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Cover: Donna O'Neill Land Conservancy, photos by Fred M. Roberts, Jr. and David E. Bramlet. **Upper left:** mixed coastal sage scrub and sumac chaparral, from near center west boundary looking north; **upper right:** eroded cliff along ridge in southern portion of preserve; **lower left:** *Calochortus weedii* flower, typical of intermediate forms between *C.w.* var. *intermedius* and *C.w.* var. *weedii*. The background color of this flower is more typical of *C.w.* var. *intermedius* although solid yellow is more typical of *C.w.* var. *weedii*; **lower right** coastal sage scrub on ridge, Cristianitos Canyon on Rancho Mission Viejo (off the the preserve) in background.



VASCULAR PLANTS OF THE
DONNA O'NEILL LAND CONSERVANCY,
RANCHO MISSION VIEJO, ORANGE COUNTY, CALIFORNIA

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ABSTRACT: The Donna O'Neill Land Conservancy is a 486 hectare (1,172 acre) reserve located within Cristianitos Creek watershed on Rancho Mission Viejo, southern Orange County. The Conservancy was set aside to offset impacts to the Talega Homes development site during the 1980s and is privately managed. The vegetation is primarily composed of coastal sage scrub, chaparral, southern oak woodland, sycamore riparian woodland, native needlegrass perennial grassland, and annual grassland, with scattered sandstone cliffs and outcrops. The authors conducted rare plant and floristic surveys of the Donna O'Neill Land Conservancy in 2003 and 2004. Two-hundred and forty-four taxa, representing 59 families, were collected during the survey. One hundred and eighty taxa were native and sixty-seven taxa were non-native. Twelve additional taxa were observed but not documented. The largest plant families were Asteraceae (51 taxa), Poaceae (35 taxa), Fabaceae (17 taxa), and Scrophulariaceae (eight taxa). Twelve documented species within the Conservancy are listed in the California Native Plant Society's Inventory of Rare and Endangered Species or considered of Local Concern.

KEYWORDS: Orange County, Rancho Mission Viejo, Cristianitos Canyon, Donna O'Neill Land Conservancy, vascular plants, special status plants.

INTRODUCTION

The Cristianitos Creek watershed is located on the southern portion of Rancho Mission Viejo, south of State Route 74 (Ortega Highway), east of San Clemente, and north of Camp Joseph Pendleton Marine Corps Base. It forms the northwestern-most tributary to the San Mateo Creek--Gabino Canyon watershed, an important site for the federally-listed endangered arroyo toad (*Bufo microscaphus californicus*). The Donna O'Neill Land Conservancy (Conservancy), previously known as the Rancho Mission Viejo Land Conservancy, contains 486 hectares (1,172 acres) of habitat along the western flank of Cristianitos Canyon. A diverse assemblage of plant communities includes coastal sage scrub, chaparral, native perennial needlegrass grassland, southern oak woodland, coast live oak riparian forest, and sycamore riparian woodland. The Conservancy also includes exposed sandstone cliffs and one of two small patches of scrub dominated by *Artemisia tridentata* on Rancho Mission Viejo. At about seven kilometers, these stands represent the closest that *A. tridentata* approaches the Pacific Ocean in San Diego or Orange Counties.

The Conservancy was set aside in the mid 1980s to offset impacts from the adjacent Talega Development. The lands set aside were centered on extensive stands of southern oak woodland dominating every major tributary within the Conservancy. Included within Conservancy lands was a portion of the extensive native needlegrass grasslands found within the Cristianitos Creek watershed. These grasslands represent some of the highest quality native grasslands remaining in southern California. For twenty years the Conservancy has protected and managed these habitats through volunteer efforts and provided environmental education. However, like too many other areas of southern California, even the Conservancy is at risk as surrounding regions are proposed for development. During the late 1990s, the Talega residential development advanced right up to the border of the Conservancy and seemingly minor boundary changes resulted in significant alterations of the watershed. Today, the Conservancy itself is within the path of the proposed Southern Foothill Tollway, which is a proposed pass through the adjacent San Onofre unit of San Clemente State Park (FHWA and TCA 2004). Like many conservation areas in Orange County, plant taxa occurring in the Donna O'Neill Land Conservancy have been surprisingly poorly documented. In 2002 Laura Cohen, the Conservancy manager, presented us with an opportunity to inventory the reserve's flora. Rancho Mission Viejo supplied additional funding to study the rare plants found within the Conservancy.

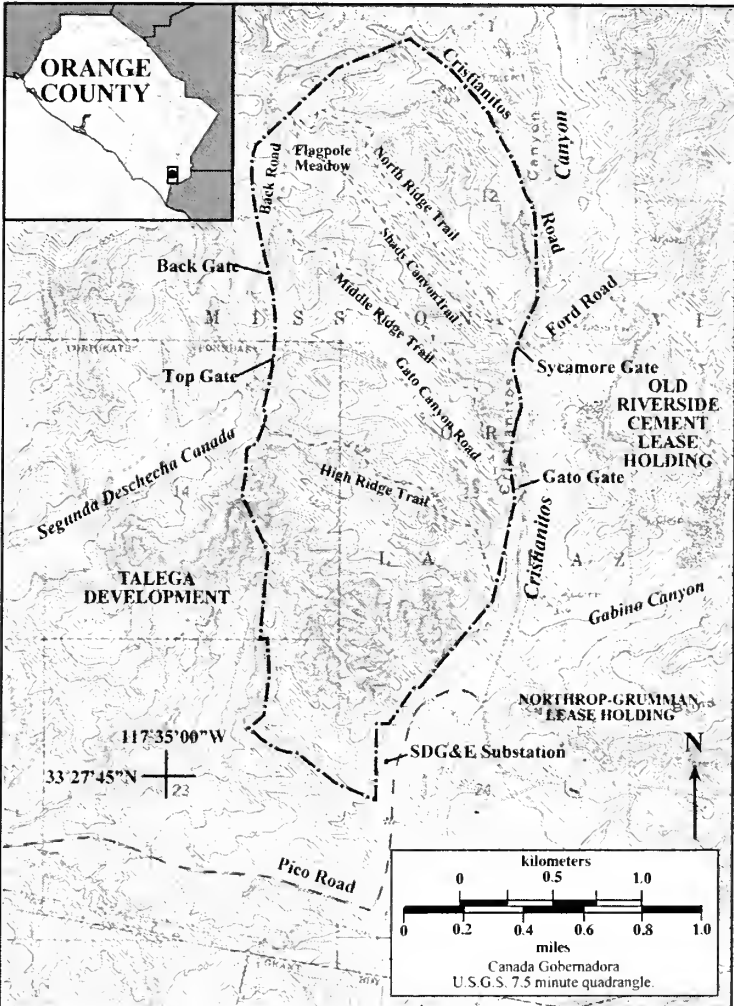
Location of the study area

The Donna O'Neill Land Conservancy is located in southern Orange County (Figure 1) within the watershed of Cristianitos Creek, generally west of the creek channel and Cristianitos Road on Rancho Mission Viejo. The middle and southern portions of the Conservancy are bordered by the Talega residential development on the west, while land to the east consists of undeveloped grazing lands, old clay pits, and the Northrop-Grumman Capistrano Test Site (formally TRW). The area immediately north of the Conservancy is also currently undeveloped, although there is a sand and gravel mining operation in the adjacent (west) Trampas Canyon. The lands immediately south of the Conservancy are currently being developed as a residential community. Camp Joseph Pendleton Marine Corps Base is to the southeast just beyond the Northrop-Grumman Capistrano Test Site. Public access to the Conservancy is restricted and may be granted for educational and research activities.

Physical description of the study area

The topography within the Conservancy is dominated by a series of northwest- to southeast-running shallow canyons and ridges leading into Cristianitos Canyon. The northern part consists of rolling hills with a few exposed clay barrens. The southern portion is higher, more rugged, and with numerous steep-sided sandstone cliffs. The lowest point in the Conservancy is 91 meters (300 feet) elevation, found at the southern edge adjacent to the TRW access road. The highest point is 263 meters (862 feet) elevation. None of the physical features within the Conservancy, with the exception of Cristianitos Canyon, have formal names on 7.5 minute U.S.G.S. topographic maps. However, Conservancy managers have informally named a number of features including Flagpole Meadow, North Ridge Trail, Middle Ridge Trail, High Ridge Trail, Shady Canyon Trail, and Gato Canyon Trail (Figure 1).

Bedrock geology throughout the Conservancy consists of a Santiago Formation, except along the streambeds. These are an Eocene formation consisting of marine sandstones



F.M. Roberts 17 January 2007

Figure 1: Donna O'Neill Land Conservancy at Rancho Mission Viejo: general location within Orange County, borders, and important physical features in and surrounding Study Area.

and conglomerates (Rogers 1965, Tan 1999). Cristianitos Creek and the smaller drainages on the reserve contain recent alluvial deposits, while some of the ephemeral drainages are composed of colluvium and alluvial deposits. Along Cristianitos Creek there are some areas of older, moderately consolidated alluvial deposits on the benches adjacent to the streambanks. In the steeper areas of the Conservancy, there are also landslide deposits. These localities are comprised of broken-up and recently weathered areas of sandstone (Tan 1999).

Soils in the region have been described in *The soil survey of Orange County and western part of Riverside County* (Wachtell 1978). Soils within the Conservancy are generally comprised of a Cieneba sandy loam 30-75 percent slopes, Botella loam 2-9 percent slopes, Botella clay loam, Capistrano sandy loam, Myford sandy loam, San Andreas sandy loam, Cieneba-Blasingame rock outcrop complex, and some small areas of Bosanko clay. Although only small patches of Bosanko clay occur on the Conservancy, it is very important in terms of plant distribution.

PLANT COMMUNITIES

The Donna O'Neill Land Conservancy is characterized by coastal sage scrub and chaparral on the slopes of many smaller canyons draining into Cristianitos Creek. Large areas of grasslands are found on the reserve and these are typically native perennial grasslands in the northern end and south central portions of the Conservancy property. In contrast, annual grasslands are more common in the southern portion of the reserve. In this area of the reserve, stands of a coastal sage scrub-grassland ecotone are also found.

Southern oak woodlands are also found on the north-facing slopes of the canyons. The upper drainages and portions of Cristianitos Creek contain coast live oak riparian forest. Sycamore riparian woodlands are found in at least two localities on Conservancy land, both in the northeast corner of the reserve and at the "sycamore gate" area at the start of the Shady Canyon Trail. Coast live oak riparian forest, willow riparian scrub, and mulefat scrub grow along Cristianitos Creek. A riparian herb community and open areas of alluvial wash are also found along the creek and other drainages on the reserve. The Conservancy land also contains some important cliff habitat, principally found in the southern portion of the reserve. See Figure 2 for a generalized map of vegetation within the Conservancy.

Coastal sage scrub

Coastal sage scrub is the most common plant community found on the Donna O'Neill Land Conservancy property and is found throughout the reserve. This community is characterized by drought deciduous shrub species, although some evergreen chaparral shrubs may be present. The reserve generally contains some eight named subassociations (Gray and Bramlet 1992, Jones and Stokes 1993) or series (Sawyer and Keeler-Wolf 1995) of coastal sage scrub. These include sagebrush scrub, sagebrush-buckwheat scrub, sagebrush-monkey flower scrub, mixed sage scrub, baccharis scrub, black sage scrub, white sage scrub, cactus scrub, alluvial fan scrub (*Lepidospartum squamatum*), and coastal sage scrub-grassland ecotone. The most common members of the coastal sage scrub community include *Artemisia californica*, *Eriogonum fasciculatum*, *Encelia californica*, *Mimulus aurantiacus*, *Baccharis pilularis*, *Salvia mellifera*, *Salvia apiana*, and *Opuntia littoralis*. Small stands of *Cylindropuntia prolifera* are found on east and south-facing slopes. *Lepidospartum squamatum* is found as a small stand on the southeast



Figure 2. General vegetation map of the Donna O'Neill Land Conservancy. Modified after Orange County county-wide vegetation map (1994).

F. M. Roberts 18 August 2006

boundary of the reserve, where Cristianitos Creek crosses into the Conservancy lands. The coastal sage scrub just south of Sycamore gate along the south-facing slope of a sandstone ridge is unusual in being dominated by a combination of *Artemisia tridentata*, *A. californica*, *Opuntia littoralis*, and *Isocoma menziesii*. This is one of the few sites where *A. tridentata* is encountered as a native within Orange County.

Chaparral

Chaparral is composed of evergreen, sclerophyllous shrubs that are occasionally found scattered in the coastal sage community, but form dense stands along the north facing slopes and other localities within the Conservancy. Most chaparral is toyon–sumac chaparral, composed mostly of *Rhus integrifolia*, *Heteromeles arbutifolia*, *Quercus berberidifolia*, *Sambucus mexicana*, and *Rhamnus ilicifolia*. Some small chaparral chaparral stands are dominated by *Q. berberidifolia* and *Q. engelmannii* X *Q. berberidifolia* hybrids. In some localities on the reserve the chaparral and coastal sage scrub communities intergrade, forming ecotonal areas between these two communities.

A chaparral stand along the western ridgeline also includes a few *Cercocarpus minutiflorus*. *Cercocarpus minutiflorus* is primarily a San Diego County species known only in Orange County from the Donna O'Neill Land Conservancy and Niguel Hill in Laguna Niguel.

Grasslands

Grasslands are the third largest community in terms of acreage on the Donna O'Neill Land Conservancy. Native perennial needlegrass grassland is characterized by open to dense stands of *Stipa pulchra*. In some localities the co-dominant is *Agrostis diegoensis*. Other species found in this community lesser amounts of *Bromus madritensis*, *B. hordeaceus*, *Distichlis spicata*, *Melica imperfecta*, and *Avena barbata*.

The annual grasslands are generally characterized by stands of *Bromus diandrus*, *Hordeum murinum* subsp. *leporinum*, *Lolium perenne*, and *Bromus hordeaceus*. Characteristic grasses on slightly drier sites include *Bromus madritensis* subsp. *rubens*, *Avena fatua*, *Gastridium ventricosum*, *Vulpia myuros*, and *Avena barbata*. The open barrens on clay soils comprise the most unique annual grasslands found on the Conservancy. Although some native perennial grasses, principally *Bothriochloa barbinodis* and *Aristida ternipes*, along with some *Stipa pulchra*, occur in these grasslands, annuals are the dominant plant species. The annual grasses found in these barrens are generally the same grasses described for the dry, annual grassland sites of the reserve.

Native herbs are a characteristic component of these grasslands and some of the characteristic perennial species include *Sisyrinchium bellum*, *Dodecatheon clevelandii*, *Dichelostemma capitatum*, *Bloomeria crocea*, *Sidalcea malvestora*, *Jepsonia parryi*, *Oxalis albicans*, *Chlorogalum pomeridianum*, *Sanicula arguta*, *Siachys rigida*, *Grindelia camporum*, *Castilleja affinis*, and *Calochortus splendens*. Common annual forbs in this grassland are *Osmadenia tenella*, *Erodium brachycarpum*, *Anagallis arvensis*, *Lotus purshianus*, *Lupinus bicolor*, *Achillea millefolium*, *Medicago polymorpha*, and *Microseris heterocarpa*. Other forbs on the open barrens consist of *Crassula comata*, *Plantago erecta*, *Filago californica*, *Lotus hamatus*, *Centaurea melitensis*, *Atriplex semibaccata*, *Salsola tragus*, *Eriastrum saphirinum*, and *Deinandra paniculata*.

Riparian

Riparian communities are associations of trees, shrubs and herbaceous species found along stream channels. The most characteristic riparian community on the Donna O'Neill Land Conservancy is coast live oak riparian forest, which occurs in the ephemeral tributaries and along Cristianitos Creek. Sycamore riparian woodland is generally restricted to two areas on the reserve, although *Platanus racemosa* trees are often a component of coast live oak riparian forest. Willow riparian scrub was generally restricted to areas along Cristianitos Creek, while mulefat scrub was found in both Cristianitos Creek and the ephemeral drainages. The riparian herb community was found in stream courses throughout the reserve. Other communities associated with stream channels include the alluvial wash and alluvial fan sage scrub, both found in open wash areas of Cristianitos Creek.

The riparian herb community is composed of herbaceous species found within or at the margins of Cristianitos Creek or the ephemeral drainages. Common species are *Agrostis viridis*, *Juncus bufonius*, *Cyperus eragrostis*, *Melilotus indicus*, *M. albus*, *Mimulus guttatus*, *Veronica anagallis-aquatica*, *Juncus arcticus* var. *mexicanus*, *Xanthium strumarium*, *Rumex crispus*, *Cynodon dactylon*, *Distichlis spicata*, *Artemisia douglasiana*, *Picris echioides*, and *Gnaphalium palustre*.

Mulefat scrub is dominated by open to dense stands of *Baccharis salicifolia*, along with some willows, usually *Salix lasiolepis*. Other characteristic shrubs include *Baccharis pilularis*, *Sambucus mexicana*, *Toxicodendron diversilobum*, *Heteromeles arbutifolia*, *Tamarix ramosissima*, and *Nicotiana glauca*. Willow riparian scrub is occasional along Cristianitos Creek. This community is composed of *Salix lasiolepis*, *Salix laevigata*, *Salix gooddingii*, *Salix exigua*, and *Baccharis salicifolia*.

Coast live oak riparian forest is found along the drainages, including Cristianitos Creek. The forest is dominated by an overstory of *Quercus agrifolia* with an occasional *Platanus racemosa*. Beneath this is a subcanopy of tall shrubs including *Salix lasiolepis*, *Heteromeles arbutifolia*, *Rhamnus ilicifolia*, and *Rhus integrifolia*. A lower shrub layer is composed of *Baccharis pilularis*, *Toxicodendron diversilobum*, *Ribes speciosum*, *Mimulus aurantiacus*, and *Galium porrigens*.

Sycamore riparian woodland contains open woodland dominated by scattered, large *Platanus racemosa*, with an occasional *Quercus agrifolia*. Shrubs among these trees include *Sambucus mexicana*, *Baccharis pilularis*, *Rhamnus ilicifolia*, *Toxicodendron diversilobum*, *Artemisia douglasiana*, and *Rubus ursinus*.

Ephemeral wetlands are characteristically small and isolated. Two types were found on the Conservancy: freshwater seep and wet meadow. Freshwater seep is found on the benches along Cristianitos Creek and some other drainages. The community is generally characterized by open to dense stands of *Eleocharis palustris*. Other species in these moist habitats include *Rumex crispus*, *Ambrosia psilostachya*, *Lolium perenne*, *Juncus arcticus*, *Trifolium hirtum*, *Sidalcea malviflora*, *Sonchus oleraceus*, *Bromus hordeaceus*, and *Ranunculus californicus*. Wet meadow occurs in several areas within the smaller ephemeral drainages. These are areas generally dominated by *Juncus arcticus*, *Geranium dissectum*, *Bromus sterilis*, *Bromus hordeaceus*, and *Sonchus oleraceus*.

Woodlands and forest

Coast live oak woodland or forest on mesic slopes not associated with an ephemeral or perennial stream channel is similar to the coast live oak riparian forest in composition but lacks the riparian elements such as *Salix* spp. or *Baccharis salicifolia*. Stands of *Quercus berberidifolia* often form the margins of this community.

Cliff and rock

Cliff and rock is an important plant habitat on the Conservancy. Generally these habitats are devoid of vegetation. However, in some areas they contain a scattered cover of *Rhus integrifolia*, *Sabia mellifera*, *Eriogonum fasciculatum*, *Opuntia littoralis*, *Yucca whipplei*, *Artemisia californica*, *Stipa coronata*, *Encelia californica*, *Lotus scoparius*, *Dudleya edulis*, and *Galium angustifolium*.

METHODS

The floral checklist was compiled from Roberts' (2004) records and new field collections. We attempted to collect at least one representative specimen of each species encountered. Voucher specimens are deposited at the Rancho Santa Ana Botanic Garden Herbarium. A few species were observed and not collected. These plants are listed in Appendix I. Fourteen surveys were made in 2003 beginning in March and running through September. Seven additional surveys were conducted in 2004, which included summer and fall surveys. 2004 proved to be a fairly dry year and floristic diversity and abundance was much improvised as compared to 2003. For example, *Deinandra paniculata* was widespread throughout grasslands of the Conservancy in 2003 but was represented by only a fraction of the number of sites and individuals in 2004. Nomenclature for the most part follows Roberts (1998) and Roberts et al. (2004) with some exceptions.

All sensitive species occurrences were recorded by UTM coordinates obtained from Magellan or Garmin GPS receivers. The location, number of individuals, habitat, and associated plant species were noted at each site. Specific details for sensitive species are reported in Roberts and Bramlet (2004) and Roberts and Bramlet (2005), on file with the Donna O'Neill Land Conservancy.

FLORISTICS

The vascular flora of the Donna O'Neill Land Conservancy includes a total of 244 taxa, representing 58 families, located and documented within the Conservancy. This total includes 242 species and one additional subtaxa. Two hybrids, one named and one unnamed, were also found. A statistical summary of the floristic diversity within the Donna O'Neill Land Conservancy is presented in Table 1. The largest families include Asteraceae (52 species), Poaceae (35 species), Fabaceae (17 species), and Scrophulariaceae (eight species). The most diverse families and a summary of life forms are presented in Tables 2 and 3. The number of species compares with 281 species for the 3,500 acres study area of the Whittier Hills (Schneider-Ljubenkov & Ross 2001); 242 species for the 202 acres study area of the University of California Natural Reserve System's San Joaquin Freshwater Marsh Reserve (Bowler and Elvin 2003)¹; and 285

¹ Fifty-eight taxa listed for the San Joaquin Freshwater Marsh Reserve in Bolwer and Elvin were not documented by vouchers and are not verifiable. Thus the total vouchered taxa were actually 144.

**Table 1. Statistical summary of floristic diversity
in the Donna O'Neill Land Conservancy**

<i>Group</i>	<i>Families</i>	<i>Genera</i>	<i>Species</i>	<i>Additional var. & subsp.</i>	<i>Total*</i>	<i>Native</i>	<i>Non- native</i>
Pteridophytes	4	6	8	0	8	8	0
Psilophyta	0	0	0	0	0	0	0
Sphenophyta	0	0	0	0	0	0	0
Lycophyta	1	1	2	0	2	2	0
Polypodiophyta	3	5	6	0	6	6	0
Coniferophyta	1	1	1	0	1	1	0
Magnoliophyta	54	163	234	1	235	171	65
Dicots	45	131	185	1	186	141	47
Monocots	9	32	49	0	49	31	18
TOTALS	59	170	243	1	244	180	67

**Table 2. Twelve largest families
in the Donna O'Neill Land Conservancy**

<i>Family</i>	<i>Total species</i>	<i>Native (%)</i>	<i>Non- native (%)</i>
Asteraceae	51	38 (75)	13 (25)
Poaceae	35	17 (49)	18 (51)
Fabaceae	17	11 (65)	6 (35)
Scrophulariaceae	8	6 (75)	2 (25)
Boraginaceae	6	6 (100)	0 (0)
Lamiaceae	6	5 (83)	1 (17)
Rosaceae	5	5 (100)	0 (0)
Polygonaceae	5	4 (80)	1 (20)
Apiaceae	5	4 (80)	1 (20)
Geraniaceae	5	2 (40)	3 (60)
Brassicaceae	6	2 (33)	4 (67)
Carvophyllaceae	6	2 (33)	4 (67)

These 156 taxa account for 63% of the flora.

Table 3. Summary of life-forms

<i>Group</i>	<i>Annual</i>	<i>Perennial Herb</i>	<i>Suffruticose Perennial</i>	<i>Shrub</i>	<i>Woody Tree</i>	<i>Vine</i>
Native	67	68	8	28	7	3
Non- native	48	13	0	1	1	0
Total (%)	115 (47)	81 (33)	8 (3)	29 (12)	8 (3)	3 (1)

plant species reported from Sycamore Canyon Park in Riverside County (Temple 1999). The flora of the Donna O'Neill Land Conservancy represents about 19 percent of the overall 1,269 taxa reported in Orange County (Roberts 1998). Twelve additional species were observed but not documented and have been included within the analysis (see Appendix I).²

Seventy-three percent (180 taxa) of the Donna O'Neill flora is of native origin, while 27 percent (67 taxa) represent introduced taxa. The following tables provide various statistical summaries of the Conservancy's vascular plant diversity.

SPECIAL STATUS SPECIES

Thirteen special status plant species were encountered during the 2003 and 2004 surveys. Nine of these species are included within the California Native Plant Society's Inventory of Rare and Endangered Plants of California (CNPS 2001). Four other taxa, including *Cercocarpus minutiflorus*, *Gnaphalium* cf. *leucocephalum*, *Juniperus californica*, and *Selaginella cinerascens* are of local concern in Orange County (Roberts 1998, Roberts 2006, in ed.). Two of these species, *Cercocarpus minutiflorus* and *Juniperus californica*, were also considered as Locally Rare by the County of Orange (Gray and Bramlet 1994). The Conservancy supports significant numbers of *Dudleya multicaulis*. *Selaginella cinerascens*, otherwise known from Orange County only in Shady Canyon within the San Joaquin Hills, is also present.

Three additional species, *Viguiera laciniata*, *Calochortus catalinae*, and *Piperia cooperi* have been reported from the Conservancy. *Viguiera laciniata* was reported within the southern portion of the Conservancy by Laura Cohen in June 2006 but the authors have not seen these plants and they have not been vouchered. It is uncertain whether the *V. laciniata* reported represent native or naturalized individuals. Where this species has been found at other locations within Orange County, it is clearly introduced. Native populations do occur within adjacent San Diego County not far from the County line. The authors did see one individual of *Piperia* likely to be *P. cooperi*, a CNPS List 4 species, however, only a single immature plant was observed and it was seen only once in April 2005. It was not seen on subsequent visits to the site. *Calochortus catalinae* has been reported to occur within the central portion of the Conservancy (FHWA and TCA 2004) but the authors did not locate this species.

The special status plants were documented at 281 sites. *Deinandra paniculata* and *Dudleya multicaulis* were the most frequently encountered special status plants during the survey, with 166 and 47 sites respectively. *Harpagonella palmeri*, *Hordeum intercedens*, and *Calochortus weedii* var. *intermedius* each occurred at over 10 locations, although the latter was restricted to the southern portion of the Conservancy. The remaining species were found at four or fewer locations. Comments on each special status species are in the Annotated List of Plant Species. All special status plants within the Donna O'Neill Land Conservancy, including their rank, number of sites, and individuals censused are summarized in Table 4. All special status of the diversity of sensitive plants found within the Conservancy is presented in Table 5.

² EIR 581 (County of Orange 2004) reported 55,736 individuals for Rancho Mission Viejo but a math error increased the total by about 10,000 individuals so the 45,436 figure is correct based on data supplied within the document.

Table 4. Special status plant species at the Donna O'Neill Land Conservancy†

Scientific Name	Common Name	Family	Rank	Colonies/ Individuals
<i>Cercocarpus minutiflorus</i>	San Diego mountain-mahogany	Rosaceae	LC	1/4
<i>Calochortus weedii</i> var. <i>intermedius</i>	intermediate mariposa lily	Liliaceae	CNPS 1B	18/585
<i>Convolvulus simulans</i>	small-flowered morning-glory	Convolvulaceae	CNPS 4	1/200
<i>Deinandra paniculata</i>	paniculate tarplant	Asteraceae	CNPS 4	166/*
<i>Dudleya multicaulis</i>	many-stemmed dudleya	Crassulaceae	CNPS 1B	47/7,963
<i>Harpagonella palmeri</i>	Palmer's grappling hook	Boraginaceae	CNPS 4	20/5,817
<i>Hordeum intercedens</i>	vernal barley	Poaceae	CNPS 3	14/878
<i>Gnaphalium</i> cf. <i>leucocephalum</i>	alluvial everlasing	Asteraceae	LC	2/21
<i>Juniperus californica</i>	California juniper	Cupressaceae	LC	3/3
<i>Microseris douglasii</i> subsp. <i>platycarpha</i>	small-flowered microseris	Asteraceae	CNPS 4	4/590
<i>Quercus engelmannii</i>	Engelmann oak	Fagaceae	CNPS 4	4/6
<i>Selaginella cinerascens</i>	ashy spike moss	Selaginaceae	LC	2/*

†See Table 5 for Rank explanation.

*Sites not censused.

Table 5. Summary of sensitive plant diversity

FE	FT	CE	CT	1A	1B	2	3	4	LC
0	0	0	0	0	2	0	1	6	4

Federal Designations:

FE = Listed by the federal government as Endangered.

FT = Listed by the federal government as Threatened.

State Designations:

CE = Listed by the State of California as Endangered

CT = Listed by the State of California as Threatened

California Native Plant Society (CNPS):

CNPS 1A = Plants presumed extinct in California.

CNPS 1B = Plants considered rare, threatened or endangered in California and elsewhere.

CNPS 2 = Plants rare, threatened or endangered in California but more common elsewhere.

CNPS 3 = Plants requiring additional information- A review list.

CNPS 4 = Plants of limited distribution - A watch list.

Other:

LC = Local Concern; while potentially common overall, rare or restricted in Orange County or southern California (Gray & Bramlet 1994, Roberts et al., 2004).

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APPENDIX I: ANNOTATED LIST OF THE VASCULAR PLANTS OF DONNA O'NEILL LAND CONSERVANCY

This is a complete list of vascular plant species documented during the 2003 and 2004 surveys of the Donna O'Neill Land Conservancy, combined with historic collections. The list is given alphabetically within major groups (ferns and allies, gymnosperms, flowering plants). Each entry is structured with the scientific name followed by the author and common name. If the name differs from the Jepson Manual, the name used in Jepson is offered in synonymy. A brief summary is offered regarding the relative abundance and habitat for the species within the Conservancy, followed by a citation of the documenting specimen. All specimens collected as part of the survey have been deposited at the Rancho Santa Ana Botanic Garden, Claremont, California (RSA). Several older collections were deposited at the Museum of Systematic Biology Herbarium at University of California, Irvine (IRVC). Additional species, which were not vouchered are listed in Appendix I.

PTERIDOPHYTES - FERNS AND ALLIES**Dryopteridaceae – Wood Fern Family**

Dryopteris arguta (Kaulf.) Watt. COASTAL WOOD FERN. Perennial from rhizome. Scattered on shady north-facing slopes; understory of oak woodland. DEB & FMR 3426 (RSA).

Polypodiaceae – Polypody Family

Polypodium californicum Kaulf. CALIFORNIA POLYPODY. Perennial originating from a rhizome. Uncommon on shaded slopes; loamy sand and leaf litter in understory of oak woodland. FMR & DEB 5873.

Pteridaceae – Lip Fern Family

Adiantum jordani K. Mull. CALIFORNIA MAIDENHAIR. Perennial. Infrequent on shaded north-facing slopes; oak woodland understory. DEB & FMR 3355 (RSA).

Pellaea andromedifolia (Kaulf.) Fee COFFEE FERN. Perennial. Occasional on dry slopes; coastal sage scrub. FMR 5695 (RSA).

Pellaea mucronata var. *mucronata* BIRD'S FOOT CLIFF-BRAKE. Perennial from rhizome. Infrequent on dry slopes; annual grassland. DEB & FMR 3359 (RSA).

Pentagramma triangularis (Kaulf.) Yatsk., Windh., & Wollenw. subsp. *triangularis* GOLDENBACK FERN. Perennial from rhizome. Uncommon on shaded slopes near Flagpole Meadow; oak woodland understory. FMR & Laura Cohen 5272 (RSA).

Selaginellaceae – Spike Moss Family

Selaginella bigelovii Underw. BIGELOW'S or BUSHY SPIKE MOSS. Low, spreading perennial. Occasional to fairly common on dry slopes, ridges, and sandstone outcrop borders; coastal sage scrub, needlegrass perennial grassland, toyon-sumac chaparral. FMR & DEB 6079 (RSA).

Selaginella cinerascens Maxon MESA SPIKE MOSS. Low, spreading perennial. Infrequent, forming small isolated patchy carpets on clay soil; needlegrass perennial grassland. Collected at two sites in the Conservancy. Also known from a ridge along

the western boundary [Dave Bramlet and Walt Wright s.n, 4 May 1986 (IRVC)] but we were unable to determine if this site was within the Conservancy or just west of it. For many years the Bramlet-Wright collection was the only report for *S. cinerascens* in Orange County. Rare: Local Concern. FMR 5675 (RSA); DEB & FMR 3425 (RSA).

GYMNOSPERMS CONIFEROPHYTA - CONE-BEARING PLANTS

Cupressaceae – Cypress Family

Juniperus californica Carr. CALIFORNIA JUNIPER. Shrub. Reported from three sites on slopes west of Cristianitos Canyon and its tributaries; coastal sage scrub and along margins of oak woodland. Rare: Local Concern. DEB & FMR 3360 (RSA).

ANGIOSPERMAE - FLOWERING PLANTS DICOTYLEDONES - "DICOTS"

Adoxaceae – Elderberry Family

Sambucus mexicana Presl MEXICAN ELDERBERRY. Small tree. Infrequent to occasional on slopes and canyon bottoms; annual grassland, coastal sage scrub, toyon-sumac chaparral, mulefat scrub, sycamore riparian woodland, and oak woodland. FMR 5684 (RSA).

Aizoaceae – Carpet-weed Family

**Carpobrotus edulis* (L.) Rotm. HOTTENTOT-FIG. Succulent, spreading perennial. Recorded from a single site along Cristianitos Creek in the south; open mulefat scrub. FMR & DEB 6083 (RSA).

Anacardiaceae – Sumac Family

Malosma laurina (Nutt. ex Torr. & A. Gray) Nutt. ex Abrams LAUREL SUMAC. Shrub. Occasional to fairly common on slopes and ridges; toyon-sumac chaparral, coastal sage scrub, and alluvial fan scrub. FMR & Laura Cohen 5271 (RSA), DEB 3594 (RSA).

Rhus integrifolia (Nutt.) Benth. & Hook. LEMONADE BERRY. Shrub. Widespread and common in canyon bottoms and hillsides; toyon sumac chaparral, oak woodland. Less frequent in coastal sage scrub. FMR & Laura Cohen 5271 (RSA).

Toxicodendron diversilobum (Torr. & A. Gray) E. Greene POISON OAK. Shrub. Fairly common throughout, especially on mesic slopes and in drainages; coastal sage scrub, toyon-sumac chaparral, baccharis scrub, mulefat scrub, and the understory of oak woodland. FMR 5665 (RSA).

Apiaceae (Umbelliferae) – Carrot Family

Daucus pusillus Michx. RATTLESNAKE WEED Annual. Occasional to fairly common throughout; annual grassland, needlegrass perennial grassland, openings in coastal sage scrub, borders of oak woodland and chaparral. FMR 5673; FMR & DEB 6028.

- **Foeniculum vulgare* Miller SWEET FENNEL. Perennial. Occasional weed on slopes, canyon bottoms, and along drainages; disturbed areas, coastal sage scrub, oak riparian woodland. FMR & DEB 6092 (RSA).
- Sanicula arguta* Coulter & Rose. SHARP-TOOTH SANICLE Perennial. Occasional on ridges and open north-facing slopes; needlegrass perennial grassland. FMR & DEB 5573, 5574 (RSA).
- Sanicula crassicaulis* Poepp. ex DC. var. *crassicaulis* PACIFIC SANICLE. Perennial. Occasional about drainages and on mesic slopes; grassy borders of oak woodland and toyon-sumac chaparral. FMR & Laura Cohen 5270 (RSA).
- **Torilis nodosa* (L.) Gaertn. KNOTTED HEDGE-PARSLEY. Annual. Occasional; annual grassland and openings in oak woodland. FMR 5672 (RSA).

Asclepiadaceae – Milkweed Family

- Asclepias fascicularis* Dcne. NARROW-LEAVED MILKWEED. Perennial. Occasional on sandy soil in canyon bottoms; sycamore riparian woodland. FMR & A. Davenport 6011 (RSA).

Asteraceae (Compositae) – Sunflower Family

- Achillea millefolium* L. var. *californica* (Pollard) Jepson CALIFORNIA YARROW. Annual. Occasional on shaded slopes; understory of oak woodland and borders of sumac-toyon chaparral, needlegrass perennial grassland. FMR & DEB 5875 (RSA).
- Acourtia microcephala* DC. SACAPELLOTE. Perennial. Infrequent on dry slopes and along ridges; coastal sage scrub. FMR & DEB 5872 (RSA).
- Ambrosia psilostachya* DC. var. *californica* (Rydb.) Blake WESTERN RAGWEED. Annual. Occasional to locally frequent along drainages, sandy washes, and on gentle hillsides; ephemeral wetlands, riparian herb community, mulefat scrub, baccharis scrub, alluvial fan scrub, and sycamore riparian woodland. FMR & A. Davenport 6005 (RSA).
- Artemisia californica* Less. COASTAL SAGEBRUSH. Shrub. Common on dry slopes and ridges; coastal sage scrub. Less common in alluvial fan scrub and chaparral. FMR & A. Davenport 6018 (RSA).
- Artemisia douglasiana* Besser CALIFORNIA MUGWORT. Perennial. Occasional to locally common in drainages, mostly in Cristianitos Canyon; sycamore riparian woodland, oak riparian woodland, baccharis scrub, mulefat scrub, and riparian herb community. FMR & A. Davenport 6012 (RSA).
- Artemisia tridentata* Nutt. subsp. *tridentata* GREAT BASIN SAGEBRUSH. Shrub. Small population on dry ridge above Cristianitos Canyon immediately south of Sycamore Gate. Possibly the closest occurrence of *A. tridentata* to the ocean in southern California; coastal sage scrub. FMR & A. Davenport 6017 (RSA).
- Baccharis pilularis* DC. subsp. *consanguinea* (DC.) C.B. Wolf. COYOTE BRUSH or CHAPARRAL BROOM. Shrub. Occasional to fairly common on slopes and along drainages, often on north-facing aspects; baccharis scrub, coastal sage scrub, mulefat scrub, and oak riparian woodland. FMR & Laura Cohen 6024 (RSA).
- Baccharis salicifolia* (Ruiz & Pavon) Pers. MULEFAT. Shrub. Fairly common along drainages, occasional in other mesic areas; mulefat scrub and willow riparian scrub. FMR 5627 (RSA).
- **Carduus pycnocephalus* L. ITALIAN THISTLE. Annual. Occasional on slopes and in drainages; annual grassland, coastal sage scrub, and mulefat scrub. Locally common in canyon bottoms within the understory of oak woodland. FMR 5682 (RSA).

- **Centaurea melitensis*** L. TOCALOTE. Annual. Fairly common weed in disturbed areas and along trails; annual grassland and open coastal sage scrub. FMR & DEB 5890 (RSA).
- Chaenactis glabriuscula*** DC. var. *glabriuscula* YELLOW PINCUSHION. Annual. Sandy places; openings in coastal sage scrub. DEB & FMR 3427 (RSA).
- Cirsium occidentale*** (Nutt.) Jepson var. *occidentale* COBWEB THISTLE. Perennial. Occasional on slopes and on ridges; coastal sage scrub. FMR & DEB 5907 (RSA).
- **Conyza bonariensis*** (L.) Cronq. FLAX-LEAVED HORSEWEED. Annual. Occasional on flats and canyon bottoms; sycamore riparian woodland. FMR & A. Davenport 6014 (RSA).
- Conyza canadensis*** (L.) Cronq. COMMON HORSEWEED. Annual. Occasional on flats, hillsides, and along drainages; annual grassland, baccharis scrub, mulefat scrub, and sycamore riparian woodland. FMR & A. Davenport 6009 (RSA), FMR & DEB 6078.
- Corethrogyne filaginifolia*** (Hook. & Arn.) Nutt. var. *virgata* (Benth.) A. Gray [*Lessingia f.* (Hook. & Arn.) M.A. Lane var. *filaginifolia*] VIRGATE SAND. ASTER. Perennial. Scattered on ridges and slopes; open coastal sage scrub, needlegrass perennial grassland, annual grassland, and ephemeral wetlands. FMR & A. Davenport 6004 (RSA).
- **Cynara cardunculus*** L. CARDOON or GLOBE ARTICHOKE. Perennial. Occasional on open slopes and along drainages; annual grassland, and baccharis scrub. This invasive weed would probably be far more abundant except for management efforts to control its spread on Conservancy land. FMR & DEB 6125 (RSA).
- Deinandra fasciculata*** (DC.) E. Greene [*Hemizonia f.* DC] FASCICLED TARPLANT. Annual. Occasional to fairly common in open areas, frequently on heavier soils; annual grassland, needlegrass perennial grassland, and openings in coastal sage scrub. FMR 5692 (RSA).
- Deinandra paniculata*** (A. Gray) Davids. & Moxley [*Hemizonia p.* A. Gray] PANICULATE TARPLANT. See Figure 3. Annual. Scattered to locally abundant on flats, slopes, and ridge lines, mostly on clay soils; annual grassland, perennial grasslands, and openings in coastal sage scrub. In 2003 *D. paniculata* was found at 166 sites forming an almost continuous population along the eastern boundary of the Conservancy and toward the interior. The stands varied in number from about ten individuals to hundreds with a few sites probably exceeding several thousand. In 2004 the population was considerably reduced. Rancho Mission Viejo forms the core for *D. paniculata* distribution in Orange County and the plant is less frequently encountered away from this area. Rare: CNPS List 4. FMR & DEB 5891 (RSA); DEB & FMR 3432 (RSA).
- Encelia californica*** Nutt. CALIFORNIA ENCELIA. Shrub. Fairly common on slopes; coastal sage scrub. FMR & DEB 5569 (RSA).
- Ericameria palmeri*** (Hall) Hall var. *pachylepis* (Hall) Nesom GRASSLAND GOLDENBUSH. Subshrub. Occasional to locally fairly common on open grassy hillsides; annual grassland. FMR & DEB 6132 (RSA).
- Erigeron foliosus*** Nutt. var. *foliosus* LEAFY DAISY. Perennial. Occasional on ridges and slopes; coastal sage scrub and toyon-sumac chaparral. FMR & DEB 5826; FMR & DEB 5891 (RSA).
- Filago californica*** Nutt. [*Logfia filaginoides* (Hook. & Arn.) Morefield] CALIFORNIA FILAGO or FLUFFWEED. Annual. Occasional on ridges, barrens, and on slopes; openings in coastal sage scrub. FMR & DEB 5827 (RSA), DEB & FMR 3339 (RSA).
- **Filago gallica*** L. [*Logfia g.* (L.) Cosson & Germain] NARROW-LEAVED FILAGO. Annual. Fairly common on ridges, barrens, and slopes; annual grassland, openings in coastal sage scrub, dirt roads and trail. DEB 3339 (RSA); FMR & DEB 5637 (RSA).

- *Gazania linearis** (Thunb.) Druce GAZANIA. Perennial. Uncommon weed; needlegrass perennial grassland. FMR 5677 (RSA).
- Gnaphalium palustre** Nutt. LOWLAND CUDWEED. Annual. Occasional along sandy washes in Cristianitos Creek; open mulefat scrub, riparian herb community. FMR & DEB 5898 (RSA).
- Grindelia hirsutula** Hook. & Arn. [*G. camporum* E. Greene, *G. c. E. Greene* var. *bracteosa* (J.T. Howell) M.A. Lane, *G. robusta* Nutt. var. *robusta*] WHITE-STEM GUMPLANT. Perennial. Occasional on hillsides and barren margins; coastal sage scrub and needlegrass perennial grassland. FMR & DEB 6126 (RSA).
- Gutierrezia californica** (DC.) Torr. & A. Gray CALIFORNIA MATCHWEED. Subshrub. Occasional on dry slopes and ridges; coastal sage scrub. FMR & A. Davenport 6015 (RSA).
- *Hedypnois cretica** (L.) Dum.-Courset. CRETE HEDYPNOIS. Annual. Fairly common in heavy clay soils along paths and disturbed areas; annual grassland and coastal sage scrub. FMR 5624 (RSA).
- Heterotheca grandiflora** Nutt. TELEGRAPH WEED. Perennial. Fairly common in sandy places and disturbed areas, flats, drainages, and on slopes; annual grassland, open coastal sage scrub, and alluvial fan scrub. FMR & DEB 5919 (RSA).
- *Hypochaeris glabra** L. [*Hypochaeris g. L.*] SMOOTH CAT'S EAR. Annual. Fairly common on slopes and in disturbed sites as along paths; annual grassland and openings in coastal sage scrub. FMR & DEB 5615 (RSA).
- Isocoma menziesii** (Hook. & Arn.) Nesom var. *vernonioides* (Nutt.) Nesom COASTAL GOLDENBUSH. Shrub. Occasional to locally frequent along drainages, flats, and on hillsides; coastal sage scrub, openings in oak riparian forest, and baccharis scrub. FMR & A. Davenport 6002 (RSA).
- *Lactuca serriola** L. PRICKLY or WILD LETTUCE. Annual. Occasional weed on slopes and in canyon bottoms; annual grassland, and sycamore riparian woodland. FMR & A. Davenport 6016 (RSA).
- Lepidospartum squamatum** (A. Gray) A. Gray SCALE-BROOM. Shrub. Uncommon along sandy creek benches of Cristianitos Creek in the south; alluvial fan scrub. FMR & DEB 6089 (RSA).
- Micropus californicus** Fischer & C. Meyer var. *californicus* SLENDER COTTONWEED. Annual. Occasional but locally common on slopes and ridges; needlegrass perennial grassland, openings in oak woodland. FMR & DEB 6037.
- Microseris douglasii** (DC.) Sch.-Bip. subsp. *platycarpha* (A. Gray) Chambers SMALL-FLOWERED MICROSERIS. Annual with nodding heads. Scattered, mostly on slopes and flats on clay soil; perennial grassland. *M. douglasii* subsp. *platycarpha* was located in four separate stands consisting of about 590 individuals in the northeastern portion of the Conservancy. Rare: CNPS List 4. DEB & FMR 3358 (RSA); FMR & DEB 5621 (RSA).
- Microseris heterocarpa** (Nutt.) Chambers [*Stebbinopsis h.* (Nutt.) Chambers] DERIVED MICROSERIS. Annual. Occasional to locally frequent on heavy soils; coastal sage scrub and needlegrass perennial grassland. FMR & DEB 5614 (RSA).
- Microseris lindleyi** (DC.) A. Gray [*M. linearifolia* (Nutt.) Sch.-Bip., *Uropappus l.* (DC.) Nutt.] SILVER PUFFS. Annual. Fairly common on slopes; needlegrass perennial grassland, annual grassland, openings in coastal sage scrub. FMR & DEB 6032.
- Osmadenia tenella** Nutt. SOUTHERN ROSIN WEED. Annual. Fairly common but variable, locally abundant in 2003 but much less common in other years; open areas, annual grassland, needlegrass perennial grassland. FMR 5676 (RSA).
- *Picris echinoides** L. [*Helminthotheca e. (L.) Holub*] BRISTLY OX-TONGUE. Annual. Occasional weed in mesic habitats along drainages, flats, and gentle slopes, often in

- disturbed areas; ephemeral wetlands, annual grassland, riparian herb community. FMR & A. Davenport 6006 (RSA).
- Pseudognaphalium bioletti* Anderberg [*Gnaphalium bicolor* Bioletti] BIOLETTI'S or BICOLORED CUDWEED. Perennial. Occasional; perennial grassland, openings of coastal sage scrub, and sandstone barrens. FMR & DEB 5589 (RSA); DEB 3349 (RSA).
- Pseudognaphalium californicum* (DC.) Anderberg [*Gnaphalium c.* DC.] CALIFORNIA EVERLASTING. Perennial. Occasional on slopes, ridges, and in openings; coastal sage scrub, baccharis scrub, annual grassland, oak woodland. FMR 5671 (RSA).
- Pseudognaphalium microcephalum* (Nutt.) Anderberg [*Gnaphalium canescens* subsp. *m.* (Nutt.) Stebb. & Keil, *G. m.* Nutt.] WHITE EVER-LASTING. Perennial. Occasional to fairly common on dry ridges, slopes, banks, and sandstone outcrops; openings in coastal sage scrub and chaparral, and alluvial fan scrub. FMR & DEB 5642 (RSA), FMR 5869 (RSA).
- Pseudognaphalium cf. leucocephalum* [*Gnaphalium l.* A. Gray] ALLUVIAL EVERLASTING. See Figure 4. Perennial. Uncommon, represented by two small stands with a total of 21 individuals, in sandy washes and stream benches along Cristianitos Creek in the south; alluvial fan scrub, mulefat scrub. Andrew Sanders at UCR has pointed out that southern California plants appear to be distinct from plants in Arizona and Mexico. If this is the case, the species is nearly endemic to southern with fewer than 25 known occurrences. In Orange County all recent records are from San Juan Creek in the vicinity of San Juan Capistrano, or the Conservancy. Regardless of its distinctiveness, *P. leucocephalum* in California would qualify as a CNPS. Rare: Local Concern. FMR & DEB 6087 (RSA), FMR & DEB 6088 (RSA).
- **Pseudognaphalium luteoalbum* (L.) Hilliard & B.L. Burt [Gnaphalium l. L.] WEEDY CUDWEED. Perennial. Uncommon and local along sandy washes in Cristianitos Creek; alluvial fan scrub and open mulefat scrub. FMR & DEB 5899 (RSA).
- Pseudognaphalium stramineum* (Kunth.) Anderberg [*Gnaphalium chilense* Sprengel, G. s. Kunth.] COTTON-BATTING PLANT. Perennial. Occasional on slopes and ridges; openings in coastal sage scrub. FMR & DEB 5842 (RSA).
- Rafinesquia californica* Nutt. CALIFORNIA CHICORY. Annual. Fairly common on ridges and canyon slopes throughout the Conservancy; coastal sage scrub. DEB & FMR 3331 (RSA).
- **Silybum marianum* (L.) Gaertn. MILK THISTLE. Perennial. Locally abundant in understory of oak woodland. FMR 5686 (RSA).
- **Sonchus oleraceus* L. COMMON SOW-THISTLE. Annual. Occasional on flats and near drainages, especially in Cristianitos Canyon; annual grassland, oak woodland, disturbed areas. FMR 5669 (RSA).
- Stephanomeria diegensis* Gottlieb SAN DIEGO WREATH-PLANT. Annual. Occasional on sandy soil in canyon bottoms, slopes and along ridges; sycamore riparian woodland, needlegrass perennial grassland, and coastal sage scrub. FMR & A. Davenport 6010 (RSA), FMR & DEB 6128 (RSA).
- Stylocline gnaphaloides* Nutt. EVERLASTING NEST-STRAW. Annual. Scattered to frequent on ridges and sandstone barrens; coastal sage scrub. FMR & DEB 5588 (RSA).
- Xanthium strumarium* L. var. *canadense* (Mill.) Torr. & A. Gray COCKLEBUR. Perennial. Infrequent on slopes and along drainages; ephemeral wetlands, riparian herb community, and mulefat scrub. FMR & DEB 6003 (RSA).

Boraginaceae – Borage Family

- Amsinckia menziesii* (Lehm.) Nels. & Macbr. var. *intermedia* (F. & M.) Ganders
COMMON FIDDLENECK. Annual. Fairly common in sunny locations, often on sandy soil; openings in coastal sage scrub, annual grassland, and disturbed sites. DEB & FMR 3333 (RSA).
- Cryptantha intermedia* (A. Gray) E. Greene COMMON CRYPTANTHA. Annual. Widespread in sandy areas along ridges and on slopes; openings of coastal sage scrub. DEB & FMR 3332 (RSA); FMR & DEB 5651 (RSA).
- Cryptantha microstachys* (A. Gray) E. Greene TEJON CRYPTANTHA. Annual. Occasional to locally frequent on ridges and slopes; openings of coastal sage scrub. FMR & DEB 5584 (RSA); FMR & DEB 5908 (RSA).
- Harpagonella palmeri* A. Gray PALMER'S GRAPPLING-HOOK. Annual with distinctive grappling-hook shaped fruits. Scattered and patchy on clay soil on slopes; annual grassland, perennial grassland, and open coastal sage scrub. Twenty stands consisting of 5,817 individuals were located along the eastern side of the Conservancy. Rare: CNPS List 4. FMR & DEB 5563 (RSA); DEB 3352B (RSA); DEB 3354; FMR 5691 (RSA).
- Plagiobothrys collinus* (Phil.) I.M. Johnston. var. *californicus* (A. Gray) Higgins CALIFORNIA POPCORN-FLOWER. Annual. Ridges and slopes; openings of coastal sage scrub. DEB & FMR 3338 (RSA).
- Plagiobothrys nothofulvus* (A. Gray) A. Gray RUSTY POPCORN-FLOWER. Annual. Occasional in open areas; coastal sage scrub and needlegrass perennial grassland. FMR & DEB 5577 (RSA).

Brassicaceae (Cruciferae) – Mustard Family

- **Brassica geniculata* (Desf.) J. Ball SHORTPOD or SUMMER MUSTARD. Biennial or short-lived perennial. Fairly common weed in open areas; annual grassland, open coastal sage scrub, and alluvial fan scrub. FMR & DEB 5921 (RSA).
- **Brassica nigra* (L.) Koch BLACK MUSTARD. Annual. Occasional weed on slopes, ridges, and canyon bottoms; annual grassland and baccharis scrub. FMR & DEB 6041 (RSA).
- Caulanthus heterophyllus* Nutt. [*C. h.* var. *pseudosimulans* R. Buck, nomen nudum]
SAN DIEGO JEWEL FLOWER. Annual. Openings in coastal sage scrub. DEB & FMR 3429 (RSA).
- Lepidium nitidum* Torr. & A. Gray var. *nitidum* SHINING PEPPERGRASS. Annual. Occasional on ridges and on slopes; openings of coastal sage scrub. FMR & DEB 5583 (RSA).
- **Raphanus sativus* L. WILD RADISH. Annual. Uncommon on slopes in disturbed areas as along dirt roads; coastal sage scrub. FMR & DEB 6043 (RSA).
- **Sisymbrium officinale* L. HEDGE-MUSTARD. Annual. Occasional weed on gentle hillsides; annual grassland. FMR & DEB 5924 (RSA), FMR & DEB 6042 (RSA).

Cactaceae – Cactus Family

- Cylindropuntia prolifera* (Engelm.) F.M. Kunth [*Opuntia p.* Engelm.] COASTAL CHOLLA. Succulent shrub. Occasional on dry hillsides; coastal sage scrub and cactus scrub. FMR & DEB 6129 (RSA).



Figure 3. *Deinandra paniculata* (A. Gray) Davids. & Moxley [*Hemizonia p.* A. Gray]
PANICULATE TARPLANT.



Figure 4. *Pseudognaphalium* cf. *leucocephalum* [*Gnaphalium l.* A. Gray]
ALLUVIAL EVERLASTING.



Figure 5. *Dudleya multicaulis* (Rose) Moran
MANY-STEMMED DUDLEYA.



Figure 6. *Calochortus weedii* Alph. Wood var. *intermedius* F. Ownbey
INTERMEDIATE MARIPOSA LILY.

- Opuntia littoralis* (Engelm.) Cockerell COASTAL PRICKLY PEAR. Succulent shrub. Fairly common on dry slopes and ridges; cactus scrub, coastal sage scrub, and toyon-sumac chaparral. FMR & DEB 6081 (RSA).

Campanulaceae – Bellflower Family

- Triodanis biflora* (Ruiz Lopez & Pavon) McVaugh SMALL VENUS'S LOOKING-GLASS. Annual. Shady openings; oak woodland. DEB & FMR 3371 (RSA).

Caryophyllaceae – Pink Family

- **Cerastium glomeratum* Thuill. STICKY MOUSE-EAR CHICKWEED. Annual. Occasional in shaded areas; annual grassland, sycamore woodland. FMR 5629 (RSA).
- Silene antirrhina* L. SNAPDRAGON CATCHFLY. Annual. Infrequent on sandy soil along dry ridges; openings in coastal sage scrub. FMR & DEB 5825 (RSA).
- **Silene gallica* L. WINDMILL PINK. Annual. Occasional on ridges, slopes, and flats; open coastal sage scrub, annual grassland, and disturbed areas. FMR 5611 (RSA).
- Silene laciniata* Cav. subsp. *major* Hitchc. & Maguire MEXICAN PINK. Annual. Occasional on ridges and slopes; openings of coastal sage scrub, borders of toyon-sumac chaparral, and shaded understory of oak woodland. FMR & DEB 5874 (RSA); DEB 3595 (RSA).
- **Spergularia villosa* (Pers.) Camb. VILLOUS SAND SPURRY. FMR & Laura Cohen 5266 (RSA).
- **Stellaria media* (L.) Villars COMMON CHICKWEED. Annual. Occasional, but sometimes abundant in shady places under oaks; annual grassland, oak woodland, sycamore woodland. FMR & DEB 6040 (RSA).

Chenopodiaceae – Goosefoot Family

- **Atriplex semibaccata* R. Br. AUSTRALIAN SALTBUCH. Perennial. Occasional to fairly common weed of disturbed sites along roadsides, trails, and barrens; annual grassland, coastal sage scrub. FMR & A. Davenport 6008 (RSA).
- Chenopodium californicum* (S. Watson) S. Watson CALIFORNIA GOOSEFOOT. Perennial. Occasional along ridgelines and in shady spots; coastal sage scrub, oak woodland. FMR & DEB 5648 (RSA).
- **Chenopodium murale* L. NETTLE-LEAVED GOOSEFOOT. Annual. Uncommon weed on hillsides; annual grassland. FMR & DEB 5926 (RSA).

Convolvulaceae – Morning-glory Family

- Calystegia macrostegia* (E. Greene) Brummitt subsp. *cyclostegia* (House) Brummitt PURPLE-BRACTED MORNING-GLORY. Perennial. Uncommon in canyon bottoms; grassy openings within oak woodland. FMR & DEB 5600 (RSA).
- Calystegia macrostegia* (E. Greene) Brummitt subsp. *intermedia* (Abrams) Brummitt SHORT-LOBED MORNING-GLORY. Perennial, often clambering over shrubs, occasional to fairly common; coastal sage scrub and annual grassland. FMR & DEB 5591 (RSA).
- Convolvulus simulans* L.M. Perry SMALL-FLOWERED MORNING-GLORY. Annual. Known only from a single location with about 200 individuals along one of the

southern ridgelines. The site is on a north-facing slope on clay soils in a needlegrass perennial meadow. Rare: CNPS List 4. FMR & DEB 5652 (RSA).

Crassulaceae – Stonecrop Family

Crassula connata (Ruiz Lopez & Pavon) Berger SAND PIGMY-STONECROP. Annual. Occasional to locally common in open sandy areas on ridges, slopes, and sandstone barrens; coastal sage scrub, needlegrass perennial grassland, and annual grassland. FMR 5867 (RSA).

Dudleya edulis (Nutt.) Moran LADIES'-FINGERS. Succulent perennial. Fairly common on dry cliffs, and borders of sandstone outcrops and barrens; coastal sage scrub. FMR & DEB 5909 (RSA).

Dudleya lanceolata (Nutt.) Britton & Rose LANCELEAF or COASTAL DUDLEYA. Succulent perennial. Occasional on dry slopes and along sandstone cliffs; open coastal sage scrub. FMR & DEB 5885 (RSA).

Dudleya multicaulis (Rose) Moran MANY-STEMMED DUDLEYA. See Figure 5. Succulent perennial. Occasional, patchy, sometimes locally common, slopes, ridges, and sandstone outcrops; needlegrass perennial grassland and coastal sage scrub. A total of 47 stands totaling of 7,963 individuals were located within the Conservancy. This represents about 18 percent of the 45,436 individuals reported from Rancho Mission Viejo (County of Orange 2004)³. Rare: CNPS List 1B. FMR & DEB 5841 (RSA).

Dudleya pulverulenta (Nutt.) Britton & Rose subsp. *pulverulenta* CHALKY LIVE-FOREVER. Large, white-chalky succulent perennial. Uncommon on dry slopes and sandstone cliffs; coastal sage scrub. FMR & DEB 6080 (RSA).

Cucurbitaceae – Gourd Family

Cucurbita foetidissima Kunth CALABAZILLA. Perennial vine. Occasional on flats; annual grassland. FMR & DEB 6130 (RSA).

Marah macrocarpus (E. Greene) E. Greene var. *macrocarpus* WILD CUCUMBER. Perennial vine. Occasional, often climbing over shrubs on slopes; coastal sage scrub, toyon-sumac chaparral. FMR & Laura Cohen 6023 (RSA).

Euphorbiaceae – Spurge Family

Croton setiger Hook. [*Eremocarpus* s. (Hook.) Benth.] DOVEWEED. Annual. Occasional on flats and gentle hillsides; annual grassland. FMR & DEB 5922 (RSA).

Euphorbia polycarpa Benth. var. *polycarpa* [*Chamaesyce polycarpa* (Benth.) Millsp.] GOLONDRINA or SMALL-SEED SANDMAT. Perennial. Occasional on dry slopes, ridges, and along sandy washes on Cristianitos Creek; coastal sage scrub, mulefat scrub, alluvial fan scrub. FMR & DEB 6086 (RSA).

Fabaceae (Leguminosae) – Pea Family

Amorpha fruticosa L. [Incl. *A. f.* var. *occidentalis* (Abrams) Kearney & Peebles] WESTERN FALSE INDIGO. Shrub. Uncommon on creek terraces along Cristianitos Creek in the south; willow riparian scrub and alluvial fan scrub. FMR & DEB 6090.

³ EIR 581 (County of Orange 2004) reported 55,736 individuals for Rancho Mission Viejo but a math error increased the total by about 10,000 individuals so the 45,436 figure is correct based on data supplied within the document.

- Lotus hamatus* E. Greene GRAB LOTUS. Annual. Occasional; openings of coastal sage scrub. FMR & DEB 5582 (RSA).
- Lotus salsuginosus* E. Greene subsp. *salsuginosus* ALKALI LOTUS. Annual. Occasional on ridges; coastal sage scrub and sandstone outcrops. FMR & DEB 5653 (RSA).
- Lotus scoparius* (Nutt.) Otley var. *scoparius* COASTAL DEERWEED. Subshrub. Fairly common on slopes and along ridges; coastal sage scrub, alluvial fan scrub, and less common in toyon-sumac chaparral. FMR & DEB 5570 (RSA).
- Lotus strigosus* (Nutt.) E. Greene var. *strigosus* STRIGOSE LOTUS. Annual. Occasional annual along ridges and on slopes; openings of coastal sage scrub. FMR & DEB 5585 (RSA).
- Lotus purshianus* (Benth.) Clements & E.G. Clements SPANISH LOTUS. Annual. Fairly common throughout; annual grassland, perennial needlegrass grassland, and openings about oak woodlands and sycamore riparian woodland. FMR 5666 (RSA).
- Lupinus bicolor* Lindley MINIATURE LUPINE Annual. Fairly common; needlegrass perennial grasslands, annual grasslands, and sandy openings in coastal sage scrub. FMR & DEB 5576 (RSA); DEB 3350 (RSA).
- Lupinus microcarpus* Sims var. *microcarpus* CHICK LUPINE. Annual. Occasional in canyons; annual grassland openings in oak woodland. FMR 5689 (RSA).
- Lupinus succulentus* Koch ARROYO LUPINE. Annual. Occasional on slopes and flats; annual grassland and needlegrass perennial grassland. FMR & DEB 5623 (RSA).
- Lupinus truncatus* Hook. & Arn. COLLAR LUPINE. Annual. Occasional; open, grassy coastal sage scrub. FMR & DEB 5580 (RSA)
- **Medicago polymorpha* L. BUR-CLOVER. Annual. Fairly common on hillsides and in canyons; annual grassland, oak woodland, and coastal sage scrub. FMR & Laura Cohen 5267 (RSA).
- **Melilotus albus* Medickus WHITE SWEET-CLOVER. Annual. Occasional along sandy washes in Cristianitos Creek; open mulefat scrub and riparian herb community. FMR & DEB 5896 (RSA).
- **Melilotus indicus* (L.) All. YELLOW SWEET-CLOVER. Annual. Occasional about drainages mostly in vicinity of Cristianitos Canyon; riparian herb community, annual grassland, and at borders of oak woodland. FMR 5668 (RSA).
- Trifolium ciliolatum* Benth. TREE CLOVER. Annual. Uncommon on slopes and sandstone barrens; coastal sage scrub and needlegrass perennial grassland. FMR 5694 (RSA), FMR & DEB 6030 (RSA).
- **Trifolium hirtum* All. ROSE CLOVER. Annual. Occasional on slopes and about drainages; perennial needlegrass grassland, ephemeral wetlands, and annual grassland openings of oak woodland. FMR 5667 (RSA); DEB & FMR 3352D (RSA).
- **Vicia benghalensis* L. PURPLE VETCH. Annual. Occasional in canyon bottoms; annual grassland and borders of coastal sage scrub and oak woodland. FMR 5683 (RSA).
- **Vicia sativa* L. subsp. *nigra* (L.) Ehrhart NARROW-LEAVED VETCH. Occasional to locally frequent along drainage borders; annual grassland. FMR & DEB 5617 (RSA).

Fagaceae – Oak Family

- Quercus agrifolia* Nee var. *agrifolia* COAST LIVE OAK. Tree. Common along drainages and on north-facing slopes; oak woodland, riparian oak woodland, sycamore riparian woodland. Less common as isolated individuals on dry slopes in coastal sage scrub and toyon-sumac chaparral. FMR & DEB 5923 (RSA).

Quercus berberidifolia Liebm. x *Q. engelmannii* E. Greene. Shrub. Fairly common on ridges, slopes, and canyon bottoms; toyon-sumac chaparral and bordering oak woodlands. FMR & DEB 5645 (RSA).

Quercus engelmannii E. Greene ENGELMANN'S OAK. Small tree. Uncommon in canyon bottoms and occasionally higher on the slopes; mostly oak woodland or bordering chaparral. *Quercus engelmannii* is known from four sites consisting of six individuals. Habitat at the northernmost site, where a single large tree grows in deep soils, is probably most characteristic of the species. Rare: CNPS List 4. FMR & DEB 5596 (RSA).

Quercus engelmannii E. Greene infl. by *Quercus berberidifolia* Liebm. ENGELMANN'S OAK. Rare: CNPS List 4. Shrub. Fairly common on slopes and in canyon bottoms; chaparral and oak woodland. FMR 5685 (RSA).

Gentianaceae – Gentian Family

Centaurium venustum (A. Gray) Robinson CANCHALAGUA. Annual. Occasional to fairly common along ridges and on slopes; annual grassland, openings in coastal sage scrub, needlegrass perennial grassland. FMR & DEB 5886 (RSA).

Geraniaceae – Geranium Family

**Erodium brachycarpum* (Godron) Thell. SHORT-FRUITED FILAREE. Annual. Fairly common on gentle slopes and canyon bottoms; annual and perennial grassland, and along dirt roads. DEB 3351 (RSA).

**Erodium cicutarium* (L.) L'Her. RED-STEMMED FILAREE. Annual. Widespread and common; annual grassland, disturbed areas, and openings in coastal sage scrub. FMR & DEB 5622 (RSA).

**Erodium moschatum* (L.) L'Her. WHITE-STEMMED FILAREE. Annual. Fairly common, slopes, flats, and canyon bottoms; mostly annual grassland and oak woodlands. FMR 5602 (RSA).

Geranium carolinianum L. CAROLINA GERANIUM. Annual. Occasional; perennial grassland. DEB & FMR 3357 (RSA).

**Geranium dissectum* L. CUT-LEAVED GERANIUM. Annual. Fairly common bordering drainages; oak woodland, sycamore riparian woodland, annual grassland, and ephemeral wetlands. FMR & DEB 5619 (RSA), FMR 5664 (RSA).

Hydrophyllaceae – Waterleaf Family

Eucrypta chrysanthemifolia (Benth.) E. Greene var. *chrysanthemifolia* COMMON EUCRYPTA. Annual. Scattered along ridges and on slopes; open coastal sage scrub. FMR 5603 (RSA).

Pholistoma auritum (Lindley) Lilja var. *auritum* BLUE FIESTA FLOWER. Annual. Occasional; mostly oak woodlands. FMR & DEB 5599 (RSA).

Lamiaceae – Mint Family

**Marrubium vulgare* L. COMMON HOREHOUND. Perennial. Occasional weed on hillsides and on flats; annual grassland, open grassy oak woodland. FMR & DEB 5927 (RSA).

Salvia apiana Jepson WHITE SAGE. Shrub. Fairly common on dry hillsides and on ridges; coastal sage scrub. FMR & DEB 5830 (RSA).

- Salvia apiana* Jepson x *S. mellifera* E. Greene. Shrub. Occasional where ever white and sage and black sage occur together. FMR & DEB 5829 (RSA).
- Salvia mellifera* E. Greene BLACK SAGE. White-flowered perennial shrub, common in coastal sage scrub. FMR & DEB 5593 (RSA).
- Stachys rigida* Nutt. subsp. *quercetorum* (Heller) Epl. [*S. ajugoides* Benth. var. *rigida* Jepson. & Hoover, in part] HILLSIDE HEDGE-NETTLE. Perennial. Occasional on mesic slopes; needlegrass perennial grassland and margins of coastal sage scrub and oak woodland. FMR & DEB 5575 (RSA).
- Trichostema lanceolatum* Benth. VINEGAR WEED. Annual. Occasional on gentle hillsides; ephemeral wetlands, needlegrass perennial grassland. FMR & A. Davenport 6001 (RSA).

Malvaceae – Mallow Family

- Sidalcea malvaeflora* (DC.) Benth. subsp. *malvaeflora* COMMON CHECKER BLOOM. Perennial. Occasional on mesic hillsides and drainages; needlegrass perennial grassland, openings in oak woodland, open coastal sage scrub. FMR & DEB 5928A (RSA).

Nyctaginaceae – Four-O’Clock Family

- Mirabilis laevis* (Benth.) Curran CALIFORNIA WISHBONE BUSH. Perennial. Occasional to fairly common, mostly south-facing aspects, along ridges and on slopes; coastal sage scrub. FMR 5605 (RSA).

Onagraceae – Evening Primrose Family

- Camissonia bistorta* (Torr. & A. Gray) Raven CALIFORNIA SUNCUP. Annual. Occasional to frequent in sandy open areas and along old dirt roads: open coastal sage scrub, and chaparral. FMR & DEB 5647 (RSA).
- Clarkia purpurea* (Curtis) Nelson & J.F. Macbr. subsp. *quadrivulnera* (Douglas) Harlan Lewis & M. Lewis FOUR-SPOT CLARKIA. Annual. Scattered on ridges and slopes; openings in coastal sage scrub, and chaparral. FMR & DEB 5641 (RSA).
- Epilobium canum* E. Greene subsp. *canum* NARROW-LEAVED FUCHSIA. Annual. Occasional in canyon bottoms and drainages; sycamore woodland, mulefat scrub, and riparian herb community. FMR & A. Davenport 6103 (RSA).

Oxalidaceae – Wood-Sorrel Family

- Oxalis albicans* HBK. subsp. *californica* (Abrams) Eiten. CALIFORNIA WOOD-SORREL. Yellow-flowered perennial. Occasional on ridges and slopes and on exposed sandstone; coastal sage scrub, annual grassland. FMR & DEB 5590 (RSA); DEB & FMR 3340 (RSA).
- **Oxalis pes-caprae* L. BERMUDA-BUTTERCUP or SOUR-GRASS. Perennial. Occasional weed, sometimes common where found, canyons; understory and borders of oak woodland. FMR & Laura Cohen 6022 (RSA).

Papaveraceae – Poppy Family

Eschscholzia californica Cham. subsp. *californica* CALIFORNIA POPPY. Annual. Infrequent on slopes and on flats mostly near Cristianitos Road; annual grassland and coastal sage scrub. FMR 5680 (RSA).

Plantaginaceae – Plantain Family

Plantago erecta Morris CALIFORNIA PLANTAIN. Annual. Occasional on clay soil or borders of sandstone barrens on slopes and ridges; needlegrass perennial grassland and open coastal sage scrub. FMR & DEB 5564 (RSA).

**Plantago major* L. COMMON PLANTAIN. Annual. Infrequent on bank above Cristianitos Creek at south end of Conservancy; willow riparian scrub. FMR & DEB 6085 (RSA).

**Plantago virginica* L. RED-SEEDED PLANTAIN. Annual. Infrequent on ridges and along dirt roads; open coastal sage scrub. FMR & DEB 5654 (RSA).

Platanaceae – Sycamore Family

Platanus racemosa Nutt. CALIFORNIA SYCAMORE. Tree. Occasional to fairly common along drainages in Cristianitos Canyon; sycamore riparian woodland. FMR & A. Davenport 6007 (RSA).

Polemoniaceae – Phlox Family

Eriastrum sapphirinum (Eastw.) H. Mason SAPHIRE WOOLLY-STAR. Annual. Occasional, sporadic, but sometimes abundant on dry ridges and slopes; openings in coastal sage scrub, annual grassland. FMR & DEB 5911 (RSA).

Leptosiphon liniflorus (Benth.) J.M. Porter & L.A. Johnson FLAX-FLOWERED LINANTHUS. Uncommon but sometimes locally frequent on grassy slopes; coastal sage scrub, and needlegrass perennial grassland. FMR & DEB 5693 (RSA).

Polygonaceae – Buckwheat Family

Chorizanthe staticoides Benth. TURKISH RUGGING. Annual. Fairly local on sandstone outcrops and open barrens; annual grassland and openings in coastal sage scrub. FMR 5871 (RSA); DEB & FMR 3424 (RSA).

Eriogonum fasciculatum Benth. subsp. *fasciculatum* CALIFORNIA BUCKWHEAT. Shrub. Widespread and fairly common on ridges and slopes; coastal sage scrub and alluvial fan scrub, less frequent in toyon-sumac chaparral. FMR & DEB 5639 (RSA).

Pterostegia drymarioides Fischer & C. Meyer PTEROSTEGIA or GRANNY'S HAIRNET. Annual. Occasional on slopes, ridges, and on barrens; open coastal sage scrub. FMR & DEB 5828 (RSA).

**Rumex crispus* L. CURLY DOCK. Annual. Occasional on slopes and along drainages; sycamore woodland, annual grassland and riparian herb community. FMR 5682 (RSA).

Rumex salicifolius J.A. Weinm. var. *denticulatus* Torr. CALIFORNIA DOCK. Perennial. Infrequent in canyons and near moist areas; sycamore woodland and drainages. FMR 5629 (RSA).

Portulacaceae – Purslane Family

Calandrinia ciliata (R. & P.) DC. RED MAIDS. Annual. Occasional on ridges and slopes; needlegrass perennial grassland, annual grassland, and open coastal sage scrub. FMR & DEB 5578 (RSA).

Claytonia perfoliata Willd. subsp. *perfoliata* COMMON MINER'S-LETTUCE. Annual. Occasional on shaded slopes; oak woodland and perennial grasslands. DEB 3352 (RSA).

Primulaceae – Primrose Family

**Anagallis arvensis* L. SCARLET PIMPERNEL. Annual. Widespread but uncommon along roads and on flats; annual grassland, mixed chaparral, coastal sage scrub, and disturbed areas. FMR & DEB 5640 (RSA).

Dodecatheon clevelandii Greene subsp. *clevelandii* PADRE'S SHOOTING STAR. Perennial. Fairly common but scattered and patchy; needlegrass perennial grassland, annual grassland. FMR & Laura Cohen 5269 (RSA).

Ranunculaceae – Crowfoot Family

Ranunculus californicus Benth. var. *californicus* CALIFORNIA BUTTERCUP. Perennial. Occasional to fairly common on open hillsides; needlegrass perennial grassland, annual grassland. FMR & Laura Cohen 5268 (RSA).

Rhamnaceae – Buckthorn Family

Rhamnus ilicifolia Kellogg HOLLY-LEAVED REDBERRY. Shrub. Occasional on ridges, slopes, and in shaded canyons; toyon-sumac chaparral and oak woodlands. Infrequent in coastal sage scrub. FMR 5607 (RSA).

Rosaceae – Rose Family

Aphanes occidentalis (Nutt.) Rydb. [*Alchemilla o.* Nutt.] WESTERN LADY'S MANTLE. Annual. Uncommon on shaded, mesic slopes; needlegrass perennial grassland along borders of oak woodland and chaparral. FMR & DEB 6038 (RSA).

Cercocarpus minutiflorus Abrams SAN DIEGO MOUNTAIN MAHOGANY. Shrub. Scarce along ridges on western boundary of Conservancy; chaparral where a small stand of four individuals was observed. Rare: Local Concern. FMR & DEB 5646 (RSA).

Heteromeles arbutifolia (Lindley) Roemer TOYON or CHRISTMAS BERRY. Shrub. Fairly common on slopes, especially north-facing slopes, and in drainages; toyon-sumac chaparral, and oak woodland. Occasional in coastal sage scrub. FMR & R. L. Allen 6020 (RSA).

Potentilla glandulosa Lindley subsp. *glandulosa* STICKY CINQUEFOIL. Perennial. Uncommon on mesic slopes; grassy borders of toyon-sumac chaparral. FMR & DEB 6035 (RSA).

Rubus ursinus Cham. & Schidl. CALIFORNIA BLACKBERRY. Shrubby vine. Occasional in canyon bottoms; sycamore riparian woodland and mulefat scrub. FMR 5626 (RSA).

Rubiaceae – Madder Family

Galium angustifolium Nutt. subsp. *angustifoium* NARROW-LEAVED BEDSTRAW. Shrub. Occasional throughout on hillsides and in canyons; coastal sage scrub, chaparral, and oak woodland. FMR & DEB 5644 (RSA).

**Galium aparine* L. COMMON BEDSTRAW. Annual. Occasional to fairly common, especially in understory of oak woodland. FMR 5674 (RSA).

Galium nuttallii A. Gray subsp. *nuttallii* SAN DIEGO BEDSTRAW. Clinging and climbing perennial. Occasional on slopes; borders of oak woodland and toyon-sumac chaparral. FMR & DEB 6036 (RSA).

Galium porrigens Dempster var. *porrigens* CLIMBING BEDSTRAW. Shrubby perennial. Occasional on hillsides; borders of oak woodland, baccharis scrub, and toyon-sumac chaparral. FMR & DEB 6029 (RSA).

Salicaceae – Willow Family

Salix exigua Nutt. [*S. hindsiana* Benth., *S. h.* var. *leucodendroides* (Rowlee) C. Ball, & *S. h.* var. *parishiana* (Rowlee) C. Ball] NARROW-LEAVED WILLOW. Shrub. Occasional along sandy washes and drainages; mule fat scrub, willow riparian scrub. FMR & DEB 6091 (RSA).

Salix gooddingii C. Ball GOODDING'S WILLOW or BLACK WILLOW. Small tree. Occasional in drainages; willow riparian scrub, mulefat scrub, oak riparian forest, and sycamore woodland. FMR & DEB 5895 (RSA).

Salix laevigata Bebb RED WILLOW. Small tree. Fairly common along drainages and washes, Cristianitos Creek and tributaries; willow scrub, mulefat scrub, willow riparian scrub, oak riparian forest, and sycamore woodland. FMR & DEB 5894 (RSA).

Salix lasiolepis Benth. ARROYO WILLOW. Small tree. Fairly common along drainages and canyon bottoms; willow riparian scrub, mulefat scrub, oak riparian forest, and sycamore woodland. FMR 5690 (RSA).

Saxifragaceae – Saxifrage Family

Jepsonia parryi (Torr.) Small COAST JEPSONIA. Perennial geophyte, often in bloom before the winter rains and leafing out in the spring. Occasional to patchy and locally common on mesic slopes; needlegrass perennial grasslands, grassy openings in coastal sage scrub and chaparral. FMR & Robert L. Allen 6021 (RSA), FMR & DEB 6127 (RSA).

Scrophulariaceae – Figwort Family

Castilleja affinis Hook. & Arn. subsp. *affinis* COASTAL PAINTBRUSH. Occasional perennial found on ridges, often in association with sandstone, coastal sage scrub. FMR 5608 (RSA).

Castilleja foliolosa Hook. & Arn. FELT PAINTBRUSH. Perennial subshrub. Occasional, often in association with sandstone outcrops, ridges and canyon slopes; coastal sage scrub. FMR 5968 (RSA); DEB & FMR 3437 (RSA).

**Kickxia elatine* (L.) Dumort. SHARP-LEAVED FLUPELLIN. Annual. Infrequent in disturbed areas such as at the parking area at Gato Gate. FMR & DEB 6093 (RSA).

Mimulus aurantiacus Curt. var. *pubescens* (Torr.) D.M. Thompson x *Mimulus aurantiacus* var. *puniceus* (Nutt.) D. Thompson [*M. a.* subsp. *australis* (McMinn)

Munz, *M. puniceus* (Nutt.) Steudel] BUSH MONKEY FLOWER. Shrub, flowers pale orange to pale orange tinged reddish, or streaked. Frequent on ridges and particularly north-facing slopes, less common along drainages; coastal sage scrub, toyon-sumac chaparral, and baccharis scrub. FMR 5604 (RSA).

Mimulus floribundus Lindley SHOWY MONKEY-FLOWER. Occasional along sandy washes in Cristianitos Creek; open mulefat scrub and riparian herb community. FMR & DEB 5902 (RSA).

Mimulus guttatus DC. SEEP MONKEY-FLOWER. Annual. Occasional along sandy washes in Cristianitos Creek; open mulefat scrub and riparian herb community. FMR & DEB 5901 (RSA).

Scrophularia californica Cham. & Schldl. subsp. *floribunda* (E. Greene) Shaw CALIFORNIA FIGWORT. Perennial. Occasional in drainages and on slopes; open coastal sage scrub. FMR & DEB 5889 (RSA).

**Veronica anagallis-aquatica* L. GREAT WATER SPEEDWELL. Annual. Occasional along sandy washes in Cristianitos Creek; open mulefat scrub, riparian herb community. FMR & DEB 5900 (RSA).

Solanaceae – Nightshade Family

Datura wrightii Regel JIMSONWEED. Perennial. Occasional on dry hillsides; annual grassland and open coastal sage scrub. FMR & DEB 5920 (RSA).

**Nicotiana glauca* Grah. TREE TOBACCO. Shrub. Uncommon in drainages and on slopes; annual grassland, coastal sage scrub. FMR & DEB 5925 (RSA).

Solanum douglasii Dunal DOUGLAS' NIGHTSHADE. Perennial. Occasional on slopes; openings in coastal sage scrub. FMR & DEB 5888 (RSA).

Tamaricaceae – Tamarisk Family

**Tamarix ramosissima* Ledeb. MEDITERRANEAN TAMARISK. Small tree. Scattered in sandy wash of Cristianitos Creek; open mulefat scrub. FMR & DEB 6084 (RSA).

Urticaceae – Nettle Family

Urtica dioica L. subsp. *holosericea* (Nutt.) Thorne HOARY NETTLE. Perennial. Occasional along drainages and in shaded areas; oak riparian forest, sycamore riparian forest. FMR & DEB 5930 (RSA).

**Urtica urens* L. DWARF NETTLE. Annual. Occasional on slopes and canyon bottoms in annual grassland and disturbed sites; locally frequent in understory of oak woodland. FMR & DEB 6039.

Verbenaceae – Vervain Family

Verbena lasiostachys Link var. *scabrida* Mold. ROBUST VERVAIN. Perennial. Occasional on slopes and in drainages; baccharis scrub, annual grassland, and oak woodland. FMR 5663 (RSA).

Viscaceae – Mistletoe Family

Phoradendron macrophyllum (Engelm.) Cockerell CHAPARRAL or LONG-SPIKED MISTLETOE. Perennial. Fairly common parasite on sycamores; sycamore riparian woodland, oak riparian forest. FMR & DEB 5929 (RSA).

MONOCOTYLEDONES - "MONOCOTS"

Agavaceae – Agave Family

Yucca whipplei Torr. subsp. *whipplei* CHAPARRAL YUCCA or OUR LORD'S CANDLE. Perennial. Occasional on dry slopes and ridges; coastal sage scrub. FMR 5870 (RSA).

Alliaceae – Onion Family

Allium praecox Brandegee EARLY ONION. Local and infrequent pale lavender-flowered perennial originating from a bulb, found along ridgeline along Middle Ridge Trail in mixed needlegrass perennial grassland and coastal sage scrub. FMR & DEB 5568 (RSA).

Cyperaceae – Sedge Family

Cyperus eragrostis Lam. TALL UMBRELLA-SEDGE. Perennial. Occasional on mesic slopes and along Cristianitos Creek; openings in coastal sage scrub and riparian herb community. FMR & DEB 5887 (RSA).

Eleocharis palustris (L.) Roemer & Schultes [*E. macrostachya* Britton] PALE SPIKE-RUSH. Perennial. Occasional around moist areas and along stream courses in Cristianitos Canyon; ephemeral wetlands. FMR & DEB 5613 (RSA).

Scirpus microcarpus Presl SMALL-FRUITED BULRUSH. Perennial. Uncommon along shaded drainages in Gato Canyon; understory of oak woodland. This population represents the only Orange County locality outside the Santa Ana Mtns. FMR & DEB 6131 (RSA).

Hyacinthaceae – Soap Plant Family

Chlorogalum pomeridianum (DC.) Kunth var. *pomeridianum* WAVY-LEAVED SOAP PLANT. Perennial geophyte. Occasional along dry ridges and on hillsides; open, grassy, coastal sage scrub, and annual grassland. FMR & DEB 5928B (RSA).

Iridaceae – Iris Family

Sisyrinchium bellum S. Watson CALIFORNIA BLUE-EYED GRASS. Fairly common blue-flowered perennial on north-facing slopes, canyon bottoms, and open ridges in mesic needlegrass perennial grassland, annual grassland, and openings in coastal sage scrub. FMR & DEB 5571 (RSA); DEB 3348 (RSA), 3349 (RSA).

Juncaceae – Rush Family

Juncus bufonius L. var. *bufonius* COMMON TOAD RUSH. Occasional, seeps, along drainages, and sandy washes; wet meadows, open mulefat scrub, and riparian herb community. FMR & DEB 5903 (RSA).

Juncus dubius Engelm. [incl. *J. rugulosus* Engelm.] MARIPOSA RUSH. Perennial. Occasional in dense patches along a ravine in lower Shady Canyon and along sandy washes in Cristianitos Creek; wet meadow, open mulefat scrub, riparian herb community. FMR & DEB 6034 (RSA).

Juncus arcticus var. *mexicanus* (Willd. ex Roemer & Schultes) Traut. [*J. m.* Willd.] MEXICAN RUSH. Perennial. Occasional but locally abundant in places, drainages and creek terraces; baccharis scrub, wet meadow, and riparian herb community. FMR & DEB 5904 (RSA), FMR & DEB 6123 (RSA).

Liliaceae – Lily Family

Calochortus splendens Benth. SPLENDID MARIPOSA LILY. Perennial originating from bulb. Fairly common on hillsides and along ridges; annual grassland, needlegrass grassland, and openings in coastal sage scrub. FMR & DEB 5581 (RSA).

Calochortus weedii Alph. Wood var. *intermedius* F. Ownbey INTERMEDIATE MARIPOSA LILY. See Figure 6. Perennial geophyte. Occasional, patchy, mostly found on dry ridges near sandstone cliffs or barrens on more gentle slopes in the southern portion of the Conservancy; coastal sage scrub. The largest stand included 186 plants situated on a gentle south-facing slope above the San Diego Gas and Electric substation near the southern boundary of the Conservancy. This stand was in scattered sandstone barrens, native grassland, and open coastal sage scrub. *Calochortus weedii* var. *intermedius* in north and central Orange County is reasonably well defined by flower color in live plants. The petals are a thin lemon yellow or “champagne” yellow with purplish-brown margins and splotches on the petal, rounded petal margins (rather than square), and the width of the sepal, which are broader and more asymmetric. *Calochortus weedii* var. *weedii* typically has bold golden-yellow flowers with fewer purplish-brown blotches. The petal margins are generally square and the sepals are narrower than those of intermediate mariposa lily. Fiedler and Ness (1993) state that the anthers are pointed (acute) in *C.w. weedii* as compared to rounded in *C.w. intermedius*. However observations of flowers for duration of a bloom for both taxa suggests this is a weak or unreliable character, better related to the age of the flower than to variety. *Calochortus weedii* var. *weedii* is characteristic of the Santa Ana Mountains and San Diego County and probably extends into the eastern portion of Rancho Mission Viejo. The best examples of *Calochortus weedii* var. *intermedius* in southeastern Orange County are found within the Tijeras Canyon area of the Rancho Mission Viejo with a northwest-southeast gradient of integradation showing increasing influence of *C. weedii* var. *weedii* toward the southeast. Within the Conservancy, the majority of individuals have pale yellow or lemon yellow flowers, rounded petal margins, and broad asymmetrical sepals typical of *C. weedii* var. *intermedius*. However, nearly half of these, particularly amongst the earliest bloomers, displayed some evidence of integradation. Only a very few plants actually had yellow petals but none where the bold yellow color typical of the southern variety. Thus the Conservancy plants for the most part represent the sensitive form. Rare: CNPS List 1B. FMR & DEB 5884 (RSA); FMR & DEB 5931 (RSA).

Poaceae – Grass Family

Agrostis diegoensis Vasey SAN DIEGO BENTGRASS. Perennial. Occasional to locally common on slopes and on ridges; needlegrass perennial grassland. DEB 3352A (RSA), DEB 3353 (RSA), FMR & DEB 5840 (RSA).

**Agrostis viridis* Gouan WATER BENTGRASS. Annual. Occasional along sandy washes in Cristianitos Creek; open mulefat scrub and riparian herb community. FMR & DEB 5897 (RSA).

- *Aristida adscensionis* L. SIX-WEEKS or ANNUAL THREE-AWNED GRASS. Annual. Infrequent, but sometimes locally common of barrens and sandstone outcrops; open coastal sage scrub. FMR 5609 (RSA).
- Aristida purpurea* Nutt. var. *parishii* (Hitchc.) Allred. [*A. parishii* Hitchc.] PARISH'S THREE-AWNED GRASS. Perennial. Occasional on sandstone outcrops; openings of coastal sage scrub. FMR & DEB 5594 (RSA).
- Aristida ternipes* Cav. var. *hamulosa* (Henn.) J.S. Trent [*A. hamulosa* Henn.] MESA THREE-AWNED GRASS. Perennial. Occasional to locally frequent on dry ridges and on sandstone outcrops; openings of coastal sage scrub. DEB & FMR 3336, FMR & DEB 5595 (RSA).
- *Avena barbata* Brot. SLENDER WILD OAT. Annual. Widespread; annual grassland, openings in coastal sage scrub, and disturbed areas. FMR 5610 (RSA).
- *Avena fatua* L. WILD OAT. Annual. Fairly common; non-native annual grassland and disturbed areas. FMR & DEB 5566 (RSA).
- Bothriochloa barbinodis* (Lagasca) Herter CANE BLUESTEM. Perennial. Occasional on ridges and borders of sandstone outcrops; openings of coastal sage scrub. DEB & FMR 3337 (RSA), FMR & DEB 5839 (RSA).
- *Brachypodium distachyon* (L.) Beauv. PURPLE FALSE BROME. Annual. Occasional and patchy on clay soils, mostly on hillsides; annual grassland. FMR 5679 (RSA).
- Bromus carinatus* Hook. & Arn. var. *carinatus* CALIFORNIA BROME GRASS. Perennial. Occasional on slopes and drainages; annual grassland borders of oak woodland and sycamore riparian woodland. FMR 5688 (RSA), FMR & DEB 5825 (RSA); DEB & FMR 3356 (RSA).
- *Bromus diandrus* Roth COMMON RIPGUT GRASS. Annual; Widespread, fairly common to locally abundant in heavy soils, particularly on north-facing and east-facing slopes; annual grassland, sycamore riparian woodland, and oak woodland. FMR & DEB 5601.
- *Bromus hordeaceus* L. SOFT CHESS. Annual. Frequent; annual grassland and open coastal sage scrub. FMR & DEB 5618 (RSA); DEB & FMR 3370 (RSA).
- *Bromus madritensis* L. subsp. *rubens* (L.) Husnot FOXTAIL CHESS or RED BROME. Annual. Common to locally abundant; disturbed sites, annual grassland, less common in coastal sage scrub openings. FMR & DEB 5565 (RSA); DEB & FMR 3335 (RSA).
- *Bromus sterilis* L. STERILE BROME. Annual. Uncommon along sandy washes in Cristianitos Creek; open mulefat scrub and ephemeral wetlands. Probably also in annual grasslands along Cristianitos Creek and elsewhere. FMR & DEB 5905 (RSA).
- *Cynodon dactylon* (L.) Pers. BERMUDA GRASS. Perennial. Occasional in disturbed areas and along drainages; riparian herb community. FMR & DEB 5638 (RSA).
- Distichlis spicata* (L.) E. Greene SALT GRASS. Perennial. Occasional and local along drainages and disturbed sites; annual grassland, wet meadow, and riparian herb community. FMR 5632 (RSA).
- *Ehrharta calycina* J.E. Smith VELDTGRASS. Perennial. Infrequent along dirt road along western margin of Reserve; mixed chaparral and coastal sage scrub. FMR & DEB 5636 (RSA).
- Elymus condensatus* J.S. Presl (*Leymus c.* (J.S. Presl) Love) GIANT WILDRYE. Perennial. Occasional on more mesic slopes; coastal sage scrub, less common in toyon-sumac chaparral. FMR & DEB 5910 (RSA).
- Elymus triticoides* Buckl. (*Leymus t.* (Buckl.) Pilger) BEARDLESS WILD-RYE. Occasional on slopes and in drainages on loamy soils; openings in oak woodland, sycamore riparian woodland, annual grassland, and mulefat scrub. FMR 5687 (RSA).

- **Gastridium ventricosum* (Gouan) Schinz & Thell. NITGRASS. Annual. Occasional along dirt roads and on ridges; annual grassland, coastal sage scrub, and chaparral. FMR & DEB 5833 (RSA).
- Hordeum intercedens* Nevski VERNAL BARLEY. Annual. Scattered sites, mostly on ridges and canyon slopes bordering Cristianitos Canyon; perennial and annual grassland. Fourteen stands with 878 individuals were located. Rare: CNPS List 3. DEB 3355 (RSA); DEB & FMR 3370 (RSA); FMR & RLA 5634 (RSA); DEB & FMR 3423 (RSA); DEB 3430 (RSA); DEB & FMR 3433 (RSA); DEB & FMR 3436 (RSA).
- **Hordeum murinum* L. subsp. *leporinum* (Link) Arcangeli HARE BARLEY or FOXTAIL BARLEY. Annual. Widespread and fairly common; annual grassland. FMR 5625 (RSA).
- Koeleria macrantha* (Ledeb.) Spreng. JUNEGRASS. Perennial. Infrequent to scattered on sandstone barrens and outcrops; coastal sage scrub. FMR & DEB 5592 (RSA); FMR & DEB 5906 (RSA).
- **Lamarckia aurea* (L.) Moench GOLDENTOP. Annual. Occasional on ridgelines and on slopes in annual grassland and openings in coastal sage scrub. FMR & DEB 5650 (RSA).
- **Lolium perenne* L. PERENNIAL RYEGRASS. Annual. Occasional in drainages and on slopes, especially in the vicinity of seeps and wet areas; mesic annual grassland, openings in oak woodland. FMR 5670 (RSA).
- Melica imperfecta* Trin. SMALL-FLOWERED MELIC GRASS. Perennial. Fairly common; coastal sage scrub. Occasional in needlegrass perennial grassland and the borders of oak woodland. FMR & DEB 5579 (RSA); DEB & FMR 3334.
- Muhlenbergia microsperma* (DC.) Kunth LITTLESEED MUHLY. Annual. Infrequent on slopes and barrens; coastal sage scrub. DEB & FMR 3431 (RSA).
- Muhlenbergia rigens* (Benth.) A. Hitchc. CALIFORNIA DEERGRASS. Perennial. Uncommon and local on mesic slopes and in drainages; perennial needlegrass grassland. FMR & DEB 6031 (RSA).
- **Pennisetum setaceum* (Forsk.) Chiov. AFRICAN FOUNTAIN GRASS. Perennial. Infrequent weed found in sandy wash of Cristianitos Creek at the southern end of the Conservancy; mulefat scrub. FMR & DEB 5893 (RSA).
- **Poa annua* L. ANNUAL BLUEGRASS. Annual. Scattered along trails, often in mesic areas; annual grassland, sycamore woodland. FMR 5628 (RSA).
- Poa secunda* J.S. Presl subsp. *secunda* PERENNIAL BLUEGRASS. Perennial. Uncommon on hillsides; needlegrass perennial grassland. FMR & DEB 6033. FMR & DEB 6033 (RSA).
- Stipa coronata* Thurber var. *coronata* [*Achnatherum c.* (Thurber) Barkworth] GIANT NEEDLEGRASS. Perennial. Occasional on barrens, rock outcrops, and on ridges; coastal sage scrub. FMR & DEB 5831 (RSA).
- Stipa lepida* A. Hitchc. [*Nassella l.* (Hitchc.) Barkworth] FOOTHILL NEEDLEGRASS. Perennial. Frequent on ridges and on slopes; coastal sage scrub, occasionally extending into needlegrass perennial grassland and non-native annual grassland. FMR 5606 (RSA).
- Stipa pulchra* Hitchc. [*Nassella p.* (Hitchc.) Barkworth] PURPLE NEEDLEGRASS. Perennial. Frequent, often the most common element of needlegrass grassland, less common in annual grassland and openings in coastal sage scrub. FMR & DEB 5572, 5586 (RSA).
- **Vulpia myuros* (L.) K.C. Gmelin var. *myuros* RATTAIL FESCUE. Annual. Frequent and widespread annual in perennial needlegrass grassland and annual grassland. FMR & DEB 5620 (RSA).

Themidaceae – Brodiaea Family

- Bloomeria crocea* (Torr.) Cov. COMMON GOLDEN STAR. Perennial geophyte. Occasional on mesic grassy slopes; needlegrass perennial grassland, annual grassland, openings in coastal sage scrub. FMR 5678 (RSA), FMR & DEB 5832 (RSA).
- Dichelostemma capitatum* Alph. Wood subsp. *capitatum* WILD-HYACINTH or BLUE-DICKS. Fairly common in needlegrass perennial grassland, annual grassland, and in openings of coastal sage scrub throughout the preserve. FMR & DEB 5567 (RSA).

APPENDIX II: SPECIES OBSERVED BUT NOT COLLECTED ON THE CONSERVANCY

The following list includes additional species that were observed but not formally documented within the boundaries of the Conservancy. In some cases, these plants were observed early in the project while not in bloom and not encountered again. Some species may have been encountered as a single individual. In others it was a simple oversight they were not collected. Because the number of unvouched taxa is fairly low, we present them in a separate list to encourage future documentation.

Apiaceae (Umbelliferae) – Carrot Family

- **Conium maculatum* L. COMMON POISON-HEMLOCK. Perennial. Occasional in annual grassland in canyons along the southern border of the Conservancy.

Asteraceae (Compositae) – Sunflower Family

- Eriophyllum confertiflorum* (DC.) A. Gray var. *confertiflorum* LONG-STEMMED GOLDEN YARROW. Coastal sage scrub and toyon-sumac chaparral.
- Viguiera laciniata* A. Gray SAN DIEGO SUNFLOWER. Shrub. Infrequent in coastal sage scrub on ridges west of Cristianitos Cyn. Not seen by authors. According to Conservancy manager Laura Cohen, two plants have been found and are located in an area that suggests the plants are of native origin. If this proves to be the case, this would be the first native population of this species recorded in Orange County. Rare: CNPS List 4.

Chenopodiaceae – Goosefoot Family

- **Chenopodium album* L. LAMB'S QUARTERS. Annual. Occasional in riparian herb community.
- **Salsola tragus* L. [*S. iberica* Sennen & Pau., *S. australis* R. Br.] RUSSIAN-THISTLE. Annual. Occasional in barrens; annual grassland.

Euphorbiaceae – Spurge Family

- Euphorbia albomarginata* Torr. & A. Gray [*Chamaesyce a.* (Torr. & A. Gray) Small] RATTLESNAKE SPURGE. Annual. Uncommon in coastal sage scrub and needlegrass perennial grassland.

Grossulariaceae – Gooseberry Family

Ribes speciosum Pursh FUCHSIA-FLOWERED GOOSEBERRY. Shrub. Occasional in toyon-sumac chaparral.

Malvaceae – Mallow Family

**Malva parviflora* L. CHEESEWEED. Annual. Occasional in annual grassland.

Orchidaceae – Orchid Family

Piperia cooperi (S. Watson) Rydb. COOPER'S REIN ORCHID. A single individual was observed in Shady Canyon in leaf. The plant was not found later in the study. Rare: CNPS List 4.

Polygonaceae – Buckwheat Family

Eriogonum elongatum Benth. var. *elongatum* LONG-STEMMED or TALL BUCKWHEAT. Perennial. Occasional in coastal sage scrub.

Scrophulariaceae – Figwort Family

Cordylanthus rigidus (Nutt. ex Benth.) Jepson subsp. *setiger* Chuang & Heckard DARK-TIPPED BIRD'S BEAK. Annual. Occasional in coastal sage scrub.

Keckiella cordifolia (Benth.) Straw. HEART-LEAVED BUSH-PENSTEMON. Shrub. Occasional in toyon-sumac chaparral.

NOTEWORTHY COLLECTIONS

New Records of Lichenicolous Fungi from California

ENDOCOCCUS OREINAE Hafellner. California: Riverside County, Santa Rosa Plateau, wildlife corridor northeast of Tenaja Road, 33° 30' 17" N 117° 21' 27" W, 690 m, on *Dimelaena oreina* on large granite boulder. Knudsen 7969.1 (UCR)

Previous knowledge. The genus *Endococcus* contains over 30 species worldwide of lichenicolous fungi. *Endococcus oreinae* was recently described (Hafellner et al. 2002) and is currently known from a few locations in the states of Sonora and Chihuahua in Mexico and from Arizona in the western United States. It is host specific, occurring on the widespread lichen *Dimelaena oreina*, but we have seen no new reports since the original description.

Significance. *Endococcus oreinae* is reported new to California. Though its host is widespread in the mountains of southern California and in the foothills along the coast, it appears to be rare.

ENDOCOCCUS STIGMA (Körb.) Stizenb. California: Riverside County, Riverside, University of California, Coyote Hill 33°58'09"N, 117°19'24"W, 384 m, on *Acarospora socialis* on granite boulders. Knudsen #3526 (UCR, hb. Diederich); San Diego County, Anza Borrego Desert State Park, Yaqui Pass, on *Acarospora socialis*. Valerie Reeb VR 23-XII-05/1 with Kerry Knudsen & Silke Werth (DUKE); Yaqui Pass 33°08'48"N, 116°20'43"W, 550 m, on *Acarospora socialis*. Knudsen #5906 with Rolf Muetter (UCR, hb. Etayo, PRM 857261); north of S22, near 33°12'43"N, 116°28'18"W, 831 m, Jojoba, on *A. socialis* Knudsen #3629 (PRM 857256); Santa Barbara County, Santa Barbara, e/o San Antonio Creek at end of Q street 32°27'44"N, 119°46'04"W, 384 m, on *Acarospora robiniae*. Knudsen #4296.2 with Melody Hickman (UCR, hb. Diederich).

Previous knowledge. *Endococcus stigma* is host specific to species of the lichen genus *Acarospora* as treated by Triebel (1989). It is widespread in Europe with several reports from North America.

Significance. The California collections are *Endococcus stigma* in the strict sense with ascomata 150-250 µm in diameter and with dark one-septate ornamented ascospores with equal cells, 12-16 x 6-7 µm. The species is reported new to California. It appears to be widespread and relatively common in southern California. According to an unpublished paper by Brand, there is an undescribed species with smaller spores and ascomata included in Triebel's concept of *E. stigma* (Diederich, pers. comm.) but we have not collected specimens of this taxon yet.

INTRALICHEN BACCISPORUS D. Hawksw. & M.S. Cole. California, San Luis Obispo County, San Simeon State Park, Molinari property, on rock pile next to ravine along old Highway One dirt road, 35° 36' 10" N 121° 07' 33" W, 27 m, infrequent on apothecia of *Caloplaca impolita*, Knudsen 8096 (UCR, PRM 857257).

Previous knowledge. *Intralichen baccisporus* is a lichenicolous hypomycete known in North America only from Nebraska (Hawksworth and Cole 2002). Recently it was

reported in Europe (Sérusiaux et al 2003) from Belgium, Luxembourg, Austria, the Netherlands and Germany.

Significance. *Intralichen baccisporus* is reported new to California. *Intralichen baccisporus* produces multicellular conidia and seems to be confined at the least to species of the genus *Caloplaca* in the family *Theleoschistaceae*, while *I. christiansenii* produces only 1-septate conidia and appears to be heterogeneous considering the wide spectrum of unrelated hosts.

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BOOK REVIEW

Before California: An Archaeologist Looks at Our Earliest Inhabitants. by Brian Fagan. 2003. Rowman & Littlefield Publishers, Inc, Lanham, MD. 361 pp. + notes and index. \$24.95 (AltaMira Press paperback edition 2004, \$21.95).

There are several excellent non-specialist overviews of Native American prehistory for other regions (e.g., Plog 1997) but Brian Fagan's Before California is the only such book now in print for California. As a Californian, I often wonder what the pre-Columbian landscape was like or how people lived here before European contact. As a botanist, I am curious about Native Californians' uses of plants and their influences on plant distributions and vegetation ecology. Because I lack the time and background to research the anthropology literature, I looked forward to reading Before California.

Brian Fagan is an Emeritus Professor of Archaeology at UC Santa Barbara and has written some two dozen textbooks and popular treatments on archaeology. He describes himself as a generalist, without special expertise in California prehistory. Fagan emphasizes in the preface and throughout Before California that published archaeological work is spotty; that much of the available evidence is from gray literature; and that reviewing information for this synthesis was an especially difficult task.

Before California seems designed as both an undergraduate textbook and an introduction for a more general audience. It is illustrated throughout and uses "boxes" to describe special topics, a common style in textbooks. It is organized into sections covering broad time periods, and the sections are arranged into chapters on geographic regions or other topics. Fagan keeps his focus on the big picture and rarely bogs down in details, data, or graphs. The writing is largely conversational, with minimal use of specialized terms, and strictly avoids the dense style of academic literature. The organization, layout, and tone all work well to provide a broad overview, as intended.

Unfortunately, Before California suffers from badly flawed writing and editing. The text is often padded with nonsensical or pithy remarks. Chapters tend to ramble well away from their chronological or geographic scopes. Ideas are repeated, often several times within chapters, within subsections, and in successive chapters. Ideas that do not fit well into specific time-frames (e.g., petroglyphs) are shoehorned into one or another of the book's chronological sections with no rationale. Rank speculation, especially about social structure (Ch. 6) and spiritualism (Chs. 8 and 9), is common and often stated as though factual. Errors and misediting are so common that they become distracting. A few examples are: upwelling is referred to as "downwelling" on p. 52; a list of seafoods "suggests a generalized diet with a heavy emphasis on terrestrial foods" on p. 97; and milkweed is called "milkwood" on p. 116.

Fagan sometimes avoids whole issues or contradicts himself as he ducks them. For example, he does not believe that the first Californians arrived by sea and he is not willing to discuss the pros and cons. "No one believes that they paddled down the . . . coast simply because there were no suitable watercraft for doing so" (p. 22). But later (p. 46), he writes of the Bering Sea crossing that "Some experts believe that the Americas were settled not only by land, but along the shores . . . by people who moved eastward in skin boats. . . ." but "there is absolutely no evidence for such activities, in part because their sites, if any, are deep below the Bering Strait." On the next page, he writes that whether the first humans came over land or by sea is "one of the great controversies of

California archaeology.” In just these few pages, he progresses from “no one believes” to “some experts believe” to “one of the great controversies.” As a non-specialist reader, I gather that (1) the evidence, if any, is underwater, and (2) Fagan does not believe that the New World was colonized by sea but cannot explain his reasoning. Similar unsubstantiated assertions, poorly constructed arguments, and self-contradictions are found throughout the book.

From the botanical perspective, *Before California* is similarly disappointing because it skips important topics and misconstrues others. Land management via deliberate chaparral burning (Anderson 1993) is not covered. Fagan presents a thorough description of the acorn-based diet in place at European contact. But his discussion of earlier food plants is indecipherable. Before acorns became a staple, he says, Indians subsisted largely on milled grass seed. But none of the food plants he names are grasses, and I can find virtually no native cismontane grasses listed in compilations of Native American food plants (e.g., Moerman 1998). Milling forb seeds into meal is well-documented among Native Californians at European contact and since. But Fagan presents no evidence for heavy use of grass seeds at contact or earlier.

As a biologist, I am often disappointed by common misunderstandings of population ecology, and Fagan promotes a serious one. Artifacts near the coast in the Kings Range predating about AD 500 are surprisingly scarce. Fagan offers the explanation (first made by others) that the coast may have been uninhabited due to more abundant food resources farther inland. Only when the interior populations expand or “hunted out their territory” did people move to the coast for its rich food supplies. The argument is nonsense. Populations in superior habitat with abundant resources expand quickly, and disperse into surrounding suitable areas. It is unreasonable to propose that humans could have lived in the New World for thousands of years and expanded their ranges across two entire continents and numerous islands before their numbers finally grew large enough to migrate to the Kings Range coast. Archaeologists should seek a better explanation for the sparse early record there.

This is the only book of its sort now in print. It presents a great deal of worthwhile information and will be a useful introduction for some readers. I found, however, that the poor writing and editing, redundancy, factual errors, unacknowledged speculation, and logical fallacies distracted so badly from the information content that reading *Before California* was more frustrating than educational. In his preface, Fagan emphasizes that there is room for more than one popular book on California archaeology. I hope to see another one soon. Meanwhile, readers may be better served by older overviews (Chartkoff & Chartkoff 1984; Moratto 1984) or compilations of more technical papers, such as Raab and Jones (2004).

Many thanks to Elizabeth Lawlor for her suggestions on an earlier version of this review.

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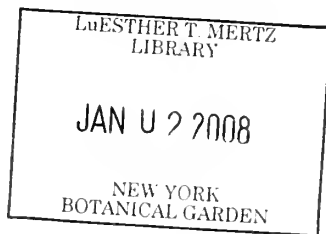
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Cover: *Penstemon grinellii*, photographed by Fred Roberts on Santiago Peak in the Santa Ana Mountains.

**PLANT SUCCESSION IN THE EASTERN MOJAVE DESERT: AN EXAMPLE
FROM LAKE MEAD NATIONAL RECREATION AREA, SOUTHERN
NEVADA**

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ABSTRACT: Plant succession remains a poorly understood process in the Mojave Desert, yet knowledge is needed in this area where increasing human populations may amplify disturbance frequencies and intensities. In a retrospective study, we examined plant communities on two pipeline right-of-ways cleared in 1998 or 1968 to supply water to metropolitan Las Vegas, Nevada. We also evaluated the effectiveness of restoration treatments (raking soil surfaces, spreading artificial desert varnish, and planting four species of native shrubs) applied by the National Park Service on the 1998 right-of-way to enhance recovery of *Larrea tridentata* communities. Plant cover was sparse (< 5%) on the untreated 1998 right-of-way eight years after clearing, with a mean shrub density of only 99/ha. On the restoration-treated area, however, *L. tridentata* established at a density of 300/ha., 36% of the density of an adjacent control area. Restoration treatments also made the right-of-way less visually distinct from surrounding *L. tridentata* communities. Even 38 years after clearing, the older right-of-way was dominated by species such as *Stephanomeria pauciflora* and *Encelia farinosa*, which are classified as early colonizers in the Mojave Desert. Our findings concur with long recovery estimates after vegetation-removing disturbances given in the literature, but suggest that ecological restoration has potential for manipulating the speed and trajectory of plant succession in the Mojave Desert.

KEYWORDS: disturbance, ecological restoration, *Encelia farinosa*, *Hymenoclea salsola*, *Larrea tridentata*, *Plantago ovata*, *Stephanomeria pauciflora*, vegetation.

INTRODUCTION

Mining, military activities, off-road vehicles, agriculture, livestock grazing, and land clearing for linear corridors (e.g., roads, power lines) are some of the many types of human disturbances impacting Mojave Desert ecosystems (Lovich and Bainbridge 1999). Plant succession (rate and species composition) following these disturbances can vary with disturbance type (Webb et al. 1987) and size (Hunter et al. 1987), precipitation (Brum et al. 1983), time since disturbance (Carpenter et al. 1986), and also with other less-documented factors such as soil type (Lathrop and Archbold 1980). *Larrea tridentata* (DC.) Cov. communities, which are a dominant vegetation type in the Mojave Desert, have generally taken decades to more than centuries to approximate pre-disturbance plant composition (Lovich and Bainbridge 1999).

Vasek (1979/1980) documented plant succession in the Mojave Desert nine years after land clearing for a highway borrow pit in southern California. He found that early colonizers included *Ambrosia dumosa* (A. Gray) Payne, *Encelia frutescens* (A. Gray) A. Gray, *Stephanomeria pauciflora* (Torrey) Nelson, and *Porophyllum gracile* Benth. These species exhibited 19-177 times greater densities in the disturbed pit bottom than in adjacent *Larrea tridentata* communities. Vasek (1983) further classified Mojave Desert perennial species into three main successional categories: early colonizers that respond strongly and positively to disturbance and have short individual life spans (e.g., *Hymenoclea salsola* A. Gray, *S. pauciflora*, *Encelia* spp.), long-lived opportunistic species important in mature communities but also exhibiting pioneering ability (e.g., *A. dumosa*, *Opuntia bigelovii* Engelm.), and long-lived perennials that recover slowly from disturbance (e.g., *L. tridentata*). Vasek (1983) also noted that many early colonizers after human disturbance are abundant in frequently disturbed "natural" habitats such as washes, and that annual plants occur in both early and late-successional communities.

Specific questions about succession, such as factors affecting its rate and trajectory, remain poorly understood in the Mojave Desert (Bolling and Walker 2000). This hinders ecological management in this desert, where increasing human populations may intensify disturbance levels (Kemp and Brooks 1998; Lovich and Bainbridge 1999). In a retrospective study in the eastern Mojave Desert, we assessed plant community and soil characteristics on two water pipeline right-of-ways (ROWs) cleared of upper soil and vegetation eight (1998) or thirty-eight (1968) years before this study. The National Park Service also applied restoration treatments designed to speed recovery of *Larrea tridentata* communities on part of the 1998 ROW. Both ROWs cross National Park Service land (Lake Mead National Recreation Area [LMNRA]) and were constructed by the Southern Nevada Water Authority to supply water to the Las Vegas Valley. Since further water developments are planned to occur within LMNRA, this study was intended to evaluate potential for ecological remediation of these disturbances. Additionally, our study adds site-specific successional data needed to build general theories of succession for the Mojave Desert. We sought to answer the following questions at this site: (1) What is species composition, shrub density, and species richness on ROWs cleared in 1998 or 1968 relative to adjacent *L. tridentata* communities? (2) On the 1998 ROW, do soil properties differ among treatments and below *L. tridentata* compared to openings? (3) How does species composition on this site after disturbance compare with other successional sequences described for the Mojave Desert?

METHODS

Study Area and Pipeline Treatments

This study was conducted in LMNRA, Clark County, Nevada, 30 km east of Las Vegas at an elevation of 400 m (UTM 696000 m E, 3993000 m N; zone 11; NAD83). The study area consisted of a 0.21-ha area in each of four adjacent locations: a 1998 ROW receiving no restoration treatments (hereafter untreated 1998 ROW), an adjacent section of the same ROW that received restoration treatments (hereafter treated 1998 ROW), an adjacent *Larrea tridentata* community off the ROW that served as a control, and a ROW cleared in 1968 adjacent to the 1998 ROW (Fig. 1). This study is limited by a lack of replication; however, the study area comprises one landform (an alluvial fan) and one soil association (Carrizo-Carrizo-Riverbend, primarily consisting of Typic Torriorthents; Lato 2006). This supports an assumption that potential differences among the four areas result from their successional age or the restoration treatments, rather than from pre-existing

Fig. 1 (a)

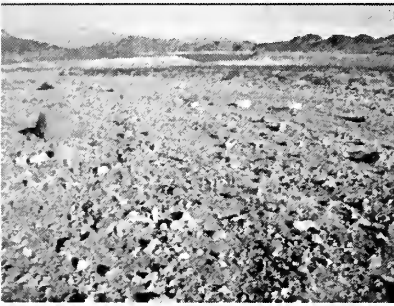


Fig. 1 (b)



Fig. 1 (c)

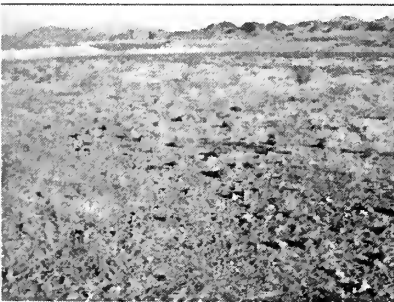


Fig. 1 (d)



Figure 1. Views of (a) bladed eight-year-old (1998) water pipeline right-of-way that received no restoration except for soil replacement; (b) the same right-of-way that received the restoration treatments of raking the soil surface, applying artificial desert varnish, and planting four species of native shrubs in addition to soil replacement; (c) control area adjacent to the right-of-way; and (d) 38-year-old (1968) water pipeline right-of-way, Lake Mead National Recreation Area, southern Nevada. Photos by S.R. Abella, 31 August 2006 for (a-c) and 25 October 2006 for (d).

environmental differences. Both the treated and the untreated 1998 ROW were cleared by blading with heavy equipment, with the upper 20 cm of soil stockpiled and reapplied after construction. The 20-cm depth may have varied slightly depending on rockiness or other factors. Procedures for clearing the 1968 ROW are not known to the authors, but are thought to have included mechanical blading without soil replacement.

Restoration treatments applied by the National Park Service in January-February 1999 to the 1998 ROW included hand-raking the soil surface after soil replacement to re-spread rocks, applying artificial desert varnish (product name = permeon) evenly to the soil surface for color restoration, and planting *Larrea tridentata* (96 plants), *Ambrosia dumosa* (12 plants), *Opuntia basilaris* Engelm. & J. Bigelow (9 plants), and *Acacia greggii* A. Gray (2 plants). Newton (2001) provides details of the planting. Survival by 2001 was 0% for *A. greggii* and *A. dumosa*, 92% for *L. tridentata*, and 100% for *O. basilaris* (Newton 2001). Annual precipitation from 1999-2005 after clearing of the 1998 ROW averaged 105% of the long-term (32 yr) mean (14 cm/yr), measured at Willow Beach, AZ, 26 km south of the study site (Western Regional Climate Center, Reno, NV).

Field Sampling

Between 31 August and 25 October 2006, we delineated a 30 x 70 m section in the centers of each of the four areas. Within these sections, we randomly established a 10 x 70 m transect divided into seven 10 x 10 m (0.01 ha) plots. Using simple random sampling, we selected three plots in each section for sampling. In six 1 x 1 m subplots per plot, we visually estimated areal percent cover of each plant species rooted in subplots using a 1-m² frame divided into 25, 0.04 m² compartments. We also surveyed whole plots on a presence/absence basis for species not occurring in subplots. We included dead annuals in subplot and plot sampling, but not dead perennials. Shrubs, including seedlings, were counted on each plot. Nomenclature and native/exotic species classifications follow Baldwin et al. (2002). To compare soils among the control and the treated and untreated 1998 ROW, we collected a 0-10 cm soil sample in an opening (≥ 1 m away from any shrub) at the northwest and southeast corners of each plot and composited these samples on a plot basis. We also selected a dominant *Larrea tridentata* on each plot on the control and on the treated 1998 ROW (the untreated ROW contained no *L. tridentata*) and collected four soil samples (composited on a plot basis) halfway between the main stem and the canopy edge.

Laboratory and Data Analysis

The air dry < 2 mm fraction of soil samples was analyzed for pH (saturated paste), total P and K (Olsen NaHCO₃ method), total C and N (Leco C/N analyzer), and texture (hydrometer method). We compared mean ($n = 3$ for each area) species richness, total shrub density, and open-area soils among the control and the treated and untreated 1998 ROW using one-way analyses of variance and Tukey's test in JMP (SAS Institute 2004). For the control and the treated 1998 ROW, paired t tests were used to compare soil properties between openings and below *Larrea tridentata*. Statistical results should not be extrapolated to other sites since treatments were not replicated, but mean comparisons are presented as interpretational aids. Mean vegetation characteristics for the 1968 ROW were compared descriptively to the 1998 ROW and the control.

RESULTS

1998 Right-of-Way

Exotic species richness/m² was lowest in the control, and was similar between treated and untreated areas (Fig. 2) in the 1998 ROW. Total species richness/100m² was similar among treatments, ranging from 8-9.3 species. The exotic annual grasses *Schismus* spp. exhibited the highest relative cover on the ROW compared to the control, but total absolute cover for all species on the ROW was only 5-6% (Fig. 3). Relative cover of the native annual *Plantago ovata* Forsskal increased from the untreated ROW to the control. Perennial forbs and grasses were sparse or absent from all treatments. Shrub density was eight times higher in the control than in the untreated ROW, which contained no *Larrea tridentata* (Fig. 4). *Ambrosia dumosa* and *Encelia farinosa* Torrey & A. Gray were the only shrubs inhabiting the untreated ROW, and these species did not occupy plots on the treated ROW or on the control. *Larrea tridentata* exhibited a density of 300/ha on the treated ROW, which was 36% of the density on the control.

In openings, soil properties were similar among the three areas except for K, which was significantly greater on the untreated ROW than on the control (Table 1). Sand concentration was 10% higher and silt 9% lower on the untreated ROW compared to the control, but all soils were still sandy loams. P and K both tended to be greater below *Larrea tridentata* than in openings for the treated ROW and the control, but the only difference that was statistically significant was for P for the control.

1968 Right-of-Way

Exotic species richness was minimal in the 1968 ROW, and total richness/100 m² was comparable to both the 1998 ROW and control (Table 2). Similar to the 1998 ROW, *Plantago ovata* was a major contributor to relative cover, although *Stephanomeria pauciflora* exhibited the highest relative cover. Total shrub density averaged 3134/ha, four and 31 times more than the 1998 ROW or the control, respectively. *Stephanomeria pauciflora* and *Hymenoclea salsola* contributed 76% of the total shrub density.

DISCUSSION

Although lack of replication and one-time sampling limits statistical inferences, our findings represent a case study of succession after land clearing in the eastern Mojave Desert and how a particular set of restoration treatments may influence succession. Several dominant species on the 1968 ROW, such as *Stephanomeria pauciflora*, *Ambrosia dumosa*, and *Eriogonum inflatum* Torrey & Frémont, were also important nine years after land clearing in the California Mojave Desert (Vasek 1979/80). Two species differences, however, were that *Encelia farinosa* was an important early colonizer in our study rather than *Encelia frutescens*, and *Chamaesyce polycarpa* (Benth.) Millsp. was important in Vasek's (1979/80) study but not in ours. Additionally, shrub densities are 50% lower on the 1968 ROW and 98% lower on the untreated 1998 ROW in our study compared to Vasek's (1979/80) study.

Also in the eastern Mojave Desert, Bolling and Walker (2002) concluded that soils beneath *Larrea tridentata*, even 88 years after road abandonment, lacked tight circular gradients in nutrient concentrations relative to control shrubs. P and K showed the strongest trends to concentrate below control *L. tridentata* in our study (Table 1). It is also possible that a weak trend may exist for these nutrients to be more concentrated below planted *L. tridentata* relative to openings on the treated 1998 ROW.

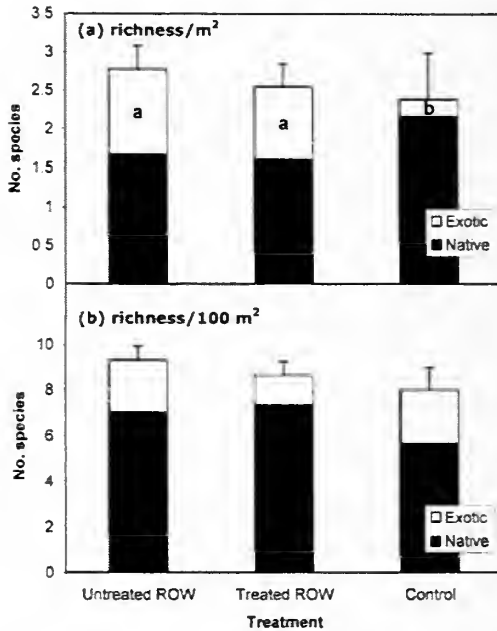


Figure 2. Mean plant species richness at (a) $1 m^2$ and (b) $100 m^2$ scales among treatments on an eight-year-old (1998) water pipeline right-of-way, Lake Mead National Recreation Area, southern Nevada. Restoration on the treated right-of-way (ROW) consisted of raking the soil surface, applying artificial desert varnish, and planting four species of native shrubs. Error bars are 1 SD for total mean richness. In comparisons within native or exotic categories, only exotic species/ m^2 differed significantly ($p < 0.05$) among treatments.

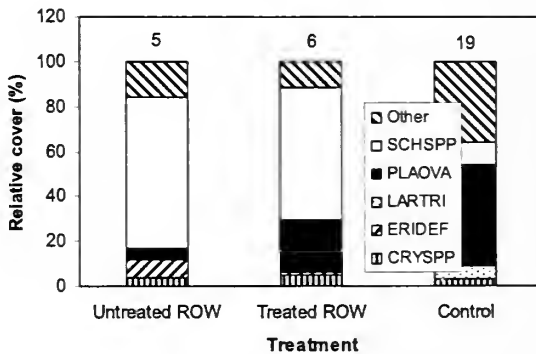


Figure 3. Relative cover of dominant plant species and genera among treatments on an eight-year-old (1998) water pipeline right-of-way, Lake Mead National Recreation Area, southern Nevada. Restoration on the treated right-of-way (ROW) consisted of raking the soil surface, applying artificial desert varnish, and planting four species of native shrubs. CRYSP = *Cryptantha* spp., ERIDEF = *Eriogonum deflexum*, LARTRI = *Larrea tridentata*, PLAOVA = *Plantago ovata*, and SCHSPP = *Schismus* spp. Numbers at the top of each bar represent total mean absolute cover.

Table 1. Comparison of 0-10 cm soil properties among treatments and between openings and below *Larrea tridentata* within treatments on an eight-year-old (1998) water pipeline right-of-way, Lake Mead National Recreation Area, southern Nevada.

Property	Untreated ROW ¹		Treated ROW		Control	
	Open	<i>Larrea</i>	Open	<i>Larrea</i>	Open	<i>Larrea</i>
pH	8.1±0.1 ²	— ³	8.1±0.2	8.1±0.1	8.1±0.1	7.9±0.1
P (mg/kg)	4.0±1.2	—	3.5±0.7	3.7±0.8	4.1±1.6	11.5±2.9
K (mg/kg)	555±13a	—	491±62ab	575±204	400±61b	552±42
C (mg/kg)	942±35	—	716±118	954±107	686±180	736±90
N (mg/kg)	27±5	—	37±14	43±8	57±27	50±15
Sand (% wt.)	70±2a	—	65±3b	67±4	60±1b	66±6
Silt (% wt.)	24±1b	—	29±3a	27±3	33±2a	28±5
Clay (% wt.)	6±2	—	6±0	6±1	7±1	6±2

¹ ROW = right-of-way. Restoration treatments included raking the soil surface, applying artificial desert varnish, and planting four species of native shrubs.

² Values are mean ± SD ($n = 3$ within each treatment and canopy combination). Letters within a row compare means among treatments for openings only. Values in bold denote significant differences at $p < 0.05$ between openings and below *Larrea tridentata* within treatments.

³ Not measured because *L. tridentata* did not occur in this treatment.

Table 2. Plant community attributes on a 38-year-old (1968) water pipeline right-of-way, Lake Mead National Recreation Area, southern Nevada.

Community attribute	Mean±SD
Species richness	
No. natives/m ²	2.2±0.2
No. exotics/m ²	0±0
No. natives/100 m ²	7.7±1.5
No. exotics/100 m ²	1±0
Relative % cover	
<i>Stephanomeria pauciflora</i>	41±16
<i>Chamaesyce</i> spp.	30±14
<i>Plantago ovata</i>	18±10
Other species	10±8
Shrubs/ha	
<i>Ambrosia dumosa</i>	367±379
<i>Bebbia juncea</i>	167±208
<i>Encelia farinosa</i>	233±321
<i>Hymenoclea salsola</i>	767±551
<i>Stephanomeria pauciflora</i>	1600±361

While effects of individual restoration treatments cannot be discerned in this study, the set of treatments including surface raking, applying artificial desert varnish, and planting of shrubs, appeared to make shrub composition on the treated 1998 ROW converge with that of the control (Fig. 4). Although our study was not designed to track survival of planted individuals, we found that *Larrea tridentata* established on the treated 1998 ROW at a density 36% of that of the control. Previous studies of *L. tridentata* outplanting have produced widely differing results, ranging from complete mortality (Graves et al. 1978) or < 2% survival (Brum et al. 1983), to > 90% survival (Wallace et al. 1980; Clary and Slayback 1984; Newton 2001). In our view, the restoration treatments also made the 1998 ROW less visually distinct from surrounding *L. tridentata* communities, an important consideration on National Park Service lands (Fig. 1).

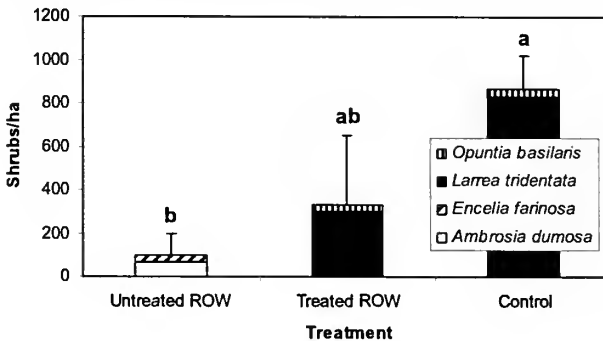


Figure 4. Shrub densities among treatments on an eight-year-old (1998) water pipeline right-of-way, Lake Mead National Recreation Area, southern Nevada. Restoration on the treated right-of-way (ROW) consisted of raking the soil surface, applying artificial desert varnish, and planting four species of native shrubs. Error bars are 1 SD for total mean density. Means without shared letters differ at $p < 0.05$ for total density.

This study highlights several topics requiring additional research for a better understanding of Mojave Desert successional patterns and how ecological restoration might be used to influence successional trajectories. The effects of soil salvage and replacement after disturbance may depend on several factors, such as soil type, depth of salvage, and length of time soil is stored (Bainbridge et al. 1998). Effects also hinge on whether or not nutrients and seed banks are diluted upon reapplication by mixing upper and lower soil layers (Nelson and Chew 1977). Soil salvage has been little studied in the Mojave Desert, and cannot be evaluated in this study since this would have required areas on the 1998 ROW that were bladed but did not have soil replaced. While we believe that applying artificial desert varnish helped make the treated 1998 ROW less visually distinct from control areas, potential ecological effects of this application are not clear. The darkening varnish could affect soil temperatures or have other ecological effects (Elvidge and Iverson 1983). While many studies in the Mojave Desert, including this one, have compared post-disturbance revegetation to composition of adjacent control communities, these "control" communities likely have been exposed to other human disturbances. These communities may not be good reference models for ecological restoration, unless a specific restoration goal is to blend a disturbed area into the surrounding matrix (Lovich and Bainbridge 1999). For example, neither the control nor the two ROWs contained perennial grasses or forbs, with the exception of *Eriogonum inflatum*. It remains unclear

whether these plant groups were more common at this site historically, or whether establishing them would produce ecological benefits.

Our analysis of the 1968 ROW revealed that species previously classified as early successional (Vasek 1983) remain dominant even 38 years after clearing (Table 2). This concurs with other research in the Mojave Desert reporting that plant composition on denuded areas can require over 40 years to approximate that of adjacent areas (e.g., Carpenter et al. 1983; Prose et al. 1987). Early successional shrub communities are not necessarily "bad," depending on ecological management objectives. For example, plant species richness on the 1968 ROW was similar to the control, and exotic species richness was actually lower (Table 2, Fig. 2). Plant assemblages similar to those on the 1968 ROW also characterize natural washes in this region (Wells 1961). Since early successional shrubs have established at only low densities eight years following creation of the 1998 ROW, future research could evaluate whether establishing these species more rapidly speeds natural recruitment of longer-lived species like *Larrea tridentata*.

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**ADDITIONS TO THE FLORA OF WESTERN RIVERSIDE COUNTY,
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ABSTRACT: We report 83 taxa vouchered from Riverside County west of the San Jacinto Mountains not included in our earlier checklist for western Riverside County (Roberts et al. 2004). In addition, four species and a variety are deleted from that checklist based on redetermination of specimens. We also include short discussions of several species reported from western Riverside County by various sources, but to our knowledge not confirmed by specimens, or excluded for other reasons. With these additions and deletions, the known western Riverside County Flora now totals 1,489 taxa (species, subspecies, varieties, and hybrids).

KEY WORDS: Riverside County, vascular plants, special status plants.

INTRODUCTION

We published *The Vascular Plants of Western Riverside County, an Annotated Checklist* in 2004, interpreting western Riverside County as the part of the county west of the San Jacinto Mountains along a rough north-south line running from the San Gorgonio River to California State Route 243, and along the western boundary of the San Bernardino National Forest extending south to the San Diego County line. See Figure 1 for a general map of the region with important landmarks. A more detailed map of this region is

presented on pages 12 and 13 of Roberts et al. (2004). We excluded most of the San Jacinto and San Bernardino mountains and Colorado Desert, and included the Riverside County portions of the Santa Ana and Agua Tibia mountains. In 2004 we reported 1,411 taxa, including 1,322 species, an additional 73 infraspecific taxa (subspecies or varieties), and 16 named and unnamed hybrids for western Riverside County.

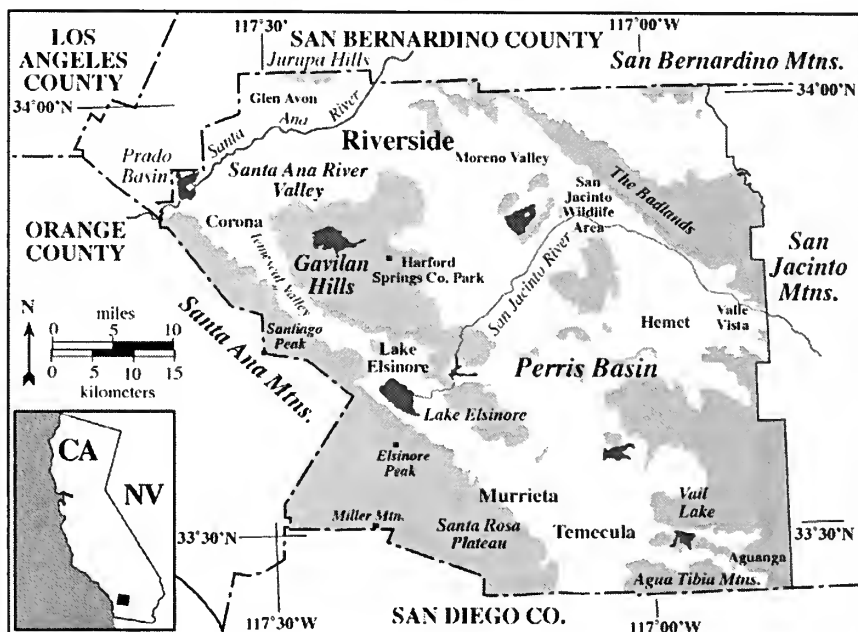


Figure 1. Western Riverside County with important landmarks.

This compilation represents the addition of 83 taxa to the flora that have come to our attention since 2004. These include 67 species, 11 infraspecific taxa (subspecies or varieties), and five unnamed hybrids. The additions are based on our continued field work, reviews of herbarium collections, reviews of data from other herbaria now available via the online Consortium of California Herbaria website (<http://ucjeps.berkeley.edu/consortium/>), and specimens provided by other field botanists or brought to our attention by readers of the 2004 checklist. We have deleted four species, *Plagiobothrys stipitatus* var. *micranthus*, *Euphorbia crenulata*, *Tamarix gallica*, *Tamarix aralensis*, and one variety, *Aristida purpurea* var. *wrightii*, based on redetermination of the specimens upon which these reports were based. We also have revised nomenclature for one species, *Machaeranthera asteroides* var. *asteroides*, reported in Roberts et al. (2004) as *M. canescens* (Pursh) A. Gray var. *canescens* based on treatment by Keil and Brown in Hickman (1993) (see discussion under *M. asteroides* below). We now recognize a total of 1,489 taxa in western Riverside County, including 1,385 species, 83 infraspecific taxa, and 21 named and unnamed hybrids.

Systematists have published new names for some taxa included in the flora. For example, Nesom (2006) revised *Gnaphalium* in the Flora of North America (Vol. 19) and we follow his treatment here for *Gamochaeta pensylvanica* (= *Gnaphalium pensylvanicum*).

But we have not attempted to update nomenclature for taxa listed in our earlier annotated checklist. We anticipate producing a completely revised and updated second edition of the checklist in several years and that work will reflect a more comprehensive review of current nomenclatural changes. Whenever we have opted to recognize a name that is not used in Hickman (1993) or the Flora of North America (Vols 1-5, 19-26), we include the name used in those references in brackets. Each account follows the format of the checklist with common names in capital letters, followed by a brief description of the abundance and distribution of the taxon in the study area. In the following list, a * symbol is used to indicate a species of special status or conservation concern, as per Roberts et al., 2004.

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We wish to thank Chet McGaugh, Kurt Campbell, Rick Riefner, Michael L. Charters, Bob Allen, Mitch Provance, and Michael Wall for collecting the first known specimens of several taxa from western Riverside County, and especially, Tom Chester for bringing several omissions from the earlier checklist to our attention, and for specimens he provided documenting several species new to the flora.

ADDITIONS AND CORRECTIONS TO THE WESTERN RIVERSIDE COUNTY, CALIFORNIA VASCULAR FLORA

DICOTS

Apiaceae – Carrot Family

**Anmi visnaga* (Kellogg) E. Greene VISNAGA. Uncommon annual in disturbed soils. [Temecula: *G. McTeer s.n.*, 3 Sep 2004 (UCR)].

Asteraceae – Sunflower Family

**Centromadia pungens* (Hook. & Arn.) E. Greene subsp. *pungens* [*Hemizonia p.* (Hook. & Arn.) Torr. & A. Gray subsp. *p.*]. COMMON SPIKEWEED. Presumably recently introduced weed found at scattered locations in the Perris Basin such as Perris, Moreno Valley, and March Air Reserve Base. [Perris (Perris Valley Storm Drain): *D.E. Bramlet 2048* (UCR)].

Gamochaeta pensylvanica (Willd.) Cabrera [*Gnaphalium pensylvanicum* Willd., incl. *Gnaphalium peregrinum* Fernald, *Gnaphalium purpureum* (L.) Cabrera of Riverside Co. authors] PENNSYLVANIA CUDWEED. Specimens previously identified as *Gnaphalium purpureum* in Roberts et al. (2004) were based on misidentified specimens of *Gnaphalium pensylvanicum* according to Guy Nesom (pers. comm. to A.C. Sanders). Note: we are following Nesom (2006) in treating the subgenus *Gamochaeta* of *Gnaphalium* as a full genus.

Gamochaeta stagnalis (I.M. Johnst.) And. [*Gnaphalium stagnale* I.M. Johnst.]. DESERT CUDWEED. Scarce annual known in the study area from Glen Avon and Menifee. [Glen Avon, sand dune area on the north slope of the Jurupa Hills: *A.C. Sanders 16566* (UCR)].

Hesperevax acaulis (Kellogg) E. Greene var. *ambusticola* Morefield DWARF EVAX. Uncommon annual on clay soils, Santa Rosa Plateau. [4 mi W of Murrieta: *E.W. Lathrop 5739B* (RSA)].

- **Lasthenia glaberrima* A. DC. SMOOTH GOLDFIELDS. Uncommon annual along borders of vernal pools on the Santa Rosa Plateau. First found in our area in 2003. [Santa Rosa Plateau: *M.L. Charters 204* (UCR)].
- Machaeranthera asteroides* (Torr.) Greene var. *asteroides* [*M. tephrodes* (A. Gray) E. Greene; *Dieteria asteroides* Torr. var. *a.*] ASH-COLORED ASTER. Late-flowering large perennial herb. Reported as *M. tephrodes* from the Hemet area by Munz (1974). Mistakenly reported as *M. canescens* (Pursh) A. Gray var. *canescens* in Roberts et al. (2004) based on Keil and Brown (1993), who synonymized *M. tephrodes* into *M. canescens* while retaining *M. asteroides* as distinct. *Machaeranthera tephrodes* is treated as a synonym of *M. asteroides*, distinct from *M. canescens*, in other treatments we have seen including Abrams and Ferris (1960) and Shreve and Wiggins (1964). Morgan (2006) places it in the genus *Dieteria* Nuttall. He retains *D. asteroides* and *D. tephrodes* as synonyms, distinct from *D. canescens*. Uncommon, washes and alluvial benches of the San Jacinto River toward the eastern margin of our area [San Jacinto: *D. Myrick 2127* (RSA)].
- **Osteospermum ecklonis* (DC.) Norlindh AFRICAN DAISY. Scarce weed, perhaps only a waif. [Agua Tibia Mtns.: *D.L. Banks & E.H. Banks 953* (RSA)].
- Stephanomeria exigua* Nutt. subsp. *exigua* SLENDER WREATH PLANT. Uncommon annual on open benches of Arroyo Seco, Agua Tibia Mtns. and Gavilan Hills area. More common east of the study area. Seems to intergrade with *S. exigua* subsp. *deanei* (J.F. Macbr.) Gottlieb around the southern and eastern margins of our area; more common to the east. [Agua Tibia Mtns.: *D.L. Banks & S. Boyd 774B* (RSA)].

Brassicaceae – Mustard Family

- **Cardamine flexuosa* With. WAVY BITTERCRESS Common agricultural weed, especially in shady and irrigated places. Difficult to separate from, and easy confused with, *C. deblis* (L.) Desv. and *C. parviflora* L., which are both also found in irrigated landscapes. [Riverside, UCR campus: *A.C. Sanders 20006* (UCR) Determined by I. Al-Shehbaz].
- **Cardamine hirsuta* L. HAIRY BITTERCRESS. Uncommon urban weed of irrigated ground. [Riverside (Arlington Heights): *C. McGaugh s.n., 12 Dec 2006* (UCR)].
- Descurainia pinnata* (Walter) Britton subsp. *glabra* (Wootton & Standley) Detl. SMOOTH WESTERN TANSY-MUSTARD. Uncommon annual in sandy soils on alluvial benches and in oak woodland in the vicinity of Butterfield Valley and Arroyo Seco, north base of the Agua Tibia Mtns. Subtaxa perhaps not truly separable and best treated only at the species level. [Agua Tibia Mtns.: *D.L. Banks & D. Hannon 1007* (RSA)].
- Draba verna* L. SPRING DRABA. Occasional in open oak woodland, shrubland, and disturbed sites, Agua Tibia Mtns. [Agua Tibia Mtns.: *D.L. Banks 1398A* (RSA)].
- Lepidium densiflorum* Schrader var. *ramosum* (Nelson) Thell. COMMON PEPPER GRASS. Scarce annual on disturbed sandy soils, Agua Tibia Mtns. [Agua Tibia Mtns.: *D.L. Banks & D. Hannon 976* (RSA)].

Campanulaceae – Bellflower Family

- Nemacladus longiflorus* A. Gray var. *breviflorus* McVaugh NOT-SO-LONG LONG-FLOWERED THREAD PLANT. Uncommon annual in coarse seasonally moist sand on alluvial benches, Agua Tibia Mtns. [Agua Tibia Mtns.: *D.L. Banks 222* (RSA)].

Caprifoliaceae – Honeysuckle Family

Symphoricarpos rotundifolius A. Gray var. *parishii* (Rydb.) Dempster PARISH'S SNOWBERRY. Uncommon shrub found in chaparral, higher elevations, Santa Ana Mtns. where known only from Santiago Peak near the Orange Co. line. [Santa Ana Mtns.: R.L. Allen 12259 (MACF)].

Caryophyllaceae – Pink Family

Spergularia macrotheca (Hornem.) Heynh. var. *macrotheca* PINK ALKALI SAND-SPURRY. Occasional perennial on alkali flats in the southern Perris Basin. Largely a species of coastal wetlands, apparently intergrades with *S. macrotheca* var. *leucantha* B.L. Rob. in alkaline pools around Murrieta. [Murrieta: P.A. Munz 2136 (POM)].

Chenopodiaceae – Goosefoot Family

Atriplex polycarpa (Torr.) S. Watson. ALL-SCALE. Recently found on alkali flats in association with saltgrass meadow on the dry lake flats south of Lake Elsinore. [Lake Elsinore: R.E. Riefner 04-306 (RSA)].

**Chenopodium ficifolium* Smith. [*C. serotinum* L. misappl.] FIGLEAF GOOSEFOOT. Represented by a single sterile collection from the San Jacinto Wildlife area, and annotated as *C. serotinum*. The specimen has the unique distinctive leaf form characteristic of *C. ficifolium*. According to Clemants and Mosyakin (2003), P. Aellen and P. Uotila have shown that the type of *C. serotinum* is based on a specimen of sterile *Atriplex*. [San Jacinto Wildlife Area: J. Greene 1082 (RSA)].

Chenopodium pratericola Rydberg NARROW-LEAVED GOOSEFOOT. Generally of higher elevations but sometimes reaching sandy flats, dunes, and disturbed riparian areas, vicinity of Riverside and Jurupa Mtns. [Riverside: M. Provance 2265 (RSA)].

Crassulaceae – Stonecrop Family

Sedum spathulifolium Hook. BROADLEAF STONECROP. Local in oak woodland understory, cool drainages of Dripping Springs Alcove, north flank Agua Tibia Mtn., considerably more common about rock outcrops at higher elevations, San Diego Co. portions of the range. [Agua Tibia Mountains: S. Boyd & D.L. Banks 8415 (RSA)].

Dipsacaceae – Teasel Family

Dipsacus sativus (L.) Honck. FULLER'S TEASEL. Uncommon biennial weed. [Temecula: K. Campbell s.n., 15 Jun 2006 (UCR)].

Ericaceae – Heath Family

Arctostaphylos pringlei C. Parry subsp. *drupacea* (C. Parry) P. Wells PINK-BRACT MANZANITA. Scarce shrub on dry slopes in chaparral, eastern slopes of Santiago Peak. Common in the San Jacinto Mtns. just east of the study area. Uncommon in the Santa Ana Mtns. Known only from one additional location in adjacent Orange Co. [Santa Ana Mtns.: D. Menz 185 (UCR)].

Euphorbiaceae – Spurge Family

- **Euphorbia lathyris* L. GOPHER SPURGE. Uncommon biennial weed near Hemet. [Santa Rosa Hills: S.D. White & J. Wood 11644 (RSA)].
- Euphorbia melanadenia* Torr. [*Chamaesyce m.* (Torr.) Millsp.] RED-GLAND SPURGE. Perennial herb, locally scarce. Widespread in the Sonoran Desert and disjunct in cismontane Los Angeles County. Only local record: South slopes of the Jurupa Hills [S. Boyd 5516 (RSA)].
- Euphorbia micromeria* Engelm. [*Chamaesyce m.* (Engelm.) Wooten & Standley] SONORAN SPURGE. Scarce annual in dry hills of the interior. Common on the deserts. [Aguanga: T. Craig & F. Craig s.n., Nov 1939 (POM)].
- Euphorbia polycarpa* Benth. var. *hirtella* Boiss [*Chamaesyce p.* var. *h.* (Boiss) Parish] DESERT GOLONDRINA. Scarce in western Riverside Co. near Riverside and the Jurupa Hills. More common in the deserts. [Riverside (Arlington Heights): L. Cushman s.n., 1 Nov 1901 (RSA)].
- Euphorbia setiloba* Torr. [*Chamaesyce s.* (Torr.) Millsp.] YUMA SANDMAT. Scarce annual in sandy places, known in our area only from the cited location. Common in the deserts east of our area, including the eastern foothills of the San Jacinto Mtns. [near Aguanga: T. Craig & F. Craig s.n., Nov 1939 (POM)].

Fabaceae – Pea Family

- Astragalus didymocarpus* Hook. & Arn. var. *dispermis* (A. Gray) Jepson DWARF WHITE MILKVETCH. Occasional annual on sandy soils and burns on hillsides and flats, scattered sites in the Perris Basin. More common east of the study area. [San Jacinto Valley: M. Wall 258 (RSA)].
- Astragalus douglasii* (Torr. & A. Gray) A. Gray var. *parishii* (A. Gray) M.E. Jones PARISH'S MILKVETCH. Fairly common perennial on fine sand in sycamore alluvial woodland at the northern base of the Agua Tibia Mtns. and at Vail Lake. More common east of the study area. [Agua Tibia Mtns.: D.L. Banks & R.M. Pant 1028 (RSA)].
- Astragalus nuttallianus* DC. var. *imperfectus* (Rydb.) Barneby SMALL-FLOWERED MILKVETCH. Scarce annual; a desert species known in this area only from one collection in 1897. This appears to have been one of several desert plants that ranged into the Perris Basin and even west to the Temescal Valley before extensive land alteration associated with agriculture and urbanization. Superficially similar to *Lotus strigosus*. (Nutt.) E. Greene [San Jacinto: H.M. Hall 434 (RSA)].
- Dalea mollis* Benth. SILK DALEA. Known in western Riverside Co. only from cited specimen. This may have been among the many desert taxa at scattered sites in W Riverside Co., or may have been a "waif," perhaps transported by sheep. *Dalea mollis* is much like *D. mollissima* (Rydb.) Munz, and this specimen is somewhat intermediate in flower size and leaf margin characters. ["Riverside vicinity": Albert J. Perkins s.n., May 1914 (RSA)].
- Lotus argophyllus* (A. Gray) E. Greene var. *argophyllus* X *Lotus heermannii* (Durand & Hilg.) E. Greene var. *heermannii*. Uncommon perennial sometimes found where the parents occur together. [Agua Tibia Mtns.: S. Boyd & D.L. Banks 8418B (RSA)].
- Lotus oblongifolius* (Benth.) E. Greene var. *oblongifolius* STREAM LOTUS. Scarce in damp soil of drainage ditch, Hemet. Presumably washed down from the San Jacinto Mtns., more typical of stream courses at higher elevations. [Hemet: S.D. White & M.L. Balk 11590 (UCR)].

Hydrophyllaceae – Waterleaf Family

Pholistoma membranaceum (Benth.) Constance WHITE FIESTA FLOWER. Uncommon annual on alluvial benches near Vail Lake. [Temecula Creek: *S. Boyd et al.* 2942 (RSA)].

Malvaceae – Mallow Family

**Lavatera cretica* L. CRETAN LAVATERA. Scarce weed recently found in a field at the cited location. [Riverside: M. Provance 288 (UCR)].

Sphaeralcea amibigua A. Gray [incl. *S. a.* var. *rugosa* Kearney] APRICOT MALLOW. Scarce subshrub or perennial herb found near Riverside, the vicinity of the Badlands, San Jacinto, Temecula, Murrieta, and Dripping Springs along the northern foothills of the Agua Tibia Mtns. Common in desert regions to the east and north. Few recent records in our area. [Box Springs Mtn.: *J. Roos* 5542 (RSA)].

Molluginaceae – Carpet-weed Family

**Glinus radiatus* (Ruiz Lopez & Pavon) Rohrb. SHINING DAMASCISA. Scarce annual found in drying stock pond at cited location. [Murrieta: *R.E. Riefner* 03-379 (RSA)].

Onagraceae – Evening Primrose Family

Epilobium brachycarpum C. Presl SUMMER COTTON WEED. Uncommon in floodplain, San Jacinto River, vernal alkali grassland near Hemet, and stream banks, Agua Tibia Mtns. [Hemet: *R.E. Riefner* 04-347 (RSA)].

Ludwigia hexapetala (Hook. & Arn.) Zardini, Gu, & Raven WATER PRIMROSE. Uncommon in still water, Temescal Wash at Walker Cyn., just north of Lake Elsinore. [Temescal Wash: *R.E. Riefner* 04-344 (RSA)].

Polemoniaceae – Phlox Family

Eriastrum densifolium (Benth.) H. Mason subsp. *austromontanum* (Craig) H. Mason SOUTHERN MOUNTAIN WOOLLY-STAR. Uncommon on alluvial benches in the Agua Tibia Mtns. The authors disagree over recognizing subspecies in *E. densiflorum*. Some of us prefer to follow Brunell (1997) who suggested that only *E.d.* subsp. *densifolium* and *E.d.* subsp. *sanctorum* (Millikin) H. Mason warrant recognition. For now we are continuing to recognize the traditional treatment. [Agua Tibia Mtns.: *D.L. Banks & S. Boyd* 784 (RSA)].

Linanthus bigelovii (A. Gray) E. Greene BIGELOW'S LINANTHUS. Uncommon annual on alluvial benches, granitic slopes, sedimentary hills, and burns near Vail Lake and the Agua Tibia Mtns. [Vail Lake: *S. Boyd* 4455 (RSA)].

Polygonaceae – Buckwheat Family

Eriogonum baileyi S. Watson var. *baileyi* BAILEY'S WILD BUCKWHEAT. Uncommon annual in sandy places Wilson Creek watershed near Aguanga. Specimen determined by J. Reveal. [Wilson Creek: *V. Moran s.n.*, 1 Sep 2003 (UCR)].

Ranunculaceae – Crowfoot Family

Clematis lasiantha Nutt. X *Clematis pauciflora* Nutt. Uncommon hybrid occurring where both parents come in contact. [Pechanga Indian Reservation: *D.L. Banks 1638* (RSA)].

Rhamnaceae – Buckthorn Family

Ceanothus crassifolius Torr. X *Ceanothus cuneatus* (Hook.) Nutt. var. *cuneatus* Sandy benches associated with the Gavilan Creek drainage in the southeast corner of Harford Springs Co. Park; a hybrid swarm with numerous introgressant forms. [Gavilan Hills: *S. Boyd 810304-Q, 4 Mar 1981* (RSA)].

Ceanothus crassifolius Torr. X *Ceanothus ophiochilus* S. Boyd, T.S. Ross, & L. Arnseth. Occasional hybrid in chaparral west of Vail Lake and on Agua Tibia Mtn. [Vail Lake: *S. Boyd 7900* (RSA)].

Rosaceae – Rose Family

**Rubus discolor* Weihe & Nees HIMALAYAN BLACKBERRY. Occasional, but poorly documented weedy vine about old dwellings, abandoned orchards, etc. in the foothills. [Santa Rosa Plateau: *T.J. Chester 979* (UCR)].

Salicaceae – Willow Family

**Populus nigra* L. LOMBARDY POPLAR. Commonly cultivated and occasionally escaping in disturbed moist areas. [Temescal Valley: *A.C. Sanders 25634* (UCR)].

Scrophulariaceae – Figwort Family

Keckiella ternata (Torr. ex A. Gray) Straw var. *ternata* BLUE-STEMMED BUSH PENSTEMON. Very local shrub found only on dry slopes at higher elevations, Santa Ana Mtns. Often fairly common in chaparral where found, especially along road cuts on Santiago Peak. Not otherwise known from our area. [Santa Ana Mtns.: *R.L. Allen 12296* (MACF)].

Mimulus aurantiacus Curtis X *Mimulus clevelandii* Brandegee. Rare hybrid occurring in chaparral where two species come into contact. [Agua Tibia Mtns.: *D.L. Banks & S. Boyd 558* (RSA)].

Mimulus moschatus Lindley MUSK MONKEY FLOWER. Uncommon annual found on old clearing on alluvial terrace along the San Jacinto River just east of Valle Vista. More common at higher elevations east of the study area. [Valle Vista: *T.B. Salvato & A.C. Sanders 895* (UCR)].

Mimulus rattanii A. Gray RATTAN'S MONKEY-FLOWER. Scarce in chaparral, Santa Ana Mtns. [Santa Ana Mtns. (Glen Ivy): *F. W. Peirson 9379* (LA)].

Penstemon grinellii Eastw. GRINELL'S PENSTEMON. Uncommon perennial in chaparral at higher elevations, Santa Ana Mtns. [Santa Ana Mtns. (Santiago Pk.): *D. Menz 182* (UCR)].

Veronica americana (Raf.) Schwein. AMERICAN SPEEDWELL. Uncommon in wet places. Known locally only from cited location. [Santa Rosa Plateau: *R.F. Thorne & E.L. Lathrop 39334* (RSA)].

Solanaceae – Nightshade Family

- **Datura quercifolia* Kunth OAK-LEAF THORN-APPLE. Scarce weed found in a former cow pasture in Riverside, collected 1984 and again in 1996. [Riverside: *A.C. Sanders et al. 19644* (UCR)].
- **Petunia integrifolia* (Hook.) Schinz & Thell. [*P. violacea* Lindley]. VIOLET-FLOWERED PETUNIA. Scarce urban weed. [Riverside: *A.C. Sanders 7046* (UCR)].

Tamaricaceae – Tamarisk Family

- **Tamarix parviflora* DC. SMALL-FLOWERED TAMARISK. Uncommon weedy tree, mainly in moist, disturbed situations. [Riverside: *M. Provance 408* (UCR)].

Tropaeolaceae – Nasturtium Family

- Tropaeolum majus* L. GARDEN NASTURTIUM. Scarce escape from cultivation, naturalized in a willow-dominated riparian thicket at Riverside. Commonly naturalized near the coast of southern California. [Riverside: *J. Ross 145* (UCR)].

Violaceae – Violet Family

- Viola purpurea* Kellogg subsp. *purpurea* MOUNTAIN VIOLET. Occasional perennial on rocky soil in openings of chaparral and cismontane woodland, higher elevations, Santa Ana Mtns. The distinction between *V. purpurea* subsp. *purpurea* and *V. p.* subsp. *quercetorum* (Baker & Clausen) R.J. Little seems ambiguous and is in need of further study. [Santa Ana Mtns. (Bear Springs): *C. Davidson 5624* (RSA)].

MONOCOTS

Alismataceae – Water-plantain Family

- Sagittaria longiloba* Engelm. LONGBARB ARROWHEAD. Occasional in persistently wet roadside ditch, Hemet. First southern California record since 1894. Possibly spread by waterfowl. [Hemet: *S.D. White & M.L. Balk 11582* (UCR)].
- Sagittaria montevidensis* S. Watson subsp. *calycina* (Engelm.) C. Bogin HOODED ARROWHEAD. Occasional in persistently wet roadside ditch, Hemet. Possibly spread by waterfowl. First record in Riverside County. [Hemet: *S.D. White & M.L. Balk 11510* (UCR)].

Convallariaceae – Lily-of-the-Valley Family

- Maianthemum racemosum* (L.) Link subsp. *amplexicaule* (Nuttall) LaFrankie WESTERN FALSE SOLOMON'S SEAL. Scarce perennial in shaded *Pseudotsuga* woodlands, Santa Ana Mtns. [Santa Ana Mtns.: *E.W. Lathrop 6909* (RSA)].

Cyperaceae – Sedge Family

- Cyperus retrorsus* Chapman PINE BARRENS FLATSEEDGE. Occasional on irrigated ground at Riverside. Native from Florida to Texas. [U.C. Riverside campus: *A.C. Sanders 24885* (UCR)].

- Eleocharis bella* (Piper) Svenson PRETTY SPIKERUSH. Occasional annual along streams in the Santa Ana Mtns., e.g., Santa Rosa Plateau, Bear Canyon., and between Tenaja and Alamos Canyons. [Santa Ana Mtns.: *E.W. Lathrop 7080* (RSA)].
- Bolboschoenus glaucus* (Lamarck) S.G. Smith [*Scirpus g. Lamarck*] TUBEROUS BULRUSH. Local perennial growing in wet places; known in our area only from cited collection. [San Jacinto Wildlife Area: *A. Sleight & A. Hainov 107* (RSA)].
- Schoenoplectus pungens* (Vahl) Palla var. *longispicatus* (Britton) S.G. Smith [*Scirpus p. Vahl*] COMMON THREE-SQUARE. Scarce perennial on sandy benches; known in our area only from cited location. [Riverside (Santa Ana River): *M. Provance 1692* (UCR)].

Iridaceae – Iris Family

- **Iris pseudacorus* L. PALE YELLOW IRIS. Scarce escape from cultivation in the Santa Ana River Valley. A widespread wetland weed in California. The cited specimen represents the first record for Riverside Co. [Riverside (Rancho Jurupa Park): *A.C. Sanders 25019* (UCR)].

Juncaceae – Rush Family

- Juncus bryoides* F.J. Herm. MOSS-LIKE DWARF RUSH. Uncommon along streams in the Agua Tibia Mtns. More common east of our area. [Agua Tibia Mtns: *D.L. Banks 167* (RSA)].
- Juncus hemiendytus* F.J. Herm. var. *hemiendytus* HERMANN'S DWARF RUSH. Uncommon, vernal pools and grassy mesas; known in our area only from cited location. More common east of the study area. [Santa Rosa Plateau: *A.C. Sanders et al. 738* (UCR)].
- Juncus luciensis* Ertter SANTA LUCIA DWARF RUSH. Local caespitose annual, moist depressions in grassland, often associated with vernal pools; known in western Riverside Co. only from cited location. [Santa Rosa Plateau: *R.F. Thorne 45498* (RSA)].
- Juncus orthophyllus* Cov. STRAIGHT-LEAF RUSH. Scarce along stream banks in grassland and oak woodland, southern Santa Ana Mtns. [Santa Ana Mtns.: *E.W. Lathrop 7081* (RSA)].
- Juncus phaeocephalus* Engelm. [incl. *J.p. var. paniculatus* Engelm.] BROWN-HEADED RUSH. Occasional in moist grasslands and along streams at the cited location. Our local plants have been treated as *J.p. var. paniculatus* Engelm. (e.g., Coffey Swab 1993). However, Brooks and Clemants (2000) suggest plants treated as *J. p. var. paniculatus* are similar to, and perhaps better treated under *J. macrandus* Coville. Studies of the entire subgenus are needed before making such a transfer. [Santa Rosa Plateau: *R.F. Thorne et al. 61169* (RSA)].

Melanthiaceae – Camas Family

- Zigadenus venenosus* S. Watson var. *venenosus* MEADOW DEATH CAMAS. Uncommon perennial in moist grasslands and vernal depressions; southern Santa Ana Mtns. from Elsinore Peak south, Santa Rosa Plateau, and Agua Tibia Mtns. [Santa Ana Mtns.: *J.D. Olmsted 3636* (RSA)].

Poaceae – Grass Family

- **Aegilops cylindrica* Host JOINTED GOATGRASS. Occasional annual weed growing along trails on the Santa Rosa Plateau. [Santa Rosa Plateau: *T.J. Chester 631* (UCR)].
- **Ehrharta longiflora* J.E. Smith LONG-FLOWERED VELDT GRASS. Locally abundant annual, apparently aggressively spreading in disturbed places and along stream courses in near the San Diego Co. line. [Santa Margarita Ecological Preserve: *A. Montalvo 662* (UCR)].
- Eriochloa aristata* Vasey BEARDED CUPGRASS. Locally common weed in ditches and roadside swales at Hemet. [Hemet: *R.E. Riefner 04-352* (RSA)].
- **Hainardia cylindrica* (Willd.) Greuter BARBGRASS. Uncommon annual weed in vernal pools at the cited location. [Santa Rosa Plateau: *G.D. Wallace et al. 2082* (RSA)].
- **Panicum dichotomiflorum* Michaux subsp. *dichotomiflorum* FALL PANIC GRASS. Uncommon in wet river sand at cited location [Corona (Santa Ana River): *R.E. Riefner 04-435* (RSA)].
- Phragmites australis* (Cav.) Steud. COMMON REED. Poaceae. Very local in coastal sage scrub at hillside spring in "Walsh Cyn." in the southeastern Gavilan Hills; to be expected elsewhere about seeps and edges of alkaline wetlands. [Gavilan Hills: *S. Boyd 11721* (RSA)].
- Poa infirma* Kunth WEAK BLUEGRASS. Occasional and scattered, mostly along foot trails at the cited location. Easily confused with morphologically very similar *P. annua* L. [Santa Rosa Plateau: *T.J. Chester 595* (UCR)].
- Poa secunda* J.S. Presl subsp. *juncifolia* (Scribner) R. Soreng RUSH BLUE GRASS. Scarce on sandstone-derived soils in chaparral. Known only from cited collection. [Agua Tibia Mtns.: *D.L. Banks 971* (RSA)].
- **Setaria adhaerens* (Forssk.) Chiov. TROPICAL BARBED BRISTLEGRASS. Occasional to locally common annual weed in irrigated landscaping and roadside seepages near Riverside. [La Sierra: *R.E. Riefner 05-793* (RSA)].

Themidaceae – Brodiaea Family

- Brodiaea santarosae* T. Chester, W. Armstrong, & K. Madore. SANTA ROSA BASALT BRODIAEA. Overall uncommon but sometimes locally frequent on Santa Rosa Basalt in grassland and sometimes near vernal pools; southern Santa Ana Mtns. at Miller Mtn., Elsinore Peak, and Santa Rosa Plateau. The Type specimen is cited. Some authors are not convinced that these plants represent a full taxon due to variation in staminode and other floral characters. The authors in S. Boyd *et al.* (1995) presumed these plants to be the result of introgressive hybridization between *B. filifolia* and *B. orcuttii*. Other authors believe T. Chester *et al.* (2007) have made a good argument that *B. santarosae* could be the progenator of these two *Brodiaea* species. Regardless, increased knowledge of these plants suggest that the status of *B. filifolia* may require re-assessment, since previous evaluations of the conservation of this species may have been overly reliant on populations on the Santa Rosa Plateau and Miller Mtn. ☹️ Local Concern. [Santa Rosa Plateau: *T. Chester et al. 927* (UCR)].

Typhaceae – Cattail Family

- Typha angustifolia* L. NARROW-LEAVED CATTAIL. Uncommon in ponds and along stream courses, Agua Tibia Mtns. [Agua Tibia Mtns.: *D.L. Banks & V. Steinmann 748* (RSA)].

ADDITIONAL EXCLUDED TAXA

The following species accounts are added to the Excluded Species discussion of Roberts et al. (2004; Appendix I, page 158).

- **Acacia baileyana* F. Muell. BAILEY ACACIA. Fabaceae. Shrubby tree. Locally scarce, probably only persisting ornamentals, as in the La Sierra area near Riverside [S.D. White 9894 (RSA)]. Additional records are needed to confirm this species as part of the flora.
- Acacia greggii* A. Gray CATCLAW ACACIA. Fabaceae. Shrub, just reaching the northeastern margin of our area along Banning Canyon Road, but not yet vouchered.
- Allium monticola* Davidson SAN BERNARDINO ONION. Alliaceae. Scattered and local in the Santa Ana Mtns. on scree slopes of Santiago and Modjeska peaks, adjacent Orange Co. To be expected in adjacent areas of western Riverside Co.
- Aristida purpurea* var. *wrightii* (Nash) K.W. Allred [A. *wrightii* Nash] WRIGHT THREE-AWNED GRASS. Poaceae. Originally included in Roberts et al. 2004 based on a single collection [J.R. Holliday 44 (UCR)]. However, this specimen has been redetermined as *A. p.* var. *glauca* (Nees) Walp. according to the Consortium of California Herbaria (2007). *A. p.* var. *glauca* is a synonym of *A.p.* var. *nealleyi* (Vasey) K.W. Allred according to Allred (2003). This latter variety is already reported as part of the flora.
- Calystegia sepium* (L.) R. Br. subsp. *binghamiae* (E. Greene) Brummitt SANTA BARBARA MORNING GLORY. Convolvulaceae. A perennial vine of wet areas once reported from "Chino Creek south of Ontario" [*I.M. Johnston 1274* (POM)]. Chino Creek is predominately in San Bernardino Co. but a small portion flows through Riverside Co. This collection suggests this taxon may have occurred at what is now the Prado Basin and may well have occurred in adjacent areas of northwestern Riverside Co. * CNPS List 1B.
- Cardamine californica* (Nutt.) Greene var. *californica* CALIFORNIA TOOTHWORT. Brassicaceae. Some plants in the Santa Ana Mountains seem to key as this subspecies, but we cannot reliably separate it from *C. californica* var. *integrifolia* (Torr. & A. Gray) Rollins, (included in our earlier checklist) and we are uncertain of the taxonomic merit of these subspecific taxa.
- Centaurium exaltatum* (Griseb.) Piper DESERT CENTAURY. Gentianaceae. Known from San Bernardino Valley in adjacent San Bernardino Co. — "near San Bernardino" (*S.B. Parish 5897* (UC)) and "along the Santa Ana River" [*S.B. Parish s.n., May 1899* (UC)]. Also known from 1935 collections at Lake Hemet [e.g. *I.W. Clokey & E.G. Anderson 6790* (UCR)] just east of our area. Almost certainly formerly found along the Santa Ana River in Riverside Co., but we can find no voucher specimens to confirm this.
- **Celtis australis* L. MEDITERRANEAN HACKBERRY. Ulmaceae. Reported to occur fairly commonly along the Santa Ana River in adjacent San Bernardino Co. by Clarke et al. (2007) but we have not been able to locate any vouchers for western Riverside Co.
- **Celtis sinensis* Persl. JAPANESE HACKBERRY. Ulmaceae. Reported to occur fairly commonly along the Santa Ana River in adjacent San Bernardino Co. by Clarke et al. (2007) but we have not been able to locate any vouchers for western Riverside Co.
- Delphinium parryi* A. Gray subsp. *maritimum* (Davidson) M.J. Warnock. MARITIME LARKSPUR. Ranunculaceae. Reported from open slopes in the Pauba Valley. [*D.L. Banks & V. Steinmann 1428* (RSA)]. But the specimen does not clearly show

- characters of this subtaxon. The infraspecific taxa in /*D. parryi*/ seem problematic to us. We do not include this taxon pending a more confident determination or a more distinct specimen.
- Dudleya cymosa* subsp. *pumila* (Rose) K. Nakai. CHALKY CANYON DUDLEYA. Crassulaceae. Reported to occur in Riverside Co. on Santiago Peak, Santa Ana Mtns. but not yet vouchered. This taxon is scattered on rocky banks, cliffs, and roadcuts in chaparral at higher elevations of the Santa Ana Mtns. in adjacent Orange Co.
- Eriogonum nudum* Benth. var. *pauciflorum* S. Watson NAKED BUCKWHEAT. Polygonaceae. Known to occur in the Santa Ana Mtns. on Santiago Peak in adjacent Orange Co. To be expected in adjacent western Riverside Co. within the highest reaches of the Santa Ana Mtns.
- Erysimum capitatum* (Douglas) E. Greene subsp. *capitatum* WESTERN WALLFLOWER. Brassicaceae. Local but fairly common on dry slopes in openings of chaparral at high elevations in the vicinity of Modjeska and Santiago Peaks, Santa Ana Mtns., Orange Co. To be expected in adjacent Riverside Co.
- Euphorbia crenulata* Engelm. CHINESE-CAPS. Euphorbiaceae. Included in Roberts *et al.* (2004) based on misidentification of two specimens of *E. spathulata*.
- Gamochaeta antillana* (Urban) Anderberg [*Gnaphalium a.* Urban] DELICATE EVER-LASTING. Asteraceae. One of three specimens on a sheet of *G. stagnale* collected in Glen Avon [*A.C. Sanders 16566* (UCR)] has been annotated by Guy Nesom as "resembling" *G. antillana*. More definitive material is needed before we add this species to the checklist, however.
- Hypericum anagalloides* Cham. & Schldl. TINKER'S PENNY. Hypericaceae. Reported to occur at San Jacinto (*Hasse s.n., 3 Jul 1892* [RSA]). This species is typically found at higher elevations and at moister sites. Hasse made other collections in the San Jacinto Mtns. that same day. While the "San Jacinto" report may be valid, it would seem more likely the label was meant to read "San Jacinto Mountains," therefore we are excluding it for now. *Hypericum anagalloides* has also been documented within San Diego Co. near the San Mateo Canyon Wilderness Area, Santa Ana Mtns. not far from the Riverside Co. line and can be expected to occur in adjacent western Riverside Co. in that region (Boyd *et al.* 1995).
- Machaeranthera canescens* (Pursh.) A. Gray var. *canescens* [*Dieteria canescens* (Pursh.) Nutt. var. *c.*] HOARY ASTER. See discussion under *M. asteroides* var. *asteroides* above.
- Opuntia phaeacantha* Engelm. DESERT PRICKLY PEAR. Cactaceae. See discussion under *O. engelmannii* Salm-Dyck in the Excluded Taxa section of Roberts *et al.* (2004). While *O. littoralis* (Engelm.) Cockerell, *O. phaeacantha*, and *O. engelmannii* are clearly defined in other areas of the southwestern United States, the relationship of these taxa, and hybrids *O. occidentalis* Engelm. and *O. x vaseyi* (J.M. Coulter) Britton & Rose are confused and uncertain in western Riverside Co.
- **Pisum sativum* L. GARDEN PEA. Fabaceae. Reported as uncommon in disturbed areas on the Pechanga Indian Reservation according to D.L. Banks (1999) based on *D.L. Banks 1365* (RSA). We believe this collection represents a waif escaped from cultivation and that this species has not become an element of the flora.
- Plagiobothrys stipitatus* (E. Greene) I.M. Johnston var. *micranthus* (Piper) I.M. Johnston SMALL-FLOWERED POPCORN FLOWER. Boraginaceae. Included in Roberts *et al.* (2004). The only reports were based on a misidentified specimen of *Plagiobothrys leptocladus* (E. Greene) I.M. Johnston [*A.C. Sanders 10927* (UCR)] and *P. undulatus* (Piper) I.M. Johnston [*R.E. Reifner 98-303* (RSA)].
- Quercus xacutidens* Torr. Fagaceae. *Quercus xacutidens* specifically applies to hybrids between *Q. cornelius-mulleri* Nixon & K. Steele and *Q. engelmannii* Greene (Tucker

1993). While plants referable to *Q. xacutidens* are almost certainly present in the foothills of the Agua Tibia and southern San Jacinto Mtns., we have not been able to locate any voucher specimens that clearly represent this hybrid form. In collections that are of hybrid origin, we can not unambiguously determine the parentage of many individuals in those areas where *Q. engelmannii*, *Q. cornelius-mulleri* and *Q. berberidifolia* Liebm. occur in close proximity. The results of a cross between *Q. engelmannii* and *Q. cornelius-mulleri* vs. that between *Q. engelmannii* and *Q. berberidifolia* can be difficult (if not impossible) to distinguish morphologically, as they converge in general appearance. More work will be required to clearly separate oaks of hybrid origin in this region.

Ranunculus occidentalis Nutt. WESTERN BUTTERCUP. Ranunculaceae. Reportedly occurs on the Santa Rosa Plateau. *Ranunculus occidentalis* is closely related to *R. californicus* Benth. and we are still evaluating whether the Santa Rosa Plateau plants are "good" *R. occidentalis* or simply a local form of *R. californicus* with lower than average number of petals.

**Solanum aviculare* Forest f. [*S. laciniatum* Ait.] KANGAROO APPLE. Solanaceae. Scarce weedy shrub once found in Riverside at Fairmont Park [*R. Cooper* 4 (RSA)]. Cooper's collection probably represents cultivated material.

Sphaeralcea emoryi Torr. EMORY'S MALLOW. Malvaceae. A desert species occasionally found west of the mountains. Known from several collections in the San Bernardino Valley of southwestern San Bernardino Co. (e.g., Redlands) near the Riverside Co. line. To be expected in adjacent western Riverside Co.

**Tamarix aralensis* Bunge. PERSIAN TMARIX. Tamaricaceae. Reported in Roberts et al. (2004) based on misidentified specimens of *T. ramosissima* Ledeb.

**Tamarix gallica* L. FRENCH TREE. Tamaricaceae. Reported in Roberts et al. (2004) based on misidentified specimens of *T. ramosissima* Ledeb.

ADDITIONS TO THE LIST OF ENDANGERED, THREATENED, AND SENSITIVE TAXA OF WESTERN RIVERSIDE COUNTY, CALIFORNIA

The following species are added to the Sensitive Species list of Roberts et al. (2004; Appendix II, page 163). *Pickeringia montana* and *Quercus palmeri* are in the 2004 checklist but we now feel they merit conservation status. *Senecio aphanactis* was inadvertently left off the original sensitive species list.

Scientific Name/Common Name	Status
<i>Brodiaea santarosae</i> Santa Rosa Basalt brodiaea	✓
<i>Erodium texanum</i> Texas storkbill	LC
<i>Machaeranthera asteroides</i> var. <i>asteroides</i> ash-colored aster	LC
<i>Pickeringia montana</i> subsp. <i>tomentosa</i> chaparral pea	CNPS 4.3
<i>Gnaphalium</i> [<i>Pseudognaphalium</i>] <i>leucocephalum</i> alluvial wash everlasting or white rabbit-tabacco	CNPS 2.2
<i>Quercus palmeri</i> Palmer's oak	LC
<i>Senecio aphanactis</i> rayless ragwort	CNPS 2.2

CNPS List 2: California Native Plant Society List 2 - Species that are rare in California but more widespread outside the State.

CNPS List 4: California Native Plant Society List 4 - Species that have restricted distribution within California.

LC: Local Concern. Locally rare species within western Riverside County or regionally rare within southern California, but without formal designation.

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NOTEWORTHY COLLECTIONS

New records of Lichens and Lichenicolous Fungi from California

CORNUTISPORA CILIATA California: Riverside County, Santa Ana Mountains, Elsinore Peak, 33° 35' 58" N, 117° 21' 13" 1004 m, on *Evernia prunastri* on bark of *Adenostoma fasciculatum*, 12 April 2007, Kocourková w/ Knudsen PRM (909116).

Previous knowledge. *Cornutispora* is a genus of four widely-distributed anamorphic parasitic coelomycetes which are fungicolous and lichenicolous. The species differ in symmetry of the basically Y-shaped pattern of conidia. *Cornutispora ciliata* was described from Tasmania (Gierl & Kalb 1993) and has been collected in New Zealand (Kalb et al 1995), Austria (Berger et al 1998), Czech Republic and Germany (von Brackel & Kocourková 2006), Luxembourg (v.d. Boom et al. 1996), the Netherlands (v. d. Boom 2002), Spain (Etayo 1996) and the Canary Islands (Hafellner 1996). It has been reported from North America (Cole & Hawksworth 2001).

Significance. *Cornutispora ciliata* is reported new to California. It occurred in mixed infection with *Lichenocodium erodens* (see below) and *Phaeosporobolus usneae* on *Evernia prunastri* on *Adenostoma fasciculatum* on Elsinore Peak in the Santa Ana Mountains.

LEPRARIA RIGIDULA (B. de Lesd.) Tønsberg. California: Riverside County, north fork of the San Jacinto River, San Jacinto Mountains, San Bernardino National Forest, northeast of Highway 243, in shaded dense watershed, 33° 47' 45" N, 116° 44' 39" W, 1641 m, on granite in shaded niche, 10 Aug. 2006, Knudsen 7064 (UCR).

Previous knowledge. Twenty-three species of leprose and sterile *Lepraria* are reported from North America (Esslinger 2007). Sixteen species of *Lepraria* are currently reported from California (Tucker & Ryan 2006, Knudsen et al. 2006, Knudsen & Elix 2007, Knudsen et al. 2007, Knudsen & Kramer 2007, Knudsen & Elix 2007). *Lepraria rigidula* is distinguished by its long radiating hyphae and its uniform chemistry of atranorin and nephrosteranic acid, a fatty acid. It is common in northwest Europe and has been reported from southern Europe, Turkey and Morocco (Kümmerling et al. 1995). Tønsberg (1993) reported *L. rigidula* from North America from British Columbia, Washington, and the Adirondack Mountains of New York. Recently it was reported from 2650-3359 meters in the mountains of Arizona (Tønsberg 2004).

Significance. *Lepraria rigidula* appears to be rare in California and is only currently known from the north fork of the San Jacinto River in the San Jacinto Mountains. The chemistry was analyzed with thin-layer chromatography in solvent C and determined to species by J.A. Elix. This represents the seventeenth species of *Lepraria* reported for California.

LICHENOCONIUM ERODENS M.S. Christ. & D. Hawksw. California: Riverside County, Santa Ana Mountains, Elsinore Peak, 33° 35' 58" N, 117° 21' 13" W 1004 m, on *Evernia prunastri* on bark of *Adenostoma fasciculatum*, 12 April 2007, Kocourková w/ Knudsen PRM (909115).

Previous knowledge. *Lichenocodium* is a lichenicolous genus of anamorphic ascomycete coelomycetes with fourteen known species (Cole & Hawksworth 2004), ten of which have been reported from North America (Esslinger 2007) with three species reported

from California (Diederich 2003; Tucker & Ryan 2006). *Lichenocodium erodens* is distinguished from other species by its small pycnidia (30–40 µm), small conidiogenous cells (4–5 x 3–3.5 µm) and conidia (2–3.5 µm) (Diederich 2004). *Lichenocodium erodens* is the most common species of the genus in parts of Europe (Kocourková 2000) and has been reported from South America (Diederich & Christiansen 1994) and China (Hawksworth & Cole 2003). It was first reported in North America from New Jersey (Hawksworth 1977). It occurs on a wide range of hosts from approximately 24 genera on over 50 species (Kocourková 2000). This wide range of hosts has led to the opinion that it only attacks hosts already damaged and weakened (Diederich 2004). It is parasitic and its infection of the host is pathogenic.

Significance. *Lichenocodium erodens* is reported new for California on *Evernia prunastri* on *Adenostoma fasciculatum*. It was locally abundant in the Elsinore Peak area. It is probably under-collected and is not expected to be rare in California.

ZWACKHIOMYCES COEPULONUS (Norm.) Grube & R. Sant. California: San Bernardino County, Cactus Flats, San Bernardino National Forest, 34° 18' 16" N, 116° 47' 00" W, 1895 m, on *Xanthoria elegans*, 16 Sept. 2004, Knudsen et al (UCR 1685).

Previous knowledge. *Zwackhiomyces* is a lichenicolous genus containing approximately twenty species (Calatayud et al. 2007) with six species reported from North America (Esslinger 2007). The genus is characterized by perithecioid ascomata, lacking ostiolar filaments, having branched and anastomosing interascal filaments, fissitunicate asci, and usually 1-septate asymmetric and verruculose hyaline spores. A distinctive granular brown pigment is deposited between the excipular cells. *Zwackhiomyces coepulonus* is parasitic on hosts from the genera *Xanthoria* and *Caloplaca* on various saxicolous and epiphytic species. It has perithecioid ascomata 150–250 µm in diameter, cylindrical asci 70–100 x 12–25 µm with 6(–8) one-septate hyaline spores per ascus, 15–21 x 5.5–9 µm. It is common in Europe (Grube & Hafellner 1990; Foucard 2001; Calatayud et al. 2007) and has been reported from Mongolia (Huneck et al 1992) and Israel (Navrotskaya et al 1996). It was reported from North America from British Columbia on *Xanthoria elegans* (Goward et al 1996).

Significance. *Zwackhiomyces copulonus* is reported new to California (Tucker & Ryan 2006) on the apothecia of its common host, *Xanthoria elegans*, growing on dolomite at Cactus Flats in the San Bernardino Mountains. It appears to be rare in California, though its host is quite common. It is to our knowledge only the second report of this species from North America. Another *Zwackhiomyces* specimen collected on *Caloplaca persimilis* growing on the bark of *Quercus engelmannii* on the Santa Rosa Plateau in Riverside County has wider spores (usually 10 µm) with more globose cells with rounded apices and taller, more saccate asci 105 x 20–25 µm (Kocourková w/ Knudsen PRM 909117) and needs further study from more collections. It may be an undescribed taxon or fit in to a slightly wider concept of variation in *Z. coepulonus*.

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BOOK REVIEWS

Designing California Native Gardens: the plant community approach to artful, ecological gardens, by Glenn Keator and Alrie Middlebrook. 2007. University of California Press, Berkeley and Los Angeles. 352 pp. (ISBN 13:978-0-520-25110-6 \$27.50 paperback)

Glenn Keator is a botanist and teacher and Alrie Middlebrook is a landscape designer. This book is the outcome of classes in which they have collaborated and it intends to introduce the general reader to the concept and methods of creating gardens based on local native plant communities. The book is divided into an introduction, twelve chapters detailing different communities and suggestions for gardens based on them, and appendices. The chosen communities are bluff and cliffs, redwood forest, coastal sage scrub, the Channel Islands, deserts, montane meadows, mixed evergreen forests, oak woodland, grasslands, chaparral, riparian woodlands, and wetlands.

In the introduction, Glenn Keator provides background by first listing reasons for choosing to build a native garden: local natives are already adapted to local conditions; maintenance is reduced; native pollinators are attracted and supported; money and water are saved; pesticides are not needed; soil preparation is less; natives are highly diverse in structure and requirements; natives are beautiful; and of course the chances of the escape of exotics into the local environment is eliminated. Factors determining what plants will grow in an area are briefly discussed, and an overview of the changes in conditions and plant communities which occur along two transects, one across central California and the other across southern California, are described. Alrie Middlebrook describes her garden making 'ethic': make a place of beauty, design a space that has meaning for the owner, create an ecologically sound garden incorporating natural features of the area. She lists six steps she follows: evaluate the physical site, select the plant community to be incorporated, design the garden, create the hardscape, build the garden, and maintain the garden. For each of these she includes a mix of general and specific suggestions.

Each community chapter begins with a description of the location, the conditions affecting the community, and the requirements of plants adapted to those conditions. This is followed by a paragraph or two about creating a garden and then by a section on a garden actually designed by the author. Diagrammatic plans for the garden are included with some information about the work which was done during construction, and the plants used in the design. A list of suitable plants with descriptions, methods of propagation, and useful notes forms the next part of each chapter. An excellent inclusion at the end is a description of places to visit where the natural community can be seen. One chapter includes information about constructing 'tree columns' (cylinders planted with shrubs every 15 ft or so) to soften the edges of high rise buildings. There is also some information on establishing green roofs.

The book has much to recommend it. Although the style is somewhat uneven, varying in formality, voice, and degree of detail, the text is very accessible to the ordinary reader. The community descriptions are good and the plant lists and notes are very helpful. There are also many excellent photographs of plants and garden areas. The semi-elevation drawings of gardens are interesting and useful. The appendix listing sources for the plants is a terrific inclusion and the lists of gardens to visit, books to read, and websites to browse are all useful. Unfortunately, many of the plants described have no photograph. This may be a problem for those not already familiar with the California flora. Smaller

annoyances were that the legends for the photographs are at the bottom of the pages and that many garden photos show interesting plants that are not identified. However, the authors have met their stated goals of informing readers about plant communities that are native to different areas, of describing plants along with their requirements and means of propagation, and of providing sample plans. This book helps to fill a need both for the amateur and professional gardener and would be a useful addition to anyone's horticultural library.

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Introduction to California Chaparral, by Ronald D. Quinn and Sterling C. Keeley with Line Drawings by Marianne D. Wallace. 2006. University of California Press, Berkeley and Los Angeles. 344 pp., 338 color illustrations, 89 line drawings, 15 tables. (ISBN 24885-4 cloth \$60.00, ISBN 24886-1 \$24.95 paper)

Well, it is about time. Not since Francis Fultz wrote *The Elfin Forest of California* in 1927 has an entire book, published by a major publisher, been devoted entirely to chaparral. Richard Halsey came close in 2005 with a self-published book entitled, *Fire, Chaparral, and Survival in Southern California* (Sunbelt Publishers, San Diego), and Rundel and Gustafson came close with *Introduction to the Plant Life of Southern California* (UC Press, 2005). What makes this chaparral book different is that it covers plants AND animals, as well as chapters on Mediterranean climate, fire, and living with chaparral. It's all here in one book.

In Chapter One the location and characteristics of chaparral are covered. It describes what chaparral is and what it isn't. For example coastal sage scrub is not chaparral. This is an introductory chapter that includes a brief introduction to chaparral adaptations, including those associated with drought and fire.

The Mediterranean climate is very well explained in Chapter Two. In fact it is a good primer on climate in California in general. In a section on microclimates the importance of slope exposure, steepness, and herbaceous cover are discussed. The section entitled "Convergence" draws comparisons to other places in the world where Mediterranean climate has caused similar communities to develop. Finally, as an example of animal life and its survival in a Mediterranean climate, the life of rain beetles is described.

Chapter Three is devoted entirely to the subject of fire. It describes the nature of the fire cycle and how plants and animals cope with it. Particularly valuable is the discussion of the history of fire in California including causes and sources of ignition. A particularly sensitive topic, that of the controversy between two points of view on large fires, is well handled. Whether large fires are a consequence of fire suppression, Santa Ana winds, or both is aptly discussed without taking sides.

Chapters Four and Five include the discussions of plants and animals. Every single plant and every single animal is not described. As such this book is not really a field guide; it is more of a natural history. The organisms are treated within groups, and the major plants and animals within each group are discussed. Here is where excellent line drawings and photographs help with identification. In the plant portion, the plants are arranged in family groupings, in order of dominance as perceived by the authors. Rosaceae and

chamise come first. Probably an irritation to some taxonomists, the Scrophulariaceae remains intact, in the manner to which we are accustomed. Interestingly, a number of coastal sage scrub species are included in a section entitled, "Other chaparral herbs and subshrubs." Finally, introduced weeds get a page. In the animal chapter there is, likewise, a taxonomic grouping, including common mammals, birds, reptiles, amphibians, insects, and arachnids. There is a wealth of interesting material on each of the animals that is discussed. If I had written this book, however, I would have included more animals. The rodents are fairly well covered, although pocket mice and pocket gophers inexplicably are omitted. Predatory birds are fairly important, but only three hawks are mentioned. Owls got a quarter page. Important reptiles (except skinks) are covered, but only two amphibians. There are so many insects and arachnids in chaparral that it would be inappropriate to attempt thorough coverage, but those that are included are well done. I do believe that spiders other than tarantulas and trap door spiders could have been discussed.

The final chapter, "Living with Chaparral," is a compendium of risks and remedies. Fire, flood, and other risks are described along with attempts by public agencies to reduce or mitigate for the risks. Fire and flood case histories are presented. This chapter includes the threats to chaparral such as shortened fire frequency, invasive plants, and climate change, and it provides a discussion of public and private land management priorities. Finally, it concludes with a section on the value of chaparral as a community, and why we should care about it.

For someone living in southern California, this is a book worth owning. It is well written and it is amply illustrated with line drawings and color photographs. While it is not a thorough compendium of all the plants and animals of chaparral, it covers all the important ones with natural history tidbits to embellish the descriptions.

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