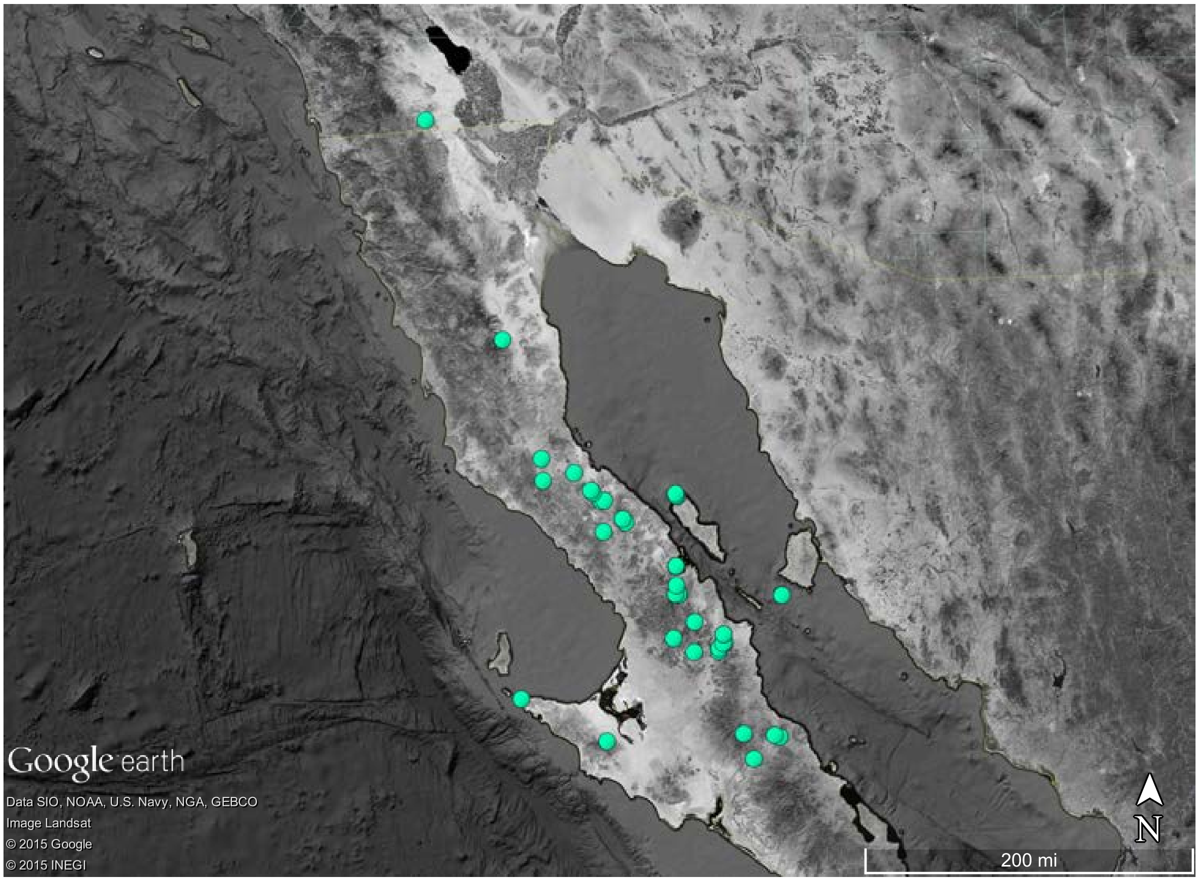
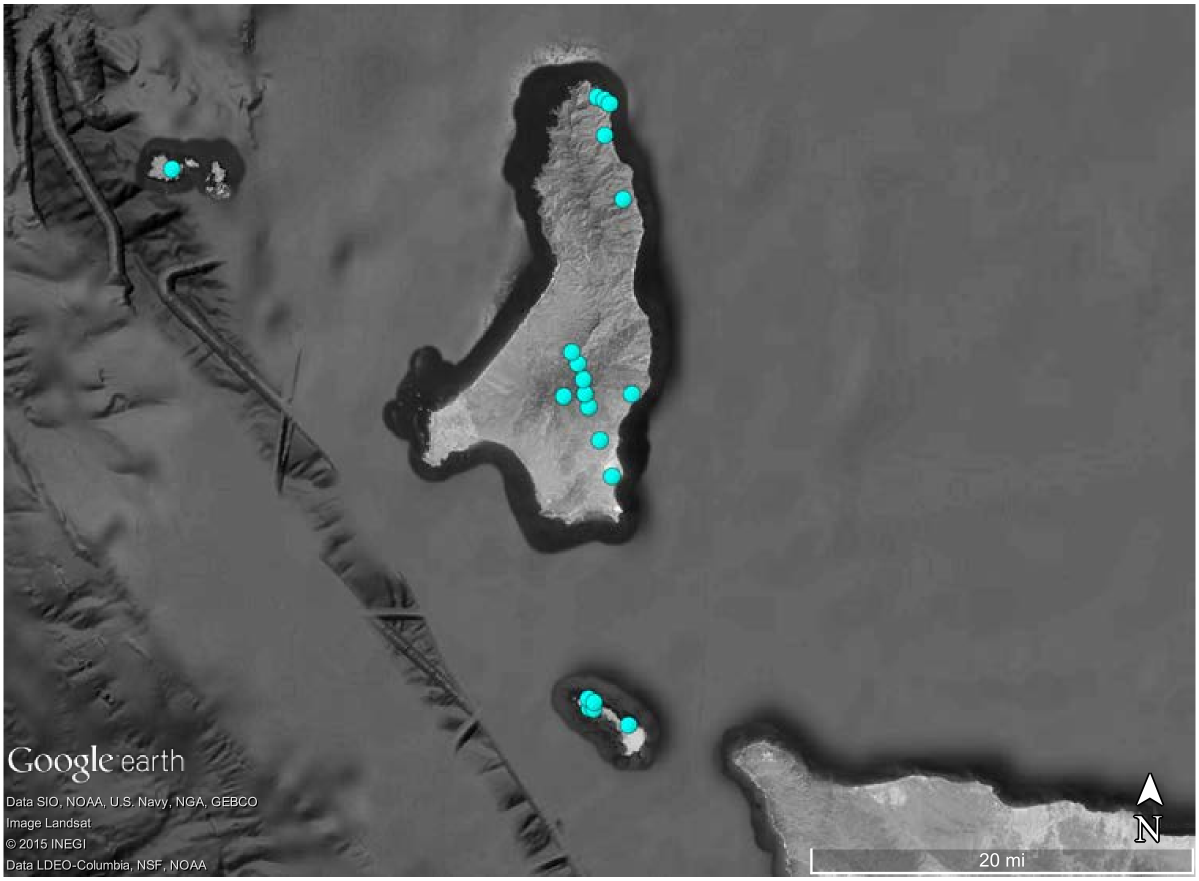

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
© 2015 Google
© 2015 INEGI
200 mi
N

Fig. 3.40. Distribution of georeferenced *Phacelia cedrosensis* (traditional circumscription) specimens in México (Baja California). Specimen from San Benito, cited as *Phacelia pauciflora* by Brand (1913), is included here in georeferenced *Phacelia cedrosensis*. Map imagery from Google Earth Pro (version 7.1), Image Landsat from INEGI, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO, and additional data from LDEO-Columbia, NSF, and NOAA. Scale bar 20 miles.



Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
© 2015 INEGI
Data LDEO-Columbia, NSF, NOAA
N
20 mi

Fig. 3.41. Distribution of georeferenced *Phacelia phyllomanica* specimens from Guadalupe Island. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 10 miles.

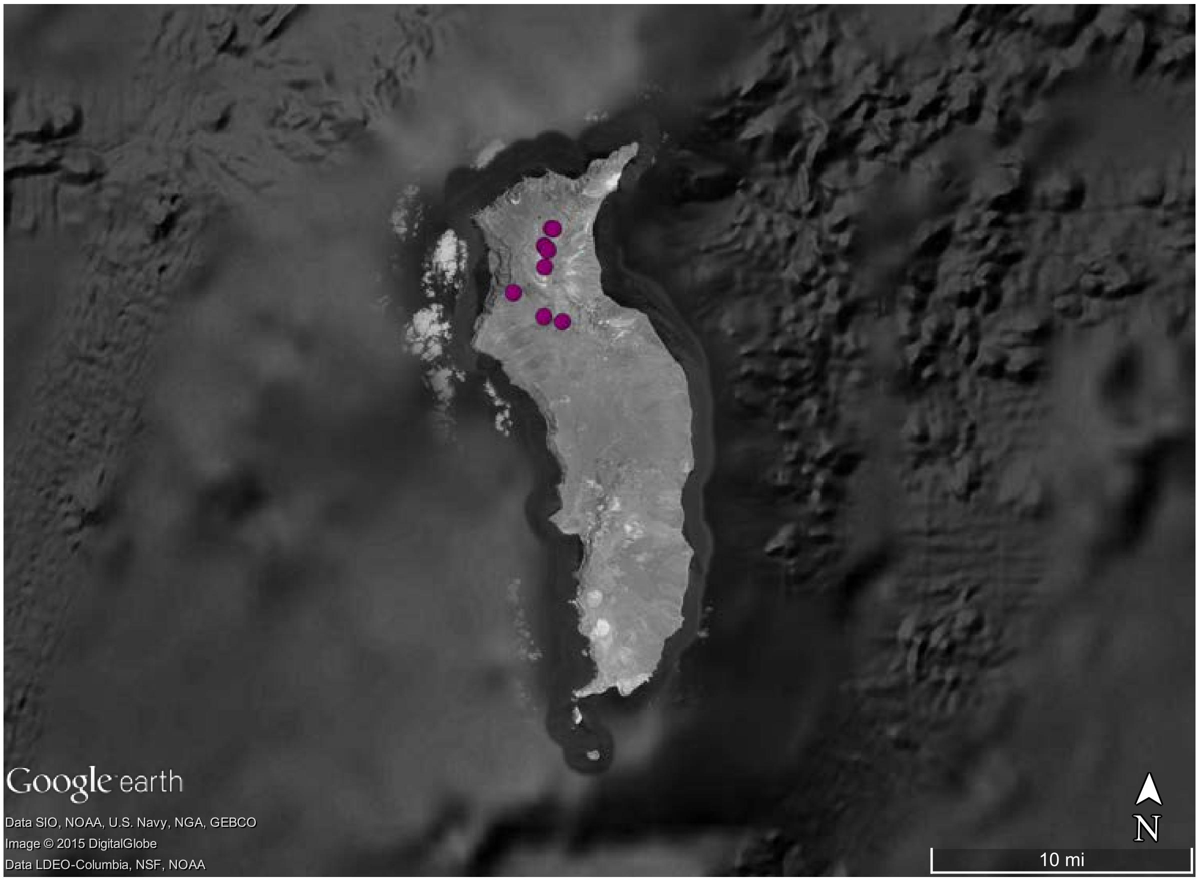

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2015 DigitalGlobe
Data LDEO-Columbia, NSF, NOAA
N
10 mi

Fig. 3.42. Distribution of georeferenced *Phacelia platyloba* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.

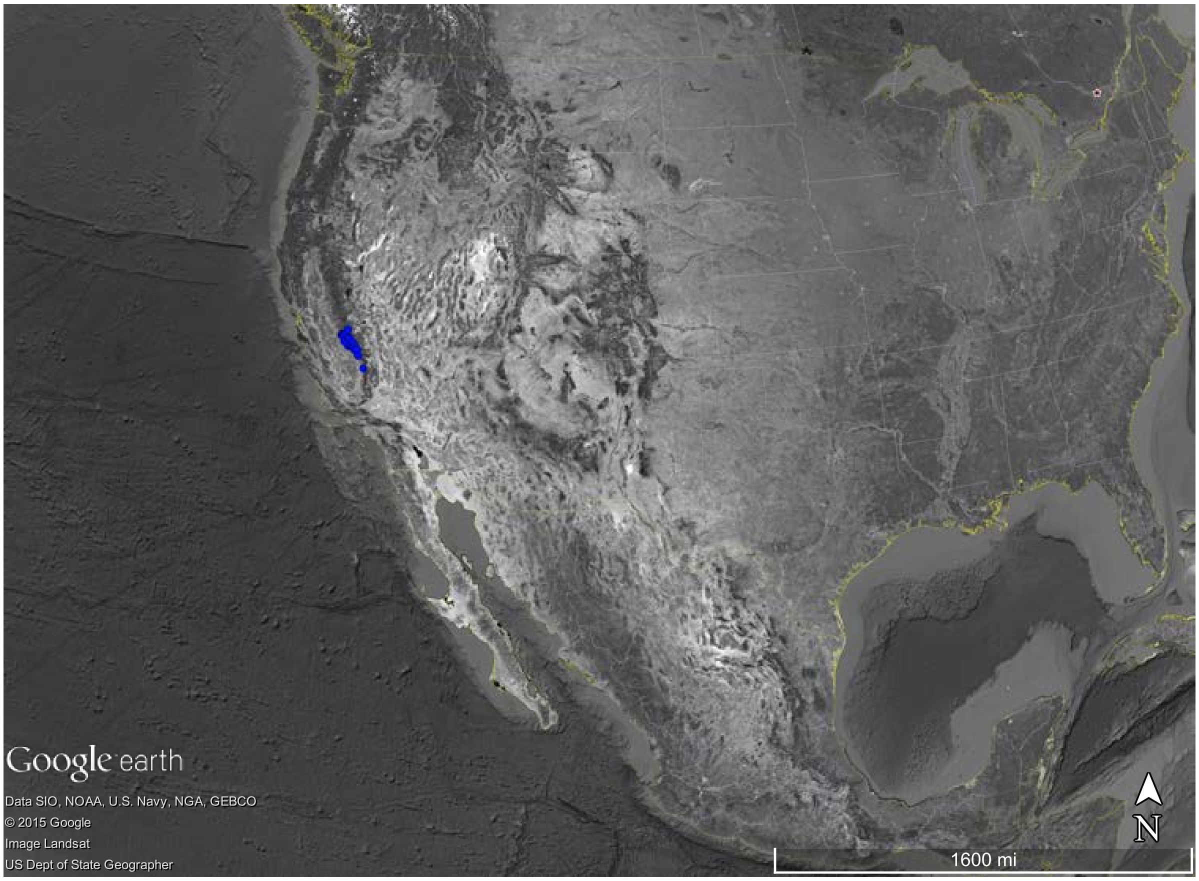

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
US Dept of State Geographer
1600 mi
N

Fig. 3.43. Distribution of georeferenced *Phacelia platyloba* specimens in California. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 70 miles.

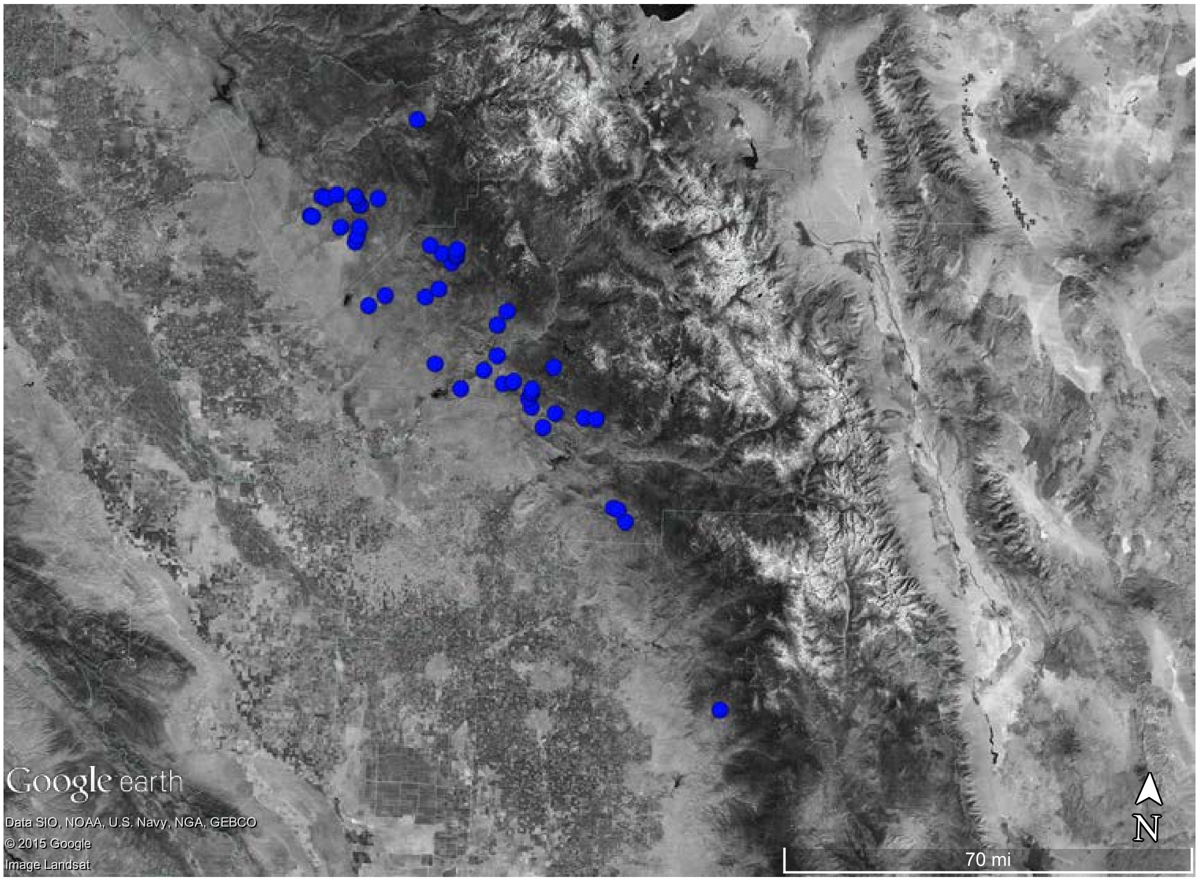

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
N
70 mi

Fig. 3.44. Distribution of georeferenced *Phacelia ramosissima* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.

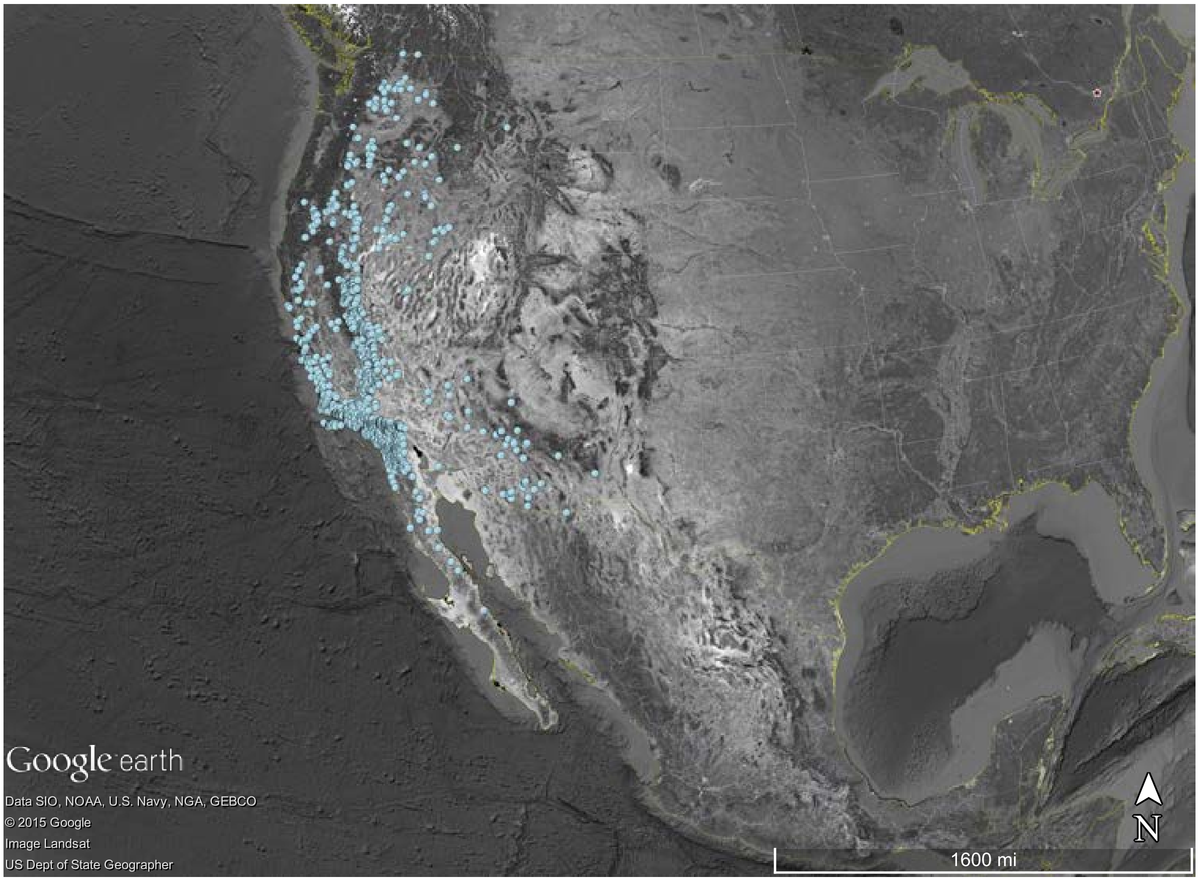

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
US Dept of State Geographer
1600 mi
N

Fig. 3.45. Distribution of georeferenced *Phacelia rattanii* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.

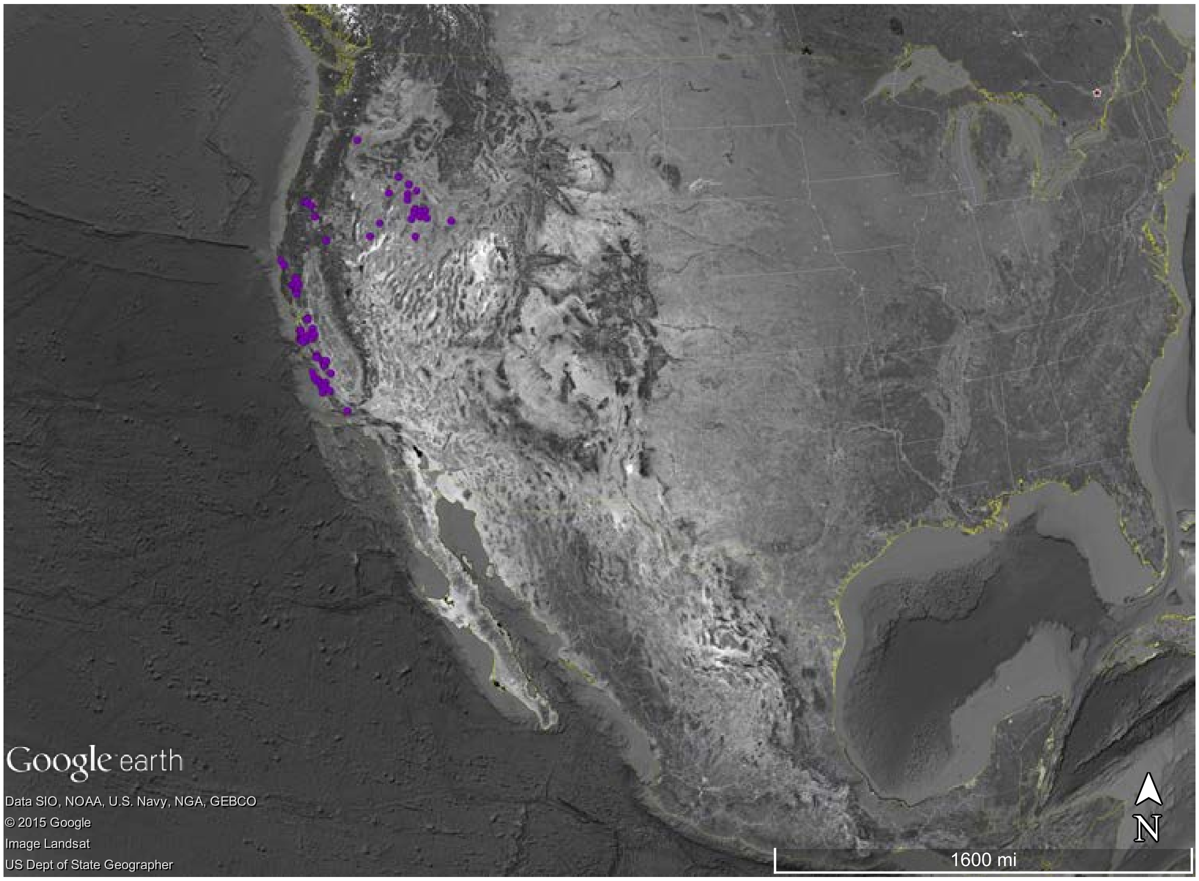

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
US Dept of State Geographer
1600 mi
N

Fig. 3.46. Distribution of georeferenced *Phacelia tanacetifolia* specimens in North America. Specimens from Oregon, Washington, and British Columbia are all likely cultivated. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.

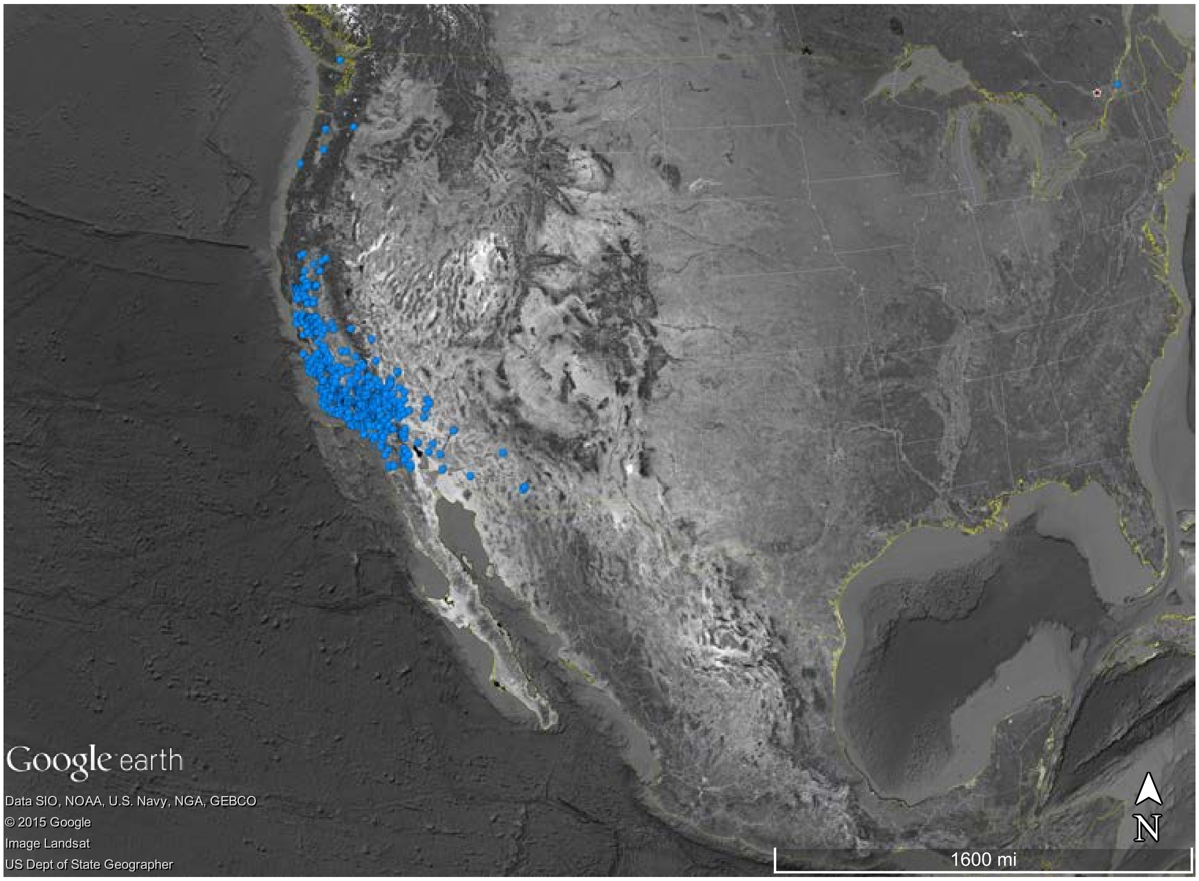

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
US Dept of State Geographer
1600 mi
N

Fig. 3.47. Screen grab from BerkeleyMapper 2.0 georeferencing of *Phacelia tanacetifolia* accession, Hwy 58, near McKittrick, Kern County, California. Plants in flower are visible along the raised berm in the foreground. Map layer imagery from Google Street View via BerkeleyMapper 2.0 portal.

Santa Maria Valley Hwy
McKittrick, California
Street View - Apr 2012
Back to Map
Google
Image capture: Apr 2012
© 2015 Google
Terms
Privacy
Report a problem

Fig. 3.48. Distribution of georeferenced *Phacelia thermalis* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1600 miles.

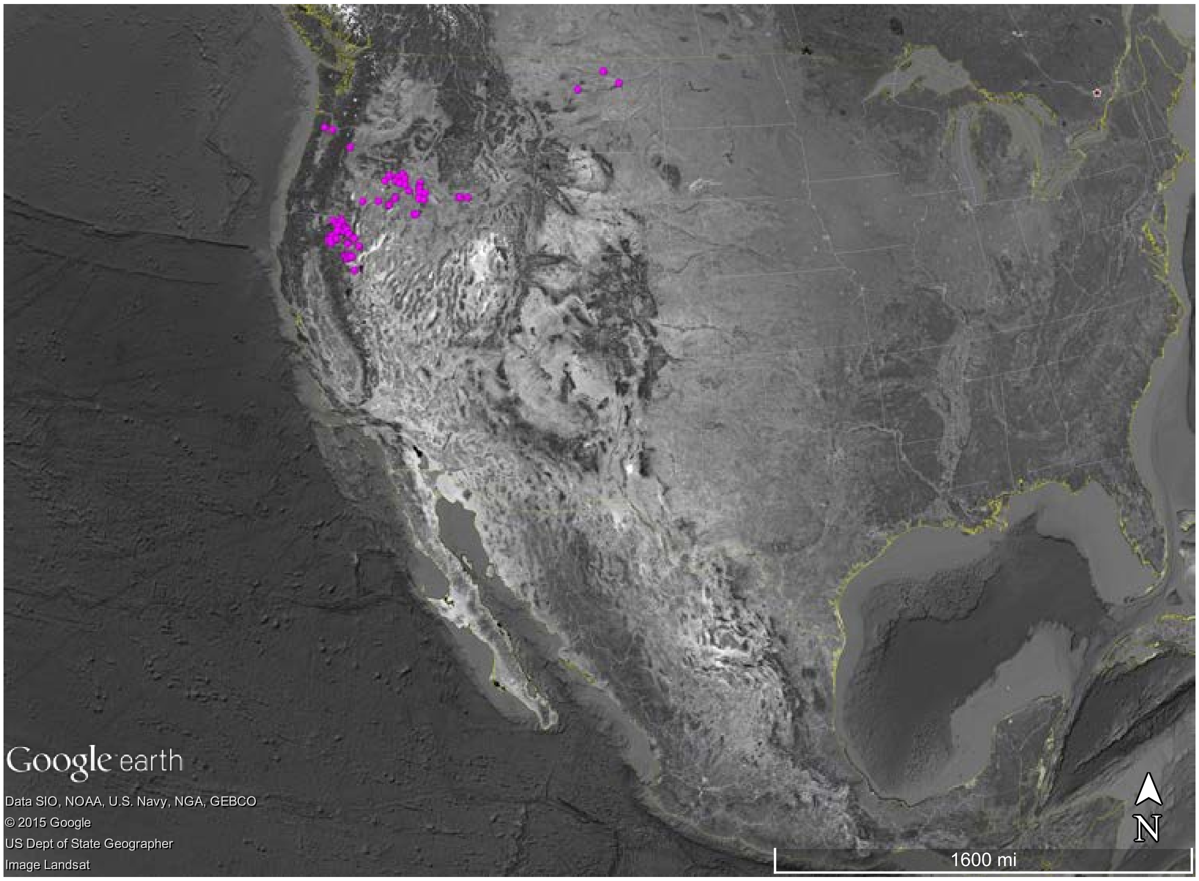

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
US Dept of State Geographer
Image Landsat
1600 mi
N

Fig. 3.49. Distribution of georeferenced *Phacelia thermalis* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 300 miles.

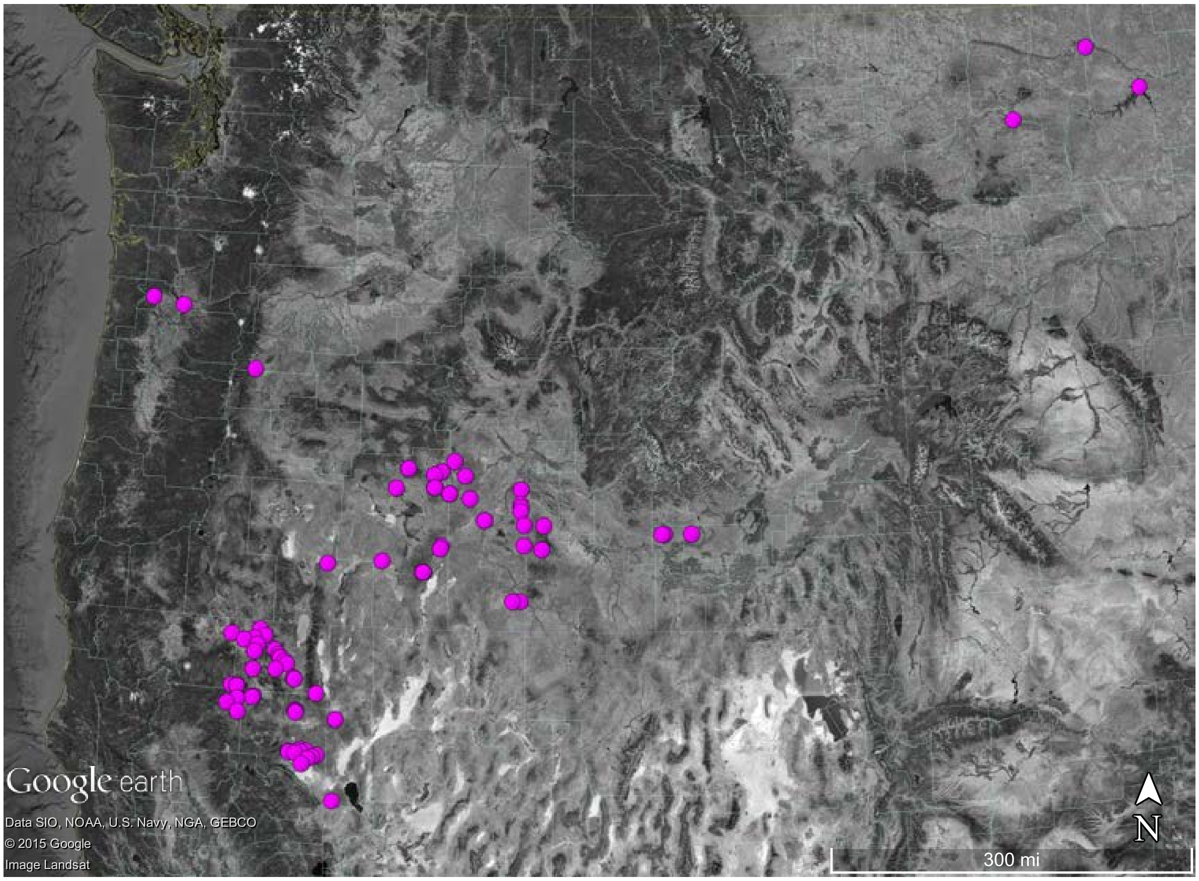

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
N
300 mi

Fig. 3.50. Distribution of georeferenced *Phacelia vallis-mortae* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 1400 miles.

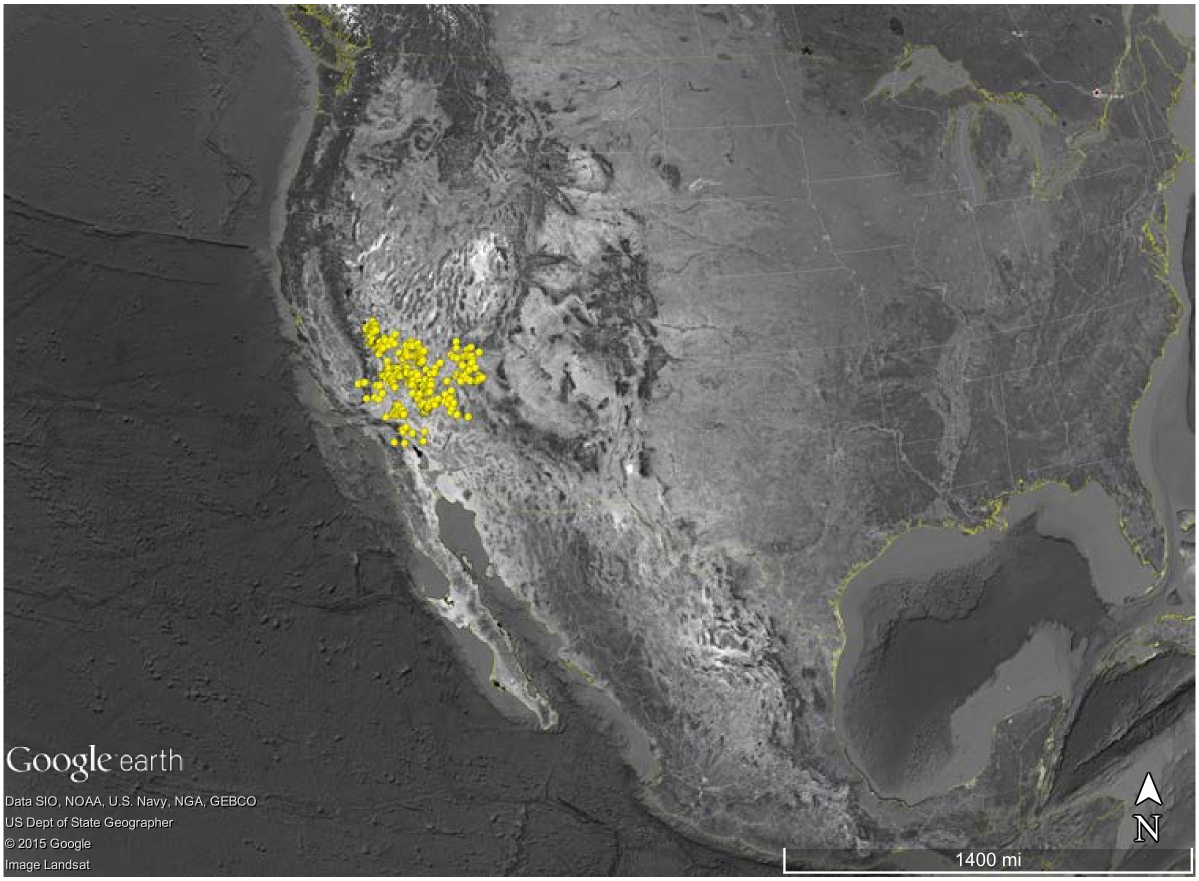
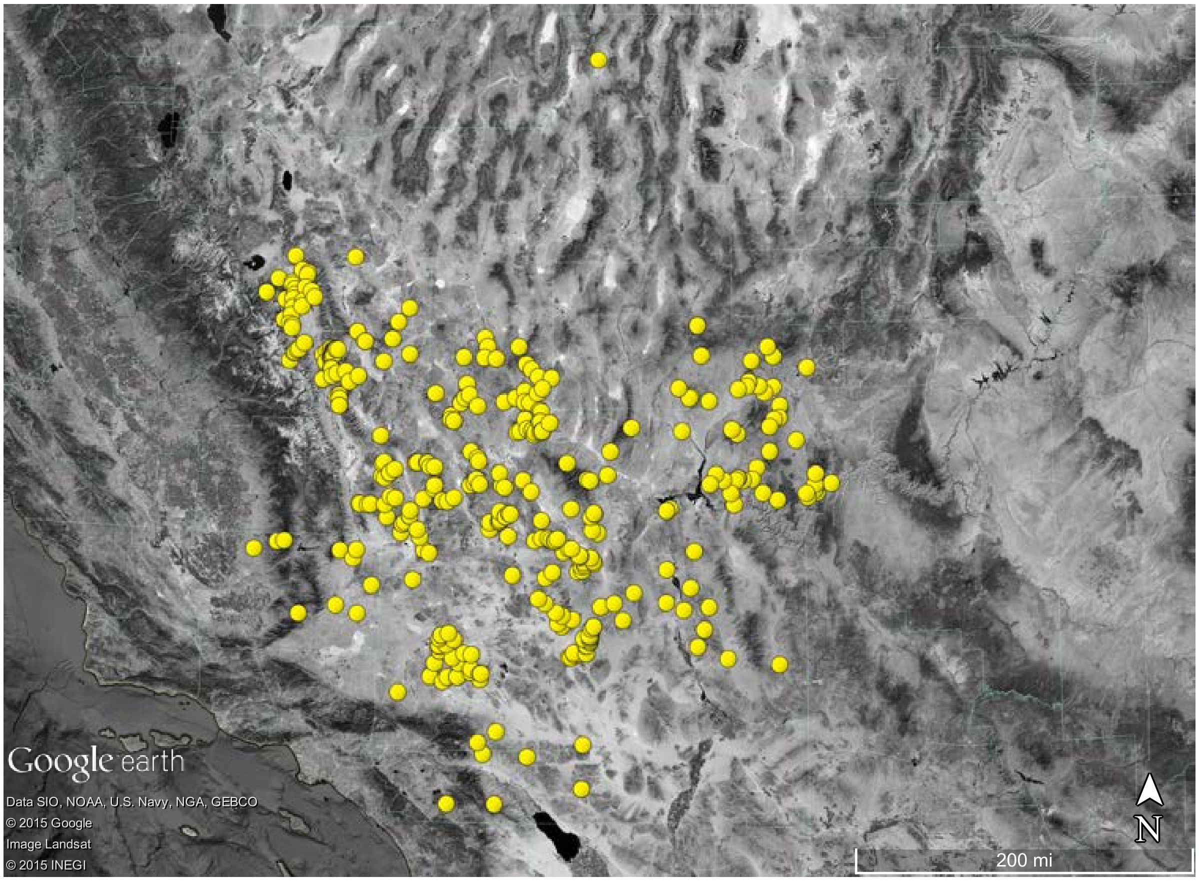

Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
US Dept of State Geographer
© 2015 Google
Image Landsat
1400 mi
N

Fig. 3.51. Distribution of georeferenced *Phacelia vallis-mortae* specimens in North America. Map imagery from Google Earth Pro (version 7.1), Image Landsat from Google, and map data providers Google, SIO, NOAA, U.S. Navy, NGA, and GEBCO. Scale bar 200 miles.


Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2015 Google
Image Landsat
© 2015 INEGI
N
200 mi