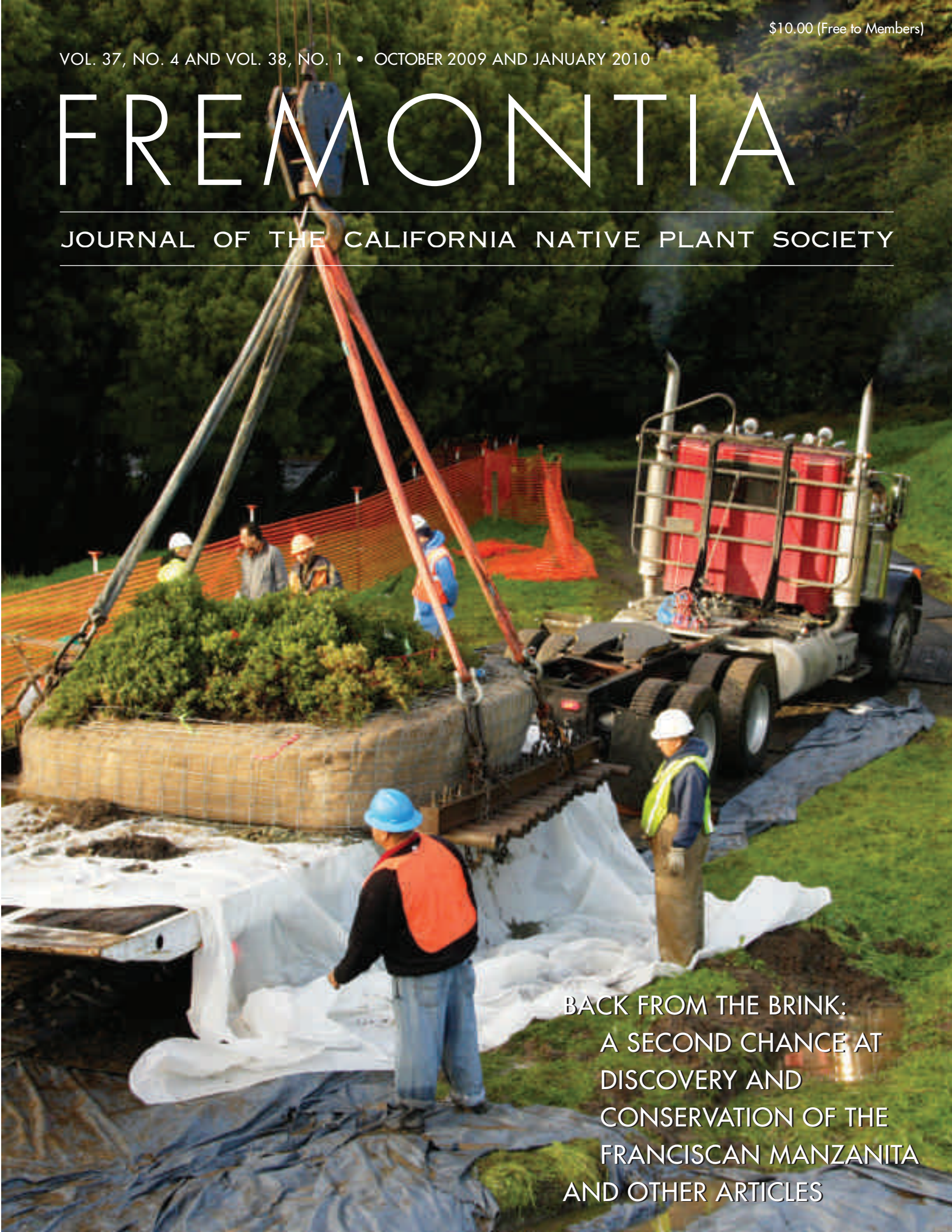


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BACK FROM THE BRINK:
A SECOND CHANCE AT
DISCOVERY AND
CONSERVATION OF THE
FRANCISCAN MANZANITA
AND OTHER ARTICLES

FREMONTIA

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CNPS carries out its mission through science, conservation advocacy, education, and horticulture at the local, state, and federal levels. It monitors rare and endangered plants and habitats; acts to save endangered areas through publicity, persuasion, and on occasion, legal action; provides expert testimony to government bodies; supports the establishment of native plant preserves; sponsors workdays to remove invasive plants; and offers a range of educational activities including speaker programs, field trips, native plant sales, horticultural workshops, and demonstration gardens.

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THE COVER: The Franciscan manzanita (*Arctostaphylos franciscana*) mother plant in transit to a safer area. The plant was rediscovered in 2009 growing near the Golden Gate Bridge. Photograph courtesy of the California Department of Transportation, J. Huseby, photographer.



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The Franciscan manzanita (*Arctostaphylos franciscana*) is readied for the drive to its new, safer location. Photograph courtesy of the California Department of Transportation, J. Huseby photographer.

BACK FROM THE BRINK: A SECOND CHANCE AT DISCOVERY AND CONSERVATION OF THE FRANCISCAN MANZANITA

by Daniel Gluesenkamp, Michael Chassé, Mark Frey,
V. Thomas Parker, Michael C. Vasey, and Betty Young

On a rainy Saturday morning in late January 2010, shortly after 3:00 a.m., a team began to assemble along a stretch of highway in the Presidio of San Francisco. Floodlights created small pools of light and illuminated large construction equipment in the cold darkness of early morning. Camera flashes reflected off safety vests and hard hats, as participants and witnesses stepped out of the darkness to record

this singular morning. Within view of the Golden Gate Bridge and with the lights of downtown San Francisco visible in the distance, we stood in the pouring rain and periodic hail and looked toward a single plant growing in the middle of a traffic island.

On an average day this stretch of highway is kept warm by the tires of 100,000 vehicles speeding on and off the Golden Gate Bridge. On an extraordinary morning the highway

is closed, the asphalt lies cool and wet in unaccustomed silence, and a few lucky biologists watch as the lone plant is lifted from its birthplace and loaded onto the back of a 75-ton truck.

The plant in question is presumably the last wild Franciscan manzanita (*Arctostaphylos franciscana* Eastwood), thought to have been extinct until rediscovered in late 2009 and months later dug from its parent soil in an attempt to save it.



The last wild Franciscan manzanita in its original location along Doyle Drive in the Presidio of San Francisco. Photograph by V.T. Parker.

To some, this may seem like a lot of fuss over one roadside shrub. But to people who are aware of the complex and poignant history of biodiversity in San Francisco, the separation of this plant from its home ground was the culmination of a century-old story. It is a story of loss and salvation, of serendipity and cooperation.

At the same time, a new story now unfolds, a story that provides a glimpse into a potentially different future for wild nature in urban areas. This is the story of the discovery and conservation of the last wild Franciscan manzanita.

SAN FRANCISCO'S LONG HISTORY OF DIVERSITY

The San Francisco Bay area is recognized as a global biodiversity hotspot, and its varied flora is one of the best documented of any major metropolitan region (Daniel and Fontaine 2006). Yet the dominant narrative of San Francisco's natural history has been that of a great sand

waste stretching from the "breakers" (the ocean) to the bay. While there is a grain of truth to this perception—about half of San Francisco is covered by dunes dating from the Pleistocene Era to more recent beach deposits—the myth of "Sand Francisco" obscures a more complex, rich, and unique natural history. One can find pieces of this puzzle in early landscape paintings and maps, writings by skilled pioneer naturalists, historical photos, geological surveys, and in the remnant fragments of ancient San Francisco that persist to the present day.

We now understand that the 46 square mile tip of the San Francisco peninsula contained a diversity of habitat types. These low-growing wind-sculpted habitats collectively comprised the distinctive Franciscan floristic region, the smallest floristic region in California (Roof 2000). One particular geologic feature contributed to San Francisco's characteristic local flora: a band of sheared rocks, including serpentinite (a metamorphic rock type composed almost exclusively of serpentine

minerals, usually with a characteristic light to dark green color), commonly found from Hunters Point northwest to Fort Point. These serpentine hilltops functioned as an archipelago of edaphic "islands" whose soil supported unique serpentine grassland and maritime chaparral communities. Franciscan communities were comprised of hundreds of plant species, many of which are now rare and endangered, and they contained several unique species of manzanita.

A few of these rocky hills were spared long enough for naturalists to study and describe them, and thus they provided some of the only clues to the vanished habitats of San Francisco. Hans Herman Behr, one of the city's first formally trained botanists, witnessed the transformation of San Francisco's natural landscape in the years immediately after the Gold Rush. Behr (1891) gives us the first detailed description of San Francisco's manzanitas in his reminiscences of the 1850s:

... somewhere about the site of the Protestant Orphan Asylum [near the current U.S. Mint], there grew the tall form of Manzanita still found so abundantly on the slopes of Tamalpais. The prostrate species . . . once abundant, still survives in a few localities, principally Laurel Hill Cemetery, but will probably disappear shortly.

Behr's description of both abundance and extirpation in the same sentence provides a striking illustration of the rapid devastation being visited upon San Francisco's flora and fauna at the time. The prostrate manzanita mentioned in Behr's writing may be an early account of Franciscan manzanita (*Arctostaphylos franciscana*). However, the rudimentary understanding of *Arctostaphylos* taxonomy at the time, and the lack of voucher specimens, makes it unlikely that we will ever fully understand the rich diversity of manzanita that existed in San Francisco prior to widespread habitat loss.

Even so, from such early writings and records it is evident that old San Francisco hosted a unique maritime chaparral and a diversity of manzanitas, with at least six taxa thought to have occurred in San Francisco's wild areas. Early botanical records also describe a diversity of *Arctostaphylos* growth forms including low-growing prostrate manzanitas which root from their stems, tall arborescent manzanitas with large woody burls, and even manzanitas that only grew on sand dunes.

FRANCISCAN MANZANITA: LOSS AND SALVATION

Legendary botanist Alice Eastwood is central to the history of San

TOP: Hedging bets against extinction: Harvesting rooted branch layers and soil seedbank for propagation at botanical gardens. Photograph by D. Gluesenkamp.

• MIDDLE LEFT: Propagation of cuttings of Franciscan manzanita at the Presidio Nursery. Photograph by M. Laskowski. • MIDDLE RIGHT: Presidio nursery staff process seeds collected from the last wild Franciscan manzanita. Photograph by B. Young.

• BOTTOM: V. Thomas Parker collects buds to provide pollen that will be used to determine if the found species is diploid or tetraploid. Photograph by M.C. Vasey.

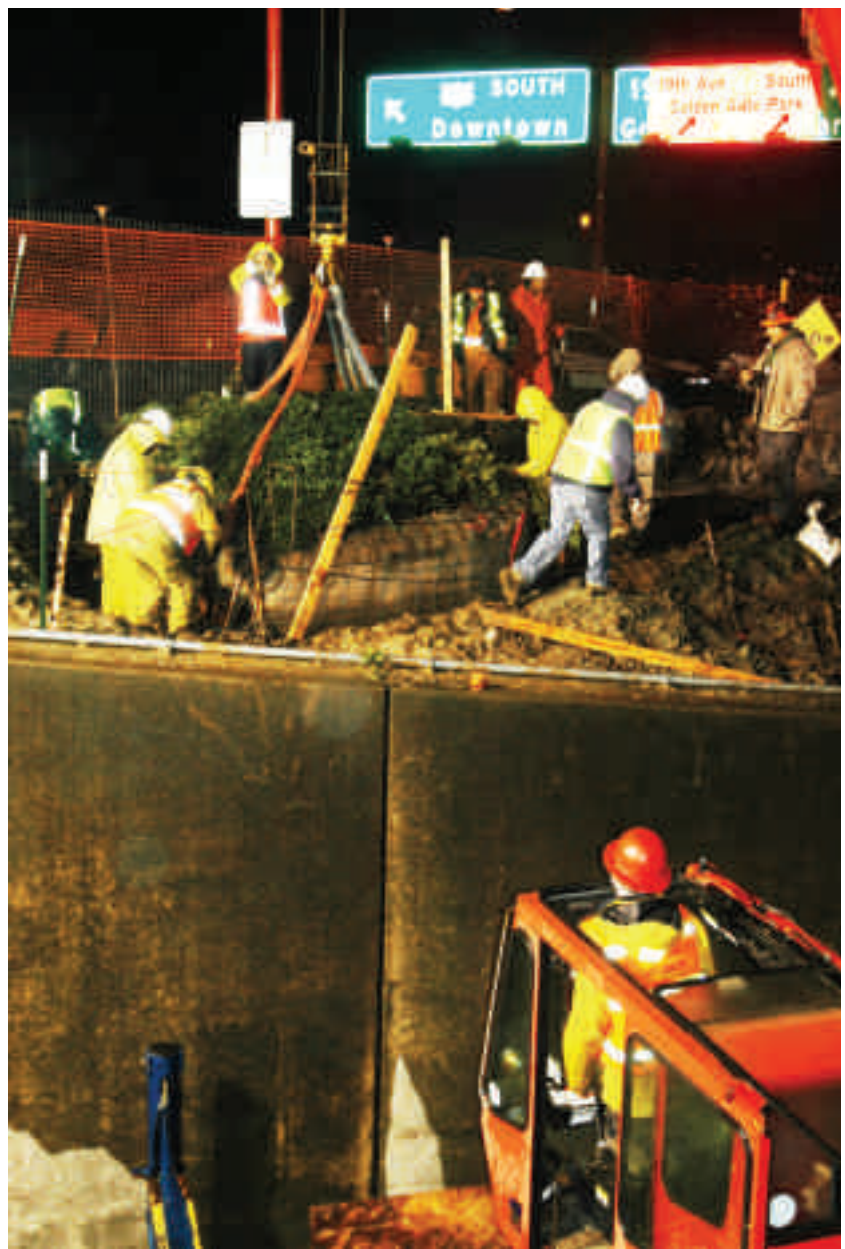


Francisco's endemic manzanitas. Famed for many legendary exploits during her long and illustrious career at the California Academy of Sciences, Eastwood had all the Bay Area stagecoach schedules memorized and had sworn off romantic attachments lest they interfere with her pursuit of new plant species.

Alice Eastwood was also an expert in the genus *Arctostaphylos* and described numerous new species (Wells 1991), including the prostrate manzanita in Laurel Hill which she collected in 1895 and in 1905 named as Franciscan manzanita (*Arctostaphylos franciscana*). Her type specimen (the original specimen from which a description of a new species is made), CAS 295, was almost destroyed in the 1906 San Francisco earthquake, but Eastwood herself made a valiant effort to save it and many other type specimens.

Shaken awake by the 1906 earthquake, Eastwood ran to the California Academy of Sciences and heroically rescued the pressed plants

The root ball tightly wrapped in burlap and wire to prevent cracking. A tent had to be assembled over the mother plant to keep the soil from getting too wet in the heavy rains. To make sure the tent did not blow away, one of the tree contractor's staff spent the night at the site under the tent, in the pouring rain, with the traffic of Highway 1 roaring a few feet away. Photograph by S. Estelle.



Work crews secure the ten-ton mass of manzanita before lifting it by crane to the back of a flatbed truck. Photograph by M. Chassé.

from the ensuing fire. The personal collection she had spent her life assembling was abandoned to the flames, but the irreplaceable type specimens she saved are still in the collection today.

In the years following Eastwood's discovery of *A. franciscana*, this prostrate manzanita was collected or observed at two other San Francisco locales: in a corner of the Masonic Cemetery on Lone Mountain and on the windswept slopes of Mount

Davidson (Roof 1976). Decades later, taxonomic sleuthing retrospectively revealed another endemic manzanita that had occupied these same rocky hills: the then undescribed Raven's manzanita (*Arctostaphylos montana* ssp. *ravenii*).

In the 1930s, however, the pressures of real estate development led to the clearing of maritime chaparral from Lone Mountain and Mount Davidson, and by 1937, Laurel Hill Cemetery's serpentine quarry pro-

vided the last refuge for San Francisco's own manzanitas. Eastwood participated in the campaign to save the old cemetery on Laurel Hill as a memorial park to the city's pioneers and, in the process, to preserve one of the last fragments of open space in San Francisco. However, in 1938, after 50 years of struggle for historic preservation, San Francisco voters elected to destroy the last San Francisco cemeteries (Shelton 2008). The following year, Eastwood posed for a professional portrait by the manzanitas of Laurel Hill Cemetery in what seems to be her farewell to the species.

Fortunately, Alice Eastwood was not alone in her love of San Francisco's endemic plants and her determination to save them from the forces of progress. Thanks to the efforts of other heroic botanists and horticulturalists, a small number of living plants were dug out and brought to botanic gardens prior to the bulldozers scraping away the last of San Francisco's manzanitas. One plant was saved by pioneer native plant horticulturalist Lester Rowntree, who admits that she "garnered it ghoulishly, in a gunnysack." She crept into Laurel Hill Cemetery in the dead of night with her shovel, exhumed a manzanita plant from among the tombstones, bagged it, and sped off to her home in Carmel with the plant in the trunk of her car.

Other plants were saved by James Roof, California botanist and former director of the Regional Parks Botanic Garden in Tilden Park, who salvaged *Arctostaphylos franciscana* plants uprooted by bulldozers and carefully nurtured these plants in the park. Decades later Roof invited Alice Eastwood, then in her nineties, to visit the botanic garden at Tilden Park, where she was shown the survivors of a species she had thought extinct. In her surprise she sat down and wept. "Tumbling over the stones, it looks exactly as it used to at Laurel Hill."

By the end of the 1940s, the last known wild *Arctostaphylos franciscana* had been replaced by buildings, roads, and tennis courts. At the same time that Franciscan manzanita was being driven from Laurel Hill Cemetery, bulldozers were at work in another part of town. The construction of Doyle Drive in the late 1930s scraped through the Presidio's serpentine headlands, fragmenting the wildflower-studded "mesa" first described by the Spanish colonists upon their arrival in the area.

Yet, ironically, these destructive forces likely provided for the renewal of a dying species by stimulating dormant seed. As cars passed by on their way to the recently completed Golden Gate Bridge, a manzanita emerged unnoticed along the top of a serpentine roadcut. Here it grew on a remarkably small patch of serpentine land completely surrounded by highway ramps. Australian tea tree (*Leptospermum laevigatum*) and other ornamental woody vegetation eventually obscured their low-growing neighbor sufficiently to evade the detection of contemporary botanists, who had found a number of rare species in nearby fragments of serpentine prairie but saw only weeds and danger as they looked across to the highway "island."

For the last six decades, *Arctostaphylos franciscana* was believed extinct in the wild. During these many years, the original Laurel Hill plants were expertly cared for by horticulturalists at botanical gardens and native plant nurseries. The seed of an idea to reintroduce the Franciscan manzanita back to the wild was just beginning to re-emerge when an amazing discovery occurred in the Presidio of San Francisco.

REDISCOVERY OF SAN FRANCISCO'S MANZANITA

In spring 2009 work began on a project to replace Doyle Drive, the

main southern approach to the Golden Gate Bridge. The 1.3 billion dollar project involved demolishing the seismically unsafe Doyle Drive overpass and replacing it with a parkway, all within the historic San Francisco Presidio. In preparation for removing vegetation from the project site, contractors salvaged over 4,000 native plants and collected thousands of the known native plant seed



The "rediscoverer" of the thought-to-be-extinct Franciscan manzanita, biologist Dan Gluesenkamp. Photograph by A. Setty.

from the construction corridor. Shortly thereafter, crews began removing the robust and primarily weedy vegetation that dominated the highway roadside south of the Golden Gate Bridge.

A low evergreen shrub obscured by this weedy vegetation lay undetected, facing the fate of being lost forever under a pile of wood chips. According to contractors, a California Highway Patrol car was parked directly adjacent to the shrub on the day the chipping of woody debris occurred. Not wanting to blow wood chips in the direction of a CHP officer, the contractors turned their chipper in the other direction and the shrub was spared.

On October 16, Daniel Gluesenkamp was driving home across the bridge and passed through the recently denuded Doyle Drive project corridor. For the first time in de-

cedes the screen of English ivy (*Hedera helix*), acacia, tea tree (*Leptospermum laevigatum*), and cotoneaster had been lifted from the

area. Gluesenkamp, a partner in the Bay Area Early Detection Network (BAEDN), was scanning the exposed roadside for red alert invasive plants

when he noticed a plant that looked like a manzanita. The plant was located on a small traffic island immediately past a high-speed freeway



Manzanita chaparral often contains manzanita species found near each other that do not hybridize or crossbreed. This is because they contain different numbers of chromosomes, which limits gene flow between populations. Illustrated is a maritime chaparral site at Ft. Ord on the Monterey Bay. The site is dominated mostly by the more prostrate Sandmat manzanita (*Arctostaphylos pumila*, left inset photo) mixed with the Woolyleaf manzanita (*A. tomentosa*, right inset photo). The Sandmat manzanita is diploid, while the Woolyleaf manzanita is a tetraploid. Photographs by V.T. Parker.

ABOUT ARCTOSTAPHYLOS

Franciscan manzanita (*Arctostaphylos franciscana*) is a member of a genus that is quintessentially Californian. A terminal lineage of the subfamily Arbutoidae of the Ericaceae (rhododendron and blueberry family), *Arctostaphylos* is a richly diverse group of woody shrubs. Fossils of manzanitas appear in the middle Miocene in western North America, a little over 15 million years before present, and a rapid proliferation of species appears to have occurred in the last 1.5 million years. California harbors

96 species and subspecies throughout the state, but some species are found as far north as British Columbia, east to Colorado, and south to Mexico. Bearberry manzanita, also called kinnikinnick manzanita (*Arctostaphylos uva-ursi*), is extremely widespread, not only present in California and the West, but also found north to Alaska and east through Canada and the northern United States, and throughout northern parts of Europe and Asia.

Manzanitas are a wonderfully complicated group. Manzanitas exist as two genetic types: diploids

(with one set of chromosomes from each parent) and tetraploids (with two sets of chromosomes from each parent). Reproduction is difficult between such genetic types. Additionally, based on recent genetic data, two evolutionary lineages make up the genus. Hybridization seems to be easy among diploid species within lineages and we only find them occurring in different habitats. Manzanitas from the two different lineages, however, often are found together in the wild yet show little hybridization (Boykin et al. 2005). Tetraploids do not usually occur with other tetra-

off-ramp so it was impossible to slow down to confirm identification. He immediately retraced his steps by car. On a second visit the plant still

looked like a manzanita, and on a third visit he slowed long enough to take a photo of this suspiciously wild manzanita.

ploids but are frequently found with diploids from one or both lineages. As a consequence, then, you can often find two or three species of manzanitas growing together in California, and rarely, even more.

The greatest diversity of manzanitas occurs along the central California coast. This is a result of their adaptation to a diverse array of topography, soil types, and climatic regimes. The San Francisco Bay Area lies within this region of high diversity. Summer fog is a factor that characterizes both the Presidio and the immediate California coastline. Fog is a major influence on the survival and diversity of manzanitas, and most *Arctostaphylos* species are found within maritime chaparral, as coastal forest edge species, or as part of closed-cone conifer woodlands and forests.

For example, 15 *Arctostaphylos* species are found in the Santa Cruz Mountains that run through the San Francisco peninsula into the Monterey Bay area. Only 4 are found outside the Santa Cruz Mountains, while 11 of these are restricted to some limited portion of this range. Similar to *A. franciscana* being restricted to serpentine in San Francisco at the north end of this range, Kings Mountain manzanita (*A. regismontana*) is only found around King's Mountain, Ben Lomond manzanita (*A. glutinosa*) and the Ohlone manzanita (*A. ohloneana*) are both restricted to Monterey shale outcrops on Ben Lomond Mountain, and the Bonny Doon manzanita (*A. silvicola*) is only found on sandy soils in the Bonny Doon area.

Wildfire has been an important selective force on manzanitas as illustrated by their adaptations to fire (Parker 2007). One group of man-

zanitas has swollen woody burls containing dormant buds that permit resprouting after fire, while another group are unable to resprout after fire or cutting and are therefore killed by fire. Both groups of manzanitas produce seeds in a dormant state that will not generally germinate unless stimulated by chemicals from wildfire smoke. Because the seeds remain dormant until after wildfire, manzanitas create what are called persistent soil seed banks in which seed build up slowly in density. While populations of the first group are sometimes also killed by fire, germination from their seed banks reestablishes those populations.

Arctostaphylos species are found almost invariably on nutrient-poor soils. The relationship of *Arctostaphylos* with poor soils correlates with a highly diverse mycorrhizal fungal community associated with the root systems of these plants. The fungi are able to provide critical nutrients to the plants. Conifers and other ectomycorrhizal trees share the ability to form mycorrhizae with a large percentage of the fungal species associated with *Arctostaphylos*; consequently, manzanitas and conifers are often found together. Conifers eventually suppress the manzanitas, but wildfires stimulate the seed banks of manzanitas and they reestablish dominance; slowly, conifers reinvade the site. Thus, wildfire creates an alternating vegetation pattern of chaparral followed by forest followed by chaparral throughout the distribution of this genus (Horton et al. 1999).

Thinking the plant might be the rare endemic Raven's manzanita, he called Lew Stringer, a biologist with the Presidio Trust. The message left on Lew's answering machine was garbled with excitement and was cut off before the story was completed. No matter. When Gluesenkamp called again 15 minutes later, Lew had already recruited his coworker Mark Frey and the two were soon en route to the site. They drove past the site twice, and then sprinted across lanes of traffic to confirm Gluesenkamp's drive-by manzanita sighting.

On the east side of the utterly inaccessible, teardrop-shaped island, six lanes of commuters sped home along Highway 101; on the west side a concrete retaining wall dropped 20 feet to the Highway 1 onramp. The island, perhaps 20 feet across, was mostly covered with wood chips. Two months earlier these chips had been a large Monterey cypress and a tangle of tea tree bushes. On the northern tip of the traffic island—the only portion of the site not covered in wood chips—a low-lying carpet of manzanita spread across an outcrop of green serpentinite rock.

As luck would have it, National Park Service ecologist Michael Chassé, who works with Stringer and Frey and was currently working on a master's thesis focused on San Francisco's endemic manzanitas, was summoned to the location. After cautiously identifying the plant as *Arctostaphylos franciscana*, the group quickly notified *Arctostaphylos* experts Mike Vasey and Tom Parker at San Francisco State University. The two visited the site within days and confirmed the initial identification. All agreed that this was San Francisco's most exciting plant discovery since Peter Raven rediscovered his namesake manzanita in the Presidio nearly 60 years before (Raven 1952).

Caltrans project managers were quickly informed. Their engineers confirmed that the traffic island was



scheduled for demolition as part of the highway repair project, but agreed to protect the unexpected discovery until plans could be made for the plant's preservation. Within two weeks after discovery, a meeting was held with managers and plant experts from the Presidio Trust, the National Park Service, Caltrans, U.S. Fish and Wildlife Service, California Department of Fish and Game, Golden Gate National Parks Conservancy, and San Francisco State University. All involved sprung into action, including CalTrans District 4 Environmental Manager David Yam. With the clock ticking on a billion dollar construction project, and with CalTrans taking the organizational lead, the agencies selected a team of biologists to develop a plan for saving the rediscovered Franciscan manzanita.



TOP: Precious cargo: The ten-ton bundle of soil, rock, and manzanita is carefully placed into its secret new home. • BOTTOM: The Franciscan manzanita in its new location away from highway construction. Photographs by S. Estelle.

CONSERVATION OF THE FRANCISCAN MANZANITA

The chance to save a presumed extinct species doesn't come along often in one's career, so agency representatives quickly set to the task

of developing a conservation strategy. At the first meeting the group identified representatives from each agency to collaboratively draft a conservation action plan. The plan focused on actions to take between the discovery of the plant and the start of construction in the discovery area. The plan evaluated three alternative treatments for the mother plant: 1) preserving it on the site, 2) moving it to a botanical garden, or 3) moving it to a managed natural area in the Presidio.

While on-site preservation would be the most desirable option under ordinary circumstances, there were several factors that weighed against this alternative. First, the remnant shrub was already traumatized by the sudden removal of its protective cover of surrounding veg-

etation and direct exposure to the elements and the exhaust gases of thousands of vehicles passing by it each day. Second, the remnant patch that it occupied was so small and isolated that it would be almost impossible to restore a viable population of other *A. franciscana* individuals around it, and so the species could not realistically recover in that location. Finally, it was determined to be infeasible to build the Doyle Drive project around the plant, given important constraints demonstrated by Caltrans.

The second option, that of moving the plant to a botanical garden, would have meant returning the plant to an "extinct in the wild" status, at least until reintroduced populations could someday be established. In addition, moving it to a botanical garden would have compromised the ability to generate viable seed for future propagation (since botanical gardens would contain other manzanita species and be subject to hybridization). Therefore, the plan chosen as the preferred alternative was moving the plant to a managed natural area, assuming that an appropriate site could be located for transplanting. Remarkably, Chassé had already started an analysis of potentially appropriate restoration sites as part of his master's project. A long list of criteria was developed and used to evaluate potential sites. The top ranked sites were further investigated with field visits and soil test pits. Ultimately, the chosen site closely matched the discovery site in geology, soil texture, slope, and aspect.

The effort to move an entire manzanita is an inherently risky operation. Consequently, the team took steps to ensure the parent plant's genetic material would be saved even in the unlikely event of a disaster before, during, or after the move. We carefully salvaged other portions of the plant: 1) stem cuttings, 2) branches that had naturally rooted around the mother plant,

3) seeds collected off of the mother plant, 4) seed-containing soil from around the plant, and 5) microbe-containing soil from around the plant.

The most reliable means of preserving clones of the single remaining plant (mother plant) was to obtain stem cuttings for subsequent rooting. These were obtained from November 2009 to January 2010. Stem fragments for propagation were distributed to East Bay Regional Parks Botanical Garden at Tilden, UC Botanical Garden at Berkeley, UC Santa Cruz Arboretum, San Francisco Botanical Garden at Strybing Arboretum, CalFlora Nursery, and to the Golden Gate National Recreation Area Presidio Nursery. This was both a pooling of incredible manzanita propagation talent as well as a way of distributing risk among many facilities. Each nursery used its most successful manzanita rooting technique to encourage stems to root and develop into clones of the parent plant, and some rooting has already begun.

Because of its mounding habit, this species of manzanita also can form roots at leaf nodes where they come in contact with the ground. These "rooted layers" were distributed to East Bay Regional Parks Botanical Garden at Tilden, UC Botanical Garden at Berkeley, San Francisco Botanical Garden at Strybing Arboretum, and the Presidio Nursery. Approximately 24 were well rooted and potted up or planted into these respective gardens.

Remarkably, although isolated and alone, this lonely mother plant bore tiny apple-like fruits. To preserve this treasure trove of its genetic code, all ripe fruit was collected from the plant, resulting in 1,346 seeds. These have been put in long-term storage: half at UC Botanical Garden at Berkeley and half at Rancho Santa Ana Botanic Garden.

Soil seed banks are important to obligate seeding manzanitas such as *A. franciscana*. Like many obligate

seeding plants, while the fire may destroy the parent plants, it also sends a cue to the stored seeds in the surrounding soil to begin germinating. In manzanitas, fire removes a plug in the seed coat which then allows water to be absorbed into the seed. Often such seeds will not germinate without receiving this fire cue, but scientists still have a lot to learn about the conditions that promote this germination.

To salvage seeds which had fallen from the plant in previous years, an 18" wide by 4" deep ring of soil surrounding the plant was removed carefully without disturbing the mother plant. The soil containing seed from around the mother plant will eventually be treated to see if any seeds can be germinated. First, however, we will test experimental germination techniques using seeds from a relative of Franciscan manzanita, Mt. Tamalpais manzanita (*A. montana* ssp. *montana*) to perfect pre-germination treatments (such as fire, smoke, and cold stratification). Then those treatments will be used on seeds from the Franciscan manzanita soil seed bank. Once we know what technique works best, seeds taken from the mother plant will be treated and sown. With luck the transplanted plant will set seed and we will have plenty of seeds to work with.

Finally, additional soil was salvaged from the rooting zone of the mother plant. Manzanitas form close relationships with soil microorganisms, and these symbioses can be critical to plant survival and growth. Salvaged soil will be stored and used to inoculate outplantings with mycorrhizae and necessary microorganisms. Outplantings will occur over time in suitable areas of the Presidio. In some cases plantings will include additional maritime chaparral species and perhaps even include the Raven's manzanita. All planted manzanitas will be carefully monitored annually.

After completing this additional salvage operation to ensure that the



A stand of maritime chaparral on a sandstone outcrop near China Grade in Santa Cruz County. A blooming Santa Cruz manzanita (*Arctostaphylos andersonii*) is in the foreground. Photograph by M.C. Vasey.

CONSERVING MARITIME CHAPARRAL, INCLUDING MANZANITA

Maritime chaparral is a distinctive California shrubland dominated by hard, evergreen-leaved species that occur in summer fog-influenced habitats along the coast and in harsh, unproductive soils with poor nutrient levels and/or reduced water holding capacity. These soil

exposures occur like islands in a terrestrial ocean of more favorable environments. Like all chaparral, this vegetation depends on periodic wildfires for regeneration and persistence.

Maritime chaparral was first described by Griffin (1978) and has since been given legal protection under CEQA and the California Coastal Act as an Environmentally Sensitive Habitat Area (ESHA). Maritime chaparral was originally conceptualized as occurring in only a few specialized places, like Monterey

Bay. However, it has since been recognized to occur sporadically from Mendocino to San Diego Counties (Sawyer et al. 2009). The reason for its protected legal status is the remarkable number of local endemic species found in maritime chaparral. For example, in the flagship genus for maritime chaparral, *Arctostaphylos*, out of 96 California taxa, almost 80% of its local endemics occur along the coastal fog zone (Vasey and Parker unpublished data).

It is important to point out that

while the conservation approach to saving *Arctostaphylos franciscana* is an inspiration, it represents a last resort as opposed to optimal conservation practice. In virtually every place but San Francisco, maritime chaparral stands still persist and the most important conservation activity is protecting these stands from habitat loss by encroaching development. While ESHA regulations provide strong legal protection, ESHA is limited to a defined coastal zone which does not extend inland far enough to protect all maritime chaparral.

Since many local endemic maritime chaparral species are not listed under federal or state statutes, they are vulnerable to development beyond the coastal zone boundary. Invasive species such as pampas grass and sea fig infiltrate the edges of maritime chaparral; however, they do not present much of a problem in intact stands. But there is the threat of cutting too many trails or clearings into chaparral, which allows these invasive species to become well established. Wildfires open chaparral and permit the expansion of these invasives.

Certainly one of the greatest challenges to conserving maritime chaparral is managing for fire regimes in the face of an expanding wildland-urban interface. Too much fire can cause chaparral to transform to grasslands dominated by non-native species, and too little fire can eventually cause chaparral to be displaced by woodland and forest. It has been recognized that the fire regime in maritime chaparral is less frequent than in interior chaparral but research is still needed to understand this relationship. Fortunately, there is research taking place on maritime chaparral response to prescribed fire at Fort Ord and elsewhere.

Yet, as maritime chaparral

stands are eroded by development and influenced by altered fire regimes, it is probable that conservation and management of existing stands may not provide sufficient protection. This situation is particularly true as pressures of changing climate—including the potential decline of the summer fog regime—unfolds (Johnstone and Dawson 2010).

In this context, the extraordinary efforts being made to conserve *Arctostaphylos franciscana* may present valuable lessons for future conservation of maritime chaparral. First, we see how important propagation of vulnerable species can be in venues such as botanical gardens, and also how important artificial seed banks might be as well. We need to collect a large selection of genotypes of vulnerable species for future restored populations. Second, we are learning that translocation is not necessarily impossible and may, under certain circumstances, be desirable. Third, habitat restoration for foundation species such as manzanitas has the potential for bringing back entire communities as well as rare species.

We need more of these chaparral restoration efforts and well designed research to see if this can be accomplished. Ultimately, while saving an individual shrub on the brink of extinction is a profound experience, the true test of the success of this project will be the restoration of one or more viable populations of genetically variable individuals in natural habitats. By bringing back the Franciscan manzanita from the edge of oblivion, we may be pioneering a new approach to conserving maritime chaparral in the face of global change.

plant's genetic material would be preserved, it was time to begin preparation to move the mother plant. Two weeks prior to the move, a hole was dug at the transplant site located within the 1,491 acre Presidio to receive the plant and soil. Simultaneously, trenches were dug around the mother plant to prepare it for transport. Because of heavy rains in the days leading up to the move, a tent had to be assembled over the mother plant. To make sure the tent did not blow away, one of the tree contractor's staff spent the night at the site under the tent, in the pouring rain, with the traffic of Highway 1 roaring a few feet away.

After the trenches had been dug, the root ball was tightly wrapped in burlap and wire, forming a monolith of tree and soil standing atop green serpentinite rock. A dozen three-inch-diameter metal pipes were driven two feet below the plant by Environmental Design Specialists. These pipes served to perforate the soil and separate the mother plant from the mother soil, and also provided a lattice of support for the burlap-wrapped plant and soil monolith. These pipes were bolted to I-beams on two sides, and a 75-ton crane was then moved into place next to the plant. By 5:30 the following morning the rains had stopped and the skies had cleared. As the sun began to rise over the eastern hills, and accompanied by a CHP escort, a ten-ton truck slowly wound its way through silent city streets to the manzanita's new home in a much quieter and serene serpentine habitat in the Presidio. With echoes of the noisy freeway no longer audible, the birdsong of white crowned sparrows greeted its arrival, along with a team of technical experts.

Now began an equally challenging operation: backing a big rig truck down a narrow, muddy trail to a second crane that had been positioned at the recipient hole. The ten-ton plant-and-soil monolith was



slowly lowered into the hole while everyone present watched with a mixture of excitement and anxiety. The crane was at capacity; it could not have moved any more weight or moved that weight any farther. After a few crucial adjustments, the plant was in place. Biologists, contractors, and Caltrans staff cheered, and shook hands for a job well done.

TOP: The manzanita's leaves, tiny and tough, with thick cuticles to reduce water loss. Photograph by V.T. Parker. • MIDDLE: The young inflorescence of the Franciscan manzanita is distinctive and helped to identify the discovered specimen as *A. franciscana*. Photograph by V.T. Parker. • BOTTOM: Flower buds are needed to do a chromosome count. Photograph by M.C. Vasey.

After the extraordinary move, we began the more mundane but critical tasks of ongoing observation and stewardship. The plant was examined daily for ten days, and has since been on a weekly monitoring regime. Until fall 2010 the plant will be protected from direct midday sun, dead branches will be pruned, weeds will be removed, and monitoring will continue to ensure the plant establishes well in its new home.

While the last wild Franciscan manzanita has now been successfully moved and hopefully will have a long life ahead of it, a bigger question remains. What is the long-term future of this *species* (not this individual shrub), and what are the prospects for restoration of this species in the context of San Francisco's long vanished maritime chaparral habitat? True recovery will not be achieved until multiple genetic seedlings are established in several restored communities. Fortunately, there are several distinct genotypes

of this species (plants with differing genetic material) present in botanical gardens that can be propagated and replanted in the wild so that genetically variable populations can be restored. Work is underway to fulfill this vision. Appropriate restoration sites will need to be carefully evaluated. Selected botanical garden specimens of *Arctostaphylos franciscana* will be analyzed to confirm their direct ties to "wild" stock and to determine the number of unique plants in cultivation.

Chassé is currently looking into suitable reintroduction sites and sources of propagation material for the Franciscan manzanita through a master's thesis project at San Francisco State University. This work will help us to develop a map of the most suitable reintroduction sites, and a blueprint for propagation that ensures the widest possible genetic diversity. The results will enable us to bring additional Franciscan manzanita plants back from their bo-

tanical garden diaspora and home once again to San Francisco's serpentine habitats. In the process, other species associated with maritime chaparral will also be restored. With hard work and a bit of luck, we hope to make it possible for San Francisco manzanita plants to exchange pollen, bear seed, and produce new, genetically wild manzanita plants that will continue the lineage long after humans have moved on to something else.

The Raven's manzanita will also be planted at some of these sites, and other rare and distinctive San Francisco plants will be encouraged to establish and grow with them. In time, a vanished community that was once part of San Francisco's rich natural and cultural history may return to enrich our experience and inspire us, much as it did the poets and botanists of old.

CONCLUSIONS

We feel fortunate to have played roles in this unexpected and serendipitous conservation success story. It has reminded us that amazing discoveries can still be made in California, even in the most unlikely places, including our thoroughly botanized and closely monitored parklands. San Francisco's manzanitas have taught us this lesson before. Consider young Peter Raven's 1952 discovery of a new manzanita species in the Presidio, the discovery of Rose's manzanita (*Arctostaphylos crustacea* ssp. *rosei*) in southern San Francisco, and the 2008 discovery of Baker's manzanita (*A. bakeri*) in a San Francisco backyard. Each of these plants is the descendant of a thousand generations of survivors, each able to pass their DNA to the next generation. When we are fortunate enough to find them, we need to assist their recovery as we are able.

This story also contains historical parallels that effectively illustrate how conservation efforts have improved in the last century. We

thought we had driven this species extinct 70 years ago, when construction equipment removed the last wild Franciscan manzanitas from their native ground so that humans could build roads and pour concrete for retaining walls. Back then, conservationists wrapped plants in burlap sacks and salvaged them for translocation to foreign soil in the East Bay hills.

In contrast, today, when construction activities threatened the last wild Franciscan manzanita for a second time, translocation was once again the only hope for saving the species. However, this time it was the *contractors* who wrapped the plant in burlap, carefully moved it to a new site, and smiled with satisfaction at saving a species from extinction. It is a hopeful sign when conservationists and developers are more likely to work together than to oppose one another's efforts. In 2010, it appears that such cooperation is driven by a weak framework of environmental regulations and the more straightforward and compelling framework of public support to save nature.

The Franciscan manzanita experience teaches us that people of good will can find a way to work together and make magic happen when they are open to each other's perceptions of a problem and are motivated to share their particular expertise in order to solve it. There is a reverence for life deep within all of us. No one truly wants a species to go extinct. We need to continue to search for opportunities to bring back nature while engaging a broader segment of our society in this mission. The collaborative model is the one we should strive for in our conservation work.

Finally, the success of this conservation story reminds us that there is hope for saving the native plants and the places that we love. One year ago the Franciscan manzanita was a poignant parable of senseless loss. Half a year ago it was a single

plant growing near a freeway. Now we have hundreds of clones, thousands of seeds, and plans to identify additional plants and bring them home to restore a previously vanished habitat. This achievement required a lot of hard work and some masterful coordination, all of which had to be accomplished within a woefully short time period, but in the end we have saved a species.

Our land is still blessed with a tremendous natural diversity. Remarkably, most of the unique and marvelous species encountered by California's first European visitors still survive in the Golden State. Our descendants are not likely to be able to say the same unless we act quickly, for many of these species persist in very small populations and many are declining. Other species are extinct in the wild but viable genetic material persists in botanical gardens, seed collections, even herbarium sheets. We need to act now to save them.

Even as we save this Franciscan manzanita, the Vine Hill manzanita, Mount Tamalpais manzanita, San Bruno Mountain manzanita, Oakland manzanita, and too many others are threatened by development, biological invaders, and ill-conceived fuel management actions. We need to identify the most sensitive species, map their locations, prioritize them for rescue, and then act to save them. If we are willing to make this a priority and allocate adequate resources to this effort, we can preserve and restore our remaining habitats for the future.

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PROPAGATING FRANCISCAN MANZANITA FROM SEEDS

There is much we need to learn before we can successfully germinate seed from the Franciscan manzanita. There is a consensus that manzanita seed should have at least a nine-month period of after-ripening—dry storage of freshly harvested seeds at room temperature—before the seed is treated (Meyer 2008; Forbes 2008, personal communication). The next steps to germination are unclear.

Steve Edwards, at East Bay Regional Parks Botanic Garden at Tilden (RPBG) notes that in fire-adapted species such as manzanitas, fire successfully scarifies (scratches or softens) the hard seedcoat so water can enter, or removes the plug in the area of the seed coat where the root emerges.

To pre-treat with fire, manzanita seed can be mixed with sand, potting media, or soil and covered with 1/4" additional media in a fire-proof pan. This helps to spread the heat without having spots that are too hot. Then, the seed and media is covered with pine needles or straw 4-6" deep and ignited.

Plant propagation experts have not determined how long to allow the pine mulch to burn. It is quite easy to kill the seed if the fire is too hot or if it is allowed to burn for too long a period. On the other hand, if the fire burns for too short a time or if the seed is buried too deeply under the pine needles, this may not provide sufficient time to scarify the seedcoat adequately for water absorption and root emergence.

Here at Golden Gate National Parks, we use a small propane torch and add pine needles or other dry native plant material to

keep the fire going about 30 seconds. We will be working on perfecting these parameters.

There is also research showing that it is not the high temperature of fire that induces germination in manzanita species (Kauffman and Martin 1991), but rather the chemical compounds in smoke or charate (ashes/charcoal) from fire that may be responsible for seed scarification in all fire-adapted species, including manzanitas (Keeley and Fotheringham 1998; Tieu et al. 2001; Shebitz et al. 2009).

In their propagation work, Holly Forbes and John Domzalski at UC Berkeley Botanical Garden use a treatment of full strength liquid smoke (yes, the stuff you put on your steak) in water for four hours, followed by 30-day cold stratification to germinate seed from fire-adapted species. Tom Parker at San Francisco State University notes that his experiments on manzanitas have achieved a small percentage of germination using hickory liquid smoke at 1:1000 dilution.

At Golden Gate National Park Nurseries, we will first be trying both fire and smoke treatments with Tamalpais manzanita (*A. montana*), which is a close relative of the Franciscan manzanita and is abundant, before we use seed from the Franciscan manzanita.

Presidio Nursery found that smoke treatment *rather* than fire induced germination in Raven's manzanita (*Arctostaphylos montana* ssp. *ravenii*); whereas, smoke plus heat did not induce germination. We will be experimenting both with dry smoke for different periods of time, using dried native plant material in a barbeque, and liquid smoke at different concentrations and from different sources.

All trials and standard pre-ger-



Seeds removed from the rediscovered Franciscan manzanita before moving it to a new location. The seeds were put in a long-term cold storage seed bank. Photograph by B. Young.

mination treatments for manzanita species do require cold moist stratification after scarification. Stratification can be done by adding moist seed and perlite in a Ziploc™ type bag and then placing it in a refrigerator set at a regular food storage temperature for 30 days. This provides winter-type chilling.

—Betty Young, Director,
Golden Gate National Parks
Nurseries

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Surprisingly, despite its exceptionally rare status, the Franciscan manzanita had never been protected under the Endangered Species Act. Long-term protection of the species is now more likely, thanks to a petition submitted by Brent Plater of the Wild Equity Institute, the Center for Biological Diversity, and the California Native Plant Society.

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ALKALINE RAIN POOLS: REMNANTS OF A VANISHING LANDSCAPE

by Robert E. Preston

Scattered among the remnants of alkali-influenced lands in California's great Central Valley are small, seasonally-inundated wetlands that have generally gone unnoticed, despite the tremendous amount of attention that has been focused on the study and conservation of vernal pools over the past 30 years. These small wetlands are "alkaline rain pools," a term I coined to differentiate them from alkaline vernal pools (also known as northern claypan vernal pools (Holland 1986, Sawyer and Keeler-Wolf 1995), which are superficially similar but differ in their vegetation, soils, and hydrology. Alkaline rain pools, which are the rarest of California's vernal pool habitats, have not been described in the botanical and ecological literature and appear to have been little studied. This article provides an introduction to their characteristic soil, vegetation, and hydrology, and it reviews their historic and current distribution.

ALKALINE SOILS

"Saline/alkaline soils" is often used as a general term for salt-rich soils, and the difference between the two soil types is based on their chemistry. Alkaline soils have high levels of sodium carbonate (soda ash, or washing soda) and potassium carbonate (potash, or pearl ash), which are also known as alkali salts. Alkaline soils are basic, that is, they have a pH greater than 7 (a pH of 7 is neutral, and a pH lower than 7 is acidic). Saline soils have high levels of neutral salts, such as chlorides and sulfates of sodium, calcium, and magnesium, although alkaline soils often have high levels of neutral salts, as well.

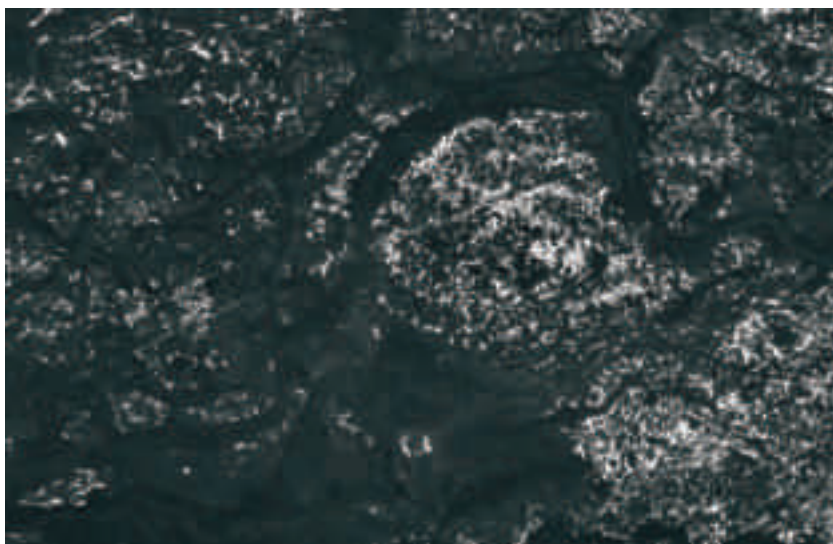
The classical theory on what causes soil salinity or alkalinity suggests that, where a high water table is present, evaporation at the soil surface draws water and salts to the surface. When the water evaporates, it leaves the salts behind at the soil

surface and over time the salts accumulate. Eventually, the level of alkali or salt becomes high enough that it is difficult for plants to uptake essential nutrients, giving them a stunted or "burnt" look. Where salt levels are high enough to kill seedlings, distinctive bare patches of soil develop that are known as salt scalds or slickspots. Salt scalds form where neutral salts accumulate, and slickspots form where alkali accumulates. Salt scalds and slickspots have similar effects on vegetation, and during the summer both features are similar in appearance. However, their different soil chemistry gives them a very different nature during the rainy season.

Alkaline rain pools form in slickspots, so-called because they do not let water pass through and have a shiny appearance when wet (Isaak 1934). In the topsoil, clay particles normally stick to each other and other soil particles, which leaves pores through which water can percolate. High alkali levels at the soil surface in slickspots causes the clay particles to disperse evenly, eliminating the soil pores and reducing permeability to the point that water ponds on the soil surface. In contrast, salt scalds do not pond water because they are caused by accumulations of neutral salts, which do not disperse the clay particles, and generally appear spongy or powdery, not "slick."

Of the 10 soil associations Holland (1978) characterized in the Central Valley as supporting vernal pools, only three support alkaline rain pools. The Lewis-Fresno Group (Lewis, Fresno, El Peco, Dinuba soil series) occurs on the lower ends of old alluvial terraces and have weakly cemented hardpans. The Solano-

Aerial photograph of slickspot terrain in the San Joaquin Valley. Alkaline rain pools form in slickspots, so-called because they do not let water pass through and have a shiny appearance when wet.



Capay-Willows Group (Solano, Pescadero, Willows soil series) occurs in basins and on basin rims and have claypans or occasionally have hardpans. The Chino Group (Chino, Traver soil series) occurs in basins and on basin rims and generally lacks claypans or hardpans.

VEGETATION OF ALKALINE RAIN POOLS

Very little is known about the historic composition or the ecology of the alkaline areas of the valley floor. Histori-

cal accounts have concluded that much of the valley floor vegetation was composed of annuals, with scattered shrubs occurring in xeric areas (Wester 1981, Schiffman 2007, Minnich 2008). The first systematic surveys of alkaline habitats were done by Joseph Burt Davy (1898). Burt Davy recognized several plant communities on alkaline soils around lake basins in the San Joaquin Valley, generally zoned according to moisture availability. Saltbush scrub occurred on the higher, more xeric sites on the valley margins, and valley sink scrub occurred in the basins, usually where a high water table is (or was) present. At intermediate sites he recognized three plant communities characterized, respectively, by interior goldenbush (*Isocoma acradenia*), bush seepweed (*Suaeda nigra*), and alkali sacaton (*Sporobolus airoides*). Jepson (1925) did not differentiate between the plant communities that Burt Davy had described, and instead referred to them collectively as alkali flats. He noted that large areas of alkali



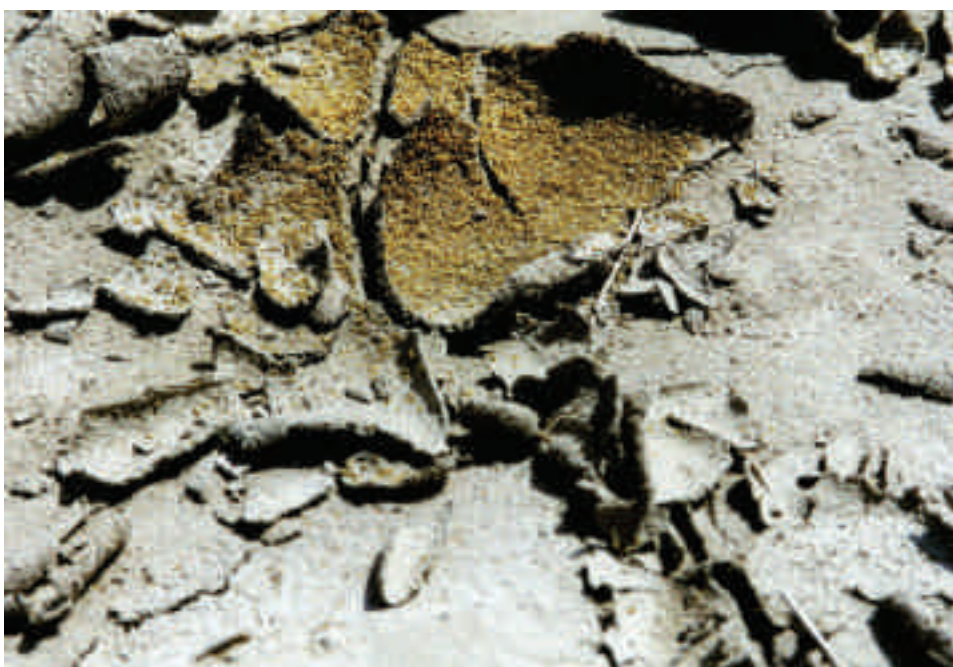
Shallowly ponded alkaline rain pool in the San Joaquin Valley. All photographs by the author.

flats were still present in the Central Valley, especially along the west side.

At present, the overall vegetation type in which alkaline rain pools occur is best characterized as California annual grassland, an herbaceous plant community dominated by non-native annual grasses (see Sawyer et al. 2009, p. 30, for a discussion of the changing perspective on California grasslands). Nevertheless, the presence of interior goldenbush, bush seepweed, alkali sacaton, and other alkaline species mark the habitat as a remnant of one of the historic alkaline plant communities. Within the annual grassland matrix, alkaline rain pools and salt scalds form a network within the uplands, with alkaline vernal pools occurring in swales. Although alkaline rain pools appear superficially similar to alkaline vernal pools during the inundation phase, the vegetation in these two wetlands is very different.

The vegetation in alkaline rain pools is sparse, being concentrated on the pool margins and along soil

cracks. In contrast, vegetation in vernal pools typically covers the entire pool bottom. Alkaline rain pools have low species diversity and lack plant species characteristic of vernal pools. Instead, the vegetation of alkaline rain pools mostly is composed of annual, alkali-tolerant wetland species (some of which are also adapted to saline soils), similar to the herbaceous understory of alkaline sink scrub. Because the vegetation is often concentrated on the rain pool margins, there often appears to be a ring of flowers, similar to vernal pools. However, alkaline rain pools generally lack the colorful floral display that vernal pools are well known for. The unvegetated portions of the pools are often covered by a cryptogammic crust, a community of mosses, liverworts, lichens, fungi, algae, and bacteria that live on the soil surface. Cryptogammic crust in alkaline rain pools is likely to be composed primarily of a blue-green alga (cyanobacteria) that is common in grasslands, vernal pools, and alkaline



TOP: Cryptogammic crust, a community of microphytic organisms that live on the soil surface of alkaline rain pools. • BOTTOM: Exoskeletons of aquatic crustaceans remain embedded in the dried pool bottoms. These tiny creatures reach maturity within two to three weeks, depositing cysts that survive the summer drought to produce the next generation with the winter rains.

sinks in southern and central California (Riefner and Pryor 1996).

In early spring, the dominant species in alkaline rain pools are alkali peppergrass (*Lepidium dictyotum*), San Joaquin goldfields (*Las-thenia chrysantha*), dwarf popcorn

flower (*Plagiobothrys humistratus*), and California alkali grass (*Puccinellia simplex*). Low barley (*Hordeum depressum*), saltgrass (*Distichlis spicata*), and bush seepweed are also common along the pool margins. By early summer, the earlier annuals

are replaced by common spikeweed (*Hemizonia pungens*), large-flowered sand spurry (*Spergularia macrotheca* var. *leucantha*), heartscale (*Atriplex cordulata*), lesser saltscale (*Atriplex minuscule*), and San Joaquin brittlescale (*Atriplex subtilis*).

Vegetation cover in alkaline vernal pools is much higher and more evenly distributed than in alkaline rain pools. The characteristic vegetation of alkaline vernal pools includes many of the same species found in alkaline rain pools, but the species diversity is much higher. Typical vernal pool endemics present in alkaline vernal pools but absent from alkaline rain pools include coyote thistle (*Eryngium vaseyi*, *E. castrense*, and *E. aristulatum*), downingia (*Downingia* spp.), popcorn flowers (*Plagiobothrys stipitatus*, *P. bracteatus*, and *P. leptocladus*), woolly-heads (*Psilocarphus* spp.), spike-primrose (*Epilobium* spp.), and vernal pool saltscale (*Atriplex persistens*).

HYDROLOGY OF ALKALINE RAIN POOLS

Wetland hydrology of alkaline rains pools is similar to that of typical vernal pools but has some substantial differences. As

in other vernal pool types, the principal water source is direct precipitation. Sometimes the pools are interconnected, so that water flows between them when the pools are full. Unlike vernal pools, however, all ponding (the accumulation of

standing water) occurs at the soil surface, and the soil immediately beneath the pools is dry. A claypan or a hardpan may be absent, or if a restricting layer is present, there is no hydrologic connection between the water table perched above it and the water ponded at the surface.

In vernal pools, the water table perches above a restricting layer, so that the soil beneath the surface is also saturated. The water table regulates water levels in vernal pools, with water lost through evaporation and transpiration partially replaced by subsurface flow from the adjacent uplands. This connection to the water table allows vernal pools to pond water for extended periods, typically from 4 to 12 weeks. In contrast, the duration of ponding in alkaline rain pools ranges from a few days to more than two weeks, depending primarily on the pool depth and the magnitude and frequency of rainfall events. The majority of alkaline rain pools probably do not pond until a substantial amount of rain has fallen, generally between 20 and 30 mm over a span of several days, although lesser amounts would still be sufficient to saturate the soil.

The duration of ponding directly affects the types of aquatic invertebrates that will be found in alkaline rain pools. Insects, such as diving beetles (*Coleoptera*) or backswimmers (*Notonecta* spp.), can fly to the pools as soon as they have ponded and can escape when the pools dry down. In contrast, free-swimming crustaceans found in alkaline rain pools, such as seed shrimp (*Ostracoda*) and Lindahl's fairy shrimp (*Branchinecta lindahli*), need two or more weeks of ponding to reach maturity and will not persist in pools that pond for only short duration. The absence of aquatic crustaceans in many alkaline rain pools indicates that they normally pond for less than two weeks. In pools that are inundated long enough to support aquatic crustaceans, exoskel-

etons can be found embedded in the desiccated mud on the pool bottoms after the pools have dried down.

DISTRIBUTION

The distribution of alkaline rain pools in California is presently unknown. They are known to occur on a conservation preserve at the Woodville Landfill in Tulare County and on lands recently purchased by Madera Irrigation District in Madera County. They are potentially found anywhere alkaline soils occur. Alkaline soils are generally located in or adjacent to the basins that occupy the middle reaches of the Central Valley. They range from Glenn and Butte Counties in the Sacramento Valley, to the southern end of the San Joaquin Valley in Kern County, as well as a number of the adjacent small valleys, such as the Carrizo Plains, the Cholame Valley, and the Livermore Valley. Based on county soil surveys prepared by the Natural Resources Conservation Service (formerly the Soil Conservation Service), over two million acres of alkaline soils were mapped in this region.

However, much of the land formerly occupied by these basins has been converted to agriculture. Many of the soil surveys, especially the older ones, provide detailed prescriptions for "reclaiming" alkaline soils by adding soil amendments such as gypsum (calcium sulfate) or sulfur. Most of the remaining habitat where alkaline soils can be found is located on state and federal lands. The largest areas of remaining alkaline habitat are within the National Wildlife Refuges (NWR), including the San Luis, Sacramento, and Kern NWR complexes. Small areas of habitat are also preserved in Department of Fish and Game Ecological Reserves, including Alkali Sink and Kernan.

The distribution of alkaline rain pools outside of California is also poorly known. There are extensive

areas of alkaline soils in the southwestern United States, on the Great Plains, and in other arid regions around the world. However, the ecological literature focuses primarily on larger playas or on alkaline sink scrub habitats (Brostoff et al. 2001), rather than on these smaller, more ephemeral pools.

CONSERVATION

The alkaline rain pool is a rare habitat that has intrinsic conservation and preservation value. However, the conservation status of this unusual wetland type presently remains unclear. Economic pressure to convert the last private parcels of remaining alkaline habitat to vineyards or dairies is a direct threat to the conservation of alkaline rain pools. Regulatory mechanisms for protecting vernal pools and other seasonal wetlands have been weakened, and impacts on landscape-level hydrologic processes that are necessary to maintain seasonal alkaline wetlands may make conservation efforts difficult.

The first step in conserving alkaline rain pools is recognizing them as a distinct habitat. Some previous surveys have mistaken them for alkaline vernal pools or have not differentiated them from salt scalds. Alkaline rain pools pose problems for wetland experts attempting to map them because their sparse vegetation and unusual hydrology and soil chemistry make it difficult to identify their characteristic wetland indicators. Under federal wetland standards, vegetation cover must be at least 5% for a feature to be considered a wetland. The dominant plant species in alkaline rain pools are hydrophytes, but the vegetation is sparse and often not much more than 5% total cover.

Furthermore, wetland hydrology is only present during the rainy season (November-March). During years of below normal rainfall or when rainfall events are separated



Left to right: Heartscale (*Atriplex cordulata*), lesser saltscale (*Atriplex minuscula*), and San Joaquin brittlescale (*Atriplex subtilis*) are typically found in alkaline rain pools during summer and early fall.

by several weeks of dry weather, the federal standard of 14 days of continuous inundation for a wetland habitat may not be met. During the summer dry season, alkaline rain pools may be indistinguishable from salt scalds except for subtle clues, such as remnants of crustacean exoskeletons. Alkaline rain pools are truly on the dry end of the spectrum of wetland types.

Another difficulty in conserving alkaline rain pools is the uncertain status of mechanisms for regulatory protection. Until recently, placement of fill in vernal pools has been regulated by the U.S. Army Corps of Engineers, but recent Supreme Court rulings, including the SWANCC and Rapanos decisions, have placed limits on the Corps' regulation of wetlands that are not tributary to or adjacent to traditional navigable waters or their relatively permanent tributaries. At the state level, alkaline rain pools are waters of the State and are protected under the Porter-Cologne Act, under the jurisdiction of the Regional Water Quality Control Boards.

Alkaline rain pools are not known to harbor state or federally listed threatened or endangered species, unlike vernal pools, for which the presence of listed species provides additional protection under the state or federal endangered species acts. However, they provide habitat for several CNPS List 1B *Atriplex* species that could be listed in the foreseeable future. On a broader scale, alkaline rain pools may be part of the habitat of the San Joaquin kit fox, blunt-nose leopard lizard, or other listed species of the San Joaquin Valley. In addition to the endangered species acts, the California Environmental Quality Act may provide some protection to alkaline rain pools, since impacts of development projects requiring approval of state and local agencies would be subject to analysis and mitigation.

A more pressing concern is whether or not conserving alkaline rain pools may even be feasible, in the long run. The historic hydrologic processes of the Central Valley have been drastically altered, and factors such as a shallow water table

or seasonal flooding may no longer play a role in maintaining the alkaline habitats. Overdrafting of valley groundwater tables, some of which are now over 100 feet below the historic level, has eliminated the shallow water table that formerly leached salts to the soil surface. Channelization or elimination of historic stream channels now prevents the seasonal flooding that helps maintain seasonal alkaline wetlands in other areas, such as in the San Jacinto Valley in Southern California or along the margins of the Great Salt Lake in Utah. The absence of these hydrologic processes also precludes the restoration of historic terrain where alkaline soils occurred, so that it may not be feasible to compensate for the loss of alkaline rain pools through habitat restoration or creation.

AN UNCERTAIN FUTURE

Much of the native vegetation in the Central Valley, like that of the Tulare Lake Basin, has been replaced by urban development and agricul-



ture. Remnants of the Valley's historic habitats are scattered, such as the relict dunelands at Arena Plains. Most studies done on these habitats have been floristic, and not enough detailed ecological work has been done on them. Burt Davy's pioneering studies of alkaline habitat back in the 1890s were never finished, as he moved on to work in other parts of the world.

Alkaline rain pools are a very small remnant that could easily be lost if there is not an effort to identify their remaining occurrences and to understand the ecological processes that formed them and that allow them to persist into the future. Hopefully we can spread this information to the conservation community and the resource management agencies before these and other remnants of the native flora vanish forever.

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THE ART AND SCIENCE OF CALIFORNIA NATIVE GARDEN DESIGN

by Rob Moore

Designing cutting-edge suburban landscapes utilizing California native plants is more than a hip new slogan. It is an idea whose time has come! A style of landscaping formerly relegated to the realm of the

niche market, the art and science of designing native gardens is now rapidly ascending to the forefront of public consciousness, where it is promising to take its logical and rightful place.

The idea of the California native

plant garden is not new. In 1891, Theodore Payne recognized the intrinsic value of the designed native garden with its promise to conserve precious natural resources, while viewing a large display of California native plants at The Royal Botanic Gardens at Kew in England. The premise of developed gardens and landscapes being aligned with the ecosystem they were to be implemented within made perfect sense to him.

CONSERVATION: THE WATER/HABITAT CONNECTION

Today this premise is supported with more relevant data than ever before. With dwindling water resources a stark reality and native plant communities such as our coastal sage scrub dangerously depleted, making the case for utilizing California native plants in suburban landscapes and gardens has become imperative.

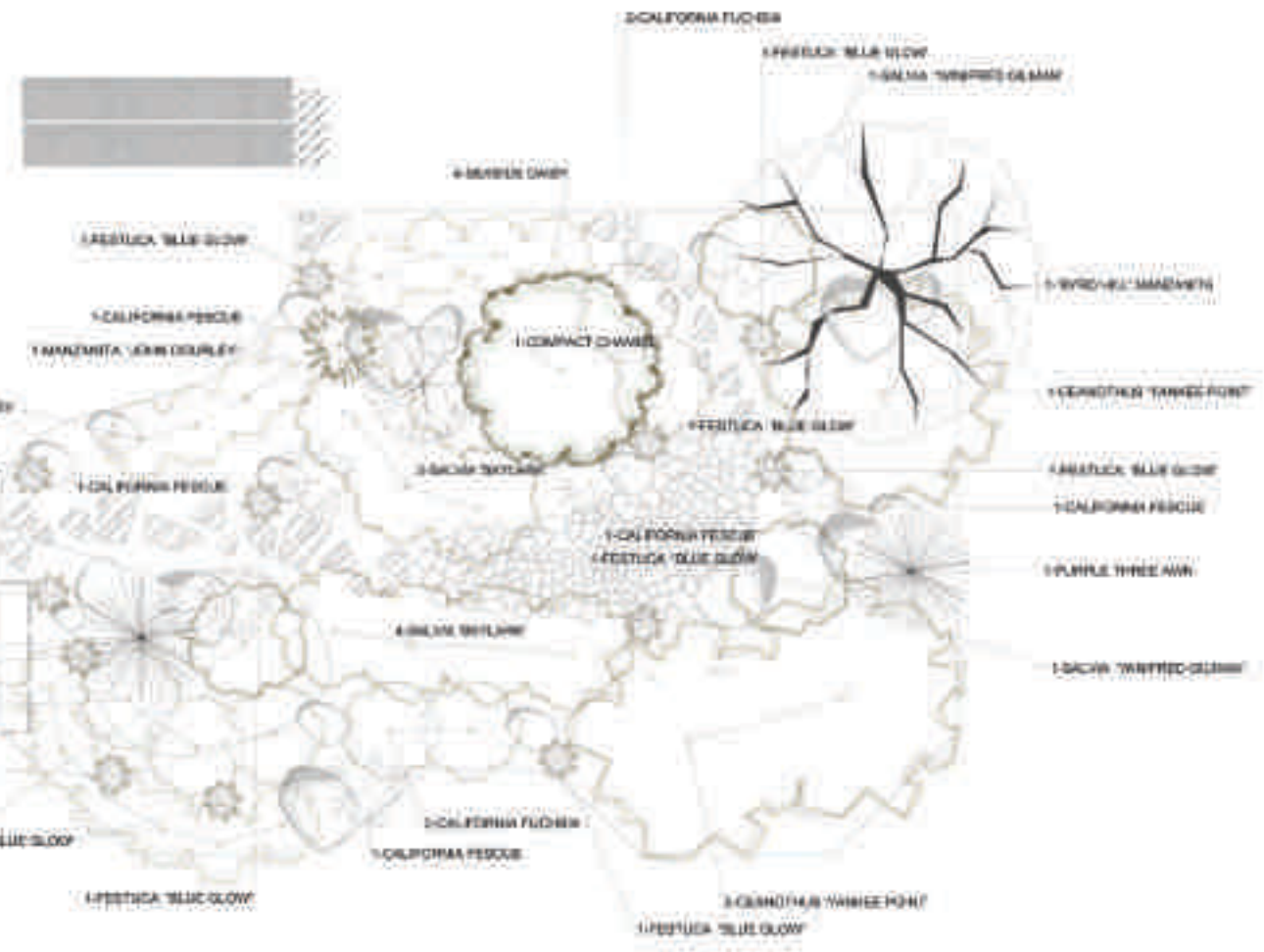
Members of CNPS and forward-thinking home and business owners are seeing evidence of this trend more and more. Municipalities such as the City of Los Angeles, San Diego, and others across the state are spending millions of dollars on pub-

The development of a small native plant garden in a suburban development. TOP: Area before design and installation. • BOTTOM: A newly installed landscape with path/swale combination. This design feature does double-duty: It collects run-off and also serves as an access path. Rolling topography creates vertical interest and emulates our native hills, valleys, and canyons. Note adequate spacing between plants, and color coordination of hardscape materials and home. All photographs by R. Moore.



Even policymakers in Sacramento are in agreement and have written and passed legislation addressing the issue. Possibly the most stark evidence of this is the passage of AB 1881 (the Water Efficient Landscape Ordinance or WELO). Going into effect in early 2010, AB 1881 mandates water conservation in landscape design, construction, and maintenance.

ABOVE: Dispelling the misconception that all native plants are slow growing, this garden illustrates how fast-growing species can fill in to create a full, aesthetically pleasing landscape in as little as six months. • BELOW: The planting plan for the native plant garden (pictured above) meets the client's desire for an environmentally sensitive landscape.





Decomposed granite path, solar lighting, and native plants in containers (middle right), combine with a simple water feature (birdbath, middle left) and a subtle wildflower cover crop to create a native garden with a more “formal” feel.

ary 1, 2010 every county and city in California (including charter cities) is required to adopt either the State Department of Water Resource’s new model ordinance, or a water efficient landscape ordinance that is at least as effective as the DWR model. With these and numerous other examples reflecting how our state has been impacted, it is obvious that a sea change is occurring.

NATIVE PLANTS AND WILDLIFE

California native plants and our native wildlife have a symbiotic relationship. Utilizing our native flora in our residential gardens and commercial landscapes creates much needed habitat. It doesn’t take a de-

gree in statistics to realize that many of our native animals’ breeding grounds, sources of food and water, and protective cover have been polluted and destroyed by decades of unchecked, rampant development and urban sprawl.

For instance, U.S. Fish and Wildlife Service statistics conclude that up to 94% of native grasslands in San Diego County have been developed. Their data also previously revealed that by the early 1990s, urban sprawl in California had reduced the indigenous coastal sage scrub ecosystem by more than 90%.

Coastal sage scrub is the habitat of the threatened California Gnatcatcher and Cactus Wren, but other lesser-known bird species have been negatively impacted as well. Some of these species include the Belding’s

Savannah Sparrow and the San Clemente Sage Sparrow. As if that weren’t enough, Towhees and other ground-foraging birds are also suffering from the added threat of feral cats.

California’s native flora and fauna go hand in hand. By choosing regionally appropriate plants for our gardens and commercial landscapes we are serving the needs of our native animals and conserving precious water resources.

MISNOMERS AND MISCONCEPTIONS

One of the main challenges we—as advocates of California’s native flora—have to overcome is the common (and understandable) misconceptions that have been perpetuated

by a mindset that exemplifies our society's "import" mentality.

One prevailing untruth is that native plants are *aesthetically* unfit for suburban gardens and landscapes. Many folks—when offered the native alternative—think of brown hillsides covered in dead weeds left over from winter rains. The fact of the matter is that most of the unattractive vegetation people see in open areas is comprised of invasive species which were introduced by early European settlers. These interlopers have gained a foothold because naturally occurring ecosystems have been disturbed by human development. Not only do these introduced species give native plants a bad reputation aesthetically, but they are accelerating fire cycles and causing native plant communities to be choked out of existence.

Fortunately throughout our state are select nurseries that propagate native plant species specifically to grow—and flourish—in suburban landscapes, all the while doing so with a fraction of the water required to sustain a garden stocked with thirsty, imported species. Many of these native varieties have eye-catching flowers, a stronger fragrance, are adaptable to soil and microclimate variations, and are perfectly suited for use in the suburban garden.

Additionally, state fire authorities such as the Orange County Fire Authority are coming to the realization that, with occasional irrigation during summer months and proper application of maintenance procedures, many native species and their cultivars can actually reduce the hazard of fire damage from seasonal flare-ups.

Another challenge to overcome is the misnomer that California native plants are fussy. Unfortunately many gardeners believe this to be true and are hesitant to embrace the use of these plants because of the entrenched belief that natives don't perform well in ornamental landscapes. Moreover, from a design per-



Native bunch grass California fescue (*Festuca californica*), Mendocino reed grass (*Calamagrostis foliosus*), seaside daisy (*Erigeron glauca* 'Bountiful'), salvia (*Salvia* spp.), coast sunflower (*Encelia californica*), and Montara sagebrush (*Artemisia californica* 'Montara') create a friendly, low-water-use California garden.

spective, many professionals believe that to successfully utilize native plants in garden design, one has to unlearn all they've been taught regarding ornamental landscape design.

With this mind-set, and decades of abundant and inexpensive water resources, it's no wonder that the general public has been loath to embrace the widespread use of our native flora in their gardens and commercial landscapes. Fortunately, with more and more information to the contrary becoming available combined with ongoing water restraints, this outdated paradigm is changing. It is shifting in favor of the inclusion of California's native plants in place of the standard, imported nursery stock that has long enjoyed preferential status.

BENCHMARK: CALIFORNIA NATIVE PLANT COMMUNITIES

Designing a native garden requires a different mind-set. In ornamental horticulture it is common practice to change the ecology of

the site to be developed in order to suit the imported nursery stock. For example, after a site has been graded, top soil imported, and the holes dug, the soil to be used for backfill is typically amended to increase its fertility. Your standard fare of plants are then introduced such as junipers, boxwood, Italian cypress, azaleas, oleanders, and exotic flowering trees, usually with the intent of creating a lush, park-like oasis such as one might see in maritime England or Hawaii.

This "ideal" then requires copious amounts of regular water, fertilizer, and pesticides, all of which run off incrementally with every subsequent watering the landscape receives. This toxic brew flows off-site and down sidewalks, entering storm drains and continuing on to pollute our natural watercourses before arriving at its final destination—the ocean.

A California native garden requires few of the aforementioned practices. Other than the removal of turf grass, grading for run-off mitigation, and removal of unwanted plant material, it is best to disturb



Canyon gray sagebrush (*Artemisia californica* 'Canyon Gray') and margarita penstemon (*Penstemon* 'Margarita BOP') combine to provide contrast in the suburban landscape.

the existing site as little as possible. Look at the design process from a different perspective—that of *emulating the natural ecosystem or plant community that existed prior to the development of the home and neighborhood where the garden is to be developed*. Identifying this natural ecosystem is the first step in that development process.

Good questions to ask include, “What plant community do I live in?” and “How do I go about identifying this community?” Generally speaking, most of the densely populated areas in California (primarily those in the southern part of the state) are located in the coastal sage scrub plant community. Inland areas in southern California such as Riverside and San Bernardino have their own version of this plant community referred to as interior, or Riversidian sage scrub.

Of course this is a generalization. There are many other climates to be considered such as northern oak woodland, northern juniper woodland, central oak woodland, yellow pine forest, Douglas fir forest, valley grassland, and Great Basin sage, to name a few. It is at

least as important to fully understand microclimates within these general plant communities prior to choosing a plant palette of California natives. Look around the neighborhood where the garden is to be designed, and take note of areas that haven't been developed. Do stands of intact native plant groups still occur naturally? Note what plants are growing there, and how they grow together. Another clue is to look for native plant volunteers popping up in people's ornamental landscapes. These *indicator plants* offer clues as to what will easily grow in that particular neighborhood.

If you live in an area where no undeveloped areas exist and where native plant volunteers are not obvious, there are other resources available. Las Pilitas Nursery has a website where you can enter your zip code, locate the plant community, and find links to plants that occur naturally in that specific region of the state. Tree of Life Nursery's website is a valuable resource as well. In particular, their article “The California Garden” (located under Resources/Sage Advice) is an excellent source from which to choose plants

based on California native plant communities.

COMBINING CREATIVITY AND ANALYSIS

Alluded to earlier was the fact that designing a native garden requires a different mind-set. Many gardeners and landscape professionals who initially want to include California natives in their gardens are disinclined to throw out all the information they've learned about ornamental landscaping in order to embrace the use of native plants.

It's true that creating a successful design utilizing California native plants requires a different approach to the design process. That being said, there is still a place for the traditional elements and principles of ornamental landscape design and their logical application in the California native garden.

Merriam-Webster defines “garden design” as “the art and process of designing and creating plans for layout and planting of gardens and landscapes.” Most people think of design as a creative endeavor and they're right to a degree. Garden design is an art, but it is also a science. Much of the work entailed in the process of landscape design is done from an analytical frame of reference. From the preliminary phases of the Site Inventory and Site Analysis, to the research aspect of identifying the native plant community, then the development of a hardscape, and finally to the plant selection, all require the gathering of detailed and specific information and applying it in an artful and practical way.

SITE INVENTORY AND ANALYSIS

The design process really begins with the Site Inventory. Taking note of what is present on the property is the first step in the development of

the landscape design. Consider views to be screened or enhanced as well as views from inside the house. These are important and pragmatic details. The needs of children and/or pets will have to be taken into account as well. Other important items to consider during the Site Inventory include utilities such as overhead power lines and underground gas or power lines, plans for future additions or renovations, existing hardscapes to be kept or removed, and existing plants to be kept and integrated, as well as those to be removed.

Seemingly innocuous things such as the color and architecture of the house play an intrinsic role in the artful design of a native landscape. Rocks, paving stones, decorative gravel, or a creek bed are all transitional elements. They help to bridge the gap between the hard, inorganic architecture of one's house and the organic, soft material and earth tones of the plants. Take the time and methodically note in the Site Inventory all pertinent components of the property where the native garden is going to be.

The next step in the process of design is the Site Analysis. During this phase it's important to consider the reasons for creating a native garden. Is it to attract specific wildlife or perhaps habitat restoration? Maybe it is something as pragmatic as saving water or reducing time spent performing maintenance tasks. These are important things to consider during this phase of the design process. If children or pets will be using the space, make safety and security considerations a priority. Outside entertaining, sitting/viewing areas, solar outdoor lighting, and access paths are other things to be noted.

Gaining a clear understanding of what the motivation is for developing a California native landscape, coupled with the intended use and how one expects to interact with the future garden, is an important step in the creation of a solid design.



A dry creek bed distributes runoff from a downspout through this landscape comprised of canyon gray sagebrush (*Artemisia californica* 'Canyon Gray'), coast sunflower (*Encelia californica*), salvia (*Salvia* 'Aromas'), sunset manzanita (*Arctostaphylos X hookeri* 'Sunset'), and California lilac (*Ceanothus* 'Concha').

THE ROLE OF HARDSCAPES

The hardscape is the physical foundation the new California native landscape will be built on. It is every bit as important as the plants that will be chosen. With native landscapes the hardscape is as much aesthetic as functional, and is literally intertwined with the plants used. Elements like paths, mounds, swales, dry creek beds, rocks, boulders, and even snags and mulch all play an intrinsic role in a functional, healthy, and aesthetically pleasing native garden.

Unlike traditional nursery plants which are typically chosen based solely on their physical appearance, native plants should be approached from a broader perspective. It is important to think about how these plants will work in tandem with their hardscape counterparts. For example, consider what looks good to the eye when out for a walk in na-

ture. Usually when one stumbles upon that "Kodak moment" it is a combination of elements working together that create the image that is pleasing to the eye.

Most professionals agree that when designing native gardens, it is important to evaluate the soil and its drainage. Analyze the way water moves across the site. Surface-drainage patterns fall into two categories: water collection and water dispersion. Make note and address this issue by shaping, i.e., grading the site to retain water on-site.

Consider how water moves across neighboring properties. If that flow impacts your site, it will need to be addressed during the design of the hardscape. For instance, suppose a neighbor's property includes turf grass that requires copious amounts of regular water that overflows onto your property. In this situation, a dry creek bed or swale might be built to channel this water



An example of a design based on a plant grouping as opposed to individual plant aesthetics. Note how existing, non-native species in the background create a complementary backdrop for this native garden in San Clemente. This client preferred using primarily cultivars of native species, which she felt were more pleasing aesthetically than the “pure” native species, so only the blue-eyed grass is a local native. (Some botanists hold that true native species provide more wildlife value than cultivars.) Species that make up this plant grouping include: salvia (*Salvia clevelandii* ‘Winifred Gilman’), wild rye (*Leymus condensatus* ‘Canyon Prince’), blue-eyed grass (*Sisyrinchium bellum*), lilac verbenas (*Verbena lilacina*), island sage brush (*Artemisia nesiotica*), island snapdragon (*Galvezia speciosa*), blue fescue (*Festuca glauca*), California fuchsia (*Epilobium canum* ssp. *latifolium* ‘Everette’s Choice’), penstemon (*Penstemon* ‘Margarita BOP’), and seaside daisy (*Erigeron glaucus*).

into an area planted with riparian species. Not only will you enjoy the benefits of your neighbor’s poor watering habits; this design feature will mitigate runoff which would end up in local wetlands and waterways.

Irrigation issues need to be ad-

dressed. Is there an existing system that needs to be updated or retrofitted? Many native plant nursery professionals recommend hand watering and/or the use of manual sprinklers. If an existing automated system is to be retrofitted, water con-

serving heads such as rotors, micro spray, or in some instances drip line should be installed. Include a smart controller. Smart controllers are irrigation clocks that automatically adjust irrigation run times in response to environmental changes.

These controllers use sensors and weather information to manage watering times and frequency.

Consider paths, access routes, and traffic patterns around the home and through the landscape, both from an aesthetic and utilitarian perspective. Paths created with surface materials such as decomposed granite or crusher fines lend a more informal, natural style to the native plant garden. Add flagstone or pavers to create a more formal feel in the landscape. Consider which elements fit into your overall vision prior to choosing paving materials.

The soil excavated from paths can be used to create interesting topography if the property being developed is flat. By reusing soil that is excavated during grading, digging paths, and/or creating swales, existing materials are kept on-site, thus minimizing the environmental impact of the project.

With respect to aesthetics, the use of mounded soil in the landscape meets several beneficial design criteria. First it creates vertical interest and visual dynamics. It employs the principle of focalization—forcing the viewer's perception to a focal point in the landscape—which evokes curiosity in the eye of the person viewing the garden. For example, a manzanita artfully placed on top of an elevated peak surrounded with companion plants from its plant community will create an instant focal point.

Contours peak the interest of the viewer, guiding the eye and inviting one to explore where the paths lead.

This design concept is often used in Japanese-style gardens, most commonly by creating meandering paths where the viewer's site is limited purposefully to induce curiosity. The use of contoured land also follows the theme of our naturally occurring native landscapes. Soil can be shaped to simulate California's rolling hills, mountains, canyons, and valleys, albeit on a much smaller scale.

If the site's soil makeup contains

poorly draining clay or compacted soil, creating mounds also makes it possible to include in the garden design plants that require better drainage.

INTERSECTION OF FUNCTIONALITY, AESTHETICS, AND HABITAT

The use of snags (a partially or completely dead tree) and/or dead wood is another aspect to contemplate in the design of a functional and aesthetic hardscape. Deadwood in a natural environment exists in many forms and serves an important purpose in a healthy ecosystem, as well as providing visual interest in the native plant garden.

Snags and deadwood offer critical habitat for many species. They provide food, shelter, and nesting places for birds and other garden-

friendly wildlife. Stumps and logs can double as focal points and refuges. They serve as an insulation blanket, cooling the ground while simultaneously offering ground-foraging birds like the threatened California Towhee refuge from heat and domestic cats.

Beneficial insect eaters like alligator lizards, blue bellies (western fence lizard), and side-blotched lizards, as well as important pollinators such as carpenter bees and the yellow-faced bumble bee will appreciate these elements as well. California's native bees are excellent pollinators and are great for vegetable gardens. It is believed that they are beneficial for improving fruit set as well. Many gardeners know that with increased pollinators comes an abundance of insect-pollinated fruit that is larger in size and greater in quantity.

Deadwood provides insect-eat-

Color, texture, and species variety combine to create a mosaic of California native plant beauty in the suburban garden. Close-up of previous plant grouping garden design.



ing birds such as our endangered Western Blue Bird with added food sources. It can also double as natural garden sculpture and/or art. Tuck a piece in between a rock and a couple of plants and leave a little open space around it through which wildflowers can pop up in the spring. Deadwood also looks good in a dry creek bed or pond. Locate a piece in the wild that is aesthetically appealing and place it accordingly to taste. Also consider leaving existing dead branches in place (provided they don't pose a hazard).

Water is another important element in a balanced hardscape. Providing fresh water offers an important resource for garden-friendly animals that are a key component in a healthy native garden. Clean, fresh water is often the hardest necessity for birds to come by. Not only will it keep the garden lively with a variety of birds and other backyard critters, but it will also attract butterflies. Place rocks or stones in birdbaths to give butterflies and birds a supportive landing area. Include a water feature in the landscape design such as a recirculated stream or pond created with rocks such as river cobble. Consider a fountain as well. The sound of running water will draw hummingbirds and goldfinches. Water, birds, and butterflies bring to the garden the elements of sound, song, and motion, allowing the homeowner to experience a deeper connection with its natural inhabitants.

Along with the element of water, include rocks, boulders, and cobbles in your design plan. They are beneficial functionally as well as esthetically. Turn over a good-sized granite boulder in the middle of summer and you'll find many life forms living there. Include a decent-sized rock placed strategically within a plant grouping like one would witness in nature. Doing so will provide a lasting source of moisture that will assist plants through the hottest months of the year.

SOME CONSIDERATIONS IN PLANT SELECTION

- Will any people who are sensitive to bees and/or pollen use the garden regularly?
- Do you want the garden to stand out or to blend in with neighbors' landscapes?
- Should the design be based on traditional principles due to homeowner restrictions on landscaping; is a more natural look desired, or can the two be combined?
- Do you want your garden to be filled with many types of plants, or do you prefer an open feel that is better achieved by using fewer plants?
- As a rule of thumb, situate plants so that they won't grow over sidewalks when their mature size is reached or obstruct views exiting driveways. Be aware of city ordinances regarding setbacks.
- Are there views or excessive noise sources you want to screen?
- Do you have a southwest corner where it might be advisable to plant a deciduous tree for summer cooling and winter heating?
- Are there specific flower colors you like best, or ones you dislike?
- Would you like to include in your design deciduous trees that signal the change of seasons?
- Do you have any favorite flowers, plants, or trees that you definitely would like to integrate into your design?
- Are there other landscapes in the area you like and would like to emulate in some way?
- Be sure to keep in mind microclimate considerations such as sun, shade, slope, wind patterns, and radiated heat.
- What kind of plants surround the property to be designed, and how might they influence your overall landscape design?
- Would container plants help to accent areas that cannot be planted?
- Consider the addition of wildflowers as a cover crop or to provide additional color and interest, particularly during the later winter and early spring.
- Group plants together that share similar needs (particularly water and light).

THE ROLE OF PLANTS

When choosing plants to recreate a native plant community, you will need to flip your perspective 180 degrees. Often when choosing plants, gardeners tend to think of individual plant aesthetics as the

primary determining factor. Instead think in terms of groupings of plants combined with their hardscape counterparts placed strategically throughout the landscape.

After referencing plant lists specific to the microclimate and location of the site, choose a dozen or

two plant species that will make up the preliminary plant list. For example, if you live in the coastal sage scrub community, consider using species such as coastal sagebrush (*Artemisia* spp.), buckwheat (*Eriogonum* spp.), wild lilac (*Ceanothus* spp.), and manzanita (*Arctostaphylos* spp.). Other plants to consider are coyote brush (*Baccharis pilularis*), coast sunflower (*Encelia californica*), salvia (*Salvia* spp.), and monkeyflower (*Mimulus* spp.). Utilize both evergreen and summer deciduous plants together in the grouping.

Set out plants as illustrated on the landscape design plan *before* digging the holes. This is the time to make final adjustments with regard to placement. It is not uncommon that plans may not accurately transcribe from paper to site due to unforeseen materials that are pre-existing both above and below ground. Additionally, quantities often are miscalculated, hardscapes inaccurately installed, and some plants may need to be omitted to provide for adequate spacing.

Plan plant placement with mature plant size in mind, i.e., carefully consider both height and width that plants will eventually achieve. Leave room between plant groupings (about enough to walk through) for maintenance access. Beneficial pollinators such as our native bees require bare soil to create nest cells. Designing open space within the garden will create habitat for them. Allowing some extra room also affords the added benefit of a wildflower display in the spring.

When choosing plants, it is paramount to match plant materials to the existing soil conditions of the site. There are copious sources of information pertaining to native plants and their soil preferences. Whether the soil is clay, silt, sand, or any combination thereof, there is a California native that is suited to that soil's makeup.

Other things to consider are sen-

sitivity to allergies (specifically bees). If you are concerned about this, keep flowering plants away from traditional focal point areas such as the front entrance of the home, or along pathways. Do you want the garden to stand out, or blend with neighbors' landscapes? If you live in a neighborhood where homeowner restrictions regarding landscaping exist, the design may need to be based on traditional design principles and elements, i.e., foundation planting against the home, and a flat area possibly substituting a lawn alternative for grass. Do you want your garden to be filled with many plants, or do you prefer an open feel that is better achieved by using fewer plants?

Be mindful not to obstruct views exiting driveways. Check city ordinances regarding street setbacks. Especially if the home is on a corner lot, be careful to choose plants that won't grow over the edges of sidewalks and driveways. Do you want to screen views or excessive noise in a particular part of the garden? Would a deciduous tree placed in the southwest corner provide summer cooling and allow winter heating? What flower colors do you prefer?

Are there other landscapes in the area or in magazines that you might want to emulate? Microclimate considerations such as sun, shade, slope, wind patterns, and radiated heat are critical factors when choosing plants. What kinds of plants surround the site on neighboring properties? Keep in mind that these plants will be the backdrop to your new garden.

California native plants work well as container plants. Think bonsai and design a naturalistic grouping in a pot as an accent in areas that cannot be planted. Wildflowers provide seasonal variation and can serve double-duty as a cover crop in the newly planted landscape. Consider their inclusion in the plant palette. Remember, always plant groupings of plants that share

similar watering needs so they can be watered at the same time when connected to an automatic watering system.

Whether the garden to be designed is comprised strictly of native plants, or combined with existing or compatible drought-tolerant exotic species, the design principles remain the same. Combining natives with existing non-native plants is a perfectly acceptable option when designing or upgrading your landscape, so long as basic considerations such as irrigation, soil compatibility, and microclimate are considered. From an aesthetics perspective, native and non-native plants can coexist and create unlimited combinations of color, form, and texture. Go totally native if your goal is habitat restoration and/or gardening to attract beneficial wildlife. At the end of the day, it all boils down to what brings you, the gardener, a greater sense of fulfillment and joy.

Statistics clearly show that decades of unchecked, rampant development and urban sprawl have not only impaired the quality of life for us and our loved ones, but also polluted and destroyed much of California's natural habitat that provides food, water, and protective cover for native wildlife. It has become clear that we as individuals need to take action.

The good news is we can! By simply changing our gardening practices, we literally transition from being a part of the problem to becoming an active part of the solution. Invite change into your garden by artfully designing a California native, wildlife-friendly garden. In doing so, you will become intimately acquainted with the essence of California's unique, beautiful native flora.

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Piedras Blancas Light Station, circa 1946. All photographs courtesy of the Piedras Blancas Light Station ONA.

NATIVE PLANT RESTORATION AT PIEDRAS BLANCAS LIGHT STATION OUTSTANDING NATURAL AREA

by Russ Lewis and Carole Adams

The Piedras Blancas Light Station Outstanding Natural Area is situated on Point Piedras Blancas, a prominent headland located in San Luis Obispo County along the central coast of California, north of San Simeon and world-famous Hearst Castle. Native vegetation on the 19-acre property is classified as a coastal scrub plant community and is situated on a low coastal terrace overlooking the Pacific Ocean.

HISTORY

In the fall of 2001 the Bureau of Land Management (BLM) assumed management of the Piedras Blancas Light Station. Previously the site was

managed by the United States Lighthouse Service (1874-1939) and the United States Coast Guard (1939-2001). In 2008 the Piedras Blancas Light Station was designated by the United States Congress as an Outstanding Natural Area within the National Landscape Conservation System.

The Coast Guard began planting iceplant on the site in 1939. An aerial photograph taken around 1946 (see above) shows iceplant growing in areas around the housing units and lighthouse. Beginning in the 1950s until the mid-1970s, iceplant (*Carpobrotus edulis* and *Carpobrotus chilensis*) was extensively planted by Coast Guard personnel, by labor provided by the Boy Scouts of America,

or by labor contracted through local landscaping companies. Presumably the goal was to stabilize the soil in areas impacted by human (surface disturbing) activities where structures and access roads had been built. According to Coast Guard personnel who lived at the site around 1950, there were two reasons why iceplant was selected. One was for ornamental purposes. It was a popular, low maintenance flowering plant requiring little water. The second reason was that it was regarded as a fire resistant plant. The plant grew so vigorously that by the 1970s most of the 19-acre site was covered by a nearly continuous carpet of iceplant.

When the BLM took over management of the site in 2001, approxi-

mately 85% of the area was overrun with a thick carpet of iceplant growing up to the foundations of buildings, covering the sidewalk, draping heavily over the tops of cliffs, and completely choking out the remaining native vegetation. Although iceplant dominated, there were more than 40 other non-native species also present to a lesser degree. Some of the most noxious non-native plants included New Zealand spinach (*Tetragonia tetragonioides*), Italian thistle (*Carduus pycnocephalus*), mustard (*Brassica nigra* and *Brassica rapa*), radish (*Raphanus sativus*), cut-leaf plantain (*Plantago coronopus*), oxalis (*Oxalis pes-caprae*), and an assortment of non-native grasses.

Widely spaced patches of native vegetation could still be found in a few small areas, consisting predominantly of seaside woolly yarrow (*Eriophyllum staechadifolium*) and seaside daisy (*Erigeron glaucus*).

ARCHEOLOGICAL CONSIDERATIONS

The BLM vegetative management plan at Piedras Blancas Light Station called for the removal of non-native iceplant and other exotics, and the reestablishment of native plants previously found on the site, enabling it to return to a native plant ecosystem. Complicating that plan was the fact that the entire 19-acre site was considered to contain valuable archeological resources and was therefore protected by state and federal cultural resource laws, as well as BLM's own cultural resources policies. Historically the site had been used by Native Americans to gather resources from land and sea. The earliest documented use of the site is around 3,300 years ago, although actual use may predate that figure.

Initially, critics questioned the removing of iceplant because it was



Location map of 19-acre parcel that comprises the Piedras Blancas restoration area.

believed it offered surface protection for artifacts buried beneath the soil. However, others pointed out that native vegetation had been present before iceplant was introduced and that native plants would cover the artifacts as well as iceplant. In contrast, it was known that the heavy biomass of iceplant caused sea bluffs to collapse, accelerating coastal erosion and threatening artifacts within that area. So the plan to revegetate the area with native plants was adopted and implemented.

RIGHT: Volunteers haul dried out iceplant by wheelbarrow and pack it into dumpsters for removal. It takes about six to eight weeks for the iceplant to dry out once pulled, but is considerably lighter to haul when dry. • BELOW: Volunteers hand pull iceplant away from native plants.

In order to protect any artifacts that might be present, BLM staff emphasized the importance of disturbing as little of the soil profile as possible. It was discovered that it was not necessary to dig up iceplant roots since little regrowth occurs when broken off at the surface. The eradication techniques for other non-native species other than iceplant varied, depending on the specific plant being targeted. Since protecting archeological resources was a foremost consideration during invasives removal, it became an important facet of volunteer training.





TOP: Piedras Blancas Light Station in 2001. Iceplant has overrun at least 85% of the area.
BOTTOM: Same spot in 2007, now mostly restored with native vegetation.

REMOVAL OF NON-NATIVE PLANTS

A revegetation program was developed under the guidance of Russ Lewis, BLM ecologist who authored

the BLM Piedras Blancas Vegetative Management Plan. Russ created a map that identified zones where the native plants predominated, and where iceplant predominated. Advice was sought from members of

the local community who had experience in removing iceplant at other locations. The consensus was to begin eradication in areas where native plants were still growing.

One purpose of the Piedras Blancas vegetative management program is to promote the permanent reestablishment of native plants once found at Piedras Blancas Light Station. The intent is not to become a regimented botanical garden or a demonstration garden. The rational objective is the reestablishment of a native ecosystem, one that was present prior to the arrival of the Europeans.

Several eradication techniques were considered. Small test areas were covered with a plastic barrier for an extended time to smother the iceplant, but this proved to be inefficient and the dead iceplant still had to be pulled out by hand. Removal of iceplant with hand tools was found to be the most effective technique in areas where there were native plants present.

In 2002 a small group of volunteers started hand pulling iceplant, New Zealand spinach, and cut-leaf plantain. The work was labor-intensive; however, the beauty of the light station setting made it possible to attract dedicated volunteers. The first zone to be cleared of iceplant was at the western tip of the point, where several seaside poppy plants (*Eschscholzia californica* var. *maritima*) were struggling to grow within the iceplant. A few days after iceplant had been removed, one of the poppy plants was in bloom. We were inspired!

The BLM volunteer list grew to include over 40 individuals who worked hard, motivated by the fantastic progress we were making. Organized community groups also assisted, including members of the local California Native Plant Society and Sierra Club, ecology students from Cuesta College, and many other organizations. Work crews provided by the California State Di-

vision of Forestry cleared several large areas of iceplant that had encroached on the parking lot and other adjacent developed areas.

Basically, the work was a huge, long-term weeding job, with the definition of a “weed” being any non-native plant species. The initial areas cleared were scattered around the site, depending on where the greatest concentrations of native plants were trying to survive in competition with the iceplant. Slowly these areas merged, resulting in contiguous zones where native plants thrived.

Iceplant is very heavy due to its high water content. At first volunteers loaded it into wheelbarrows and moved it to a large pile to be removed from the site. Soon we learned it was less effort to create smaller piles near the areas where we were working and allow the iceplant to dry out before carting it in wheelbarrows to a centralized large pile (which we affectionately referred to as the “mother pile”).

Iceplant does not compost well since it is a succulent and has a high water content. It dries out slowly after being pulled, and lessens in volume and weight, but it is tenacious, frequently resprouting within the pile. Also, the duff (accumulation of dead dried pieces underneath the green growing plant) does not break down quickly. It was found that duff accumulations of only one-half inch prevented growth of natives, and in some places there was over 12" of duff, so it was necessary to remove it all, or leave only a very thin layer.

Where there were existing native plants, non-native plants were pulled by hand, being careful not to disturb the ground. A scraisping tool called a hula hoe (or stirrup hoe) was used in some areas where archeological artifacts might be present, because it does not penetrate the substrate. In areas where there was a solid monoculture of iceplant growing in dense accumu-

SUCCESS STORY: COMPACT COBWEBBY THISTLE

One of the native plant successes at Piedras Blancas Light Station involves a native plant species, compact cobwebby thistle (*Cirsium occidentale* var. *compactum*), a CNPS List 1B.2 species (Rare, threatened, or endangered in California and elsewhere; fairly threatened in California). When the BLM took over management of Piedras Blancas in 2001, its botanist only found one individual specimen of this special status species growing on site. However, it became one of the first native plants to return to an area cleared of invasive non-native plants.

This thistle species is now reproducing abundantly and thrives in cleared areas. In the spring of 2004 there were approximately 230 compact cobwebby thistle plants counted; in the spring of both 2005 and 2006 there were approximately 480 counted. In the spring of 2010 there were about 1,200 seedlings. Due to competition and predation by various rodents, their numbers are significantly reduced later in the season. This thistle species is now reproducing freely and thriving in many cleared areas. Compact cobwebby thistle seeds were evidently present on the site, in dormancy, beneath the iceplant and heavy duff. (Wind dispersal of its seeds is also occurring.) Observing



the success of this plant continues to be a great motivation for our volunteers.



Compact cobwebby thistle (*Cirsium occidentale* var. *compactum*), a rare endemic plant. In 2001 only one known specimen was found at Piedras Blancas. Thanks to restoration efforts, today it is reproducing freely.

lations, and where no native plants were present, the herbicide glyphosate was used to kill the iceplant and allow it to dessicate before removal. A front-end loader was used to pick up the dead iceplant, taking care to disturb the soil as little as possible.

The methods for disposing of non-native plants other than iceplant varied. Plants in bloom, or those producing seeds, were bagged and disposed of to prevent seed dispersion. Some non-native plants that were pulled before they posed a risk

of reproducing were left to decompose, unless they were at risk of rerooting. A weeding guide was prepared for use by the volunteers that listed each non-native plant and provided photographs, characteristics, and tips for removal. Work occurred under the supervision of a project leader.

Erosion was a concern, because when volunteers cleared areas, this exposed the sandy soil to high winds. For this reason, the clearing of iceplant was first performed in small increments and carefully monitored



Rocky knoll in 2002 (top) and then in 2006 (bottom).

for wind erosion. Further monitoring of the restoration area has shown that wind erosion has been minimal due to the rapid onset of native plants to form a ground cover.

REVEGETATION

Native plant restoration at Piedras Blancas is a two-part process: removal of non-native plants and the encouragement of successive native revegetation. Nature is allowed to take its course through passive revegetation, whereby native plants sprout and spread on their own. The process of native plant recovery is enhanced by seeding, using seeds collected on site. In some areas native plants have been transplanted. The majority of the

native plants sprouted from seeds that were buried under the iceplant, and were waiting for an opportunity to grow. Some seeds were undoubtedly blown in by wind or transported by wildlife or humans. Others were collected and simply scattered on the surface after the first rainfall of the season. A benefit of sowing seeds by hand is that there is no preparatory disturbance to the soil. Transplants used were moved from previously cleared areas where native plants were found germinating in profusion.

During the initial stages of the revegetation planning process, a search of the literature and an inventory of the coastal headlands nearest the lighthouse was undertaken by BLM personnel and volun-

teers. The search was conducted outward along the coastal terrace, ranging from three miles northward to Point Sierra Nevada and about five miles southward to San Simeon Point. A small pristine area north of the light station was discovered with a diverse variety of native plants. Seeds collected were later sown in rehabilitated areas at the light station. In some cases, seeds were germinated in planters in a small temporary nursery at the light station, and used only during the first season of plant restoration. Later, volunteers planted the seedlings in the areas being rehabilitated, taking care to reintroduce them in the same habitat in which they evolved.

Traditional gardening methods are never used in our revegetation

NATIVE PLANTS OF THE PIEDRAS BLANCAS

The predominant native plants found at Piedras Blancas include the following:

seaside woolly yarrow (*Eriophyllum staechadifolium*)
 seaside daisy (*Erigeron glaucus*)
 cotton-batting plant (*Gnaphalium stramineum*)
 hedge-nettle (*Stachys bullata*)
 coast morning glory (*Calystegia macrostegia* ssp. *cyclostegia*)

Also found in good numbers are:

common (white) yarrow (*Achillea millefolium*)
 locoweed (*Astragalus nuttallii* var. *nuttallii*)
 prostrate deerweed (*Lotus heermannii* var. *orbicularis*)
 coastal bush (tree) lupine (*Lupinus arboreus*)
 beach evening primrose (*Camissonia cheiranthifolia*)
 California poppy/seaside poppy (*Eschscholzia californica* var. *maritima*)
 Pacific seaside plantain (*Plantago maritima*)
 sea pink/thrift (*Armeria maritima*)
 salt grass (*Distichlis spicata*)
 California buttercup (*Ranunculus californicus* var. *cuneatus*)
 white ('Douglas') nightshade (*Solanum douglasii*)
 man-root/wild cucumber (*Marah fabaceus*)
 coast dudleya/sand lettuce (*Dudleya caespitosa*)

A complete listing of all native plants found at Piedras Blancas Light Station is posted at www.piedrasblancas.gov.

Four of the native plants that have made a comeback at Piedras Blancas include (front to back): California poppy/seaside poppy, cotton-batting plant, dudleya, and seaside daisy.



work. We do not feed, prune, or remove dead plant material from native plant areas.

Dead native plant material is allowed to decompose on site. We do not water, except temporarily as a measure to help transplants become successfully established.

The results of the revegetation effort were staggering. Native plants quickly filled cleared areas within one rainy season. Over 60 native plant species have subsequently been identified at Piedras Blancas Light Station. Most of them were barely surviving near the encroaching iceplant or they persisted in limited pockets on the site. Detailed records for the revegetation project have been compiled and are kept at the light station by Carole Adams, project leader. A complete survey is performed once a year during the spring.

MAINTENANCE

The success of the native plant revegetation project at Piedras Blancas is in large part due to the efforts of detail volunteer hand weeders. To only remove the iceplant and other non-native plants in one sweep is not enough. There must be continual follow-up weeding or non-natives will quickly recolonize.

Surprisingly, despite its dominance, iceplant has not been the worst offender in terms of its persistence. Although we do need to keep a watchful eye out for iceplant seedlings, oxalis, cut-leaf plantain, New Zealand spinach, and scarlet pimpernel (*Anagallis arvensis*) are some of the non-native species that threaten to recolonize large areas in rapid order. Non-native vegetation produces large quantities of viable seed, which are capable of germinating many years later if favorable conditions exist. Seeds that remain in the soil for long periods of time are referred to as a seed bank. One goal is to eliminate non-native seedlings through continued site monitoring.

Another is to diminish and totally deplete the non-native seed bank. This effort will take time and perseverance.

SUMMARY OF PROGRESS

Most of the iceplant present when the BLM took over management of the Piedras Blancas Light Station in 2002 has now been eradicated. Beginning with manual removal, and later utilizing chemical and mechanical methods, areas with dense monocultures of iceplant were treated first. Later, those areas containing both iceplant and native plants were successfully treated. As of July 2010, over 25,000 volunteer hours have been logged in the revegetation effort.

The site is now a testimony to the power of nature to heal itself, given assistance by scores of dedicated volunteers. We have also observed an increase in the number of native animal species inhabiting the site.

LESSONS LEARNED

In the past eight years, dedicated volunteers using hand tools and other means of removal have endured to eliminate 90% of the iceplant and other non-native plants growing at Piedras Blancas. What was once a matted spongy monoculture of iceplant now supports a diverse assemblage of native plants. Hard work, dedication, and persistence has been the key to achieving this long-range goal. Critical to the success of the program was teamwork and positive energy.

Sometimes it takes a herculean task to reverse unintended mistakes from an earlier time. The surrounding Piedras Blancas terrace is now taking on the appearance of a native ecosystem. This project has been a rewarding learning experience for



Coastal bush lupine (*Lupinus arboreus*) now thrives at Piedras Blancas Light Station.

all the individuals involved, who have shown incredible dedication in helping restore the native flora of what is officially—and now more appropriately—called the Piedras Blancas Light Station Outstanding Natural Area.

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CONSERVATION AND COMMUNITY AMONG THE SANTA ROSA PLAIN VERNAL POOLS

by Michelle Jensen and Nancy C. Emery

Nestled within the rolling grasslands of the Santa Rosa Plain in Sonoma County are shallow topographic depressions where water, soil, and sunshine mingle. Each year the sprinkling of seasonal precipitation over a landscape lined with a soil hardpan cause vernal pool wetlands to swell, triggering a remarkable cascade of biological events.

In response to the onset of rain in the late fall, terrestrial plant species begin to germinate while salamanders, copepods (a group of small crustaceans), and fairy shrimp wake

from their hot weather dormancy among the loamy soils. Months later, as the days warm signaling the onset of spring, rapidly unfurling floral displays entice native solitary bees and pollinators to produce future generations before the water table recedes and the summer sun laps the last few molecules of standing water into the sky.

Ephemeral vernal pool wetlands are rare in the state of California and the Santa Rosa Plain is one of the few coastal regions containing relicts of this biodiverse ecosystem. It is theorized that northern hardpan pools on the Plain were developed through the scouring activity of creeks and rivers. This action shaped the hummocky (ridge-like) uplands of Wright clay loam that encircle shallow depressions, or meander scars (abandoned portions of a channel) where vernal pools are commonly found (Norwick 1991).

The pools are botanically intriguing in that they represent a diverse oasis of native annuals that are adapted to the harsh fluctuations of full inundation in winter and complete aridity in summer. Species found amidst these “islands among the grasses” include downingia (*Downingia concolor*), smooth or rayless goldfields (*Lasthenia glaberrima*), California semaphore grass (*Pleuropogon californicus*), Douglas’s beardstyle (*Pogogyne douglasii*), and the delicate Lobb’s aquatic buttercup (*Ranunculus lobbii*).

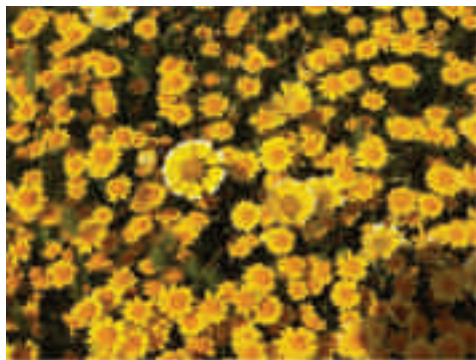
The pools may also contain three endangered plant species that are largely endemic to Sonoma County:

Burke’s goldfields (*Lasthenia burkei*), Sebastopol meadowfoam (*Limnanthes vinculans*), and Sonoma sunshine (*Blennosperma bakeri*), all CNPS List 1B.1 species. All three have been substantially impacted through a history of pressures from development and land conversion, and have spurred an intensive conservation movement to preserve the few populations that remain today (e.g., see CH2M Hill 1995). Considering that California has now lost up to 95% of its vernal pool habitat (Holland 1978; Holland 1998), each remnant of this unique ecosystem represents a last-standing refuge for many endemic and endangered species.

HISTORY ON THE PLAIN

Between 1970 and 1990 Sonoma County experienced a major population boom, resulting in an escalation of urban development that encroached onto the Plain and into vernal pool habitat. During this period, species of concern became protected under Federal and State Endangered Species Acts, triggering the implementation of mitigation projects as a means to address the loss of wetland habitat.

Mitigation on the Plain primarily involved the creation of artificial vernal pool habitat at alternative sites using heavy equipment to contour the soils. Seed (or scraped soils containing seeds) from destroyed or donor pools was then used to “inoculate” the created pools. Oftentimes seed was transported in larger quantities, at greater distances,



ABOVE LEFT: One of the most vibrant of endangered vernal pool species on the Santa Rosa Plain, Burke’s goldfields (*Lasthenia burkei*) has experienced a decline in population size over the last 25 years. Photograph by D. Ackerly. • LEFT: Sebastopol meadowfoam (*Limnanthes vinculans*), another species endemic to the Plain, is also threatened by development. Photograph by M. Jensen.



Created vernal pool in winter on mitigation property in Sonoma County with a staff gauge for monitoring pool hydrology in the center. Large Valley oak trees (*Quercus lobata*), as seen in the background, are often found scattered among the wet meadows of the Plain. Photograph by M. Jensen.

and deposited in ways that did not reflect natural patterns of seed dispersal. Furthermore, seeds were often sown haphazardly across pools, without regard to subtle differences in elevation (microtopography). This can have dramatic influences on plant germination and survival, as small changes in elevation within pools is often associated with vastly different hydrological conditions, soil types, and plant community composition.

Regardless of the onset of mitigation practices and their intention to reduce impacts to endangered species, incessant pressures from urban encroachment and land use on the Plain continued well into the new millennium. Recognition that these demands needed to be addressed resulted in a collaboration of stakeholders who developed the Santa Rosa Plain Conservation Strategy in 2005 (Goude et al. 2005). Instead of dealing with land conversion on a project-by-project basis, this guid-

ing document advocated setting aside *contiguous* conservation areas associated with projected urban growth boundaries. However, at the time of its inception, many natural vernal pools remained scattered on private lands and beyond the jurisdiction of the Strategy.

WHERE ARE WE NOW?

When a vernal pool specialist is asked about the state of the pools on the Plain, they most often reply with concern. The role and “success” of mitigation in the conservation of endangered plant species is contentious, and we still don’t understand how past seed translocation activities are affecting these populations. Despite strong opposition from CNPS (Hubbart et al. 2001) and various conservation scientists (Elam 1998; Howald 1996), seed translocation practices are still utilized to this day.

Unfortunately, a majority of the

remaining vernal pools on the Plain are heavily degraded or unmanaged, leaving populations vulnerable to changes in environmental or land-use conditions. Properly managing these landscapes can be an expensive and daunting task, demanding a fundamental understanding of the complexities associated with vernal pool systems and their annual fluctuations.

Presently we are at a point where development and land conversion has temporarily declined in the region, thereby giving pause for stakeholders to engage in the acquisition, management, and conservation of the remaining vernal pools. We can also reflect upon what we have learned over the last 25 years, considering our past mistakes and achievements in preparation for the next set of challenges.

Instead of approaching the circumstances on the Plain with reservation, we can reevaluate our position and recognize the Plain as a



Volunteers learning to identify Sebastopol meadowfoam, one of the three endangered species monitored annually through the Adopt a Vernal Pool citizen science program. Photograph by H. Brown.

case study of mitigation. Adopting this perspective opens up many opportunities for local botanists, ecologists, naturalists, and students, as well as land managers and policy-makers, to explore a system that has been tampered with yet still requires active long-term management. Given that population growth in California is inevitable, we must learn how to best conserve and manage our treasured flora, regardless of site history.

RESEARCH ACTIVITIES

A growing awareness of the uncertain future facing vernal pools throughout California has led to a recent surge of research activity on the endangered plant species found on the Santa Rosa Plain. Armed with contemporary scientific techniques that are increasingly accessible, local researchers are exploring the conservation ecology, evolution, and genetics of vernal pool plant species. The list of research possibilities seems endless, covering everything from grazing regimes to the effects of hydrologic connectivity between neighboring pools and

swales on seed dispersal. Some of the current research projects related to vernal pools that are taking place on the Plain include:

- comparisons of local pollinator communities observed in created and natural pools (Kandis Gilmore, Sonoma State University);
- genetic diversity and structure across endangered plant species' ranges, as well as within individual pools (Dr. Christina Sloop, San Francisco Bay Joint Venture; Michelle Jensen and Dr. Nancy C. Emery, Purdue University; see Ayres and Sloop 2008);
- the effects of soil compaction on plant growth and morphology (Michelle Jensen and Dr. Nancy C. Emery, Purdue University); and
- vernal pool seed bank dynamics (Hattie Brown, Laguna de Santa Rosa Foundation; and Dr. Christina Sloop, San Francisco Bay Joint Venture).

It is the goal of many of these research projects to establish an up-to-date baseline dataset that will enhance our knowledge of vernal pool species to assist conservation efforts.

BECOMING INVOLVED

There are now many opportunities for members of the public to participate in research activities on the Plain. One is the Adopt a Vernal Pool (AVP) citizen science monitoring program, which was initiated in 2007 through the collaborative efforts of the California Native Plant Society's Milo Baker Chapter and the Laguna de Santa Rosa Foundation. The AVP program currently consists of over 50 volunteers that annually monitor endangered vernal pool plant populations across the Plain. Standardized data collections are annually compiled in a publicly accessible database available at www.citizen-science.org.

In the last three years, AVP volunteers have increased our understanding of vernal pool dynamics and have brought attention to a recent threat of invasive plant species infiltrating vernal pool habitat, including the notorious pennyroyal mint (*Mentha pulegium*). Through these observations, land managers have been alerted and are beginning to coordinate their efforts to eradicate this threat before it takes root.

This exemplary program has engaged public participants from all backgrounds. With direction from AVP, they have been able to develop a connection with the pools they watch over, increasing their knowledge of the flora and scientific data collection methods, while becoming part of a growing local conservation community.

FUTURE PROSPECTS

As stewards of the landscape, we must adapt to new challenges, much like the plant species occupying these unusual ephemeral wetlands. Tomorrow may bring new, unanticipated biological threats, and changes in weather patterns or political climates. Attempting to conserve the remnant pools on the Santa Rosa Plain—no matter how de-

graded they may be—is a daunting task. The contributions of everyone, from academics to backyard naturalists, are essential for improving our research and management efforts. Searching for clues among our past activities on the Plain will assist policymakers, landowners, and managers statewide to make better-informed decisions about how best to conserve our valued vernal pool habitat. By looking back on the Plain through the lens of collaborative understanding, we can begin to move forward.

ACKNOWLEDGMENTS

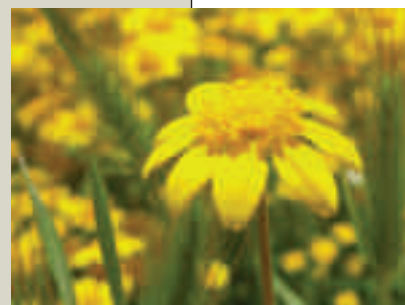
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ENDANGERED PLANT SPECIES OF THE SANTA ROSA PLAIN

- **Burke's goldfields** (*Lasthenia burkei*) (RIGHT) *L. burkei* may possibly be the most threatened of the three endangered plant species found on the Plain. A member of the sunflower family (Asteraceae), *L. burkei* is noted for its golden composite inflorescence made up of both ray and disk flowers. Photograph by D. Ackerly.
- **Sebastopol meadowfoam** (*Limnanthes vinculans*) (MIDDLE) *L. vinculans* was originally discovered and described by Robert Ornduff in 1969. There are approximately 30 known populations found in a variety of wet meadows, swales, and vernal pools. The seeds of meadowfoam plants are called nutlets and have identifying ridges, or tubercles, on the seed coat. Some speculate that these ridges may assist seed dispersal by increasing seed buoyancy. Photograph by M. Jensen.
- **Sonoma sunshine** (*Blennosperma bakeri*) (BOTTOM) Also known as Baker's stickyseed, *B. bakeri* is an early bloomer on the Plain with flowers signaling the approach of spring in early March. This lovely species is found only within Sonoma County. The specific epithet of the scientific name, *bakeri*, refers to the historic botanist for whom the local CNPS chapter is named: Milo Baker. Photograph by K. Gilmore.



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Typical habitat of *E. sparsiflorum* in Kings Canyon. All photographs by S.J. De Groot.

WALKING IN ALICE EASTWOOD'S FOOTSTEPS: *ERIASTRUM SPARSIFLORUM* IN KINGS CANYON

by Sarah J. De Groot

It must have been an amazing trip. In July 1899, Alice Eastwood, a botanist and curator of the herbarium of the California Academy of Sciences (CAS) in San Francisco, traveled with three companions into the Sierra Nevada. As Eastwood tells it, “We were twelve days (July 2-14) in the region, and traveled on foot from Millwood to the headwaters of Bubbs Creek, ascending both branches, the one leading to East Lake and Harrisons Pass, the other to Bullfrog Lake and Kearsarge Pass. We ascended what is known as Mt. Stanford, but no other peak as the

time was too limited” (Eastwood 1902b).

Millwood was located a few miles west of the present site of the Grant Grove visitor center in Kings Canyon National Park (Durham 1998). From there, the party probably followed a trail past Lookout Peak, which reached the south fork of the Kings River at Cedar Grove. Although this was the route generally taken through the area (LeConte 1893-6), Eastwood’s exact route is unknown, since her field notebooks were lost in the San Francisco fire of 1906 (R. Wenk, California Acad-

emy of Sciences, personal communication, July 22, 2009), and in publication Eastwood gave only the general account of the route as quoted above.

Somewhere along the way, Eastwood collected a few specimens of a new species of *Gilia*. She described this plant three years later as *Gilia sparsiflora*, noting that it “belongs to the same group as *G. virgata* Steud” (Eastwood 1902a). Today both of these species are recognized within the genus *Eriastrum* (woolly-star, in the Phlox family, Polemoniaceae), and *Gilia sparsiflora* is now called

Eriastrum sparsiflorum (few-flowered woolly-star). Eastwood specified a general locality where she collected plants of this species: “Collected by the author in Kings River Cañon, in July, 1899; and also along Bubbs Creek trail” (Eastwood 1902a).

I came across this species while working to revise the classification of the genus *Eriastrum*, with the aim of providing an easier means to identify each species. Already I had seen a number of other *Eriastrum* species in the field, and had a good idea of their preferred habitat. *Eriastrum sparsiflorum* in Kings Canyon was of particular interest for two reasons: 1) the species was described from specimens collected in Kings Canyon—making Kings Canyon plants the standard by which the species, *E. sparsiflorum*, is defined; and 2) most plants of *E. sparsiflorum* occur east of the Sierra crest, while Kings Canyon is on the west slope. Given the height of the Sierra Nevada and the barrier this could pose to plant pollinators or seed dispersal, I wanted to see plants on both sides of the mountains to ensure that they did indeed belong to the same species.

Using Eastwood’s publications, label data, probable route, and the 1905 USGS Tehipite 30' quadrangle (see below), the likely place where *Eriastrum sparsiflorum* was first collected can be narrowed down to about 11 miles along the Kings River and Bubbs Creek. This seems a bit imprecise for anyone wishing to relocate the plant, given that *E. sparsiflorum* is a small annual plant with small white flowers—certainly easy to overlook and walk past. Could

additional specimens of this species from Kings Canyon offer more precise location information?

One problem with using other specimens was that there was only one other collection besides Eastwood’s. John Thomas Howell, another botanist at CAS, made a collection of *Eriastrum sparsiflorum* on the 10th of August, 1940. He narrowed the location down better than Eastwood had: “Mouth of Bubbs Creek to Zumwalt Meadows, Canyon of S. Fk. of Kings River, Fresno, Co.” (Howell field notebook, R. Wenk, CAS, personal communication, 21 July 2009). This covers a distance of just over two miles along the south fork of the Kings River. Howell’s location seemed precise enough that it appeared it would be fairly easy to relocate the plants by searching the area between Bubbs Creek and Zumwalt Meadow.

For many botanists, particularly those concerned with conservation of rare plants, the lure of rediscovering a plant that has not been seen for a long time is strong. It is exciting when a plant that is presumed extinct (e.g., any plant on CNPS List 1A) or thought to be extirpated in an area is found again. While the species *E. sparsiflorum* was alive and well east of the Sierra Nevada, it had not been seen for 70 years in Kings Canyon. Was it extirpated, or just not documented because no one had bothered to look for it? I had to find out.

My first attempt was near the end of July 2006. It was a little late in the season, but dried *Eriastrum* plants sometimes persist for a few

months after going to seed, and I thought at the very least I might find a site to return to the next year. Upon arrival in Kings Canyon, I headed straight for the high country along the Bubbs Creek foot trail—Eastwood said she found the plant along Bubbs Creek, so I headed a half-day’s walk up the Bubbs Creek trail in search of it. Although the habitat looked promising in some areas, I did not see any sign of *Eriastrum*.

In 2008, I decided that the flat, sandy benches along the Kings River had better habitat and therefore were more likely areas to find *Eriastrum*. Incidentally, this was also a bit earlier in the season, at the beginning of July, and I had a volunteer field assistant along, thinking that an extra set of eyes could help to spot the plants. Although we spent the day combing the flat areas between Road’s End and Bubbs Creek on the north side of the river, we did not see any *Eriastrum*.

Looking at a map, a search of just two miles along the Kings River appeared to be a fairly quick and easy task. But when you get into the field and start walking, you realize that those two miles are pretty wide in places, and you have to make a lot of zigzags to comb through all of it for a population of annual plants that may be no larger than a dining room table. So in 2009, with the enthusiastic help of the park plant ecologist, Sylvia Haultain, I spent a day combing the area from Zumwalt Meadow to Bubbs Creek, on both sides of the river, accompanied by 8 other botanists and plant enthusi-

Tehipite 30' quadrangle, as reprinted in 1924. The area along the Kings River between Zumwalt Meadow (marked with an asterisk) and the confluence with Bubbs Creek was searched in 2006, 2008, and 2009. In 2010 the search began farther downstream at Cedar Grove and headed east. Map courtesy of U.S. Geological Survey.



asts—18 eyes looking for the elusive annual. We hunted nearly every possible spot where *Eriastrum sparsiflorum* was likely to grow, but did not find a single plant.

At that point, I wasn't quite sure where to look next. It seemed that all the likely areas had been searched, without success. And after all, it had been 70 years since Howell's collection. Maybe *Eriastrum sparsiflorum* just didn't exist in Kings Canyon anymore.

EASTWOOD'S FOOTSTEPS?

A road trip in late June 2010 took me right past Kings Canyon, so I thought I'd take one more look since I was in the area anyway. First, though, I studied the 1905 Tehipite 30' quadrangle (see p. 45). It was surveyed in 1903, so I guessed that the trails shown on the map were probably the same or very similar to the ones on which Eastwood traveled in 1899. While there were trails on both sides of the Kings River between Cedar Grove and Bubbs Creek, only the one on the north side is continuous. So assuming Eastwood and her companions reached the south fork of the Kings River at Cedar Grove, they may have crossed there to the north side, then crossed back to the south side at the mouth of Bubbs Creek. Since she also had said that time was limited (Eastwood 1902b), I guessed she probably had not wandered far from the trail. I found the pack trail at Cedar Grove and started up the canyon on the north side of the river, figuring I would follow Eastwood's most likely route and try to see what she saw.

And there they were. Right along Cedar Trail between Cedar Grove and Roaring River, there were those elusive little white-flowered annuals. Although the flowers were just starting to open, the cottony wool on the bracts and calyces told me it was certainly *E. sparsiflorum*. The habitat looked virtually identical to the habitat of areas farther upstream

that I had searched previously. Why here, now, and not there, then? I have no idea.

The plants were so dense in places that I had to be very careful where I walked, for fear of stepping on them. There were about 600 plants up at this site in 2010. This number almost certainly fluctuates from year to year, depending on the amount of winter precipitation. They appeared to be doing fairly well, even though the extent of the population was not particularly large.

It was 70 years since Howell's collection, and apparently 70 years since it was last seen, but *Eriastrum sparsiflorum* still grows in Kings Canyon—a good reminder that *the absence of evidence is not evidence of absence*. Just because a particular species is not seen in an area for some time does not mean that it no longer grows there. The site seen in 2010 was just east of Cedar Grove,

BELOW TOP: Few-flowered woolly-star (*E. sparsiflorum*). Close-up shows the unique woolly hairs on the calyx and bracts. The scale bar provides an indication of how small the flowers are. BELOW BOTTOM: Photo shows the plant's usual branching pattern.



but there is plenty of similar habitat along the Kings River between there and Bubbs Creek. It is possible that additional populations of *Eriastrum* are hiding in other places in the canyon, or even along Bubbs Creek, but just have not been seen recently.

So if your travels take you to Kings Canyon, keep an eye out for a little annual plant, 4-12 inches tall, with small white 5-petaled flowers in narrow heads and, most importantly, cottony wool on the calyx and bracts.

ACKNOWLEDGMENTS

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A colorful planting of hybrid monkey flowers (*Mimulus*) gives visitors ideas for their home habitat gardens. All photographs by Lloyd Chasey unless otherwise noted.

MARTHA WALKER CALIFORNIA NATIVE HABITAT GARDEN: CELEBRATING 25 YEARS

by Kathleen Chasey and Leah Hawks

The Martha Walker California Native Habitat Garden encompasses a three-acre oasis within Napa's Skyline Wilderness Park, a 900-acre preserve with hilly woodlands and chaparral, including trails, camping, disc golf, archery, a lake, and a diversity of flora and fauna.

In the late 1970s when Napa State Hospital made this land available to potential developers, interested citizens rallied to save the valu-

able oak woodlands, hillside chaparral, and riparian corridors and created Skyline Wilderness Park. A three-acre portion—formerly the State Hospital's dump—would ultimately become the home of Napa's only public native plant garden.

THE INGOLS' VISION

In 1968 Ralph Ingols and his wife Evelyne became members of the California Native Plant Society,

and began using their backyard to propagate native perennials for CNPS plant sales. This is where they and friends first discussed the idea of a public native plant garden where visitors could learn about and enjoy California's flora in protected and easy-to-access surroundings.

The Ingols spent many years traveling throughout California, studying and collecting its native flora and gaining valuable knowledge and background in plant iden-



With the aid of hand lenses, CNPS docent Loretta Radey teaches visiting school children about the wonders of coral bells (*Heuchera* spp.) and why they attract hummingbirds. The garden's founders wanted the garden to be used as an outdoor science classroom, and the community-funded CNPS docent program continues that legacy.

tification and propagation. By 1985, and with the help of conservationist friends, CNPS, and the Skyline Citizens Association, Ralph and Evelyn

CNPS Docent Chairman Kent Rupert shares interesting bird facts with visiting school children in the garden's central gazebo, which is shaded by native vines, including wild grape (*Vitis californica*) and Chaparral clematis (*Clematis lasiantha*).

founded the Martha Walker Native Habitat Garden on Skyline Park land, and became its first curators.

The garden was named in memory of Martha Walker, a Napa gardening icon who wrote a weekly column "Let's Go into the Garden," which ran for 35 years in the *Napa Register*. She shared her knowledge of plants on local radio station KVON, and taught a gardening class at Napa Valley College, "Adventures in Gardening." She also helped found the Napa Valley Chapter of the CNPS and was involved with other conservationist groups. Martha passed away in 1983.

The Ingols were the driving force behind the success of the garden in its beginning years. After Evelyn's death in 2000, Ralph continued as curator emeritus. Terry Chappell fol-

lowed the Ingols as curator for nine years and retired in 2009. Current curator Kathleen Chasey oversees care of the garden along with a group of hard-working volunteers, as well as the garden's steering committee and the board of the Napa Valley Chapter.

The initial garden site has been described as a "ravine," which made it an ideal spot for the hospital dump, as it was close to the main road. Because of this proximity, it was also ideal to develop later on as a garden. The Ingols and other native plant enthusiasts combined their efforts to maintain the new native plant garden site. Community volunteers, including those who came to camp at the Park, took an active part in the maintenance process.

Since the garden area was once

the Napa State Hospital's dump, much work had to be done to transform this unlikely site into the beautiful grounds it could become. There were numerous challenges. Cows, deer, and jack rabbits grazed the plants. Well water availability was inconsistent, and thirsty stands of redwood saplings (*Sequoia sempervirens*) and spicebush (*Calycanthus occidentalis*) suffered. Soil consisted of clay, rock, and hospital trash.

The initial trails were cut and graveled. Huge spray heads were plumbed and a spring diverted to create a meandering creek. Cows and deer were kept out with a new fence and the garden expanded to include an adjacent man-made pond where wood ducks raise their young each spring and kingfishers hunt the chorus of frogs.

EDUCATION AND AWARENESS

As with Martha Walker's own mission, the mission of the Martha Walker California Native Habitat Garden is to increase public understanding and appreciation of Cali-

fornia native plants in their environment, and to recognize the mutually beneficial association of plants with animals and people.

Both Ralph and Evelynne had been career educators, so it was important to them that the garden be used as an outdoor classroom. This legacy continues as a top priority of the Napa Valley Chapter of CNPS. In 2010 the chapter set as new goals to double the number of youth groups that participate in nature-related activities in the garden, and to increase the general public's awareness of the garden and its value as a teaching tool. Each season now, CNPS volunteers teach native plant identification, propagation, and gardening. They lead tours during the wilderness park's special event days as well as during the Chapter's plant sales and Spring Wildflower Show.

Today 400 students visit the garden annually during class trips and scout outings. Hundreds more explore the garden with friends and family on day trips and while camping nearby. One of the most rewarding programs is the CNPS Natural Science Docent Program, an all-volunteer, community-funded organi-

zation that provides science and cultural enrichment to Napa County school children. The program offers activities to explore the mysteries of native plants, birds, beneficial insects, and other critters with binoculars and hand lenses. Docents teach native plant identification and use, and demonstrate tools and artifacts, giving children a glimpse into the lifestyle of Napa Valley's native peoples. Children handle, smell, and learn how to use the plants that sustained Napa County's original residents for thousands of years.

When it became obvious that birds, butterflies, and beneficial insects were becoming more plentiful in the garden, we realized that it was turning into a successful habitat garden. Birdbaths with dripping water were soon added, and the bird population expanded considerably to 130 species.

Beautiful pipevine swallowtail butterflies laid their eggs on Dutchman's pipe/California pipevine (*Aristolochia californica*), and in short order a host of pollinators moved in.

Today the garden includes both young and mature native plants in five plant communities, including oak woodland, mixed evergreen forest, chaparral, redwood, and riparian. Volunteers planted hundreds of trees and shrubs representing the key species of each of these plant communities. These specimens produce the seed, blooms, pollen, and overall environment necessary to support the many species of wildlife that make their homes in the garden.

One of the garden's showiest natives is a massive fuchsia-flowered gooseberry (*Ribes speciosum*) covered with thousands of dangling blossoms and the many Anna's Hummingbirds that feed on it. Another is the western redbud (*Cercis occidentalis*), a tree-size specimen. Matilija poppies (*Romneya coulteri*) and bush anemone (*Carpenteria californica*) are covered with blooms in late

Equipped with new knowledge on local bird species, children enter the garden with binoculars to see what they can identify.





This heritage valley oak (*Quercus lobata*) is the signature oak of the garden, which includes young and mature native plants in five different plant communities.

spring. Invariably, visitors ask what these flowering plants are and about the possibility of obtaining such natives for themselves. Fortunately the signage below these plants gives the novice important plant identification information.

One section is now The Children's Garden, and includes child-size tables and benches, and other inviting features, so that even the smallest children can be introduced to the natural world. Recently a work group from a local winery built a teepee-shaped trellis for native California pipevine (*Aristolochia californica*) and added stepping stones throughout the Children's

Garden to invite further exploration through the giant sequoias.

While today the garden is truly an example of biodiversity, this has also been one of the challenges in maintaining it. With the exuberance of planting trees and large shrubs comes crowding, low air circulation, occasional limb die-off, and sometimes disease. After 25 years of growth, the amount of light penetrating the understory is limited, so it is up to the horticultural expertise of the garden's steering committee to come up with possible solutions.

Funds to maintain the garden come from donations, grants, occasional fundraising efforts, and the proceeds from the Chapter's spring and fall plant

sales. In addition, Ralph Ingols continues to donate to the garden the proceeds from books he's authored in the last decade.

CURATORS & COMMUNITY VOLUNTEERS

The effort of the community has been invaluable in the success of the garden. Community volunteers—including individuals, groups, clubs, and local businesses—have worked tirelessly to maintain the garden by weeding, trimming, planting, mulching, and filling nectar and seed feeders for the birds. Local businesses and wineries have begun choosing the Martha Walker Garden as a place where their employees can volunteer. Business colleagues gather there equipped with gloves, tools, and wheelbarrows, and work together while learning about the garden's history, diversity, and the value that California native plants contribute to the environment. For many, it is a welcome introduction to conservation and the natural sciences.

Numerous Boy Scout Eagle candidates have also donated time and energy to enhance the garden with such improvements as plant signs, bird baths and feeders, and a gazebo. Last fall three young adults—

Ralph Ingols in fall 2010 at the dedication of a new gate at the entrance to the Martha Walker Garden. In 1985 he and his wife Evelynne helped to found Napa County's only public native plant garden. Photograph by C. Belluomini.



Jackson Downing, Ryan Marquette, and Brian Mattis—transformed a sunny quarter-acre weed patch into a bunchgrass and wildflower meadow, complete with dry creek bed, wooden bridges, and bird-houses.

Foundation grasses in the meadow now include deergrass (*Muhlenbergia rigens*) and fescue (*Festuca idahoensis*). Jackrabbits and deer sometimes nibble the new blooms of the wildflowers, but the first spring display is still colorful with blue-eyed grass (*Sisyrinchium bellum*) contrasting with the ever faithful California poppy (*Eschscholzia californica*).

Recently the local Napa-Solano Audubon Chapter, with funding from Toyota's "Together Green" campaign, sponsored the planting of a new demonstration garden of native plants favored by birds and butterflies. A variety of nectar, pollen, berry, and seed-producing specimens were planted and labeled, indicating the specific wildlife they attract. A month later in celebration of Earth Day, the Audubon Chapter returned to the garden with another 30-plus volunteers, most new to gardening with California natives. They helped to install a 90-foot hedgerow for habitat along the garden's northern fence line, while learning about the benefits of the species they planted.

WORLD PEACE GARDEN

The Martha Walker Garden attained an unusual designation several years ago when it became a World Peace Garden, one of only about a dozen in the world, and the first in the United States. The England based World Peace Garden Project is dedicated to helping form a network of gardens and parklands that serve as retreats for peaceful reflection, including both smaller personal gardens and large public spaces.

The garden has become both a classroom and a place of respite.

TODAY AND THE NEXT 25 YEARS

In celebration of the garden's 25th anniversary, the deer fence surrounding the garden has been raised two feet and a new artisan metal gate dedicated to founders Ralph and Evelyne Ingols has been installed. The garden is seeing bursts of renewed energy from volunteers, resulting in new plantings of a wildflower meadow and hedgerow, and other additions such as secondary meandering paths and a picnic area beneath the walnut tree. The Steering Committee's three-year plan includes interpretive signs explaining major plant communities and habitat, and what birds or other wildlife will be attracted to specific natives.

The Napa Valley community is fortunate to have this mature, three-acre California native habitat garden, which is enjoyed by local people of all ages, as well as those from other states and countries. The winding paths are easy-to-use, many are wheelchair accessible, and there are benches and picnic tables available throughout. The varied gardens create a calming effect, and at any time of year visitors can observe the connection between plants and wildlife.

The Napa Valley Chapter of CNPS is responsible for maintaining and improving the garden, which has become an invaluable educa-



A children's garden invites exploration by youngsters of all ages.

tional tool. Thanks to Ralph and Evelyne Ingols and their CNPS friends, their vision over 25 years ago of a public native habitat garden has resulted in this spot being transformed into a place of beauty and growing biodiversity.

(For more information on the garden, visit www.napavalleycnp.org and at the top of the page click on Martha Walker Garden.)

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TWO VIEWS OF CNPS FELLOW CAROL WITHAM

by Eva S. Butler . . .

At the December 2009 Meeting of the California Native Plant Society (CNPS), Carol Witham became a Fellow of the Society. She was bestowed with this highest honor for the myriad contributions she has made that have benefitted the flora and the people of California. Her leadership and dedication to conservation, education, and research have led to better outcomes for native plants throughout the state.

We applaud the litigation victories. We glow over her latest publication—the lovely *Field Guide to the Mather Field Vernal Pools*. We appreciate the leadership roles she has played and the places she has managed to lead us. Though laudable, these outcomes are not her greatest achievements.

Carol's most lasting influence will defy definition and measure. It is the subtle, almost undetectable goal of activism: a change in expectations. Once expectations change, we quickly lose sight of how things were. A new paradigm emerges and people get on board. We progress as though it were always the plan.

Like a cloud shadow, Carol's influence is evident on a landscape level: UC Merced will alter its development footprint; Sacramento developers will preserve more vernal pools; preserves will have solid management plans. Species and landscapes will persist because Carol took the time to research, write, debate, and negotiate on their behalf. Carol has changed expectations.

When we look backward, digging deeper into the origins of fundamental change, we find the stories of our heroes. This is where the story of Carol Witham will live. Her story celebrates flower power—that is, the triumph of flowers over power.

As the story unfolds, her character emerges as strategic, tenacious, and decidedly drawn to challenges. Though rooted in a passion for plants, her actions speak of intelligence, persistence, and dogged attention to detail. She does not fight for the sake of fighting; she fights for what is at stake, for things

that truly matter: rare plants, vernal pools, education, and the organization that champions these causes: CNPS.

As is true of all heroes, Carol has sacrificed much in her quest to help Californians understand and appreciate their native flora. Few are willing to devote so much of their time on this planet to saving it. While we hope that the journey was its own reward, we feel compelled to do more, to say more. We want to recognize the sacrifice and celebrate the successes of our hometown hero.

If imitation is the sincerest form of flattery, there is no better way to honor Carol's contribution than to emulate it. She has changed our expectations of what is possible. By her example, she has changed our expectations of ourselves. Her story empowers us to be more and to do more because we see the difference one person can make.

As Carol Witham joins the company of the exalted Fellows of CNPS, we are reminded that she follows a well-worn path, blazed by those who have led the way. Through our words and our deeds may we join her in conveying our belief and our optimism that California's native plants will continue to bloom long after we are gone. What greater legacy can one attain than to leave a path strewn with flowers?

. . . and by Diana Hickson

The Sacramento Valley Chapter nominated Carol Witham to become a Fellow of CNPS in recognition of her tremendous contributions to the Society and her remarkable achievements in the conservation and appreciation of California's vernal pools.

Carol has been a volunteer and leader within CNPS for over two decades. Over the years, her active roles in the Society have been many and varied. Upon becoming a member, Carol immediately took on educational activities at the chapter level and pro-

duced regular "rare plants of the Sacramento Valley" articles for our newsletter.

She has served as chair of many chapter committees over the years including rare plants, vegetation, periodic plant watch, and conservation. When Carol is not leading activities, she is always prepared to help out by unloading plants for our fall sale, writing scores of comment letters, representing CNPS at land use planning meetings, and more.

At the state level, Carol has served as CNPS president, vice president, and member of the Board of Directors. She is a long-term active participant in numerous program committees and board committees. Carol represents CNPS in various environmental consortiums including the California Endangered Species and Habitat Alliance and the California Rangeland Conservation Coalition. Because of her leadership-by-example style, Carol has also been highly successful in recruiting new leaders for the Society.

By far Carol's most significant contribution to the flora and the Society



Carol at Oroville Table Mountain, February 2010. Photograph by D. Rosen/Wildside Photography.



TOP: A teachable moment at Oroville Table Mountain focused on the natural history of butterflies that use native violets (*Viola* sp.) as larval food sources. • MIDDLE: A Splash field trip for school children to a vernal pool. Carol played a large role in helping to create the curriculum, which is used by over 2,200 children each year in Sacramento County. Photographs by D. Rosen/Wildside Photography. • BOTTOM: Carol emphasizing a point during a monitoring training workshop at the Kiefer Landfill Wetland Preserve. Photograph by M. Pakenham-Walsh.

has been her multi-faceted and indefatigable campaign to preserve vernal pools. Carol is a self-educated expert in the ecology of vernal pool ecosystems and uses her knowledge to educate, inform, and advocate for vernal pool conservation. Her expertise was most recently recognized by the U.S. Fish and Wildlife Service when she was appointed to chair their Vernal Pool Recovery Plan Implementation Team.

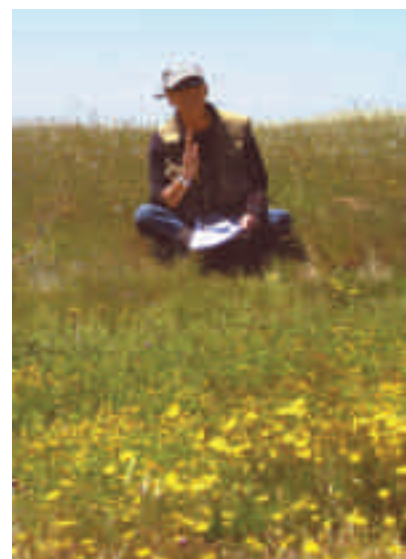
In 2006, after many years of negotiations, Carol's efforts resulted in a reduced and shifted footprint for the University of California Merced campus, thereby protecting many species and sensitive habitat. She has championed several successful lawsuits to protect vernal pools and ensure adequate disclosure of environmental impacts. To fund these lawsuits, Carol has organized three highly successful fund-

raising events, solicited donations from CNPS members and other organizations, and has raised \$70,000.

Carol teaches about vernal pools at all levels from children to graduate students, laypersons to docents, and land use planners to lawyers. Carol is author of *Field Guide to the Vernal Pools of Mather Field, Sacramento County* which is a key outreach and fundraising tool for the chapter.

In addition to being a scientist, educator, and conservation advocate, Carol has also been generous in her giving to the Society. She is a member of the *Donor Circle* and *Legacy Circle*.

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BART O'BRIEN HONORED BY CNPS

by Brett Hall

During the March 2010 Chapter Council Banquet at Rancho Santa Ana Botanic Garden (RSABG), we honored Bart O'Brien for his creative and extraordinary service to CNPS as *Fremontia* editor (2006–2009).

Next to indigenous people, Bart is about as Californian as possible. He is a fifth generation native from Hollister, California with a lineage going straight back to the Mayflower! Bart's interest in native plants started very early. By the age of five he was running transects along the railroad tracks in search of wildflowers—a deed for which he remembers getting into “serious” trouble with his parents!

Bart and lemon lily (*Lilium parryi*) in July 2009 in the San Bernardino Mountains. Photograph by S. De Groot.



Bart finished his early schooling in Hollister and then attended UC Davis, graduating with a degree in environmental planning before heading to Harvard School of Design for a master's degree in landscape architecture. He practiced landscape architecture and design in Marin County, where he became familiar with Wayne Roderick and a number of other Northern California botanical experts. He mapped populations of stink bells (*Fritillaria agrestis*) in Nicasio for the California Natural Diversity Database and later moved to the Santa Clara area and joined CNPS.

Soon after, he received a welcoming note from the chapter's board of directors inviting him to lectures and board meetings. So he went and discovered all kinds of wonderful people, and also that native plants could be far more than just a full career and a pastime: it could be all-consuming and a way of life.

Joining the Santa Clara ranks with Barbara Coe, Ken Himes, Tony Corelli, Susan Sommers, Bob Will, and many others helped Bart become heavily involved. Another new friend was Gerda Isenberg, who later hired Bart to manage Yerba Buena Nursery in the late 1980s, where he joined a short list of important botanists and horticulturists who have held that same post. In 1990 he was hired as director of horticulture at Rancho Santa Ana Botanic Garden in Claremont, California.

Bart has had an adventurous two decades with RSABG and his accomplishments are fascinating. In fact he's pretty well known these days. Last year *LA Times West Magazine* named him among the 100 most influential people in the region!



Bart in his old office at Rancho Santa Ana Botanic Garden. Photograph by B. Eisenstein.

Bart is quick to describe the big accomplishments he has enjoyed during his Rancho days as marvelous collaborations with friends and colleagues, notable among them the cultivar garden at Rancho with its beautiful plants and magnificent baked enamel signs. Bart is well-known for an earlier project—his cultivar list book—which is an unpublished compendium on California cultivars. Did you know there have been over 7,000 named California native-derived cultivars? Bart's scholarly research and forensics in enumerating and describing these have earned him the affectionately used title, “King of Cultivars.”

The Green House Horticulture complex and Seed Lab were all features established at RSABG when Bart arrived, but at the time they were housed in separate areas with fewer facilities and resources available to them. Bart's job was to create detail for the complex and coordinate with

researchers and others to develop the facilities. Today they clearly serve the conservation, botanical, and horticultural goals that Bart and his collaborators set forth.

Bart has many ongoing special research directions. Among them, the cultivation of *Arctostaphylos*, *Ceanothus*, *Fremontodendron*, *Salvia*, and *Dudleya* (especially Baja, California *dudleyas*), restoration planning for the Los Angeles and San Gabriel Rivers, and recently, the Baja Rare Plant Project with many important collaborators.

Bart has published many papers and two recent books, with another one on the way. He has introduced some 50 California selections into horticulture and we hope many more of those are on the way.

A few years back he moved within Rancho, handing over the director of horticulture post to Susan Jett. He now holds the title, director of special projects. In this new focus, Bart secured for RSABG long-term use of 12 acres of Veterans Administration land for a nursery which will grow natives

for contract and retail for the region, and offer programs in horticultural therapy to veterans, among other very interesting projects.

Bart thoroughly enjoyed his time as *Fremontia* editor, and we immensely appreciate the quality and creativity of his issues, as well as his other numerous accomplishments to date.

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BARBARA M. PITSCHEL: 1939–2010

by Suzanne Harmon

It is with great sadness that I share with you news of the sudden passing of my dear friend, former colleague, and fellow Yerba Buena Chapter board member Barbara Pitschel. Barbara joined her beloved husband Roland in death exactly one year and two days after his passing. On August 3, with daughter Justine and her two granddaughters by her side, Barbara died from lung cancer, only two weeks after she had developed pneumonia and just five days after having been diagnosed with an advanced form of cancer.

I first met Barbara upon attending my very first CNPS meeting. I was given such a warm welcome, and her hospitality so impressed me, that I was inspired to become a member of CNPS on the spot. Several years later, I went on to have the privilege of working with Barbara at the San Francisco Botanical Garden, where we quickly became friends, and where I formed a deep appreciation of her impeccable attention to detail, which made working together a dream come true. Barbara's hospitality, professionalism, and attention to detail are traits that ran strongly through every aspect of the multitude of things she did for our community.

Barbara, along with husband Roland, was one of the founding members of the Yerba Buena Chapter of CNPS, and the Pitschels were both active and indispensable to the chapter on so many levels. Bar-

bara fittingly took on the role of hospitality chair, providing at her own expense food and refreshment at the chapter's monthly membership meetings. This hospitality shone through in all that Barbara did, and when she took on the additional task of program chair, she insisted that the speakers at the wonderful and varied programs be treated to dinner beforehand. She always thoughtfully anticipated any travel, equipment, or logistical needs of the speakers, and made sure they were graciously thanked afterwards.

Barbara was also long-time editor of the chapter's newsletter, the *Yerba Buena News*, the coordination of which

was impeccably orchestrated, from calls for submissions, getting the newsletter to the publisher, or arranging mailing party gatherings in the comfort of her own home. The newsletter was consistently produced in an extremely timely fashion, and always contained interesting and relevant topics that were educational to its readers.

Barbara was long-time head librarian at the San Francisco Botanical Garden's Helen Crocker Russell Library of Horticulture, where she could always be found ready to assist and answer questions about gardening and native plants to anyone who came through the doors. Michael McKechnie, executive director of the San Francisco Botanical Garden Society, had high praise for her:

"Barbara was one of the most phenomenally dedicated staff people I have ever had the pleasure of working with. She loved this garden and the library and dedicated so much of her life to both. She also made sure that there was a young and able successor, Brandy Kuhl, to take up the reins. That to me is the ultimate expression of her love for the place."

During the nearly three decades she worked there, the library became the site of the largest and most comprehensive horticultural collection in northern California.

In addition, she had a long in-

Barbara Pitschel. Photograph by M. Bors.



volvement with the Council on Botanical and Horticultural Libraries (CBHL), serving as its president, on the board of directors, and on numerous committees. In addition, for many years she was West Coast editor of the Council's newsletter, as well as being a popular conference speaker. In 2006 Barbara received the Charles Robert Long Award of Merit for her outstanding dedication to CBHL and her many contributions to the field of horticultural literature and information service and research.

The Pitchels were pivotal in the establishment of San Francisco's Bernal Hill Park as a natural area, beginning with organized trash removal parties, which evolved into the hilltop habitat restoration work parties that still continue to this day, and which would, of course, famously end with a wonderful feast prepared by Barbara at her nearby home.

Amid all that Barbara did both professionally and as a volunteer, she al-

ways found time to express her thanks, and I was regularly treated to a handwritten thank you card, even for routine work that I performed. In these cards and in visits, she would frequently tell me that my husband and I reminded her exactly of herself and Roland when they had been our age. While I don't think that I could ever be as energetic or exuberant as Barbara, I have always thought that to be able to accomplish even a small part of what Barbara had accomplished was something wonderful to aspire to, and I continue to do so to this day.

There is so much more that Barbara accomplished, and a fuller appreciation of both Barbara and Roland Pitschel can be found in the Spring 2007 issue of *Fremontia* when they were named Fellows of the California Native Plant Society.

Suzanne Harmon, P.O. Box 1977, Murphys, CA 95247, suzharmon@gmail.com

MATERIALS FOR PUBLICATION

Members and others are invited to submit material for publication in *Fremontia*. Instructions for contributors can be found on the CNPS website, www.cnps.org, or can be requested from *Fremontia* Editor Bob Hass at bhass@cnps.org.

Fremontia Editorial Advisory Board

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HARLAN KESSEL: 1928–2010

by Phyllis M. Faber

Harlan Kessel died on August 27 from pulmonary fibrosis at his home in Oakland, a home notable for his book collection and his warm, welcoming enthusiasm. Harlan served as publication chair for CNPS from 1981 to 1988 and remained on the Society's Publications Committee until 1999. He brought to his work a great knowledge of publications as well as enthusiasm for the work of the California Native Plant Society.

Harlan served as marketing director for the University of California Press under August Frugé, the director of the University of California Press, where they became close friends. After his retirement, August and his wife, Susan began spending more time enjoying and protecting California's native plants. When August became President of CNPS, he drew Harlan in as its publications chair. Harlan's friendship with August and Susan Frugé lasted throughout the remainder of the Frugés' lives.

Books were always a vital part of Harlan's world. He amassed an amazing collection that he and his wife Esther carefully cataloged in their later years. Harlan was a cofounder of the Northern California Bookseller's Association and Western Heritage Press and was editor-in-chief of the Book Club of California.

Harlan was also a crusader for open space in the Bay Area and a longtime director of the East Bay Regional Park District (1976-1992), where he fought many battles for open space. His wins include the acquisition of Claremont Canyon in Berkeley and the protection of the Apperson Ridge Wilderness Park.

Harlan was a strong supporter of both the *CNPS Bulletin* and *Fremontia*. He encouraged first Marge Hawakawa,



Harlan Kessel. Photograph by A. Curtis.

and later, me (in 1984) to expand *Fremontia* in order to increase our understanding of the special nature of California plants and the activities that lent support to protecting them. Harlan enthusiastically encouraged the Society to create a publications program that, over its ten-year tenure, published seven floras and grew to provide a third of the CNPS annual

budget with books like *California's Wild Gardens* and the first *Manual of California Vegetation*.

Harlan lived a long, productive life working with open space issues, publications, and for our California native plants. His work and effectiveness will be sorely missed.

Phyllis M. Faber, 212 Del Casa Dr., Mill Valley, CA 94941, pmfaber@comcast.net



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CONTRIBUTORS (continued from back cover)

Brett Hall is director of the UCSC Arboretum, and president of the CNPS Board of Directors.

Suzanne Harmon was a long-time colleague and friend of Barbara Pitschel, and currently serves as membership chair for the Yerba Buena Chapter of CNPS.

Leah Hawks is a long-time active member of the Napa Valley Chapter of CNPS, and coauthor of the soon-to-be-published *Skyline Wilderness Park, Nature's Gift to Napa Valley*.

Diana Hickson is a past State CNPS Board member, member of the Sacramento Valley Chapter, and a biogeographer with the Vegetation Classification and Mapping Program at the Department of Fish and Game.

Michelle Jensen is a graduate student at Purdue University, and the recipient of a 2008 CNPS Education Grant.

Russ Lewis, retired BLM ecologist, initiated the native plant restoration project at the Piedras Blancas Light Station Outstanding Natural Area. He was a member of the SLO Chapter of CNPS for many years before moving to Washington state.

Rob Moore is a California native landscape designer based in Orange County. He currently serves as sustainability cochair for the Greater LA District Chapter of the Association of Professional Landscape Designers.

V. Thomas Parker is a professor of biology at SF State specializing in plant ecology and has worked on understanding manzanita ecology and evolution for three decades.

Rob Preston is a senior botanist at ICF International (formerly Jones & Stokes) and a research associate with the herbarium at UC Davis.

Michael Vasey studies the systematics of *Arctostaphylos* and is completing his Ph.D. at UC Santa Cruz on the ecology of maritime chaparral in Central California.



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Carole Adams, BLM volunteer, was mentored by Russ Lewis and has been the native plant restoration project leader at Piedras Blancas Light Station since 2002. She is a member of the San Luis Obispo Chapter of CNPS.

Eva Butler is a colleague of Carol Witham and a life member of CNPS who is dedicated to conserving vernal pools in the Sacramento region through education.

Kathleen Chasey is garden curator of the Martha Walker Native Habitat Garden in Napa County, and owner/designer of Down to Earth Landscape Design.

Michael Chassé is an ecologist with the National Park Service at Golden Gate National Recreation Area. He has been involved with community-based ecological stewardship and rare plant monitoring for over 14 years.

Sarah J. De Groot is a graduate student in botany at Rancho Santa Ana Botanic Garden and Claremont Graduate University, and the recipient of a 2008 CNPS Education Grant.

Nancy Emery is an assistant professor in the Departments of Biological Sciences and Botany and Plant Pathology at Purdue University.

Phyllis M. Faber is a past editor of *Fremontia* (1984-1999) and for many years also served as CNPS publications chair.

Mark Frey manages the Presidio Trust's habitat restoration program, where he has worked since 2002.

Daniel Gluesenkamp directs habitat protection and restoration for Audubon Canyon Ranch's 30 properties in Sonoma County, and is cofounder of the Bay Area Early Detection Network. He is a past president of the California Invasive Plant Council.

FROM THE EDITOR

Due to a series of coincidences this past month, I happened to open a copy of the first issue of *Fremontia*, published in April 1973. As long-time members of CNPS may recall, this issue replaced the Society's newsletter, which had been called The California Native Plant Society Newsletter and from then on was called the *Bulletin* (now the *CNPS Bulletin*). The name *Fremontia* had been selected in a contest held by a publications committee and Gunder Hefta, *Fremontia*'s first editor.

As I turned the pages of this premier 24-page issue, I was impressed by a number of things. It did not look like a first issue of a new publication, much less that of a journal. It appeared to have been professionally designed, had a clean, crisp appearance, and contained a variety of articles, photos, and illustrations.

The lead article featured "amateur" botanist Ernest Christian Twisselmann, who had died the previous year. There was an article about valley oaks and their regeneration problem, which if published today would still be timely. Other articles included a longer piece on vernal pools, one on California's Channel Islands where endemic plants were being decimated by feral goats and pigs, a horticultural defense of using the hardy species McNab cypress in the home garden, and even something on edible weeds along with a recipe.

As is true of all *Fremontia* articles, those who write them do so without recompense. Although some may be able to justify a part of their time spent writing as work-related, much if not all of the work is a labor of love. The same can be said of all CNPS members and others who donate time to chapter activities and projects. Our cover story about the Franciscan manzanita is a case in point.

—Bob Hass

(continued on inside back cover)