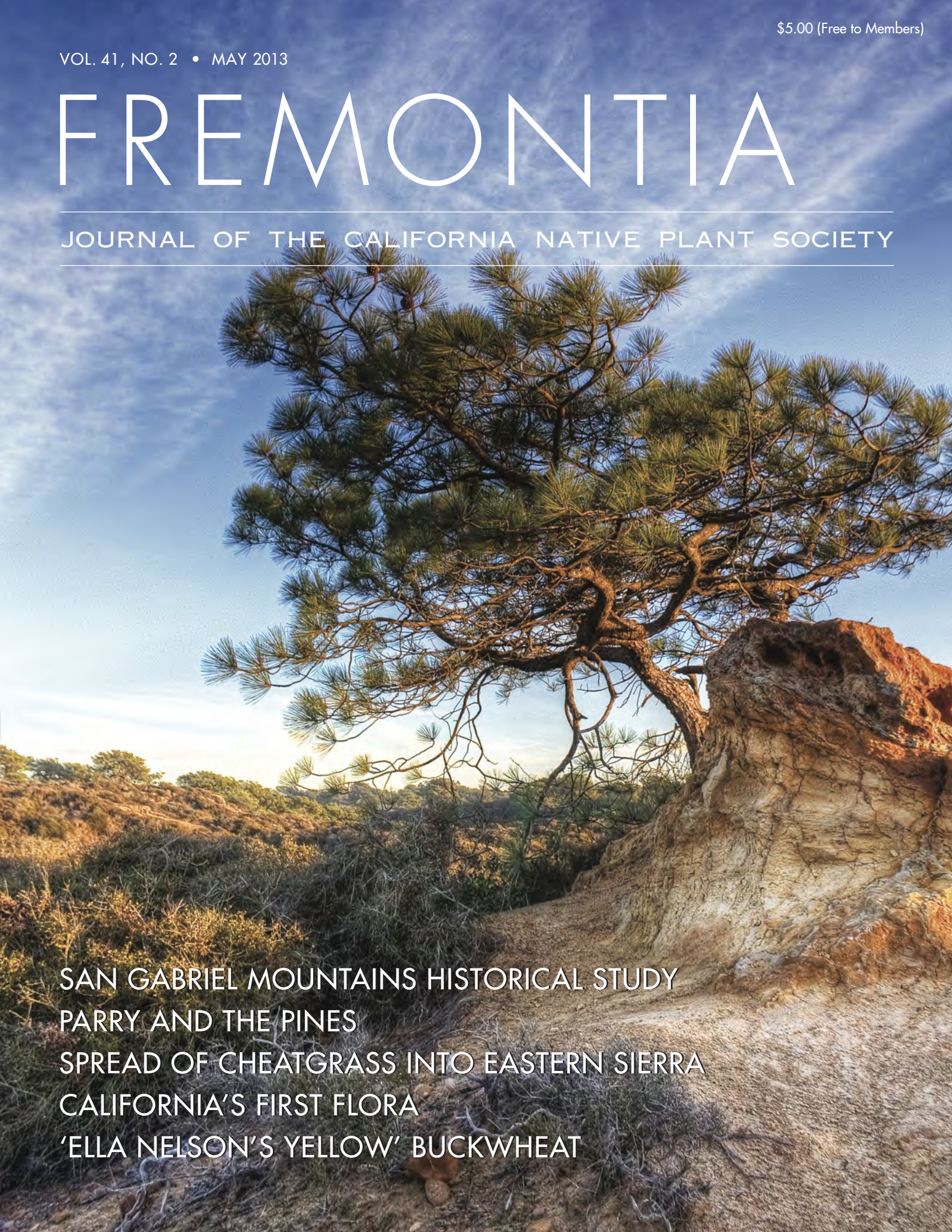


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FREMONTIA

JOURNAL OF THE CALIFORNIA NATIVE PLANT SOCIETY



SAN GABRIEL MOUNTAINS HISTORICAL STUDY
PARRY AND THE PINES
SPREAD OF CHEATGRASS INTO EASTERN SIERRA
CALIFORNIA'S FIRST FLORA
'ELLA NELSON'S YELLOW' BUCKWHEAT

FREMONTIA

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the California Native Flora*

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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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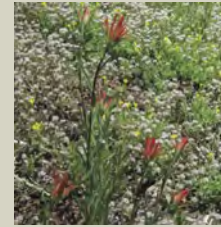
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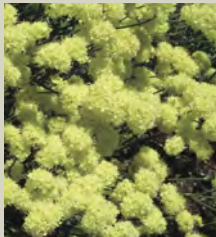


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A brief saga of Charles Christopher Parry, famous 19th century US botanist, his travels in early California, and his contributions to the state's flora and to protecting the Torrey pines.



THE GARDEN INTRODUCTION OF *ERIOGONUM NUDUM* 'ELLA NELSON'S YELLOW' *by Eric Nelson* 20

As climate conditions become warmer and drier, this colorful new buckwheat cultivar, selected from a seldom-used species, is a good choice for home gardeners.

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European botanists first collected in California in the late 18th century, but it was almost a hundred years later that our first comprehensive state flora was published.



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THE COVER: A Torrey pine (*Pinus torreyana* subsp. *torreyana*) in Torrey Pines State Reserve, La Jolla, California. Photograph by Patrick Lee. Story on page 14.



LEFT: 1981 view of the east boundary of the Lily Spring study site from a turnout on the Angeles Crest Highway. Photograph by Wayne Sawyer. RIGHT: 2011 view of the same landscape. The area from Lily Spring down to the highway is the small portion of the study site that did not burn in 2002. Many dead trees line the steep meadow in the left side of the picture. The most striking difference between the 1981 and 2011 views is on the slope between the meadow and Mt. Hawkins which was deforested in several places (see corresponding red area on the map, page 5). Photograph by Jane Tirrell.

A HISTORICAL COMPARISON OF HABITAT AND PLANT POPULATIONS IN THE MID-RANGE SAN GABRIEL MOUNTAINS

by Jane Tirrell, Walter Fidler, Jane Strong, and Graham Bothwell

Phenology—the timing of biological events such as flowering, breeding, and migration—provides information about how well animals and plants are adapting to changing conditions. Interest in phenology has been increasing among botanists and others concerned with conserving native plant communities as the threat of climate change has become more apparent.

In January 2010, the San Gabriel Mountains Chapter of the California Native Plant Society was presented with a unique opportunity to contribute to the growing body of phenology information. Gary Wallace, a chapter member, discovered a *Crossosoma* article written by the late Wayne E. Sawyer in 1981 that presented flowering dates for 95 insect-pollinated plants in the

San Gabriel Mountains centered around Lily Spring (Sawyer 1987). Gary suggested that a chapter project repeating the survey 30 years later would provide an excellent means of documenting changes in plant populations and flowering times.

Flowering phenology was important to Sawyer because of his interest in competition among insect pollinators (Sawyer 1985). In addition to listing flowering dates, his *Crossosoma* article described the study site, approximately a 360-acre region above the Angeles Crest Highway in the San Gabriel Mountains between Little Jimmy Spring and Throop Peak. The site is accessible from the Pacific Crest Trail as well as from the highway.

A small group formed of chapter members conducted the survey over the next three years and posted field

reports and photographs on the chapter website (www.cnps-sgm.org/lilyspring). We spent 2010 learning the identities and locations of the plants in the study site, conducted the survey of flowering times in 2011, and collected vouchers (retained in the herbarium at Rancho Santa Ana Botanic Garden) in 2012.

COMPLICATIONS OF REPEATING A 30-YEAR-OLD SURVEY

As we began surveying the study site in 2010, we were aware that the Curve Fire had burned the area in 2002. However, we did not appreciate the extent of the habitat loss until we examined a US Forest Service map of the fire (page 5). It showed that all the area within the site had



been burned except for a small portion due north of Lily Spring. The map shows the fire area superimposed on a US Geological Survey map of the study site and indicates the severity of the fire conditions.

Even after examining the fire map, the full impact of the Curve Fire on the site was not apparent until fall 2011 when Helen W. Nyerges, regional park superintendent of the Eaton Canyon Natural Area, loaned us Sawyer's slide collection. When we saw the robust mixed conifer forest in Sawyer's 1981 photographs, we realized how devastating the fire had been. We then knew that we were exploring a sunnier, less forested site than the one Wayne Sawyer surveyed, and that this major event would complicate our attempts at interpreting the findings.

In 1981 Sawyer described five different habitats: 1) moist yellow-pine forest characterized by Jeffrey pine (*Pinus jeffreyi*), white fir (*Abies concolor*), and sugar pine (*Pinus lambertiana*); 2) montane chaparral dominated by chinquapin (*Chrysolepis sempervirens*); 3) montane meadows at Little Jimmy Spring and Lily Spring; 4) forested ridges characterized by lodgepole pine (*Pinus contorta* subsp. *murrayana*) and limber

pine (*Pinus flexilis*); and 5) exposed ridges. In 2012, a decade after the Curve Fire, our photo comparisons showed the yellow pine forest and forested ridges contained stands of dead and fallen trees, and the montane chaparral had expanded over previously forested slopes. We believe only the montane meadows and exposed ridges were similar to the way they were in 1981.

In addition to the landscape changes brought about by the 2002

Curve Fire, we encountered another complication in conducting our survey. We had few details about how Sawyer had conducted his study; these protocol ambiguities could affect our findings depending on how we interpreted his statements. The flowering criteria used by Sawyer were subjective. He stated "a species was in flower if a few individuals each bore many open flowers or many individuals each bore a few open flowers." We also used subjec-



TOP: 1981 view from the Angeles Crest Highway of the drainage at mile marker 66.82 showing a forest alliance of Jeffrey pine (*Pinus jeffreyi*) with a well developed shrub layer. Photograph by Wayne Sawyer. BOTTOM: 2012 view of the same landscape showing the almost completely deforested hillside due to the 2002 Curve Fire (see the corresponding red area on the map, page 5). The landscape has become a shrubland alliance dominated by mountain whitethorn (*Ceanothus cordulatus*). Photograph by Graham Bothwell.



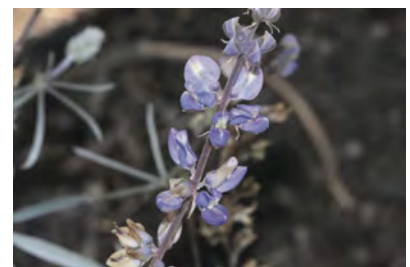
Parish's oxytheca (*Acanthoscyphus parishii* var. *parishii*), CRPR 4.3, is an herb rare in unburned areas adjacent to the study site. Following the fire it appeared in the millions on a burned hillside above the Angeles Crest Highway. Photograph by Jane Tirrell.



tive flowering criteria, however. We defined flowering as three individuals with three open flowers in more than one location. We made exceptions for species that occurred in only one location, and for species characterized by having only one or two flowers per individual.

Another protocol question involved whether Sawyer had observed plants in the same locations each week when he said a species was flowering, or whether he observed that particular species throughout the study site. We decided a species was flowering if our criteria were met *anywhere* within the site, but realized that noting a species was flowering in different habitats could lead to an increase in observed flowering durations.

We also had to decide how we should organize the timing of our observations. Sawyer had recorded his observations by the week, ending on Friday but had not given the actual dates. We assumed the weeks



should run Saturday through Friday and therefore grouped our observations accordingly, assigning our observations to particular weeks, e.g., M1-M4 for weeks 1 through 4 of May, J1-J4 for weeks 1 through 4 of June, etc., as Sawyer had done. We understood that this manner of assigning dates in 2011 into weeks as compared with the dates of those weeks in 1981 introduced about a

Members of the San Gabriel Mountains Chapter who participated in the Lily Spring Survey found that many rare plant species were present in great numbers, and attribute this to the 2002 Curve Fire. The following rare plants are just a few of those that were found.

ABOVE LEFT, MIDDLE: Ewan's cinquefoil (*Drymocallis cuneifolia* var. *ewanii*) CRPR 1B.3, grew in large mats on moist, sunny slopes throughout the site. Photograph by Graham Bothwell. • ABOVE LEFT, BOTTOM: Mojave phacelia (*Phacelia mohavensis*), CRPR 4.3, turned the hillsides white near Lily Spring where sunlight filtered through dead trees. Photograph by Jane Tirrell.

ABOVE RIGHT, TOP TO BOTTOM: Johnston's monkeyflower (*Mimulus johnstonii*), CRPR 4.3, occurred in the hundreds on a badly burned, previously forested, north-facing slope along the Pacific Crest Trail. • Close-up of Mojave phacelia. • Close-up of Parish's oxytheca. • Silky lupine (*Lupinus elatus*), CRPR 4.3, was present in large numbers throughout the site. All photographs in this group by Graham Bothwell.

half week of uncertainty into the data. (The actual dates of our observations are available on the CNPS website under Rare Plant Science/Rare Plant Forums/Rare Plant Phenology.)

Sawyer also stated that “plant populations accessible by hiking trails were observed.” By this, we were unsure whether he had confined his observations to regions near the Angeles Crest Highway, the crests of the ridges, the Pacific Crest Trail, and the discontinued trail to Lily Spring, or whether he also had hiked to less accessible parts of the site. In our comparison of 2011 and 1981 flowering phenology, therefore, we decided only to include observations of plants in the more accessible areas, although we had volunteers scout more remote areas as well.

Ironically, many of the species we observed that had not been described in 1981 occurred in less easily reached areas. Other new species were found along the study site boundary, the actual location of which was somewhat approximate based on Sawyer’s map. Thus it is likely we were able to observe new species because we had more observers exploring a greater extent of the study site, and perhaps also because we slightly extended the site’s boundaries.

We also observed a few species not described in 1981 by starting our observations earlier in the season (April 5) and ending considerably later (November 4). Sawyer started on May 2 and ended September 11. Although our observation

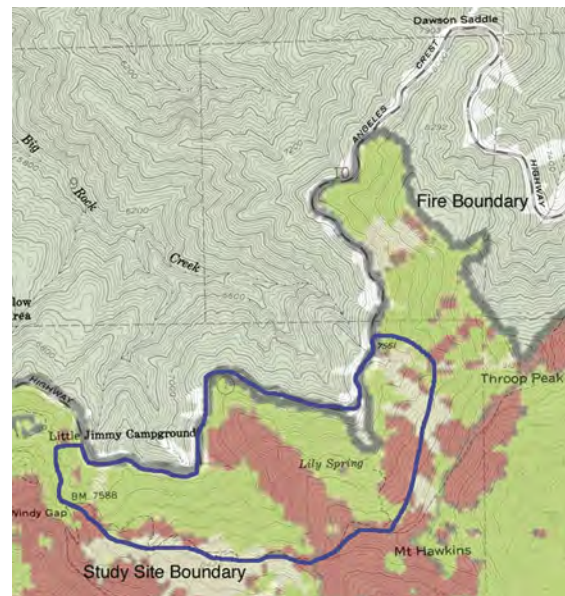
season was longer than Sawyer’s, it is important to note that our phenology comparison, including flowering duration, is for the same period of time, the first week of May through the second week of September.

FLOWERING TIMES IN 1981 AND 2011

For the set of 95 species as a whole, flowering onset occurred at about the same time, with a similar number of species flowering earlier (32) in 2011 as flowered at the same time (31) or later (32). However, the species that flowered earlier in 2011 tended to be early-season bloomers (April and May), and the species that flowered later tended to be late-season bloomers (July, August, and September). Table 1 lists our observations of the change in flowering times for species flowering during various months of the season.

Flowering phenology is affected by multiple factors that include temperature, precipitation, day length, and availability of nutrients. A quick calculation using the annual average temperature for Mt. Wilson in the San Gabriel Mountains showed that the period 1991–2011 was warmer by about 1.5 degrees Celsius (almost three degrees Fahrenheit) than the period 1961–1981 (Western Regional

MAP OF 2002 CURVE FIRE SUPERIMPOSED ON LILY SPRING SURVEY AREA.



US Geological Survey map of the Lily Spring study site, outlined in blue, as shown in Sawyer (1987), superimposed on the corresponding portion of the US Forest Service map of the 2002 Curve Fire. The fire boundary is shown by a wide dark gray line. The bright green and red areas within the fire boundary indicate post-fire forested and deforested conditions, respectively. The fire stopped at the Angeles Crest Highway, the northern boundary of the study site. The area due north of Lily Spring was not burned. Source: US Geological Survey; US Forest Service; and Sawyer, W.E. 1987. A list of high elevation angiosperms and their phenology in the San Gabriel Mountains, Los Angeles County, California. *Crossosoma* 13(1): 5-10.

Climate Center 2012). Based on other phenology studies (Ahas et al. 2002; Fitter and Fitter 2002; Miller-Rushing and Primack 2008; Tooke and Battey 2010), we would expect some plants to flower earlier, and that is what we observed. However, we also observed unchanged and delayed flowering, as did several of these studies. As noted above, delayed flowering appears to be more commonly observed for plants that flower late in the season (Sherry et al. 2007; Dunnell and Travers 2011).

We recorded substantially longer flowering du-

TABLE 1. CHANGE IN FLOWERING TIMES OBSERVED BY SAWYER IN 1981 IN LILY SPRING SURVEY AREA.

Month of Flowering Onset in 2011	Change in Flowering Onset (average number of weeks earlier or later)
April and May	1.5 weeks earlier
June	0.4 weeks earlier
July	0.3 weeks later
August and September	2.1 weeks later

Source: Lily Spring Area Survey, San Gabriel Mountains Chapter, California Native Plant Society, 2012.

TABLE 2. 2011 FLOWERING TIMES AT LILY SPRING AS COMPARED TO 1981.

FLOWERED EARLIER IN 2011	NO. WKS.	FLOWERED AT THE SAME TIME (NO. WKS. = 0)	FLOWERED LATER IN 2011	NO. WKS.
Parish's oxytheca** (<i>Acanthoscyphus parishii</i> var. <i>parishii</i>)	1	Greenleaf manzanita† (<i>Arctostaphylos patula</i>)	California brickellbush (<i>Brickellia californica</i>)	3
Burlew's onion (<i>Allium burlewii</i>)	2	Curleaf mountain mahogany† (<i>Cercocarpus ledifolius</i>)	Littleleaf brickellbush (<i>Brickellia microphylla</i>)	1
San Bernardino mountain onion (<i>Allium monticola</i>)	2	Arroyo willow† (<i>Salix lasiolepis</i>)	Mountain whitethorn (<i>Ceanothus cordulatus</i>)	1
Prickly poppy (<i>Argemone munita</i>)	1	Nevada birdsfoot trefoil (<i>Acmispon nevadensis</i> var. <i>davidsonii</i>)	Chinquapin (<i>Chrysolepis sempervirens</i>)	1
Broad-seeded rockcress (<i>Boechera platysperma</i>)	1	Western columbine (<i>Aquilegia formosa</i>)	Sierra larkspur (<i>Delphinium glaucum</i>)	1
Yosemite rockcress (<i>Boechera repanda</i>)	2	Plain mariposa lily (<i>Calochortus invenustus</i>)	Fragrant shootingstar (<i>Dodecatheon redolens</i>)	1
One-seeded pussypaws (<i>Calyptidium monospermum</i>)	3	Claspingleaf wild cabbage (<i>Caulanthus amplexicaulis</i>)	Smooth willowherb (<i>Epilobium glaberrimum</i>)	1
Giant red paintbrush (<i>Castilleja miniata</i>)	1	Santolina pincushion (<i>Chaenactis santolinoides</i>)	Rubber rabbitbrush (<i>Ericameria nauseosa</i>)	2
Prickly popcorn flower (<i>Cryptantha muricata</i>)	1	Virgin's bower (<i>Clematis ligusticifolia</i>)	Leafy daisy (<i>Erigeron foliosus</i>)	1
Showy cycladenia (<i>Cycladenia humilis</i> var. <i>venusta</i>)	2	Blue-eyed Mary (<i>Collinsia torreyi</i> var. <i>wrightii</i>)	Naked buckwheat (<i>Eriogonum nudum</i> var. <i>pauciflorum</i>)	1
Ewan's cinquefoil* (<i>Drymocallis cuneifolia</i> var. <i>ewanii</i>)	2	Slender draba (<i>Draba albertina</i>)	Rock buckwheat (<i>Eriogonum saxatile</i>)	1
Fringed willowherb (<i>Epilobium ciliatum</i>)	1	Southern California draba (<i>Draba corrugata</i>)	Sierra hoary coffeeberry (<i>Frangula californica</i> subsp. <i>cuspidata</i>)	1
San Jacinto mountain daisy** (<i>Erigeron breweri</i> var. <i>jacinteus</i>)	2	Sticky cinquefoil (<i>Drymocallis glandulosa</i> var. <i>reflexa</i>)	Lowland cudweed (<i>Gnaphalium palustre</i>)	1
Davidson's buckwheat (<i>Eriogonum davidsonii</i>)	2	California fuschia (<i>Epilobium canum</i>)	Nevada bitterroot (<i>Lewisia nevadensis</i>)	1
Parish's buckwheat (<i>Eriogonum parishii</i>)	2	Yerba santa (<i>Eriodictyon trichocalyx</i> var. <i>trichocalyx</i>)	Lemon lily* (<i>Lilium parryi</i>)	1
Alpine sulfur flower buckwheat** (<i>Eriogonum umbellatum</i> var. <i>minus</i>)	1	Wright's buckwheat (<i>Eriogonum wrightii</i> var. <i>subscaposum</i>)	Silky lupine** (<i>Lupinus elatus</i>)	1
Pinewoods fritillary** (<i>Fritillaria pinetorum</i>)	2	Twinleaf bedstraw (<i>Galium bifolium</i>)	Suksdorf's monkeyflower (<i>Mimulus suksdorfii</i>)	3

rations in 2011 (8.9 weeks) than in 1981 (5.4 weeks). One factor contributing to this difference was our criterion that a species was in flower

if we observed three flowers on three individuals anywhere within the study area. Many species occurred at multiple locations and elevations

within the area and flowered at different times in different places. Another factor was the precipitation pattern during the summer. Online

FLOWERED EARLIER IN 2011	NO. WKS.	FLOWERED AT THE SAME TIME (NO. WKS. = 0)	FLOWERED LATER IN 2011	NO. WKS.
Groundsmoke (<i>Gayophytum</i> sp.)	3	Bigelow's sneezeweed (<i>Helenium bigelovii</i>)	Gray monardella** (<i>Monardella australis</i> subsp. <i>cinerea</i>)	1
Volcanic gilia (<i>Gilia ochroleuca</i> subsp. <i>vida</i>)	3	Urn flowered alumroot** (<i>Heuchera caespitosa</i>)	Sweet cicely (<i>Osmorhiza berteroi</i>)	1
Granite prickly phlox (granite gilia) (<i>Linanthus pungens</i>)	2	Oceanspray (<i>Holodiscus discolor</i> var. <i>microphyllus</i>)	Grinnell's penstemon (<i>Penstemon grinnellii</i>)	1
Woodland star (<i>Lithophragma tenellum</i>)	1	Bitterroot (<i>Lewisia rediviva</i> var. <i>minor</i>)	White bog orchid (<i>Platanthera dilatata</i> var. <i>leucostachys</i>)	1
Many-flowered monkeyflower (<i>Mimulus floribundus</i>)	4	Starry false lily-of-the-valley (<i>Maianthemum stellatum</i>)	Common knotweed° (<i>Polygonum aviculare</i> subsp. <i>depressum</i>)	3
Musk monkeyflower (<i>Mimulus moschatus</i>)	1	Scarlet monkeyflower (<i>Mimulus cardinalis</i>)	Pinedrops (<i>Pterospora andromedea</i>)	3
Downy monkeyflower (<i>Mimulus pilosus</i>)	3	Beaked penstemon (<i>Penstemon rostriflorus</i>)	White-veined shinleaf (<i>Pyrola picta</i>)	2
Woolly mountain parsley* (<i>Oreonana vestita</i>)	1	Long-stemmed phacelia (<i>Phacelia longipes</i>)	Wax currant (<i>Ribes cereum</i>)	1
Tehachapi ragwort** (<i>Packera ionophylla</i>)	1	Bog orchid (<i>Platanthera sparsiflora</i>)	Sierra currant (<i>Ribes nevadense</i>)	2
Pine lousewort (<i>Pedicularis semibarbata</i>)	2	White-stemmed raspberry (<i>Rubus leucodermis</i>)	Sierra gooseberry (<i>Ribes roezlii</i>)	2
Southern mountain phacelia (<i>Phacelia austromontana</i>)	2	Russian thistle° (<i>Salsola tragus</i>)	Blue elderberry (<i>Sambucus nigra</i> subsp. <i>caerulea</i>)	2
Mojave phacelia** (<i>Phacelia mohavensis</i>)	1	Blue-eyed grass (<i>Sisyrinchium bellum</i>)	Parish's catchfly (<i>Silene parishii</i>)	1
Snowplant (<i>Sarcodes sanguinea</i>)	1	California goldenrod (<i>Solidago velutina</i> subsp. <i>californica</i>)	Parish's snowberry (<i>Symphoricarpos rotundifolia</i> var. <i>parishii</i>)	1
San Francisco campion (<i>Silene verecunda</i>)	1	Gray horsebrush (<i>Tetradymia canescens</i>)	Mountain carpet clover (<i>Trifolium monanthum</i> subsp. <i>grantianum</i>)	1
Gray-leafed violet* (<i>Viola pinetorum</i> subsp. <i>grisea</i>)	3		Corn lily (<i>Veratrum californicum</i> var. <i>californicum</i>)	1
†These species were in flower when observations began in both 1981 and 2011. *CRPR 1B.2 or 1B.3 **CRPR 4.3 °Non-native Source: Sawyer, W.E. 1987 A list of high elevation angiosperms and their phenology in the San Gabriel Mountains, Los Angeles County, California. <i>Crossosoma</i> 13(1): 5-10 and Lily Spring Area Survey, San Gabriel Mountains Chapter, California Native Plant Society, 2012.				

records from the Western Regional Climate Center and MesoWest indicate that the summer of 1981 was dry, while there was monsoonal ac-

tivity during the summer of 2011 that contributed to longer flowering times (T. Chester, personal communication). A third factor that may

have affected flowering duration was the 2002 Curve Fire that reduced the canopy cover. The more open site allowed the growth of annuals and

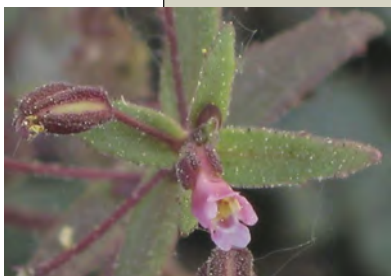
THE MYSTERY OF THE RED-STEMMED MONKEYFLOWER

By the end of 2011 we had found all but three of the species Sawyer described in his *Crossosoma* article. The missing species were Parry's pussypaws (*Calyptridium parryi*), spotted coralroot (*Corallorhiza maculata*), and red-stemmed monkeyflower (*Mimulus rubellus*).

An odd thing about the red-stemmed monkeyflower was that Sawyer reported it had purple and yellow forms that flowered at different times. The yellow form, identified from our photograph by Naomi Fraga, a conservation botanist at Rancho Santa Ana Botanic Garden whose research interests include monkeyflowers, turned out to be a different species. It was Suksdorf's monkeyflower (*M. suksdorfii*), which we had found in 2010 and 2011 at Lily Spring. We did not find the purple form in either year, so we wondered if Sawyer had mistaken a third species, Brewer's monkeyflower (*M. breweri*), for the red-stemmed monkeyflower.

Brewer's monkeyflower is similar in size and color to red-stemmed monkeyflower and we had found many of these plants at Lily Spring. By June 2012 we had almost given up hope of finding the real red-stemmed monkeyflower when CNPS member Walt Fidler decided to do a more thorough search. Walt's persistence paid off. He found 8 to 12 individuals of this plant that we could see was different from Brewer's monkeyflower.

As of 2012 we still have not found Parry's pussypaws and spotted coralroot anywhere within the Lily Spring study site.



The suspect lineup regarding the red-stemmed monkeyflower mystery. CLOCKWISE FROM UPPER LEFT: Brewer's monkeyflower (*Mimulus breweri*), Suksdorf's monkeyflower (*Mimulus suksdorfii*), and red-stemmed monkeyflower (*Mimulus rubellus*). All three photographs by Jane Tirrell.

herbaceous perennials. Greater numbers of plants meant flowering was easier to observe and probably contributed to our findings of both earlier flowering onsets and longer flowering durations.

Lists of the species observed with flowering times, photographs, and trip reports are available at www.cnps-sgm.org/lilyspring, and dates of observations with flowering informa-

tion are on the phenology page of the CNPS website (mentioned earlier).

FIRE INCREASES ABUNDANCE OF SEVERAL RARE PLANTS

We have no information about the relative abundance of the plants Sawyer observed in 1981. Our ob-

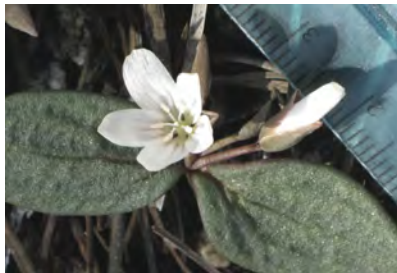
servations indicated the fire that opened up the study site allowed sun-loving species to grow prolifically. In contrast, many of these species, some of which were CNPS rare, threatened, or endangered plants were absent from the unburned, forested area above Dawson's Saddle just outside the eastern border of the study site. Examples of some of the rare plants we believe are present in increased numbers are shown on page 4.

In addition to those pictured, other rare plants seen in both 1981 and 2011 were San Jacinto mountain daisy (*Erigeron breweri* var. *jacinteus*), California Rare Plant Rank (CRPR) 4.3; alpine sulfur-flowered buckwheat (*Eriogonum umbellatum* var. *minus*), CRPR 4.3; pine-woods fritillary (*Fritillaria pinetorum*), CRPR 4.3; urn-flowered alumroot (*Heuchera caespitosa*), CRPR 4.3; lemon lily (*Lilium parryi*), CRPR 1B.2; gray monardella (*Monardella australis* subsp. *cinerea*), CRPR 4.3; woolly mountain parsley (*Oreonana vestita*), CRPR 1B.3; Tehachapi ragwort (*Packera ionophylla*), CRPR 4.3; and gray-leaved pine violet (*Viola pinetorum* subsp. *grisea*), CRPR 1B.3.

ADDITIONAL SPECIES OBSERVED 2010–2012

One of the things we expected to find from this survey was that species present in 1981 had been lost from the site. Of the species Sawyer included in his phenology study (in addition to the 95, he mentioned five that were already in fruit when he observed them), we found all but two: Parry's pussypaws (*Calyptridium parryi*) and spotted coralroot (*Corallorhiza maculata*).

We found 40 plant species not listed in 1981. This was probably because we explored the site both earlier and later in the season, and because we had more observers, which enabled us to cover more of the site. There were wind-pollinated



An additional 40 species that had not been listed in 1981 were observed during the Lily Spring Survey. Three of these species are shown above, with possible reasons they were not seen in 1981. CLOCKWISE FROM LEFT: California broomrape (*Orobancha californica* subsp. *feudgei*), not seen every year, only appeared in late September, past the time Sawyer could have observed it in 1981, since his survey ended on September 11. It is shown growing with Wright's buckwheat (*Eriogonum wrightii* var. *subscaposum*). • San Gabriel linanthus (*Linanthus concinnus*), CRPR 1B.2, was found in 2012 on a highway cut on the north side of the Angeles Crest Highway. • Peirson's spring beauty (*Claytonia lanceolata* var. *peirsonii*), CRPR 3.1, is an ephemeral herb that usually emerges right after snow melts, but only lasts for about two weeks. It was seen for the first time in this region of the San Gabriel Mountains in 2012. All three photographs by Jane Tirrell.

species (excluding grasses) that may have been present earlier but were not listed due to Sawyer's interest in insect pollination. We found fire followers that appeared after the 2002 fire. There were tiny or ephemeral species, species that did not flower every year, species found in less accessible areas or near the site boundary, and others which may have been new to the site. We also found many non-natives (excluding grasses) that were not reported as being present earlier, and may have appeared partly because of the fire and also due to an increase in visitors to the Angeles National Forest where Lily Spring is located.

CONCLUSION

Thirty years after the initial study by Sawyer, the plants in the Lily Spring study site are thriving with little loss of species diversity. However, future surveys are needed at regular intervals before we can determine definitively whether flow-

ering phenology in this community is being affected by climate change.

Our study was complicated by the dramatic change in the landscape caused by the 2002 Curve Fire. To understand the effects of the fire on flowering phenology, additional studies are needed, such as recording flowering behavior of the same species in similar habitats in burned and unburned areas. While we presently have no plans for further studies at Lily Spring, we will continue to monitor the plants in the area.

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The eastern Sierra Nevada is a land of extremes in climate and topography. Although the region has remained relatively pristine, it faces new challenges with climate change and invasive species encroachment. All photographs by the author unless otherwise noted.

THE SPREAD OF CHEATGRASS INTO THE EASTERN SIERRA

by Amy Concillo

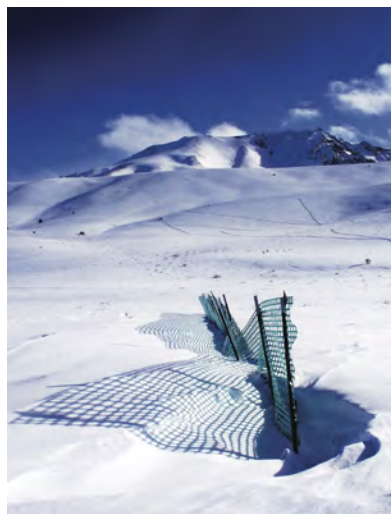
[Author's Note: Amy Concillo was a recipient of an educational research grant from CNPS, which helped to support the restoration component of her doctoral work.]

The Sierra Nevada drops sharply along its eastern escarpment from peaks over 14,000 feet in elevation to the Owens Valley 10,000 feet below, providing dramatic, breathtaking views eastward to the White Mountains. This extreme environment has protected native plants and animals at upper elevations from disturbances such as development, roads, traffic, and cattle grazing, leaving ecosystems in a relatively pristine condition. However, montane regions face new challenges from climate change and invasive species (Pauchard 2009).

Temperature drops markedly along the steep topographic gradi-

ent of the eastern Sierra Nevada escarpment. It can differ by as much as 25° F from the ridge tops to valley floor and gives rise to a range of different plant communities. Climate change models predict that temperature will increase significantly in the Sierra Nevada over the next century, which is likely to cause species to move to higher elevations. Invasive species may be particularly well-

Snow fences have been used to manipulate snow depth and study the effects of climate change on cheatgrass spread in the eastern Sierra Nevada.



suited to capitalize on these changing conditions due to their high rates of seed dispersal and establishment.

In the eastern Sierra Nevada, of particular concern is the spread of the invasive annual grass, *Bromus tectorum*, commonly known as cheatgrass or downy brome. Although ubiquitous throughout the Great Basin, cheatgrass growth is patchy at high elevation, most likely due to cold winter temperatures and deep snowpack (Chambers et al. 2007, Griffith and Loik 2010).

Cheatgrass gains dominance over native plants by increasing the frequency of fire. It germinates in the fall if there is sufficient soil moisture, overwinters as a seedling, completes its life cycle by early spring, and then dries out, thereby creating a fuel load ripe for ignition. Native bunchgrasses and shrubs are poor competitors with cheatgrass at the seedling stage, so more fire promotes

more cheatgrass. Although cheatgrass exists in the eastern Sierra Nevada, it has not yet reached the densities necessary to transform the fire cycle. Its impacts have, therefore, been minimal in California compared to those in other parts of the Great Basin. But how might climate change affect its spread?

CHEATGRASS RANGE EXPANSION

Changing temperatures due to climate change may affect plants directly by increasing (or decreasing) the potential area where they could grow (due to physiological limitations), or indirectly through their effect on precipitation. In an arid region like the Great Basin, precipitation matters a lot! Total precipitation is not the only critical factor—the type of precipitation, as snow or rainfall, and timing are also important.

Rainwater often falls during the hotter times of the year due to monsoon rains, can evaporate quickly from the dry soil surface, and provides water primarily for shallow-rooted species. On the other hand, water from snowmelt percolates into the soil, recharges the groundwater, and provides a more consistent supply that deep-rooted species are able to tap into throughout the long, dry summer. The dominant native shrubs and bunchgrasses of the Great Basin are perennial species that get most of their water from snowmelt. A shift from snow to rain, likely with temperature increases, may favor short-lived annual plants, including cheatgrass. Another consequence of increasing temperature will be a shift toward earlier snowmelt dates, which could mean prolonged drought for the area. Coincident with these changes, we expect to see shifts in plant community composition.

Recent research suggests that cheatgrass expansion at high elevation may depend on the timing of



In the most dense cheatgrass infestations, native forb diversity is markedly reduced. Some species that are often missing from these sites include (LEFT TO RIGHT): desert paintbrush (*Castilleja angustifolia*), Wilcox's eriastrum (*Eriastrum wilcoxii*), and sandcorn (*Toxicoscordion paniculatum*). It is not yet clear whether cheatgrass invasion is leading to reduced biodiversity, or whether areas of high biodiversity are less likely to be invaded by cheatgrass.

snow and rain events. Alden Griffith and Michael Loik (2010) measured cheatgrass population growth in response to increased and decreased snowpack. They used snow fences to create different snow pack depths to mimic the potential impacts of climate change. They found that decreased snow was associated with decreased cheatgrass population growth, which was attributed to earlier onset of drought. However, research at the same site with an experimental increase in springtime rainfall suggests that a shift from snow to rain may be more likely to facilitate cheatgrass range expansion at high elevation, depending on the timing of rainfall events (Concilio et al. 2013).

Cheatgrass already appears to be spreading at higher elevations. In 2000, Bruce Orr and Ann Howald surveyed plant communities of the Sierra Nevada Aquatic Research Laboratory, located 10 miles south of Mammoth Lakes, CA at about 6,500 feet in elevation. They described cheatgrass as being “occasional in disturbed areas.” We have been monitoring the plant community at the same site in permanent plots since 2007 and found a 150% increase in cheatgrass cover over the last five years (Concilio and Loik forthcoming).

In the five most disturbed re-

search plots (out of 54 plots total, each two square meters in size), cheatgrass cover is now over 50%. This is above the threshold (45%) at which fire danger reaches a maximum in eastern Washington (Link et al. 2006). Although the natural fire flash point for fuels is likely to differ between eastern California and Washington, this dramatic increase in cover is still alarming.

Coincident with higher cheatgrass cover, we measured a decrease in species diversity (calculated with both Shannon-Weiner and Simpson indices), although it is not yet clear whether cheatgrass invasion is affecting biodiversity or biodiversity is affecting cheatgrass invasion. Based on this data, we can expect increased impacts if these infestations are left unchecked. Based on current climatic conditions, cheatgrass has not yet altered the fire cycle. Consequently, there are still opportunities for restoration of invaded sites and conservation of uninvaded sites in the eastern Sierra Nevada.

OPPORTUNITIES FOR CHEATGRASS CONTROL

For widespread invasive weeds such as cheatgrass, control can be incredibly costly. Therefore containment—limiting the invasion to a



At upper elevations in the eastern Sierra Nevada, cheatgrass only exists along roadsides (as shown here) and in other disturbed areas likely because its growth and spread are limited by cold winter temperatures and deep snowpack. These infestations are prime candidates for control measures that could reduce spread to adjacent sites.

core area and eradicating outlier patches to stop its spread—may be a better option. In the western Sierra Nevada, the California Department of Food and Agriculture and partner agencies are using this strategy to contain the spread of yellow starthistle (*Centaurea solstitialis*) at the leading edge of its invaded range. (For more information, see “Yellow Star Thistle Leading Edge Program,” http://www.cdffa.ca.gov/plant/ipc/ystmapping/ystmapping_hp.htm.) Similarly, cheatgrass infestations at high elevation along the eastern Sierra Nevada could be prime candidates for this type of management.

Above about 7,000 feet in elevation, cheatgrass occurs only along roadsides and other disturbed areas whereas native sagebrush steppe habitat is still relatively pristine. My dissertation research focused in part

WHAT IS CHEATGRASS?

Cheatgrass (*Bromus tectorum*) originated in southern Europe and adjacent regions of Asia and Africa, and was introduced to the US in the mid-1800s, probably through ballast water from ships and contaminated grain seed. It is now present in most states, but is particularly problematic in the Intermountain West (between the Rocky Mountains on the east and the Cascade Range and Sierra Nevada on the west) where it is the dominant annual grass on sagebrush rangelands. Cheatgrass germinates early and grows rapidly, depletes soil moisture down to low levels, and can outcompete native plants at the seedling stage. It dies each year in the spring, leaving a carpet-like cover of dry grass ripe for ignition.

Historically, sagebrush ecosystems of the Intermountain West are estimated to have experienced fire at intervals of about 50 to 300 years. However, where cheatgrass cover is dense, fire frequency can decrease to as little as two to three years, and because cheatgrass is so competitive at the seedling stage, it can easily come to dominate the post-fire plant community.

In addition to its impacts on native plant communities, cheatgrass also increases costs of fire fighting, decreases the abundance of important forage species, and its awns can penetrate an animal's skin and cause painful abscesses. It is a prolific seed producer with a potential output of more than 300 seeds per single individual, and can build up large soil seed banks. Once dominant, cheatgrass is very difficult to control.

Cheatgrass when green, and after it has dried out by summer. Photographs by Jason Willand (TOP) and Steve Dewey, Utah State University, Bugwood.org (BOTTOM).



on how to control or eradicate these types of infestations in the Mammoth Lakes region (from 6,500 to 8,000 feet). Although herbicides are the most common approach for controlling small patches of invasive weeds such as cheatgrass, it is not always possible to do so for regulatory, economic, or social reasons. I experimented with non-technical, non-

chemical weed control methods for reducing cheatgrass infestations at high elevation, including soil solarization, hand pulling, mulching, and reseeding native forbs and bunchgrasses.

Results from this work were promising. Soil solarization and mulching dramatically reduced (by 99%), and sometimes eliminated,

Soil solarization is one method that has been tested to reduce or eradicate cheatgrass patches. The method involves saturating the soil (left) and covering the area with an airtight tarp (middle) during the hot summer months. The soil heats up to such a degree that nearly the entire seed bank is killed (right). The area would have to be revegetated with native species to avoid reinfestation by cheatgrass.



cheatgrass from plots with just a single treatment. The drawback was that these two methods were non-specific and also killed native forbs; follow-up revegetation with native plants would be necessary. Unfortunately, our reseeding trials were completely ineffective, likely due to dry conditions, and so we now think direct planting of seedling plugs would be preferable.

Although tedious and time consuming, hand pulling was also effective at dramatically reducing cheatgrass cover (by 94% after just 2 years) without any negative effects on native plants. Each of these techniques could be used with volunteer groups and would greatly reduce costs. Since funding for invasive plant removal is often not available, this could be a feasible approach for small infestations.

However, cheatgrass also exists as low-density widespread infestations in the region (at about 4,000 to 7,000 feet). In this case, complete removal would be impractical, but a reduction in cheatgrass fuel loads could help reduce its impact and prevent the transition to a grass-fire cycle. One way to manage fuel loads is through timed grazing. The Bishop, CA Bureau of Land Management (BLM) field office conducted an experiment at two sites near Coleville, CA, to determine whether or not grazing sheep in the early spring would effectively reduce cheatgrass biomass and consequently its capacity for carrying fire.

At one site, grazing led to a 30% reduction in fine fuel loads (pounds per acre), but no difference was measured at the other site. Other researchers have been experimenting with a fungus that specifically targets and kills cheatgrass seeds, which could be an effective way to reduce or maintain low cheatgrass density.



The 2010 Constantia Fire that burned 1,369 acres in Long Valley, California very likely started in cheatgrass. Fighting such fires drains public coffers. Twelve hand crews, seven engines, one dozer, three water tenders, seven helicopters, and a crew of 452 firefighters were involved. Photograph by Nolan Preece, www.nolanpreece.net.

(For more information, see <http://www.fs.fed.us/rm/grassland-shrubland-desert/research/projects/cheatgrass-biocontrol/>.)

CHALLENGES TO CONSERVATION

Although opportunities exist to reduce the spread of cheatgrass, their practical implementation is hampered by a host of economic, regulatory, and cultural barriers (see Concilio 2012 for a complete discussion). Land managers at the BLM and US Forest Service are faced with tightening budgets, and rely on volunteer support to help with weed control work. These factors make it difficult to use methods that require technical training. State agencies and the Weed Management Areas also struggle to maintain adequate funding for weed control projects, as there is no stable long-term source of funding that has been allocated toward weed control. The resources that do exist are prioritized for those species on state or federal noxious weed lists (which are mainly agricultural pests and exclude cheatgrass).

Of course these issues are not unique to the eastern Sierra Nevada, nor are they unique to cheatgrass. Invasive species control in California needs stable sources of funding and trained personnel to implement

control measures as soon as they spot incipient infestations. This need will become increasingly urgent as new challenges arise from climate change and invasive species encroachment into new areas.

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Torrey pine (*Pinus torreyana*) on north facing slope of Santa Rosa Island, at top of the main grove above Becher's Bay, 2013. Photograph by Sangeet Khalsa.

PARRY AND THE PINES

by Elizabeth Adelman

On his first visit to California in 1850 as a botanist on the US-Mexican Boundary Survey, Charles Christopher Parry

(1823–1890) discovered a new pine just north of San Diego. After that trip he went about crossing the Plain's vast prairies, clambering up every mountain range west of the

Mississippi, and camping in parched deserts—all to hunt plants. Later he returned time and again to the Pacific coast's "Land of Wonders" (Engelmann 1874).

With his devotion to finding plants in the untamed wilderness, one might be baffled by Parry's enthusiasm for westward expansion. In his younger years, Parry envisioned the West as a place for commerce to develop natural resources. He later came to see the need to protect vanishing natural resources, including the Torrey pine.

PARRY'S BACKGROUND

Born in Gloucestershire, England, and then raised in upstate New York, Parry attended Union College in Schenectady, New York. Parry's enthusiasm for plants started during medical school at Columbia College in New York where Dr. John Torrey taught. Torrey (1796–1873), a physician by training and a botanist by avocation and profession, later became one of America's foremost taxonomists, internationally regarded scholars, and promoters of botany. Parry described Torrey as "a good friend whose considerable kindness for many years has endeared him to me like a father . . ." For millennia plants made up the world's medicine, so many physicians were also botanists.

After medical school, Parry moved to Davenport, Iowa to start a medical practice, but quit only months later to pursue his first love, botany. Initially, he worked on government surveys. The US conducted military surveys to locate boundaries, and to find routes for new roads, canals, and railroads in the vast, undeveloped areas of the country. Scientists, including botanists, often took part in the surveys to find, collect, and catalog the vegetation.

Parry first worked as a botanist on a federal survey of central Iowa in 1847. Then, as the botanist for the Northwest Territory Survey, he collected plants in Minnesota and Wisconsin, and authored a highly acclaimed report on the plants of the Territory that identified and described 727 taxa.



Charles Christopher Parry. Image courtesy of the University and Jepson Herbaria, University of California, Berkeley.

US ROLE IN US-MEXICAN BOUNDARY SURVEY

Under the Treaty of Guadalupe-Hidalgo at the end of the Mexican-American war, Mexico formally ceded 525,000 square miles of Mexico to the US, and relinquished all claims to Texas for another 389,166 square miles, for a total of 914,166 square miles. The Treaty ordered surveyors to designate the boundary line from San Diego to the mouth of the Rio Bravo del Norte at the Gulf of Mexico. Parry eagerly joined as a botanist to the US-Mexican Boundary Survey.

Parry stayed with what was left of the Survey team after many abandoned it to mine for gold. He joined Lieutenant Emil Whipple on the most dangerous route across the California desert, from San Diego to the junction of the Gila and Colorado Rivers. Temperatures hit 120° F. By night they crossed the desert, "barren and desolate in the extreme," as Parry described it. Dead animals lay in and near the salty water at Carrizo Creek. The dehydrated men and horses trudged on further without water. They desperately dug for water with no success. Unexpectedly, storm clouds appeared in the eastern sky. After a maelstrom of sand hit with gale force, rain poured down, turning to hail and then floods.

They reached the Colorado River 20 days after leaving San Diego. For three months they camped, and

Parry hunted plants and studied the neighboring Yuma Indians. He sent his plant collections with Whipple, destined for Torrey in New York, but the specimens never arrived. His collections may have been destroyed by fire while in Panama. (Before the construction of the Panama Canal, travel between the Atlantic to the Pacific meant sailing to Panama, crossing the isthmus overland, then waiting for another sailboat, which sometimes took months.)

Parry returned to San Diego from the Sonoran Desert. While he waited for the Survey to continue, never content to sit, he hunted plants for a year, searching north to Monterey, San Luis Obispo, Los Angeles, Santa Barbara, San Juan Bautista, and then back again. His friend, entomologist John LeConte, told him about a curious pine just north of San Diego. Parry found the pine and identified it as a new species which he named Torrey's pine (*Pinus torreyana* subsp. *torreyana*). Parry wrote:

A new species of pine is peculiar to the district It occupies an arid tract near the ocean beach, about twelve



RIGHT: Torrey pine seed cone from *Forest Trees of the Pacific Slope* by George B. Sudworth. USDA, 1907. BELOW: Seed cones from a Torrey pine, Santa Rosa Island, California, 2007. Photograph courtesy of Wikimedia Commons.



CHARLES CHRISTOPHER PARRY'S RELATIONSHIPS WITH OTHER WELL-KNOWN US BOTANISTS

George Engelmann (1809–1884)

Shortly after he moved to Iowa, Parry travelled to St. Louis to meet a giant in US botanical chronicles, George Engelmann, and they soon became friends



George Englemann. Image courtesy of the Missouri Botanical Garden Archives.

and collaborators. Born and educated in Germany, Engelmann immigrated to the St. Louis area where he set up a medical practice and engaged in his passion, botany. He inspired and mentored others to search out plants, which he then identified or sent on to Asa Gray at Harvard for identification. Engelmann specialized in cacti and conifers of the West and Southwest. To remedy Engelmann's despondency after the death of his wife, Parry invited him to go botanizing in California on a trip.

Edward Lee Greene (1843–1915)

Greene collected plants during his service in the Thirteenth Wisconsin infantry of the Union Army. Moving to Colorado, where he first met Parry, he explored the Rocky Mountains, then the Southwest and Mexico before migrating to Berkeley as an Episcopal priest and botanist. He served for a couple of years as curator of the herbarium at California Academy of Sciences, but then left in 1855 to become UC Berkeley's first professor of botany. He resigned his professorship at Berkeley after a dispute with the University's president over nomenclature reform, and moved to Catholic University in Washington (1895–1904). Later he worked as botanical associate at the Smith-



Edward Lee Greene. Image courtesy of the Hunt Institute for Botanical Documentation, Carnegie Mellon University, Pittsburgh, Pennsylvania.

sonian Institution (1904–1915). Greene and Parry became very close personal friends. Parry, 20 years older than Greene, sometimes whimsically referred to Greene as "son."

John Gill Lemmon (1832–1908)

Lemmon called himself an "amateur botanist, collector in natural history, and dealer in seeds, bulbs, and roots of rare California plants." He started collecting plants while recuperating in California after his release from a Confederate prisoner-of-war camp, and discovered many new species in California and Arizona. Lemmon and his wife, Sara Plummer Lemmon, also a plant collector, nicknamed one another "Lemmonia" and "Amabilis." They became very close personal friends of the Parrys.



John Gill Lemmon. Image courtesy of the University and Jepson Herbaria, University of California, Berkeley.

John Muir (1838–1914)

Author, botanist, consummate advocate for nature, and "patron saint of the American wilderness," John Muir had more popular influence on preservation than possibly any other American. He helped create Yosemite Valley National Park and helped save Sequoia National Park. His writings and speeches inspired untold numbers of people. Muir founded the Sierra Club, which continues the fight to preserve nature today. Before phones and before the Internet, people wrote letters. America's two most respected scholarly botanists of the day, Harvard University's Asa Gray and Columbia University's John Torrey, each wrote letters to their friend John Muir describing visits with Parry in a rickety cabin in the Colorado Rockies, painting a scene that Muir would prize. Once in California, Parry wrote to Muir and invited him to lunch. They became close personal friends and occasionally stayed at each other's homes. Muir penned Parry's eulogy in a letter to mutual friends. "It seems as if all the good flower people, at once great and good, have died now that Parry has gone . . ." (Muir 1890).

Edward Palmer (1821–1911)

As the US Department of Agriculture's botanist, Parry worked with Edward Palmer, who collected plants for the Department. Malaria nearly killed Palmer more than once, but being an obsessive collector, he never ceased collecting. Included among his "finds" were an estimated 1,200 new species of plants, as well as animals, insects, corals, mollusks, newspaper clippings, coins, Indian artifacts, Indian skeletons, and chips off old buildings. He collected in Paraguay, Mexico, and much of the US, including all parts of California. He was also a botanist for the Geological Survey of California.



Edward Palmer. Image courtesy of the National Anthropological Archives, Smithsonian Institution.

Samuel Bonsall Parish (1838–1928)

William Fletcher Parish (1840–1918)



Samuel Bonsall Parish. Image courtesy of the University and Jepson Herbaria Archives, University of California, Berkeley.

These two brothers served in the Union Army, mined in Utah and Arizona, and then settled down to make a vineyard and orchard near the banks of the Santa Ana River in San Bernardino. Curiosity about local flora led them to Lemmon who, always in need of money, charged them 50 cents (a sizeable sum back then) for each plant name he pointed out in their flower garden. The brothers then met Parry, who freely introduced them to native plants. Enthusias-

tically they sought out native plants in Southern California, built up a large botany library and herbarium, collected professionally for herbaria and arboreta, wrote for local journals, and advised Willis Jepson. Both brothers were devoted to Parry.

miles north of San Diego, at the entrance to Soledad Valley. In this locality (the only one in which it has been found) it forms a small-sized tree, with rather open foliage. It is particularly distinguished by its long fascicles of leaves, which are in fives, and its rather ponderous cones. This species . . . I have ventured to designate, in compliment to a distinguished American botanist, as *Pinus Torreyana* (Torrey 1859).

Dr. Torrey undertook the monumental task of identifying all of the plants that had been collected during the Survey and writing a report. Parry authored the introduction to the report by describing the area's ecosystems. The *Report of the Botany*, as it was titled, "must be ranked as the most important publication of the kind that has ever appeared," declared Asa Gray.

Parry returned to Davenport, Iowa where he remained for the next six years and retired from botany. During the hiatus he married, had a daughter, and both wife and daughter died. He remarried a widow, Emily Preston, nicknaming her "Goodness." Parry then returned to the field and collected in the Colorado Rockies on four trips, earning him the sobriquet "King of Colorado Botany."

RETURN TO CALIFORNIA

The dream of a transcontinental railroad linking the Atlantic to the Pacific became a national obsession. To construct this railroad required finding a route. Parry returned to California as botanist on the Kansas Pacific Railroad Survey. Starting at Needles, the survey party crossed the Sierra Nevada at Tehachapi Pass, and then marched through the Tulare and San Joaquin Valleys to San Francisco.

After a stint as the US Department of Agriculture's first botanist and collecting plants in Wyoming and Utah, Parry opined that he might "drift on to California sometime" but not to botanize in "that well worked field" (Parry 1874).

After the transcontinental railroad was completed, Parry obtained free railroad passes that enabled him and Mrs. Parry to make several trips to California and also spend a few years there. During the winter of 1875 in San Bernardino, Parry remarked how very pleased he was having access both to the mountains by lumber roads and to the desert by railroad. He decided thereafter that California was "where his chief [botanical] interest lies . . ." (Parry 1885).

Botanists roamed and collected together, studied specimens together, and when they weren't



Torrey pine grove in Channel Islands National Park, Santa Rosa Island. Photograph courtesy of Wikimedia Commons.

together, wrote each other with reports of where they were and what they were doing. Parry befriended some of the plant powerhouses of the day. He explored and collected with Edward Palmer, John Gill Lemmon, Edward Lee Greene, John Muir, the Parish brothers, and Dr. George Engelmann. (See sidebar on pages 16 and 17.) He spent weeks and sometimes months studying plant specimens in the herbarium at the California Academy of Sciences in San Francisco. He enjoyed relationships nurtured there and despaired when conflicts arose between botanists.

Parry valued collecting in pairs and in ensembles but sometimes he preferred going it alone. When traveling with Arnold Arboretum's Charles Sprague Sargent and George Engelmann, he engineered "an amiable arrangement for separation," feeling that Sargent rushed, leaving

little time to look. Parry preferred "to select a good location, rather varied, but not too extensive and work it up thoroughly." Parry liked his usual outfit of a tent and pickax rather than the "big dinners and wine sipping, at fashionable hotels" (Parry 1881).

Undoubtedly Parry encountered hardships tramping outdoors in the mountains, valleys, and deserts of California, but he looked on the bright side of things. In the Mojave Desert one February he camped on ice an inch thick. Instead of complaining, he reasoned that the ice would be water for the plants in spring. Parry's enthusiasm for botanizing seemed limitless, and he trekked over all parts of California in search of new plants. (Some of his discoveries are listed in Table 1.)

Parry dried, pressed, and labeled all the plants he collected, with help from Mrs. Parry, and herbaria, mu-

seums, and private collectors purchased them. His specimens were sought after, because they contained all the parts of each plant, rendering them more valuable. Acquiring all the plant parts was an ambitious undertaking, however, and required a collector to return to each location to harvest both flower and fruit. For Parry this was a labor of love, and he is known to have valued the uninterrupted time he spent in his "den" engaging in all these tasks.

He also collected seeds and bulbs to sell. In some cases this required inordinate patience and stamina, such as when he was "awfully busy watching seeds of conifer, almost afraid to sleep lest they should open and fall out" (Parry 1872). Some of the trees that populated the new Stanford University in the 1880s came from Parry's seeds, acquired by Leland Stanford, founder of the university.

SAVING THE TORREY PINES

Parry returned to San Diego in 1883 and revisited the Torrey pines that he had discovered 33 years earlier. He knew this was the rarest pine in America and saw that it was in jeopardy of extinction due to development pressures and vandalism. Parry sounded the alarm and wrote a historical and scientific account of the pines, explaining the importance of preserving them. He then presented it to the San Diego Society of Natural History. In 1885 the San Diego County Board of Supervisors ordered that signs be posted offering a \$100 reward for information leading to the arrest of Torrey pine vandals. Then in 1888, Parry's friend J.G. Lemmon urged more ordinances be enacted to protect the trees. Finally in 1899, after more trees had been cut, the City of San Diego established a public park on more than 350 acres where many of the Torrey pines were located.

Although Parry died the following year, the work he had started to protect the Torrey pines continued. Around 1910 philanthropist Ellen Browning Scripps bought more land adjacent to the park to prevent proposed development. She donated it to San Diego under the stipulation that it became part of the park. In 1924 the City added more land to the park, increasing the area to almost 1,000 acres, again with the intention of protecting the Torrey pines. In the 1950s, following a special city election, the City turned park ownership over to the State, which then established it as a state reserve. The new status afforded it greater legal authority to protect the endangered trees.

Torrey Pines State Natural Reserve remains today as one of the wildest stretches of land on the Southern California coast, and encompasses 2,000 acres of chaparral, the rare and elegant Torrey pines, miles of unspoiled beaches, and a lagoon that is vital habitat for mi-

TABLE 1. A SAMPLE OF PLANTS DISCOVERED BY C.C. PARRY IN CALIFORNIA.

Napa Range near Calistoga:

Whiteleaf manzanita (*Arctostaphylos manzanita*)
Wavyleaf ceanothus (*Ceanothus foliosus*)
Parry ceanothus (*Ceanothus parryi*)

Monterey County:

Parry's mallow (*Eremalche parryi*)

San Bernardino Mountains:

Parry's blue-eyed Mary (*Collinsia parryi*)

Desert East of San Bernardino:

Parry's beargrass (*Nolina parryi*)

San Diego Area:

California barrel cactus (*Ferocactus cylindraceus*)
Parry's phacelia (*Phacelia parryi*)

San Geronio Pass:

Lemon lily (*Lilium parryi*)

San Felipe Area:

Engelmann's hedgehog cactus (*Echinocereus engelmannii*)

grating birds. Parry is honored by the Parry Grove Trail at the Reserve. The pine is still the rarest in America. More details about the story can be found at www.torreypine.org/history/history.html.

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View of the author's garden in May with a yellow form of naked buckwheat (*Eriogonum nudum* 'Ella Nelson's Yellow') in profuse bloom. Note the slope of the garden, which provides good drainage, a requirement of most buckwheats. All photographs by the author.

THE GARDEN INTRODUCTION OF *ERIOGONUM NUDUM* 'ELLA NELSON'S YELLOW'

by Eric Nelson

E*riogonum nudum* 'Ella Nelson's Yellow' is a seed strain I have named and introduced through California Flora Nursery in Sonoma County. The species is commonly known as naked or nude buckwheat. It is a widespread and drought-tolerant California native perennial. 'Ella Nelson's Yellow' naked buckwheat features sulfur-yellow pom-pom flower clusters atop several naked stems that reach up to three feet tall. Not only

does the plant easily survive harsh summer conditions without water, but it continues to bloom over a long period of time.

Plants produced from this seed strain have performed admirably in my relatively low-elevation Sonoma County garden when afforded abundant sun and well-drained soil. This seed strain is from a population located near the Trinity-Humboldt County border in northwest California.

I have dedicated the horticultural use of this naked buckwheat to my late grandmother, Ella Nelson, who was a lover of plants and an avid gardener well into her nineties. She and my grandfather, Elmer Nelson, helped raise me and provided my initial exposure to the garden use of native plants at a young age. Their El Cerrito, California backyard contained many plants reflective of the northwestern California campgrounds they visited every

summer. The focal point of the yard was provided by two large redwood trees propagated from cuttings by my grandfather. Beneath the shade of these trees, my grandmother planted sword fern and redwood oxalis. My grandmother remained a garden enthusiast for nearly the entire 72 years she lived in her East Bay home. In 2008, at the age of 97, she moved to Santa Rosa.

PLANT DESCRIPTION

The one- to two-inch spooned-shaped gray-green leaves of 'Ella Nelson's Yellow' naked buckwheat form a basal mound six to ten inches wide. The non-descript foliage belies the large rootstock that extends deep into the ground below it. The moisture-conserving foliage and the tough, moisture-seeking roots combine to allow the plant's survival through the extreme drought conditions in the open gravelly areas where the plant tends to make its home.

As spring arrives, several one- to three-foot tall naked stems appear. Beginning around mid-May, a profusion of bright sulfur-yellow flower clusters adorn the tips of the plant's green stems. Once the heat of summer intensifies and lingers, most of the spring flowers dry to a golden brown. However, there is some sporadic bloom during the later summer months when other native plant color is lacking in the garden. Another show of blooms, albeit not nearly as striking as the spring show, may appear when the early fall heat fades. These sparser blooms may last deep into the fall. As with all buckwheats, 'Ella Nelson's Yellow' attracts many pollinators and other beneficial insects, and therefore is also a terrific plant for a habitat garden.

CULTURE

Like most buckwheats, *Eriogonum nudum* needs well-drained soil and abundant sun, although it can tolerate light shade and periodic wa-

tering. Planting in loose hillside soil or atop slight mounds will provide optimal conditions for this buckwheat. Groupings of at least three plants located about one foot apart will enhance the flower display.

New plants in the garden should only need periodic watering until established. Established plants require little or no summer water. Too much water can weaken or kill the plant. Leaves tend to shrivel during the hottest months of summer, particularly on those plants receiving maximum sun. The basal clump of leaves will rejuvenate during the winter.

The plant requires little, if any, maintenance. Brown stems and flower heads can be removed to improve the appearance of the plant as the dry season wears on. Although this buckwheat is a relatively short-lived perennial, volunteer seedlings are common on well-drained bare ground if the spent flower heads are allowed to remain on the plant.

Gardeners should take special note that many buckwheats readily hybridize. To preserve and protect local genetic strains, 'Ella Nelson's Yellow' should not be planted in the vicinity of wild populations of naked buckwheat (*Eriogonum nudum*) or other hybrid-compatible buckwheats such as seaside buckwheat (*E. latifolium*) and red-flowered buckwheat (*E. grande* var. *rubescens*).

OTHER NAKED BUCKWHEATS

Other naked buckwheat color selections I have grown in my garden have proved equally as hardy as the yellow form, but have not come close to providing the same color intensity. A white form from Sonoma County looked interesting in the light of a full moon. A pink form from Lake County approached its bloom period with a flush of deep red, but flower clusters opened to a light dusty pink. No garden-worthy offspring arose from the crossbreed-



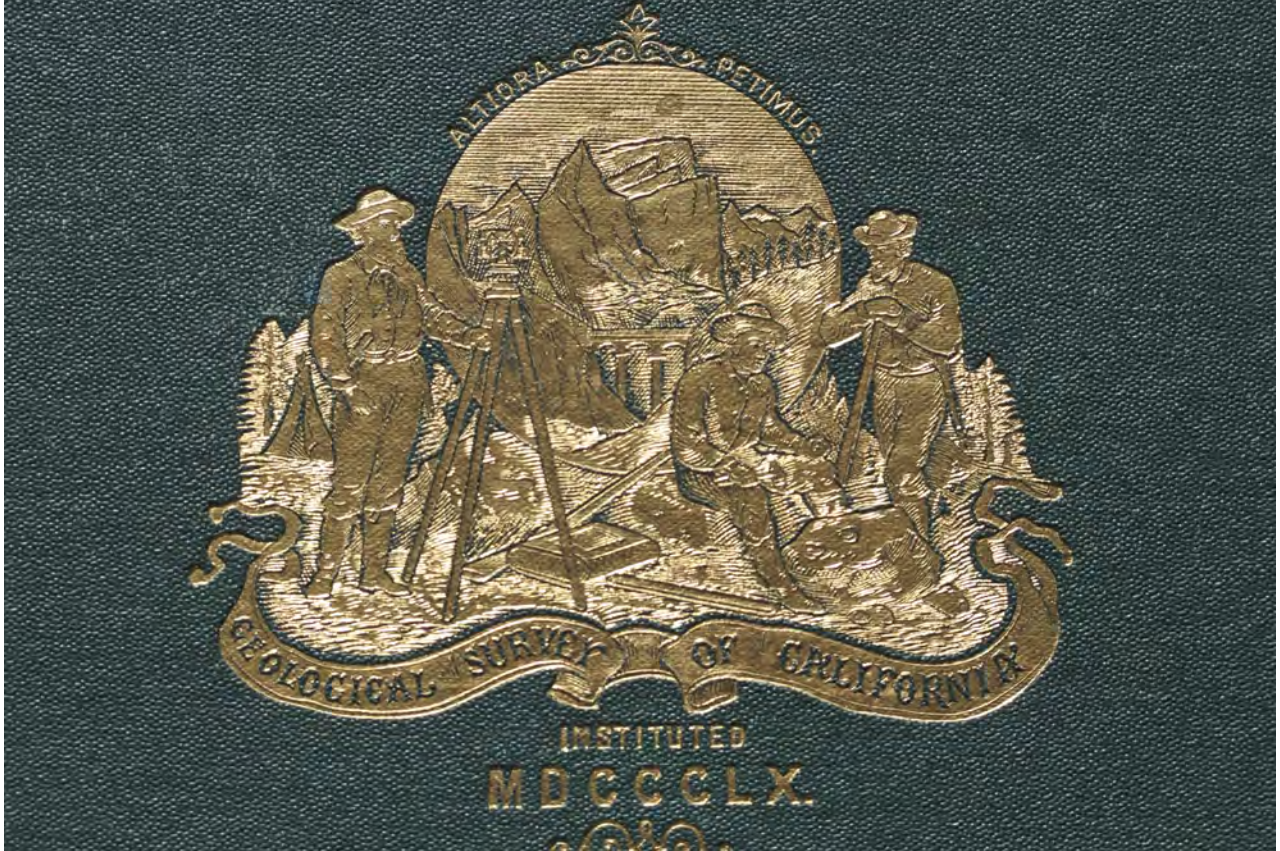
This buckwheat's bright yellow flower clusters have an airy appearance.

ing of the three color forms of naked buckwheat I have grown. However, there are likely other forms of *Eriogonum nudum* to be discovered in the wild which will prove welcome additions to native plant gardens.

GARDENING FOR A WARMING CLIMATE

As climate conditions continue to become warmer and drier, the many species of available native buckwheats, including the seldom-used *Eriogonum nudum*, can provide a wide array of very drought tolerant and attractive subjects for the water-wise garden. Lester Rowntree (1879–1979), pioneering California botanist, adventurer, writer, and lecturer, wrote the following about a yellow form of *Eriogonum nudum* in her book *Hardy Californians: A Woman's Life With Native Plants*: "This grows in northern California and covers bare banks of sandy soil with its dark green, three-foot stems and branching sprays of light or bright yellow flowers. This buckwheat should make a hit with gardeners." The colorful *Eriogonum nudum* 'Ella Nelson's Yellow' has many fine qualities that will attract gardeners to the use of this beautiful and hardy buckwheat species.

Eric Nelson, 5619 Monte Verde Dr., Santa Rosa, CA 95409, ericn@saber.net



CLOCKWISE FROM ABOVE, THESE TWO PAGES: Cover with embossed emblem of the California Geological Survey, title page of Volume I, and book spines, all from the first flora of California.

THE BOTANY OF CALIFORNIA: CALIFORNIA'S FIRST FLORA

by James P. Smith, Jr.

[Editor's Note: This is a botanical companion piece to a historically oriented article on the same subject that appeared in *Fremontia* 40.1/40.2, January and May 2012.]

Imagine two books bound in green with embossed gold leaf images on their covers. The spines bear the words "Geological Survey of California Botany, Vol. I and Vol II." Together they number 1,187 pages with detailed descriptions of about 3,400 plants. This work is the first comprehensive flora of California. Volume I, written by William Henry Brewer, Sereno Watson, and Asa Gray, was published in 1876. A second edition, with no substantive changes, appeared in 1880, along with Volume II, authored solely by Watson. The publication of this first flora was made possible by private

donations and book sales to subscribers. The books are now rare and rather expensive in the out-of-print market, but readily available in reprint editions.

EARLY BOTANICAL EXPLORATION OF CALIFORNIA

Let's put this flora in some context. Native Americans had named and classified California plants for thousands of years. Their activities had a very practical basis—some plants were edible, others were not; some were poisonous, while others had curative powers. Some of that knowledge has come down to us through oral tradition, but much of it has been lost.

The study of our flora entered a

new phase with the arrival of explorers and scientific parties from France, Spain, and Russia. In 1786, Jean-Nicolas Collignon of the Jardin du Roi was a botanist on the La Pérouse expedition to the South Seas. He sent three seed packets back to France from his ten days of botanizing at Monterey. They yielded plants of a new species, described by Jean-Baptiste Lamarck as *Abronia umbellata* (pink sand verbena). It would be the first new plant described from west of the Mississippi River.

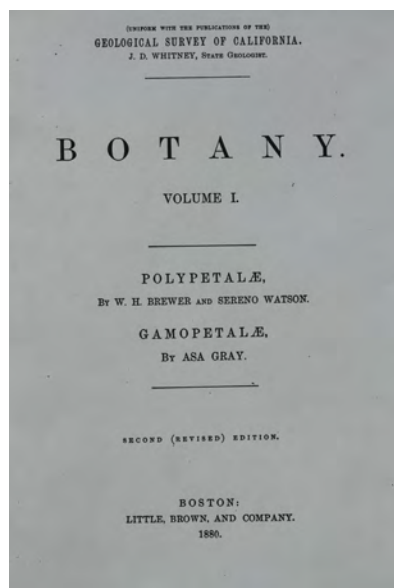
In September 1791, the *Descubierta*, commanded by Alessandro Malaspina landed at Monterey Bay. On board were two botanists, Luis Née and Thaddeus Haenke; the latter would make the first scientific collections of western North American plants. By this I mean pressed and dried plant specimens that

would be deposited in a herbarium. He collected a “red cypress,” what we now call coast redwood (*Sequoia sempervirens*). Haekne’s plants were initially described and published by Karel Presl (1825–1835).

In 1816, the *Rurick*, under the command of Otto von Kotzebue, entered San Francisco Bay. On board were Adelbert Ludwig von Chamisso and Johann Friedrich Eschscholtz. Von Chamisso would name one of the plants they found, *Eschscholzia californica* (California poppy), and in 1903 it would become our official state flower. In the next few decades, numerous botanists from around the world and from the eastern United States came to study and collect the flora of the Pacific coast. Archibald Menzies, David Douglas, Thomas Coulter, Thomas Nuttall, William Gambel, Charles Geyer, Karl Hartweg, Charles C. Parry, John Jeffrey, George Engelmann, John Frémont, John Torrey, and Asa Gray are names familiar to students of botanical history. Every one of them is honored in the scientific names of California plants. They collected thousands of specimens that were often sent to world-renowned plant taxonomists at Harvard, Kew, Paris, and Berlin for determination or description as a new genus, species, or variety.

What was missing was some way of organizing this knowledge and making it available to the scientific community and to the public. Herbarium specimens of California plants had been made, but almost all of them resided in collections back east or in Europe. There were dairies, collection notes, and fragmentary lists of collections in scientific journals, but nothing that purported to be even a rudimentary flora of California.

The most extensive compilation to date had been published by William J. Hooker and G. Arnott Walker in their account of the plants collected by Tradescant Lay and Alexander Collie during the 1825–



1828 voyage of *H.M.S. Blossom*, under the command of Captain Frederick Beechey. It contained two catalogues of California plants, the first reporting 51 families, 128 genera, and 183 species. In 1840–1841 they published a supplement to the California flora. Hundreds of plants were listed. For the most part, these plants were not collected by Lay and Collie, but by David Douglas, Archibald Menzies, and others. To add to the confusion, some of the plants they list were not collected in California, but from as far away as present day Wyoming.

The account of the United States Exploring Expedition of 1838–1842, under the command of Charles Wilkes, contains a major inventory of the vascular plants of the Washington Territory, Oregon, and California written by John Torrey (1874). He listed 78 families, 249 genera, and 347 species as occurring in California. Although both of

these works provide specimen-based accounts, neither was intended nor should be seen as comprehensive.

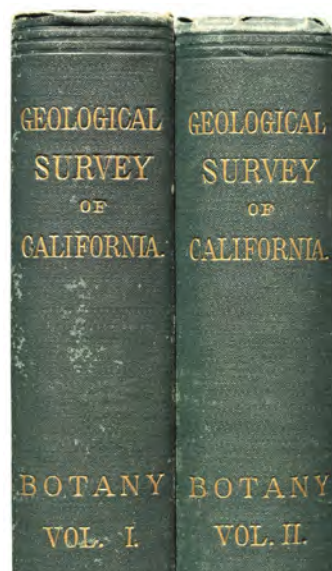
CALIFORNIA GEOLOGICAL SURVEY AND ITS CHARGE

A critical event in our story occurred in 1860. The California legislature created an Office of State Geologist, named Joseph Dwight Whitney to fill the position, and then authorized a geological survey to include a “full and scientific description of its botanical productions.” Whitney chose William Henry Brewer to be chief botanist. They estimated that the flora of California would contain about 2,000 plants, and that identifying and describing them could take up to two years. That number, by the way, was considerably higher than other estimates of the time.

Much of the actual naming of the specimens was done by Asa Gray at Harvard University. Major contributions were made by George Engelmann (oaks, pines, dodders, and mistletoes), Michael S. Bebb (willows), Daniel Eaton (ferns and mosses), and George Thurber (grasses). Brewer’s collections of 1860 to 1864, along with those of Henry Bolander from the Sierra Nevada and the northern Coast Ranges, would later form the basis of the University Herbarium at Berkeley, founded in 1895.

THE FORMAT OF THE BOTANY OF CALIFORNIA

When we page through these two volumes, what do we find? They are in English. Be grateful. Slightly older works were written in Latin, the language of science and scholarship of the period. Although the commentary in the Torrey (1874) flora is in English, all of the plant descriptions are in Latin. A typical page in the *Botany of California* is very similar





While many family concepts have changed little, if any, since the publication of the *Botany of California*, others have undergone dramatic revisions. For example, the geranium family (Geraniaceae) of 1800 includes many species that we now place in the touch-me-not family (Balsaminaceae), meadow foam family (Limnanthaceae), nasturtium family (Tropaeolaceae), and sorrel family (Oxalidaceae). Above are

to that of a modern flora. There are descriptions of families, genera, and species, but no photographs or illustrations.

On closer inspection you will notice that what the authors call orders we now call families. Many of these names are very familiar to us. There are minor differences in spelling of family and plant names, and in terminations of specific epithets. There was no international set of rules dealing with such matters at the time. There are keys, but many of them are not in the format of modern dichotomous keys. Measurements are in feet, inches, spans, and lines. (A span is the distance from the tip of the little finger to the tip of the thumb when the hand is fully extended, or about 9" (23 cm). A line equals 2.25 mm.)

In 1880 Rutherford B. Hayes was president and Victoria sat on the throne of England. The two volumes reflect the now wonderfully archaic language of that time. Financial backers, among them Leland Stanford and Charles Crocker, were thanked for providing "the necessary pecuniary means" and for their "munificent act[s]." There are many

"thithers" and "thences." Plants were said to "exhale an agreeable aroma." They were "homely weeds," "strikingly handsome," "unpleasantly rank," or "modest and unpretentious, but peculiar." They had "demulcent properties" or were "wholly inert" and sometimes "occur in multifarious forms." Fruits were "innocent and aromatic." Plants were "peculiar" to an area, or "not met with," but "will doubtless be detected." Species concepts were "presently received," but sometimes "confounded" with one another. Some plants were "exceedingly tenacious of life." They noted that "Nature furnishes several varieties and art has produced many more."

The title of our first real flora, *Botany of California*, is not quite accurate. Plants from southern Oregon, Arizona, and northern Nevada are included, as are those that are "no doubt here" and "to be expected." Some entries have no location information; in others a place is cited, but it is difficult to find it on modern maps. This complicates making a quick tally of plants.

Volume I begins with the treatment of the buttercup family (Ra-

nunculaceae), continues through the treatment of the plantains (Plantaginaceae), and ends with ten pages of additions and corrections. The sequence of families follows earlier works by Gray and John Torrey, where plants are "arranged according to the natural system."

Volume II continues the treatment of flowering plants, beginning with the four o'clock family (Nyctaginaceae) and ending at the mistletoes (Loranthaceae), the last dicot family. Next you would expect to launch into a treatment of the monocots, but prepare to be shocked—it's the gymnosperms. This was standard at the time because many gymnosperms had two cotyledons and their reproductive structures were routinely referred to as flowers. Next come the monocot families, beginning with the water weeds (Hydrocharitaceae) and ending with the grasses (Gramineae).

After the flowering plants were what the authors call "flowerless plants:" ferns and mosses. The original flora would have included liverworts, lichens, and fungi, but they were insufficiently known and as Watson noted, "inasmuch as they



illustrations of a few of these species that have changed families since the original flora was published. All illustrations are by Walter Sydoriak except the one of red sorrel, which is by Suzanne Cogen. LEFT TO RIGHT: Long-beaked filaree (*Erodium botrys*); white meadowfoam (*Limnanthes alba*); yellow sorrel (*Oxalis corniculata*); Bicknell's geranium (*Geranium carolinianum*); Richardson's geranium (*G. richardsonii*); and redwood sorrel (*Oxalis oregana*).

would be of no use to the many and could be of little good to any, they have been wholly omitted." The remainder of Volume II consists of an extensive list of additions and corrections to Volume I ("rendered necessary by fresh discoveries made by various zealous collectors in the field"), a glossary, and a fascinating and useful list of the principal collectors of our flora compiled by Brewer.

Those familiar with Munz (1959), Hickman (1993), or Baldwin et al. (2012), will feel reasonably comfortable with many of the family concepts in the *Botany of California*. A few names, such as Cupuliferae and Ficoideae, are no longer used, although their modern equivalents, Fagaceae and Aizoaceae, are immediately evident. Similarly, joint-fir or Mormon tea (*Ephedra* spp.) and yerba mansa (*Anemopsis californica*) were placed in the Gnetaceae and Piperaceae, respectively.

On the other hand, the *Botany* was ahead of its time in taking a broader view of the heath family (Ericaceae), by including the maples and horse chestnut in the soapberry family (Sapindaceae), and placing

the bur-reeds (*Sparganium*) in the cattail family (Typhaceae). The greenbriars were placed in their own family (Smilacaceae). Tamarisk or salt-cedar had not been reported for the state, but the family (Tamaricaceae) appeared. It contained the ocotillo (*Fouquieria splendens*), now in its own family.

SIZE OF OUR FLORA, THEN AND NOW

A comparison of our flora as reflected in the *Botany of California* of 1880 and as it is treated in the new edition of *The Jepson Manual* (Baldwin et al. 2012) is revealing (Table 1): a 239% increase in the current flora over what was known in 1880 is certainly dramatic. What accounts for this? Many decades of field work documented that hundreds of previously described native plants from *outside* California now were found growing in California. Those same efforts also yielded hundreds of native plants that were new both to California and to science in general. A third component was the influx of hundreds of species of

weeds, escaped crops, and ornamentals from around the world, and that are now well established in our state. Their persistence has been documented in California floras subsequent to the *Botany of California*.

Our evolving concept of the limits of families, genera, and species is an important factor in explaining the change and in confounding what might otherwise be a straightforward comparison between the first flora and the new *Jepson Manual*. The change from 117 to 165 families could suggest that flowering plants belonging to 48 unreported families have made their way into California since 1880. What those numbers hide is that more recent research has led to the merging of some closely related genera and species with one another, while in other cases to recognizing new entities from within the spectrum of variation of existing genera and species. The Boraginaceae of 1880 did not include the Hydrophyllaceae, as it does today; nor did the Apocynaceae include the Asclepiadaceae. The Liliaceae of 1880 is now distributed among 13 families. Plants of the Scrophulariaceae of 1880 now find themselves in three



Changes in botanical nomenclature are continually occurring—the two illustrations here are of species that have been reclassified in the new *Jepson Manual*, 2nd edition. They include Santa Cruz cypress (*Cupressus abramsiana*) that was renamed *Hesperocyparis abramsiana*, and tanoak (*Lithocarpus densiflorus*), which is now *Notholithocarpus densiflorus*. Both illustrations are by Maria Cecilia Freeman, <http://www.mcf-art.com>. (The first may be familiar to *Fremontia* readers, because she won first prize for it at the 2009 CNPS Conservation Conference Botanical Art Show.)

families. Genera have suffered a similar fate. The *Aster* of 1880 is now nine smaller genera, none of them *Aster*; *Haplopappus* has been dismembered into 11 genera; *Polygonum* into five; and *Scirpus* into six. This might be termed a taxonomic version of putting old wines in new bottles.

The publication of the *Botany of California* and a series of local and regional floras had a curious and unintended consequence. They created the impression in some that our knowledge of the flora of California was now essentially complete. Plants that could not be identified in a dichotomous key should be discarded. They were considered “not to be of much moment,” otherwise they would have appeared in these authoritative works. Marcus E. Jones, an eccentric and sharp-tongued figure of the time, is reported to have felt sorry for future botanists because all of the plants in the western United States had been named. What was left for them to do?

As it turned out, much more indeed. In 1909, Willis Linn Jepson published the first volume of his *Flora of California*, which began on page 33 with the gymnosperms and was never completed. In 1923, LeRoy Abrams published the first volume of his monumental *Illustrated Flora of the Pacific States*, which hastened the appearance in the following year of Jepson’s *Manual of the Flowering Plants of California*. In 1959, Philip Munz published *A California Flora*, followed by a major supplement in 1968. In 1993, we saw the appearance of the first edition of *The Jepson Manual of Higher Plants of California*, edited by James Hickman. A second edition was published in 2012, edited by Bruce Baldwin and others.

Lest we fall prey to the notion that now, at last, we really do know all there is to be known about the flora of California, the words of

Sereno Watson in his introduction to the second volume of the *Botany of California* provide us guidance:

There still remains ample opportunity for good botanical work at almost any locality among the mountains, hills, and valleys of the State, to which it is hoped that these volumes may prove both an incentive and an aid.

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TABLE 1. COMPARISON BETWEEN TWO CALIFORNIA FLORAS.

	<i>Botany of California</i>	<i>The Jepson Manual (2nd ed.)</i>
Number of families:		
Ferns and allies	11	16
Gymnosperms	5	4
Flowering plants	117	165
Total	133	185
Number of genera:		
Ferns and allies	22	35
Gymnosperms	14	16
Flowering plants	739	1269
Total	775	1320
Number of species:		
Ferns and allies	53	111
Gymnosperms	38	62
Flowering plants	2733	6145
Total	2824	6318
Number of taxa:		
Ferns and allies	62	116
Gymnosperms	45	71
Flowering plants	3063	7392
Total	3170	7579
Five largest families in terms of genera	Sunflower (128) Grass (61) Lily (31) Mustard (30) Rose (28)	Sunflower (234) Grass (100) Mustard (64) Legume (50) Rose (45)
Five largest families in terms of species	Sunflower (474) Legume (179) Grass (171) Figwort (139) Lily (116)	Sunflower (901) Grass (447) Legume (394) Borage (315) Mustard (294)
Five largest families in terms of taxa	Sunflower (543) Legume (200) Grass (181) Figwort (156) Lily (132)	Sunflower (1106) Legume (521) Grass (482) Borage (370) Buckwheat (349)
Five largest genera in terms of species	<i>Carex</i> (76) <i>Eriogonum</i> (51) <i>Gilia</i> (42) <i>Lupinus</i> (42) <i>Astragalus</i> (41) <i>Phacelia</i> (37)	<i>Carex</i> (136) <i>Eriogonum</i> (118) <i>Astragalus</i> (96) <i>Phacelia</i> (95) <i>Lupinus</i> (73)
Five largest genera in terms of taxa	<i>Carex</i> (88) <i>Eriogonum</i> (58) <i>Gilia</i> (52) <i>Lupinus</i> (49) <i>Astragalus</i> (44)	<i>Eriogonum</i> (214) <i>Astragalus</i> (144) <i>Carex</i> (141) <i>Lupinus</i> (104) <i>Phacelia</i> (106)

Under the Command of Charles Wilkes, U.S.N., ed. A. Gray. Vol. XVII. Botany. Sherman & Company, Philadelphia, PA.

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BOOK REVIEWS

The California Native Landscape, The Homeowner's Design Guide to Restoring its Beauty and Balance by Greg Rubin and Lucy Warren. 2013. Timber Press, Portland, OR. 372 pages, \$25.79, hardcover. ISBN #978-1-60469-232-7.

In their first collaboration, Greg Rubin and Lucy Warren have put together a colorful and information-filled new treatment on native plant landscaping. Sure, there are lots of how-to books out there devoted to the use of native plants in the garden. But the authors have created a different and very functional guide to the design, selection, and planting of native species ranging from ground covers to large trees and everything in between.

Much of this book is based on a tried-and-true methodology. Greg was

formally trained as an aerospace engineer. He made the big career switch to native plant landscaping when landscaping his parents' home in Los Angeles many years ago. Lucy, a master gardener and gifted writer, loves all things that are plant-related, but had never specifically focused on native species. Each of the authors brings a unique approach to the subject.

The book is divided into eleven chapters. The important middle chapter (Chapter 6) on plant selection stands out. It is printed on orange and yellow-edged paper, which flags it for easy reference. The first five chapters provide background.

Chapter 1, The California Environment, describes the rich diversity of native species found in natural areas of our state. The second chapter, Human Impact on the Landscape, corrects some of the misinformation about what makes a landscape truly "native," and how the concept of lawns, greenspaces, and ornamental plants has changed the way many Californians see nature. This fascinating section discusses the countless changes that humans have brought to the natural world, and how very few areas remain in California that are not marred with non-native invasive species such as Saharan mustard (*Brassica tournefortii*) and cheatgrass (*Bromus tectorum*).

Chapter 3 examines the often underappreciated relationship between soil (particularly soil microorganisms) and native plants. Chapters 4 and 5 delve into landscape design and garden style. These two chapters are "must reads" for anybody looking to design a new landscape project or who wants to significantly modify an existing one. Elements such as plant structure, massing, color and texture, the use of paths, garden furniture, stones and boulders, etc. are discussed at length in Chapter 4, providing precisely what is needed for success. I particularly valued the discussion of contrasts and the use of the landscape design elements in an integrated fashion to create mood. Yes, I know that this is Landscape 101, but it is wonderfully presented in this chapter.

Chapter 5, Garden Style, presents five distinct types: Formal, Contemporary, Mediterranean, Desert, and Asian. Each contains a one-page description, followed by an exemplary illustration

and photographs of actual native plant gardens based on these themes.

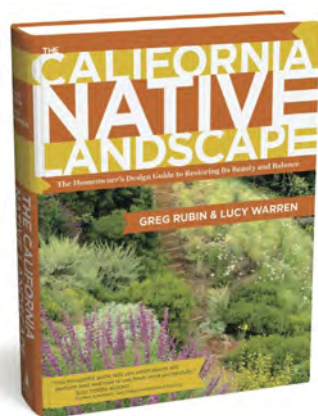
The last five chapters contain the nuts and bolts of landscaping: Installation (Chapter 7), Care and Maintenance (Chapter 8), Pests and Disease (Chapter 9), Weeds (Chapter 10), and Fire (Chapter 11). As a biologist, my work is focused largely on habitat restoration, which in most ways is a form of native plant landscaping. So I was particularly interested in the discussion in Chapter 7 about irrigation, since overwatering is a leading cause of habitat restoration failure and is known to shorten the life of many native species, particularly California lilac (*Ceanothus* spp.). The authors acknowledge this and are careful to explain how irrigation, if overused or used at the wrong time, can ruin native landscapes.

The last chapter, which is about fire, is a fascinating discussion of how native landscaping integrates (or should integrate) into California fire management. The chapter dispels a number of myths about the "fuel" that our native plants supposedly accumulate which then creates a fire hazard.

The book ends with a vision for California that many readers will share. To quote the authors, this vision is one of a better approach to landscaping throughout the state, one that is "much more purposeful, healthier, and sustainable . . . full of color, fragrance, and wildlife."

So should you own this book? You can bet that I do! For anyone with an interest in doing their own native plant landscaping or planting natives in general, the answer is a resounding "Absolutely!"

—Vince Scheidt



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FROM THE EDITOR

In recent years I've found myself wondering what leads some people to care about the natural world and want to protect it. My theory is it has to do with things experienced during one's early years.

In my case, at the age of nine my bedroom was cluttered with plants I had started from seeds, and also where I raised brine shrimp for the inhabitants of my fish tank. I took care of our small backyard garden, where I got to witness close-up rabbits, squirrels, and cardinals. Who knows why a child is drawn to certain things, but these were my passions.

In contrast, my neighbors' four-year-old, Sidney, seems to be acquiring a love for the outdoors for entirely different reasons. Her family spends weekends camping every chance they get. She has also lived with two dogs and a cat since she was born, so having animals nearby is natural to her. Even at home, her family spends much of its time outdoors, and she doesn't own lots of electronic gadgets to distract her and her playmates.

The 24-year-old Patrick Lee who took this issue's striking cover photo, says his appreciation of nature developed during high school when he came across beautiful landscape photos on the Internet. They inspired him to buy a camera and take his own photos of nature. He also ended up majoring in biology at UCSD.

Everyone has a different story. If you are motivated to share yours, send a brief (150-word) summary of what shaped your love for nature to bhass@cnps.org, and it might get published in a future issue of *Fremontia*.

—Bob Hass
