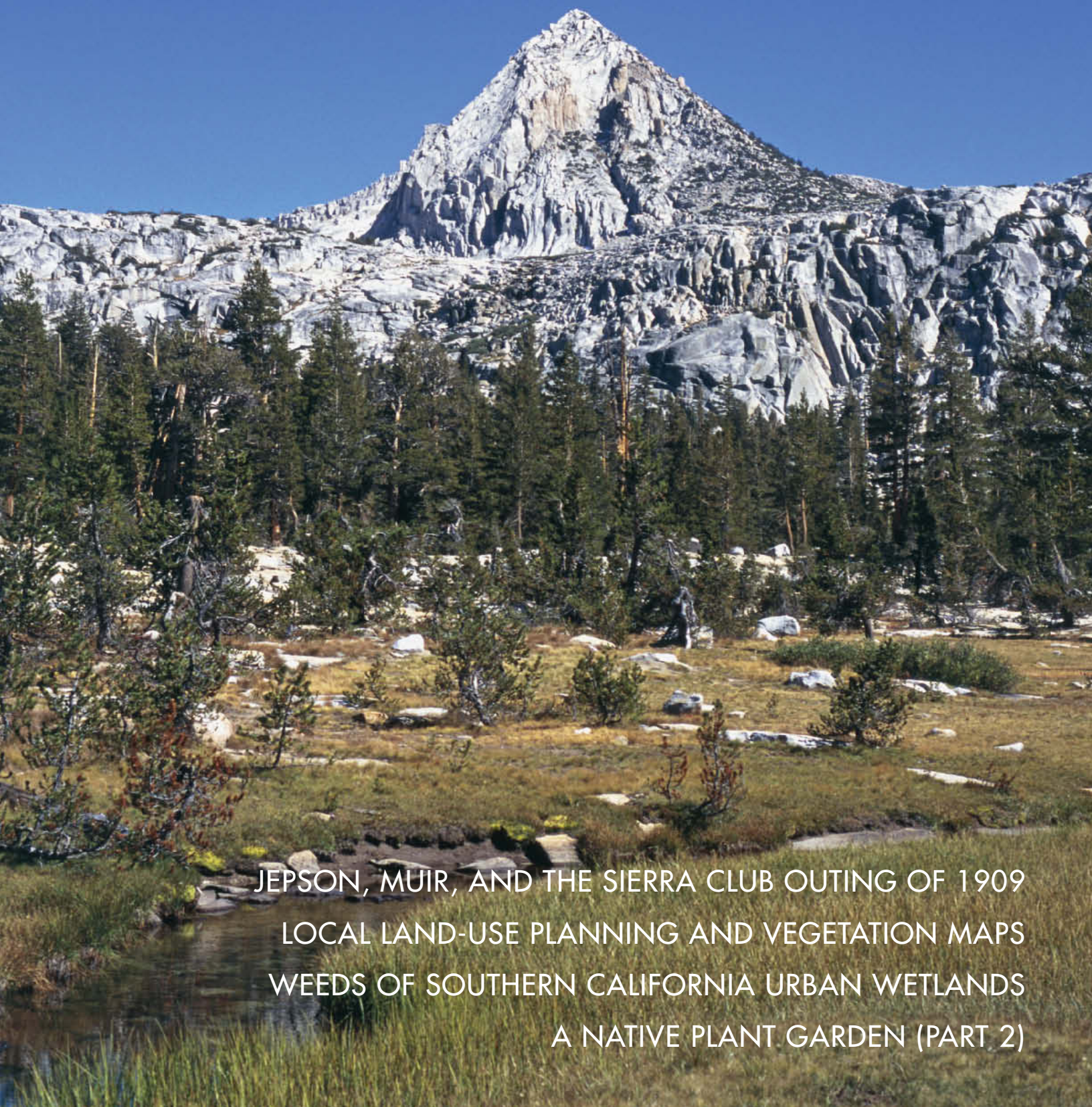


VOL. 34, NO. 3 • JULY 2006

FREMONTIA

A JOURNAL OF THE CALIFORNIA NATIVE PLANT SOCIETY



JEPSON, MUIR, AND THE SIERRA CLUB OUTING OF 1909
LOCAL LAND-USE PLANNING AND VEGETATION MAPS
WEEDS OF SOUTHERN CALIFORNIA URBAN WETLANDS
A NATIVE PLANT GARDEN (PART 2)

FREMONTIA

VOL. 34, NO. 3, JULY 2006

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California Native Plant Society

Linda Ann Vorobik and Bart O'Brien,
Co-Editors

Bob Hass, Copy Editor

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CALIFORNIA NATIVE PLANT SOCIETY

*Dedicated to the Preservation of
the California Native Flora*

The California Native Plant Society (CNPS) is a statewide nonprofit organization dedicated to increasing the understanding and appreciation of California's native plants, and to preserving them and their natural habitats for future generations.

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.

Since its founding in 1965, the traditional strength of CNPS has been its dedicated volunteers. CNPS activities are organized at the local chapter level where members' varied interests influence what is done. Volunteers from the 33 CNPS chapters annually contribute in excess of 87,000 hours (equivalent to 42 full-time employees).

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Most of Fremontia readers know the name Willis Linn Jepson as the first botanist at UC Berkeley and the namesake for one of our state floras: The Jepson Manual. In this article view Yosemite from Jepson's perspective, as he travels through the area with John Muir and others in the early 1900s.

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As a good-bye to readers in her last issue as editor of Fremontia, Linda Ann Vorobik shares some of her photographic images collected from the Sierra Nevada: a page of insects and flowers, and a page of paintbrushes (Castilleja). These images were taken during her field work for her upcoming guidebook to Sierra Nevada plants.

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THE COVER: Mountain, subalpine, and meadow in the high Sierra, as would have been seen by W.L. Jepson and his companions on their 1909 journey (see page 3). Photograph by L. Vorobik.

EDITORIAL: WELCOME BART O'BRIEN!

After over five years of editing *Fremontia*, journal of the California Native Plant Society (CNPS), I am very pleased to hand over the role of editor to Bart O'Brien, long-time CNPS member, outstanding horticulturist and botanist at the Rancho Santa Ana Botanic Garden (RSABG), and co-author of the award-winning *California Native Plants for the Garden* with Carol Bornstein and David Fross. This beautiful volume is reviewed in the January issue of *Fremontia* (Volume 34, No.1).

Bart brings so much to this society as editor of its journal. He has authored numerous publications including those in *Fremontia*, and was the convening editor for the special issue of *Fremontia* on growing native plants for the garden (Volume 29, No. 1).

His ongoing work with the Los Angeles River substantially contributed to the collaborative publication of the award-winning *Los Angeles River Master Plan Landscaping Guidelines and Plant Palettes* for the Los Angeles County Department of Public Works in 2004. His latest book, co-authored with Betsey Landis of CNPS and Ellen Mackey of Theodore Payne Foundation, is the bilingual *Care & Maintenance of Southern California Native Plant Gardens – Cuidado y mantenimiento de jardines de plantas nativas del sur de California* to be published this summer by Metropolitan Water District of Southern California.

Bart is best known for his knowledge as a horticulturist: he has introduced numerous different native plant cultivars including those from some of our favorite genera: *Arctostaphylos*, *Ceanothus*, *Dendromecon*, *Heuchera*, *Malacothamnus*, *Zauschneria* (*Epilobium*), and section *Audibertia* of the genus *Salvia*. He was named Horticulturist of the Year in 2005 by the Southern California Horticultural Society. This year he was honored with a life membership from the California Garden Clubs, Inc. In addition, Bart is a fifth generation Californian (born and raised in Hollister) and is an accomplished collector, grower, photographer, and lecturer.

Bart also brings with him a thorough knowledge of Southern California native plants, as he has done extensive field work in the southern inner Coast Ranges (especially in San Benito County), the eastern Mojave ranges, as well as in Baja California, primarily from the US border south to the Vizcaino Peninsula.

I am particularly excited that *Fremontia* will now be seated in Southern California at RSABG. Now we can strengthen the numbers and kinds of contributions to our journal from that area. Thanks to RSABG for supporting Bart in his role as *Fremontia* editor, and to the University Herbarium, UC, Berkeley for their support in kind of my editorship.

Linda Ann Vorobik
Out-going Editor, *Fremontia*

USEFUL WEBSITES AND CONTACT INFORMATION

California Native Plant Society (CNPS):

www.cnps.org, with links to conservation issues, chapters, publications, policies, etc.

For updates on conservation issues:

Audubon Society
www.audubon.org

Center for Biological Diversity
www.sw-center.org

Native Plant Conservation
Campaign www.plantsocieties.org

Natural Resources Defense
Council
www.nrdc.org

Sierra Club
www.sierraclub.org

Wilderness Society
www.wilderness.org

For voting information:

League of Women Voters
www.lwv.org, includes online voter guide with state-specific nonpartisan election and candidate information.

US Senate
www.senate.gov

US House of Representatives
www.house.gov

California State Senate
www.sen.ca.gov

California State Assembly
www.assembly.ca.gov

To write letters:

President George W. Bush
The White House
1600 Pennsylvania Ave. NW
Washington, DC 20500

Senator Barbara Boxer
or Senator Dianne Feinstein
US Senate
Washington, DC 20510

Your CA Representative
US House of Representatives
Washington, DC 20515

BOTANY MAN JEPSON, NATURALIST MUIR, AND THE SIERRA CLUB OUTING OF 1909

by Richard G. Beidleman

There's nothing like a succinct academic exchange to clear the mountain air. It happened along the bank of lower Rancheria Creek in Hetch Hetchy Valley, where naturalist John Muir and Dr. Willis Linn Jepson, UC Ber-

keley professor of botany, were having lunch. The topic was plant names, and Muir was saying that he didn't like the "folk names" of plants, even if they didn't "misrepresent botanically." Citing the digger pine, he exclaimed emphatically

"No, call it Sabine pine, after Dr. Sabine."

While the designated common name for digger pine is now "foot-hill pine" or "gray pine," the scientific name remains *Pinus sabiniana*, honoring Joseph Sabine, the long-time secretary of the London Horticultural Society. Jepson did not much care professionally for plant common names either, but during his botanical travels he always noted what names the locals used for different plants. So his quick reply to John was, "If you go into the foothills and say Sabine pine to the settlers, no one would know what you mean. But the settlers know what I mean in plant names since I speak their language!"

In truth, both Muir and Jepson spoke the same mother tongue, a love for the out-of-doors. While John was a major founder of the Sierra Club, Willis was among the select few who endorsed the Sierra Club incorporation papers in 1892. The two knew each other, of course, but the previous time they were together in the field was undoubtedly at the Aleutian island of Unalaska in 1899, when the Harriman Expedition's natural scientists (including Muir) met with a four-man botanical expedition from Berkeley that included Jepson. The present Rancheria Creek luncheon exchange took place on July 27, 1909, during what was Jepson's first participation in a summer Sierra Club outing, this one to Yosemite National Park.

AS CHANCE WOULD HAVE IT

Jepson had anticipated being in Yosemite the summer of 1909, but not necessarily with the Sierra Club.

Hetch Hetchy Falls, with maul oak (*Quercus chrysolepis*), incense cedar (*Calocedrus decurrens*), and big-leaf maple (*Acer macrophyllum*). This and other black and white photographs by W. Jepson, 1909, courtesy of the Herbarium Archives, UC Berkeley.



Some months earlier, he had promised to give a series of lectures on California flowers for the newly formed Yosemite Valley Chautauqua. When problems arose with the lecture schedule and the stipend he was supposed to receive, and he was reminded that the Sierra Club was having its summer outing in Yosemite, he wavered about the lectures. The deciding factor was the controversy raging over the Hetch Hetchy Valley dam building, and Professor Jepson finally decided in favor of the Sierra Club, "for this summer I have missionary work to do . . ."

Thus it was that Willis Jepson joined the Sierra Club party of some 30 men and women for the start of the Yosemite outing at El Portal on July 3. It was indeed a distinctive field party, which included, among others, William E. Colby, secretary of the Sierra Club, Allen Chamberlain, former president of the Appalachian Mountain Club, Professor William O. Crosby, geologist of M.I.T., geologist George D. Lauderback, George Schwarz who had worked for the US Forest Service, C.W. Pohlmann who would soon be serving on the Club's Local Walks Committee, Jepson's personal friend Charlie Dutton, impresario Degraasi with his violin, and John Muir.

THE PARTY HEADS OUT

Jepson was in his floral element on the trip to Yosemite Valley from El Portal, jotting down in his field book the variety of trees and shrubs along the Merced River route, from red bud (*Cercis occidentalis*) and mustang mint (*Monardella lanceolata*) to poison oak (*Toxicodendron diversilobum*) and the first Douglas-firs (*Pseudotsuga menziesii*). When the distinctive California torreyas, with their shiny green fruit resembling unripe plums, began showing up in abundance, Jepson was delighted to inform the travelers that these were definitely not plum trees.

Two days later the excursion was on its way up into Little Yosemite Valley, past Happy Isles, Vernal and Nevada falls, and by July 7 climbing the Sunrise Trail (now part of the Muir Trail) and then east towards Echo Creek. At an overnight campsite where snow bush (*Ceanothus cordulatus*) matted the ground, hikers simply put their bedrolls atop the bushes. Off to the south was a striking view of Mt. Clark, named by Joseph Whitney of the early California Geological Survey after Galen Clark, Yosemite State Park's first guardian.

REMINISCING AND BOTANIZING

Muir told the group that the year after he first came into Yosemite Valley he had gone to work for Clark's friend James Hutchings at \$70 a month, cutting up ponderosa pine with a straight saw for lumber which would be used to build a sawmill. Muir also reminisced about his 1877 trip with Harvard botanist Asa Gray and Sir Joseph Hooker of Kew Gardens, London, toward Mt. Shasta. One evening Gray had expressed surprise that Linnaeus's favorite plant, twinflower (*Linnaea borealis*), had been found in Oregon but not in California. The next morning Hooker, crossing a small gully, discovered a plant sprawling over the slope which turned out to be the very species. "It is *Linnaea*!", Hooker exclaimed. "Strange," Muir reflected, "that it should have been found so soon after Gray's remark."

Evening saw the Sierra Club party on the shore of Lake Merced, where Jepson discovered the finest grove of quaking aspen (*Populus tremuloides*) he had ever encountered in California. With the same diligence that went into gathering data for his forthcoming *Silva of California*, Jepson proceeded to measure height and circumference of eight aspens, the tallest 80 feet high. In the process, he noted that many of the trunks bore

marks of bear claws, "sometimes long gashes where drawn down, sometimes sharp points like a driven nail."

On the evening of July 13 the group camped at the base of Lembert Dome in Tuolumne Meadows. The next morning they headed for a base camp below Mt. Dana. On the trail, Jepson and Muir discussed the different forms of tamarac (lodgepole) pines (*Pinus contorta* var. *murrayana*) in the west, noting that the ones along the coast (*P. c.* var. *contorta*) were usually dwarfed, while in other places some held closed cones for years until opened by fire.

TWO JOHNS: TORREY AND LEMBERT

The next day, while scaling Dana, Muir conversed about guiding Asa Gray in Yosemite Park back in 1872. He had shown Gray the unique torreya (*Torreya californica*), and the two chatted about the botanist for whom it had been named, John Torrey of Columbia College. Muir asked Gray if Torrey was planning a California trip, to which Gray replied "Oh, Torrey is an old man now. If you want to see Torrey you will have to go to New York." Gray had no sooner departed from the Park by way of Coulterville Trail than Muir received a message that there was another botanist at the hotel who wanted to see him. He was tired of botanists by this time, but when Joseph LeConte said "You must come up," Muir acquiesced and met none other than the venerable John Torrey, who had just come into Yosemite Valley by the Big Oak Flat Trail! What a coincidence.

In Tuolumne Meadows Jepson delivered a stirring oration on the Sierran forest, from Sonoran foothills to alpine summits, with palatable but limited facts and a plethora of stirring emotions for the gathered congregation, "garnering in this July treasures of mountain delights to have the thrifty sweetness for December." Climaxing his talk was a

reciting of “The Campfires of the Young Men.” This was indeed a day for lecturing, because at the evening campfire William Colby talked about John Lembert, after whom Lembert Dome had been named, noting that Professor Edward Lee Greene, Jepson’s old mentor at UC Berkeley, had named a composite flower (*Senecio lemberti*, now *S. pauciflorus*) after Lembert.

PICKING UP THE PACE

Next morning, as a relief from lectures, the hikers headed for Mountains Lyell and McClure, eventually making their way across a wintry landscape of snow fields and great rocky slopes with patches of soil where snow-melt streams were trick-

ling down. The alpine flower gardens were disappointing, because the season was too early at high altitude. But Jepson prostrated himself to count petals, stamens, and styles of ten delightful alpine lewisia *Lewisia pygmaea*, the tiny relative of the bitter root *Lewisia rediviva*, discovered by Meriwether Lewis over a century earlier in Montana.

Jepson’s collecting the cinquefoil *Potentilla brewerii* (now *P. drummondii* ssp. *brewerii*) here occasioned Muir to refer to William Brewer, whose surveying party in 1863 had named Dana and Lyell peaks after America’s and England’s foremost geologists. “What legs he had beneath him! He astonished even the natives!” Not to be outdone, Jepson was quick to reply that “he did not

collect a really good deal—not nearly the amount one would have expected from four years in the field.” When the quartet of climbers including Jepson made it back from the Lyell base camp to Tuolumne Meadows, they emulated Brewer by covering the eight miles in two hours, led nearly the entire way by flower lover Eloise Fife, who was as diminutive as some of the subalpine vegetation.

At Tuolumne Meadows several parties took off on a knapsack trip down the Tuolumne River, the men carrying packs weighing 30 to 37 pounds while the women only toted 9 to 15 pounds. Jepson vented his disgust: “In other words, the men are carrying food for the girls. Many of them are no mountaineers at all.” But there was general merriment

McClure Fork toward Mt. Florence.



when Jepson's loquacious friend Charlie Dutton, in crossing Conness Creek on a log, shrilly cried out for help when he got half way over, and had to be assisted the rest of the way.

The main party hiked to the cascades below Conness Creek where they got a beautiful view down the Grand Canyon of the Tuolumne. After a lunch stop on a windy outcrop, the trail dropped into a moist valley filled with wildflowers: waist-high lupines, blue larkspurs, several species of mariposa lilies, scattered aspens and conifers, and a thicket of huckleberry oak (*Quercus vacciniifolia*) that was about 30 feet square but only a foot high.

Junipers (*Juniperus occidentalis*) and tamarac pine (*Pinus contorta* ssp. *murrayana*) on granite at McClure Fork.



A BEDAZZLING GRANITE WILDERNESS

On July 20 the party was making its way up Return Creek and across to the northwest into Matterhorn Canyon, where they encountered a grove of mountain hemlock (*Tsuga mertensiana*), the finest Jepson had ever seen in California, with many trunks five feet in diameter. The next day they traversed Benson Pass, and from a rocky promontory had a superb view eastward towards the snowy peaks of Ritter, Banner, Dana, Lyell, Hoffman, and Conness, and of the wild, high granite wilderness to the north. At the viewers' feet were beautiful rock gardens of mountain pride (*Penstemon newberryi*), forming rose-red flower clusters a foot across in the granite crevices, with reclining mats of whitebark pine (*Pinus albicaulis*) whose upright branchlets had been manicured by the wind.

Now came the scenic series of tarns which today lie along the Pacific Crest Tahoe-Yosemite Trail: Smedberg, Rodgers, Neall. There were wonderful reflections just after sundown in Rodgers Lake, right before the afterglow began. Jepson wrote quickly in his field book, "It is the most wonderful scene of the sort that ever met my eye. A high rock dominating the opposite shore, the snow-banked cliffs with a few clusters of tamarac pines and hemlocks—the whole with the brilliance of the California atmosphere and with that unusual softness seen in the English lakes."

POLITICS INTRUDES ON THE SOLITUDE

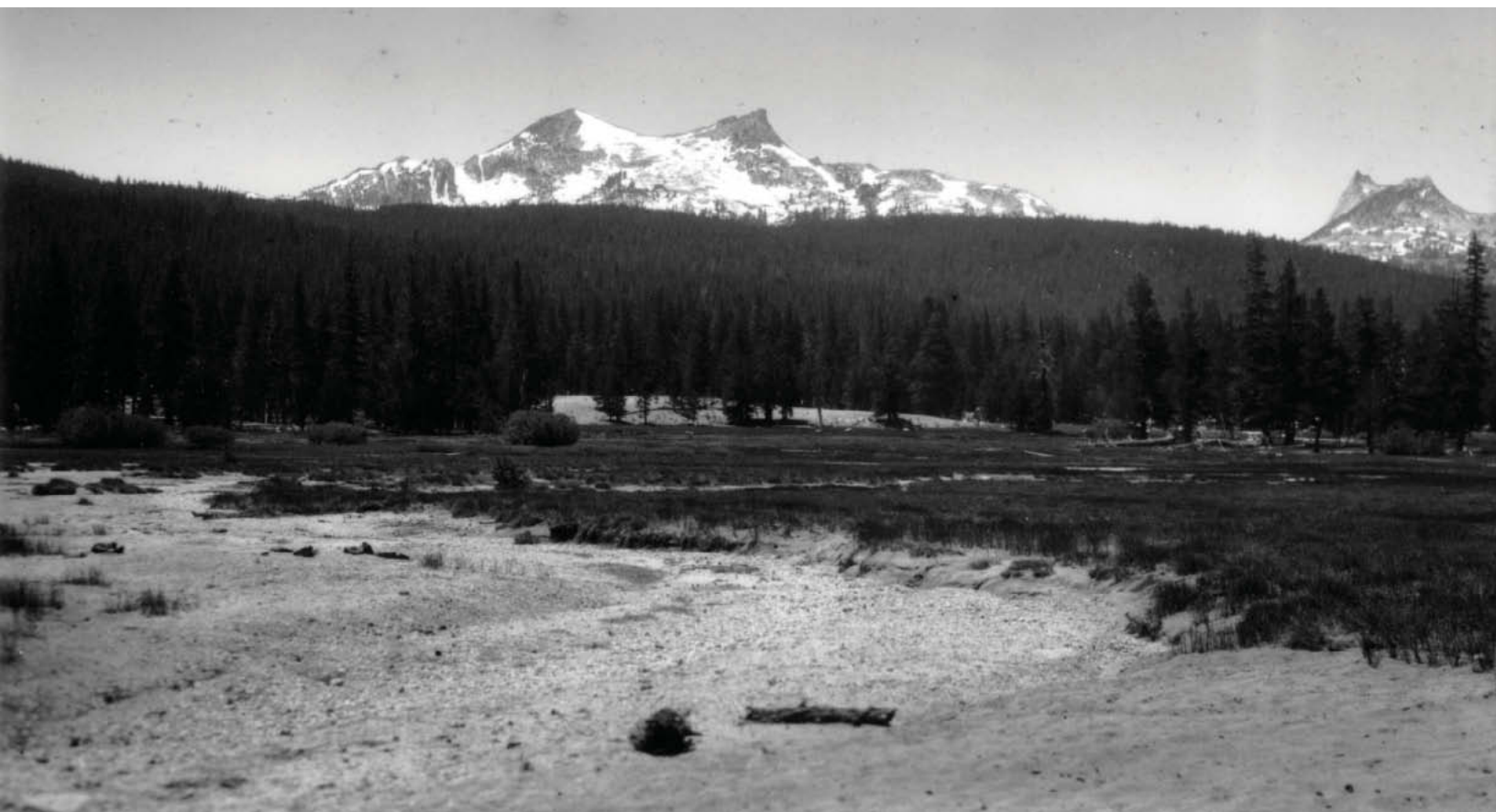
On July 23 the Sierra Club hikers were in Pleasant Valley, having come down Rodgers Canyon, with a side trip to an overlook into the narrow Muir Gorge of the Tuolumne, and a steep rocky scramble past Table Lake to Piute Creek in the canyon bottom where

they set up camp at 7,000 feet. The following day the party took the trail up the side of Rancheria Mountain overlooking Piute Creek, and continued into Pate Valley and the Grand Canyon of the Tuolumne, with Hetch Hetchy Valley to the west. Muir was telling Jepson he was aggravated that UC Berkeley President Benjamin Ide Wheeler could not make up his mind to take a stand against damming Hetch Hetchy, despite Muir's urging. In Muir's opinion Wheeler did not want to "risk offending some rich man in San Francisco—it being his business 'to lay for money' all the while." Indeed, during his decade in office President Wheeler had been an unusually successful fundraiser.

TREE CLIMBING FOR FIR CONES

The track along Rancheria Mountain was hemmed in for a ways by the reddish purple mountain monardella (*Monardella odoratissima*), and the minty scent of crushed foliage was exceedingly heavy and strong. Jepson was irked that some Sierra Club members, who actually knew better, insisted on calling the mint pennyroyal. "People will have common names," Jepson muttered to himself. "If they can't get the special name, they will transfer one from a garden plant."

The day's lunch site was beneath spreading limbs of an incense cedar, beyond a little springy meadow across which were "thrown" two streamers of strikingly beautiful shooting stars (*Dodecatheon jeffreyi*). In the afternoon the trail began to drop down, and rocky cliffs at the upper entrance to Hetch Hetchy were coming into view. The trees of lower altitude were replacing the high-country vegetation, red firs giving way to white firs. And, because fir cones never fall to the ground unless cut by squirrels, Jepson climbed 50 feet up a white fir to collect the candle-like purplish cones for his hiking companions.



REACHING HETCH HETCHY

On July 26 the Sierra Club group was down in Hetch Hetchy Valley, at its upper end near Pate Valley, where rose great rock walls studded with trees. The valley floor's green fields were surrounded by scattered groves of pines and oaks, and along the Tuolumne River were stands of black cottonwoods, which despite the name were beautifully white-trunked in the moonlight of the first camping night in the valley. The next day as the group traveled farther west, the cliffs became like those of Yosemite, smooth towering granite massifs with a dotting of maul oaks in rifts of the wall. They passed numerous midsummer waterfalls and a multitude of wildflowers.

The final camping spot in Hetch Hetchy was at the west end, on July 28. As Jepson wrote in his journal, what "a delightful and lazy camping spot, the wind rustling through the



TOP: Tuolumne Meadows, in the Canadian Zone according to W.L. Jepson, with tamarac pine (*Pinus contorta* ssp. *murrayana*), whitebark pine (*Pinus albicaulis*), and western white pine (*Pinus monticola*). • BOTTOM: Tuolumne Pass, with whitebark pine and tamarac pine in foreground. Whitebark pines also on mountainside.

great oaks and pines, the woodpeckers calling in the oaks just as they called when I was a boy and thought then as I think now that there is no more alluring and gratifying woodland sound." At the evening camp-

fire, Allen Chamberlain of the Appalachian Mountain Club talked about the club's outings in the Northeast, where rain and wetness were often the order of the day and night, and cooking had to be done



TOP: Benson Pass, with tamarac pine (*Pinus contorta* ssp. *murrayana*) and mountain hemlock (*Tsuga mertensiana*). • BOTTOM: Rodgers Lake, with tamarac pine and mountain hemlock.

in the protection of a tent. What different memories there would be of the Sierra, with cloudless nights for almost a month now, and the days brilliant, always cool, invigorating, bracing. The Californians hoped that Chamberlain would use recollections of this beautiful western setting to solicit his club's support against the damming of Hetch Hetchy!

goodbye speeches, a violin solo by Degross, and finally the grand finale. The whole assemblage formed a huge circle, joined hands; "and with the moon above the trees throwing great shadows," The Botany Man recited with uplifted hand the goodnight benediction of the fairies in *Midsummer Night's Dream*: "Weaving spiders come not here."

AN ENDURING LEGACY

On July 30 the outing made its way out of Hetch Hetchy down to Hazel Green and the Merced Grove of big trees, where Jepson energetically counted all the sequoias and plotted them on a map in his field book. Near Crocker Ridge the group held the last campfire of the outing. There were

Sad to say, the scenic wilderness valley of Hetch Hetchy would in a few years become a reservoir, despite the many voices raised against the dam. On Christmas Eve of 1914 John Muir passed away; but his botanical colleague of the 1909 outing would make many a return visit to Yosemite, giving lectures, teaching classes, leading hikes, and investigating flora. During the last five years of his life, Willis Linn Jepson would serve as honorary vice president of the Sierra Club, which he had helped found almost 60 years earlier.

In the year 2000, the 50th anniversary of UC Berkeley's Jepson Herbarium was celebrated. Among its vast collection of plants are the many Yosemite specimens which Jepson garnered in 1909, and in the Herbarium Archives is the field book in which The Botany Man described his first Sierra Club outing.

Richard G. Beidleman, *The Jepson Herbarium*, 1001 Valley Life Sciences Building #2465, University of California, Berkeley, CA 94720-2465.



In order to protect locally rare and significant plant communities, the Ventura County Planning Division evaluates the potential influence of human development on vegetation. Photograph by J. Evens.

A WINNING COMBINATION: LOCAL LAND-USE PLANNING AND FINE-SCALE VEGETATION MAPS

by Liz Chattin, Lorraine Rubin, and David Magney

This is the forth article of a series from the California Native Plant Society's Vegetation Program, edited by Julie Evens and Todd Keeler-Wolf. See Fremontia Volume 34, No. 1, pp. 3–16 for the first two articles, and Fremontia Volume 34, No. 2, pp. 11–18 for the third article. The fifth and

last article of the series will appear in Fremontia Volume 34, No. 4 (the October 2006 issue).

Historically, those involved in conservation work have either overlooked or have been unaware of the piv-

otal role that local land-use planning departments can play in furthering habitat protection. Some even perceive local agency staff as “part of the problem.” But when local California Native Plant Society (CNPS) chapters take the time to cultivate good working relationships with local planning staff, the preservation of rare plants and high-priority plant communities can be achieved.

To do so first requires understanding the role that local land-use planning departments play in protecting natural resources, and also the importance of having reliable

The authors of this article, Liz Chattin, biologist, Lorraine Rubin, grants administrator, and David Magney, botanist and environmental consultant, work for the Ventura County Planning Division. With grant funding from various sources, they are working to improve the protection of wetlands and other sensitive biological resources through the land-use planning process.

baseline data that can guide planning decisions. It also requires that we reshuffle our own conservation goals, so that obtaining fine-scale vegetation maps becomes one of the highest priorities of local and other agencies.

The truth is that many of our best environmental policies, from the California Environmental Quality Act (CEQA) to the local General Plan, are often only as good as the procedures and resources of the local land-use planning department. This is where many of these policies are implemented. Those of us in the trenches of the Ventura County Planning Division are often surprised at how few people in the business of resource protection understand this.

Lengthy watershed plans are sometimes written by special-interest groups and can cost millions of dollars and several years to complete. Frequently, the local planning agencies are not actively involved in drafting the plan. Consequently, these watershed plans generally have no teeth of their own. Implementing the recommendations of a watershed plan is largely dependent on a local jurisdiction modifying existing policies and programs, such as carrying out riparian buffer setbacks, smart growth policies, and low-impact development strategies. This is often why many of the recommendations in these noble plans are ignored or fail to have key elements converted to policy.

As planners, we have seen millions of dollars in habitat protection grants issued every year for “restoration” work. But where is the money for prevention and implementation of the policies that protect these resources in the first place? There are many other critical areas related to restoration that are rarely funded. These include: 1) mapping the resources at a useful scale; 2) developing guidelines for impact analysis and mitigation strategies that actually work; 3) monitoring

the long-term success of mitigation projects; and 4) maintaining lands donated for mitigation. Public agencies have to be pretty clever or lucky to find grantors who will fund these sorts of efforts.

Meanwhile, pressures for development continue unabated. The population continues to grow, rising real estate values encourage new development, applications for new land-use permits continue to be submitted to the County, grading permits are issued without adequate

“If your goal is habitat protection, one of the biggest bangs for your buck is to give local land-use planning agencies the resources they need to implement the policies they already have in place.”

knowledge of the resources, and violators are rarely penalized (due to lack of coordination or communication between departments and lack of funding or political will) for bulldozing local streams and wetlands and stripping the hills of natural vegetation.

If our goal is to protect habitat, one of the wisest uses of funds is to provide local land-use planning agencies with the resources they need to implement the policies (often quite powerful) they already have in place. And, in today’s world of computer mapping or Geographic Information Systems (GIS), one of the greatest needs of local governments is finer scale GIS maps of the resources we are charged with protecting. We can do a much better job of resource protection when we have baseline data that we can easily visualize and use.

VALUE OF VEGETATION DATA

CEQA Analysis

When applicants come into our county government center wanting a permit for a new land use, the Planning Division acts as “lead agency” under CEQA. The Planning Division is responsible for coordinating the CEQA review of these projects for potentially significant impacts to the environment.

Planning staff decide whether a project may have a potentially significant impact on biological resources, and whether an assessment by a professional biologist is warranted. This decision is made easier, and the resources are ultimately better protected, when planners have information regarding the nature of the biology onsite. In our jurisdiction and in others throughout the state, determining significant impacts to biological resources from a project is often based on two things: 1) a review of coarse maps, if available; and 2) a single site visit conducted by a planner who typically does *not* have biological expertise.

On the other hand, when vegetation maps are drawn at a fine-scale (e.g., at the Alliance or Association level), they can provide useful information regarding the location, percent, and total area of common, rare, and invasive plant communities—something the coarse maps do not provide. Such coarse maps rarely include scarce or rare habitats, many of which support rare plant species. If local planning agencies had such comprehensive, fine-scale vegetation maps, it is likely this would not only improve the accuracy of CEQA determinations, but also improve the efficiency of the process, which could translate into lower costs to the applicant.

CEQA also requires that we assess the cumulative impacts of projects when added to the overall effect of all other projects (those from the past, present, and in the

foreseeable future). Without a detailed vegetation map of the county, which would provide a baseline inventory of existing biological resources, determining an individual project's cumulative impact on biological resources becomes very difficult.

Regional Planning

Standardized vegetation maps are also important for developing regional and general plans. For instance, western Riverside County recently completed a standardized vegetation classification system and map based on the CNPS *Manual of California Vegetation*, which was instrumental in developing their Multiple Species Habitat Conservation Plan (MSHCP). The MSHCP is part of the Riverside County Integrated Project and is intended to streamline the environmental process, reduce regulatory agency involvement with future projects, and conserve important habitat areas for multiple species.

Mitigation

Land-use planners must balance many issues, two of which are resource protection and property rights. This balancing means compromises must be made; thus, we have mitigation measures recommended and implemented (hopefully successfully) for all significant impacts to the environment resulting from the project. Depending on the resource impacted, mitigation may occur onsite or offsite, and in-kind (like-for-like). For example, if a project would destroy a rare plant population, mitigation for that significant impact could include avoiding the population onsite, transplanting it or planting new plants in an appropriate place onsite, or establishing a new population or expanding an existing one offsite. (Note: CNPS recommends *avoidance* of the impact as the preferred mitigation measure, as it has the highest likelihood of success.) Mitigation

is ideally planned for and agreed upon in advance.

Fine-scale vegetation maps are extremely useful in helping to locate areas for offsite mitigation, such as habitat restoration. For example, in Los Angeles County, vegetation maps developed according to the *Manual* have been used to find appropriate restoration sites for the Lyons Canyon Ranch Environmental Impact Report.

In land-use violation cases involving illegal grading and vegetation removal, it can be extremely helpful to know what plant communities were present prior to the violation in order to properly restore the site. Many land-use violations in Ventura County involve damage to wetland and stream habitats. While most wetland maps do not identify the plant communities present within a wetland, vegetation maps (mapped to the Alliance or Association level) would identify the native plant communities that were present prior to the violation.

In addition, these maps make it is easier to identify and track infestations of non-native invasive species in these habitats. Selecting a stream bank restoration project may be more straightforward if relative plant communities are already known. Fine-scale vegetation maps would also improve fire management by providing the necessary data to understand burn patterns and risks.

Agency Coordination

Finally, use of standardized vegetation maps would

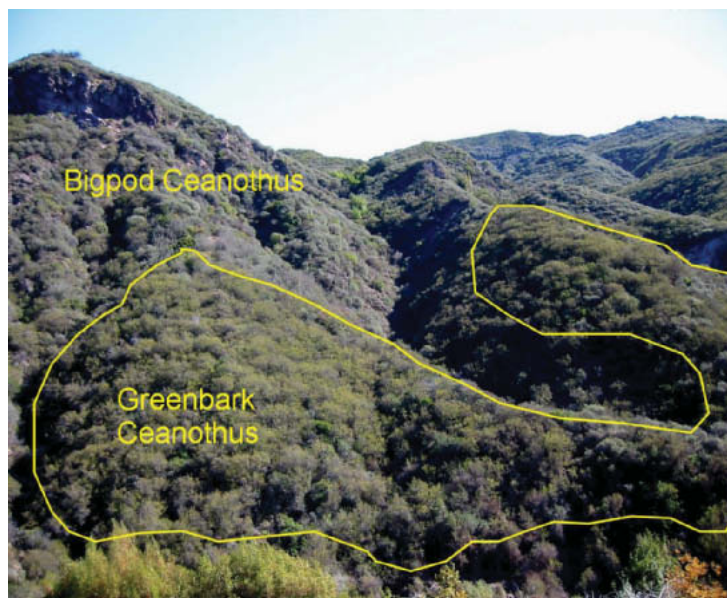
allow agencies to better communicate and coordinate the management of biological resources.

NOT JUST ANY DATA WILL DO

Very coarse vegetation maps, often derived from satellite imagery and classified into a handful of categories (such as chaparral, mixed conifer forest, or grassland), are available for many areas. While these are better than the absence of mapped data, fine-scale maps are needed for these data to be truly useful for making decisions about land-use planning, policy, permitting, and restoration.

Ventura County's Planning Division does receive fine-scale vegetation maps on a fairly regular basis, but for relatively small areas of the County. These maps come in biology reports submitted as part of the CEQA review process. But the number of different ways vegetation communities can be classified appears to be equal to the number of

The Holland system would map this entire area as bigpod ceanothus (*Ceanothus megacarpus*). The International Vegetation Classification system (IVC) at the Association, or finest, level shows two distinct vegetation communities, thus providing much more useful information about the habitat and the potential for associated sensitive status species. Photograph by J. Christian, National Park Service.



different consulting firms doing the mapping.

All of the benefits listed above assume that local governments have consistent and standardized vegetation data. A project-by-project patchwork of maps prepared by consulting firms using different classification schemes and different scales is not very helpful. This method offers no easy way to combine data, and therefore no way to consistently analyze them. With the explosion of GIS data development at all levels of government, adherence to data consistency standards becomes imperative so that data can be widely used, shared, and understood across agencies. With the adoption of the International Vegetation Classification system (IVC) by federal (US Forest Service) and state resource agencies (California Department of Fish and Game), and global and national conservation organizations (e.g., The Nature Conservancy), it became clear that as a unit of local government, our planning department also needed to align with this standard. In California, the CNPS *Manual of California Vegetation* uses the IVC system.

While we plan to use the IVC, we have some reservations about doing so. This relatively new system brings with it some

challenges, including the fact that not all vegetation classes have been developed for Ventura County, and the cost of developing statistically accurate classes is quite high. In addition, many biologists are reluctant to use this classification system since it does not always convey wildlife associations (such as “conifer forest,” “chaparral,” and “freshwater marsh”) directly. And many also prefer the familiarity and simplicity of the Holland system.

OUR APPROACH

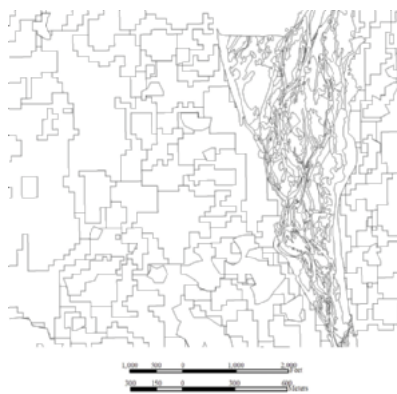
Funding for the development of comprehensive fine-scale vegetation maps is not in most local government budgets these days. Grant funding is sometimes an option; however, those funds are typically for a focused geographical area and task (such as removal of the noxious weed, *Arundo donax*) and usually cannot be used to map an entire county.

The unincorporated area of Ventura County (our jurisdiction) covers approximately 82,650 acres (excluding the Los Padres National Forest). One estimate for mapping our area according to the IVC system to the Association level was \$2.50/acre, or \$206,625. This estimate does not include the cost of the imagery (both stereo and color infrared) needed for a project of this scale, which makes it prohibitively expensive: stereo coverage for an area the size of Ventura County could easily be \$500,000, with sufficient vertical accuracy and high enough resolution to adequately identify dominant species of the different plant communities. As much as we need it, the costs of collected comprehensive fine-scale vegetation data according to the IVC are out of the question for us at this time.

Step 1: Compile, Cobble, and Crosswalk Old Data

The obvious thing to do is to start with the data and resources we have. So far, we have researched and compiled the digital vegetation data that already exist for Ventura County. We have found six data sets worthy of integrating into a baseline map. All the datasets use different classification schemes and are at different resolutions, based on the needs of the original mapping projects. We have one data set from each of our three main watersheds—the Ventura River, the Santa Clara River, and the Calleguas Creek watershed. We also have three additional data sets from two other sources: the US Forest Service’s California Vegetation Mapping database or CalVeg, and the US Geological Survey’s National GAP Analysis Program.

In GIS, we cobbled these disparate data sets together, always giving preference to the finest scale data when the datasets overlapped. Then, using David Magney’s botanical expertise and knowledge of local plant communities, we determined how each dataset corresponded to the



Ventura County has combined existing mapping datasets into a countywide vegetation map using one classification system. A section of the map is provided above, showing the juxtaposition of a fine-scale dataset (left) and a coarse-scale data set (above). Maps by D. Magney.



Teaching local biologists how to map and classify vegetation according to the International Vegetation Classification (IVC) system at a recent workshop in Ventura County. Photograph by L. Chattin.

Alliance level. What we ended up with is one countywide vegetation map that uses a single classification system.

Step 2: Plan to Add New Data Project-by-Project

While we do not have funding for a comprehensive countywide mapping effort, what we do have in our favor is that vegetation maps associated with CEQA documents come through our office on a regular basis. Applicants are already paying for development of these maps. If they are classified according to the IVC, we can begin getting the consistency and detail that we want. Therefore, this has become our plan.

These project-by-project data, along with other sources of new IVC data, will be combined with our current vegetation base map to continually expand and refine the story of Ventura County's flora. For now,

biologists will make use of the vegetation classes that do exist, and where the existing classes do not work, they will create new ones according to IVC protocols. We will then work with CNPS so these new classes contribute to the development of official, statistically determined classes.

Before implementing the new mapping protocols, however, we had to address a potential hurdle—the fact that most local biologists are not very familiar with the IVC system. So the Ventura County Planning Division, with assistance from CNPS (Julie Evens) and the Department of Fish and Game (Todd Keeler-Wolf), led a two-day IVC vegetation mapping and classification workshop for area consulting biologists. The workshop was well-received, with many attendees asking for additional training.

The next step will be implemen-

tation. Stay tuned for a later report on our success. We feel confident that our push for standardized data, as well as the fine-scale data that tell us so much more about our habitats and their biodiversity, will help us to make more informed planning decisions in the future. With more precise vegetation mapping data, we will soon be able to implement more effectively the many biological resource protection policies that land-use planners play such a central role in, from the General Plan, to CEQA, to watershed management plans, and much more.

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WHAT WEEDS DOMINATE SOUTHERN CALIFORNIA URBAN WETLANDS AND WHY?

by Brad Burkhart

Since the late 1960s there has been a turnaround in national and state attitudes towards urban wetlands, especially in California. We have moved from a philosophy that used to view urban freshwater drainages as water sources (for drinking, washing, and processing) or sewage/storm water conveyance systems, to one that recognizes the importance of wetland habitats in maintaining water purity and healthy habitat for wildlife.

We have also come to recognize the role our own activities play in degrading wetlands. These include physical impacts (such as bridge or drainage improvements), chemical runoff, increased flooding (due to paving over watersheds with nonpermeable surfaces like asphalt), and the introduction of non-native plant species that out-compete the natives. Is it any wonder that riparian habitat restoration and preservation have become high priorities?

MANY SOUTHERN CALIFORNIA WETLANDS ARE A RECENT PHENOMENON

Even though we frequently hear the figure that 90-95% of California's original wetlands have been filled or drained, the fact is that almost no perennial streams existed in southern California before the onset of urban development (Ellis and Lee 1919). Most drainages were originally episodic, flowing only a few months of the year during and after storm events.

Today the situation is greatly changed. Former episodic rivers and creeks now carry water year-round

due to irrigation runoff from landscaped areas, both residential and commercial. Many new wetlands have sprouted up in finger canyons and arroyos where none existed decades ago. For example, data taken from a US Geological Survey water flow station on Peñasquitos Creek in the north city area of San Diego shows this once episodic creek became a permanent year-round creek in 1982, and has remained so even through several bouts of severe drought. This change, due to the intense urbanization of this watershed, began in the 1970s and continues today (White and Greer 2002). There is little doubt that this increase in urban wetlands has expanded nesting and foraging opportunities for many riparian animal species beyond what existed previously.

THE INVASION OF EXOTIC SPECIES

However, urbanization of the landscape in Southern California has also introduced many non-native plant species for ornamental and functional purposes. Some of these plants are able to invade and exclude native wetland vegetation cover because their ecological needs are broader than those of native species and they do not have pests from their countries of origin to slow their spread. What has resulted are large monocultures of single non-native species where formerly many native species coexisted. Although some invasive plant species provide at least minimal habitat for a few species, including roosting locations, nesting sites, and forage or pollen and nectar, studies have shown that these non-native mo-

nocultures displace a native habitat of far greater diversity and quality (Ohmart 1982).

Additionally, some species such as giant reed (*Arundo donax*) or tamarisk (*Tamarix* spp.) transpire water at such high rates that they can drive the water table below the surface, eliminating surface flow (Sudbrock 1993; Johnson 1986; Hoddenbach 1987) and the associated native cover it supports. Unlike surplus runoff that often benefits wetland habitat expansion, invasions by exotic plant species usually decrease habitat values and the amount of native wetlands.

For these reasons, the eradication of highly invasive exotic species, such as giant reed and tamarisk, and the replanting of areas occupied by these species with native wetland species has become a high priority in many urban areas. To the best of our knowledge, few comprehensive, quantitative surveys of urban wetland systems have been carried out. Therefore, many land managers and regulatory personnel have tended to focus on the most obvious invasive species, such as giant reed, and forget there are other species waiting in the wings to fill their ecological niche once the dominant species is eradicated. In addition, because most programs oriented towards invasive wetland weed eradication are funded by the need for wetland mitigation credits, they tend to focus on the acreage needed for credit, rather than choosing sites that are defensible against reinvasion after required maintenance activities cease. A lack of funds for the long-term maintenance of restoration sites is the biggest barrier to preventing the reinvasion of weed species.

SAN DIEGO RIVER WETLAND WEED SURVEY

It was with this problem in mind that Burkhart Environmental Consulting and Kelly and Associates

developed a proposal for the Friends of the Mission Valley Preserve to map 11.5 miles of the most dominant invasive weed species in wetlands along the San Diego River and within the city limits (Table 1). The

project was funded in early 2001 by the City of San Diego using sewer spill fines imposed by the California Water Regional Quality Control Board. The study area runs from Interstate 5 on the west (starting about one mile from the ocean) to the Santee City border on the east, but excludes Mission Trails Regional Park which has already largely eliminated invasive species within its borders.

Mapping data was collected utilizing specially flown low-elevation, 50-scale aerial photos that were later verified on foot after initial hand drafting from the aerials. This scale of mapping was selected because it can be easily translated into the landscape construction documents used to guide contractors in implementing habitat restoration projects when funds become available for restoration. To make the translation of final weed maps easy to use by groups seeking mitigation credits, the square footage of each polygon of weed cover was also noted on the maps, making it easy to assemble the mitigation credit required for specific projects. From these maps, acreage of cover for each weed were also assembled and analyzed for the entire study area.

A second purpose of the project was to provide a plan for the eventual eradication of the invasive weed species from the river's wetland habitats and their replacement with appropriate native species. Therefore a second task funded under the grant was to develop a master weed eradication and habitat restoration plan that could be used by the city and private developers, as monies became available, to restore the river's wetlands. This plan, called the San Diego River Invasive Exotic Weed Eradication Master Plan, was completed in September 2002. The city is currently incorporating it into the San Diego River Resource Management Plan being developed by its Parks and Recreation Department and due to be approved by the San

TABLE 1. SAN DIEGO RIVER WETLAND WEED SURVEY

	Acres	% Weed Cover	Nos.
WEED SPECIES			
Giant Reed (<i>Arundo donax</i>)	37.95	57.8%	*
Pampas Grass (<i>Cortaderia selloana</i>)	0.55	0.8%	1970
EXOTIC BROADLEAF TREES			
Brazilian Pepper (<i>Schinus terebinthifolius</i>)	6.85	10.4%	649
Eucalyptus (<i>Eucalyptus</i> spp.)	6.27	9.6%	975
Evergreen Ash (<i>Fraxinus uhdei</i>)	0.63	1.0%	91
Other Exotic Trees**	2.48	3.8%	358
TOTAL BROADLEAF TREES:	16.23	24.7%	2073
PALM TREES***			
Large Palms	0.4	0.6%	37
Medium Palms	1.37	2.1%	194
Small Palms	0.68	1.0%	392
TOTAL NON-SEEDLING PALMS:	2.45	3.7%	623
TOTAL SEEDLING PALMS:	0.07	0.1%	538
Castor Bean (<i>Ricinus communis</i>)	2.42	3.7%	*
Tamarisk (<i>Tamarix</i> spp.)	0.98	1.5%	91
Ludwigia (<i>Ludwigia</i> spp.)****	4.97	7.6%	*
TOTALS:	65.62	100%	

* Numbers not counted for these clonal species.

** Including: lemon bottlebrush (*Callistemon citrinus*), Peruvian pepper (*Schinus molle*), carrotwood (*Cupaniopsis anacardioides*), Chinese elm (*Ulmus parvifolia*), common fig (*Ficus carica*), myoporum (*Myoporum laetum*), oleander (*Nerium oleander*), other minor species.

*** Including mainly Mexican fan palm (*Washingtonia robusta*) and Canary Island Palm (*Phoenix canariensis*).

**** Both native and non-native species of *Ludwigia* are found in California and create wetland weed problems. The *Ludwigia* mapped in Table 1 likely includes several taxa.

NOTE: In addition to the above listed species, minor populations of the following invasive weed species were documented in the study area: Cape ivy (*Delairea odorata*), cruel vine (*Araujia sericofera*), fennel (*Foeniculum vulgare*), sticky eupatorium (*Ageratina adenophora*), tall whitetop (*Lepidium latifolium*), and Virginia creeper (*Parthenocissus quinquefolia*).

Diego City Council in 2006. Thus as additional local habitat restoration funding becomes available through public or private sources, the city intends to use the project Master Plan as a template for developing and permitting new projects. Significantly, these maps constitute the majority of urbanized areas along the river that would be generating projects requiring wetland mitigation credits to implement.

Finally, the project included funding for an initial eight-acre restoration of a demonstration site to be implemented after the management plan was completed. Regulatory permits were secured in the fall of 2002 for this pilot project and weed eradication began at that time. Pilot project planting was completed in the spring of 2003.

This article summarizes the results of the Master Plan study. It also discusses some of the ecological reasons why the species mapped are currently the most dominant invasive species in Southern California riparian systems and will continue to expand their coverage without active human intervention to prevent their spread.

SELECTION OF TARGET WEEDS FOR MAPPING

The target species selected for mapping account for almost all non-native canopy cover in the wetlands under study, and have the highest potential for expanding their coverage. We start by reviewing the seven categories of invasive weed species selected for mapping under the study (see Table 1). Later we will discuss more about why the particular ecological characteristics associated with these species make riparian wetlands especially prone to their invasion. Each category delineates a single weed species except those for broadleaf trees and palms, where several species were lumped under one mapping category due to similar ecological char-

TABLE 2: PILOT PROJECT TREE REMOVALS

	Large	Medium	Small	
	12"+ DBH	6-12" DBH	1-6" DBH	TOTALS
Unmapped:	26	24	10	60
Total Trees Mapped:	9	44	35	88
Total Trees Removed:	35	68	45	148
% of Total Trees Mapped:	26%	65%	78%	59%
% Increase During Install:	289%	55%	29%	68%

acteristics. All of these species were part of the original project design except castor bean (*Ricinis communis*), which was added after it became apparent during the data collection that it dominated large areas along the river corridor.

Approximately 438 acres of wetland habitat were surveyed. Of this total, 65.6 acres or 15% constituted weed species cover. In addition to mapping weed cover, we also counted numbers of tree species and estimated numbers of individual pampas grass. With palm trees, the numbers of plants were further divided into large (6%), medium (37%), small (63%), and seedling palms. Although no attempt was made to assess the size of broadleaf tree species, some preliminary data on this subject was obtained from the pilot project and is shown in Table 2. Pilot project implementation also allowed us to discern the amount of error in the mapping methods used by comparing actual numbers of trees eradicated to those originally mapped.

Two categories of weed cover account for the majority of weed acreage. Giant reed, a non-native grass species, comprised the greatest percentage of cover, or 58% of all exotic weed acreage mapped. Broadleaf evergreen tree species accounted for another 25% with the highest amounts for Brazilian pepper (10.4%) and eucalyptus (9.6%). If the palm category is included with these first two categories over 86% of weed cover mapped is accounted

for. *Ludwigia*, an aquatic plant that can form large monocultures on slow moving open water, constituted the third largest category of cover at about 8%. The pampas grass, castor bean, and tamarisk categories combined add only an additional 6% of cover.

The lower cover categories are somewhat deceptive since the numbers of pampas grass, palms, and tamarisk (3,221) are nearly one-third more than the number of broadleaf trees counted and therefore probably have a higher expansion potential than their current coverage would suggest. Similarly the number of palms and palm seedlings (which were probably undercounted) is over half as great as all broadleaf trees (1,160 compared to 2,073) and if these seedlings survive to maturity they will account for a much greater acreage of cover. Nevertheless, giant reed and evergreen trees are clearly the top two weed types in need of control.

A later result of site data collected during implementation of the pilot project was that greater acreage and numbers of plants were found to occur on site when restoration work was implemented. This occurred despite conscientious aerial mapping and ground-truthing that was hampered in areas by impenetrable vegetation and where other species had spread under the native canopy. For instance, approximately 20% greater acreage of giant reed was encountered during removals at the pilot project site than was

shown on Master Plan maps. Table 2 also shows that the numbers of broadleaf trees were underestimated by 68% overall, while trees over a 12-inch diameter at breast height were underestimated by almost 300%. This was particularly surprising, since it was expected that the larger trees would be the most apparent on aerial photos. As it turned out, the single largest canopy exotic tree, eucalyptus, had no distinct signature on the aeriels unless its shadow could be detected falling outside the riparian area. By comparison, giant reed, Brazilian pepper, and even castor bean had more or less distinct signatures.

Although the quantities shown in Table 1 are probably underestimated, they do give a fair assessment of the degree to which these species are able to invade urban wetlands. And although the amount of weed infestations will vary by species and extent in other Southern California wetland systems, we anticipate these same species will continue to be the dominant invasive weeds in urban wetlands because of their special ecological characteristics. Our previous work in many other drainages in Southern California supports this conclusion. Later in this article we will discuss why these species are particularly successful in invading urban wetlands.

Another major finding of the study is that exotic broadleaf and palm tree species are the second most dominant category of riparian weeds after giant reed. This is significant, since relatively few if any riparian habitat restoration projects along the river have targeted non-native tree species for removal, nor have most other riparian mitigation/restoration projects in Southern California.

Also, as anticipated, it was found that where funding was in place for long-term weed management of former mitigation sites, there was a low reoccurrence of invasive weed species. In contrast, previous mitigation projects that did not have on-

going weed management programs usually showed substantial reinvasion of weed species. Over 14 major and minor wetland restoration/mitigation projects have taken place within the area over the last 15 years. However, the only one which consistently resisted reinvasion by the most pernicious species was the city-managed First San Diego River Improvement Project (FSDRIP), which includes funding for long-term weed management.

Finally, the study's initial field surveys revealed small infestations of two well-known, highly invasive species, Cape ivy (*Delairea odorata*), formerly known as German ivy (*Senecio mikanioides*), and tall whitetop (*Lepidium latifolium*), also known as perennial peppergrass. Although their numbers were too small to make the acreage tables, their recognition has already led to efforts to eradicate both before they spread.

MECHANISMS ALLOWING INVASIVES TO DOMINATE

To better understand why certain weed species can out-compete native riparian woodland species while other introduced species cannot, let us look at some of the major ecological characteristics of plant species which allow for non-native invasions.

Lack of Pests and Diseases. We have already provided a partial answer to this question in noting these are imported species without their original native pests. Pests become most important over the long-term as the lives of older native plants are shortened or their structure weakened by insect, bird, or mammal foraging and fungal, bacterial, or virus infections. Non-native species live longer in most cases because they are much less likely to be impacted by such vectors.

In addition to being more resistant to pests and diseases, a number of plant growth and seed germi-



TOP: Removing giant reed (*Arundo donax*) at San Diego River Pilot Project site. BOTTOM: Replanting eradication areas with riparian woodland species. All photographs by author.

nation characteristics also give highly invasive weed species a clear advantage in out-competing native trees and shrubs for a place in the riparian woodland canopy and open water.

Plant Form. Generally the most important physical characteristic that allows a species to dominate vegetative cover is its growth form. The taller a plant is at maturity, the more likely it is to out-compete other species. This means a species must reach a mature height tall enough to be a component of the vegetation canopy cover. In the riparian woodlands that constitute most urban wetlands, this means a species must reach the mature heights of mule fat, sycamore, willow, and cottonwood trees and shrubs that natu-

rally dominate these woodlands, typically from 6 to 40 feet or more. All the species noted as dominant in Table 1 reach such heights except for ludwigia, which dominates open water areas because there are no other significant floating aquatics in the Southern California native flora.

More Effective Reproduction.

Dominance of a plant species in a vegetative cover begins with the establishment of the species on a site. Those species which have the most flexible strategies for getting seed or propagules to a site and then getting them established have a clear advantage in dominating the cover. In one or more of three key areas, the weed species that dominate urban wetlands possess clear reproductive advantages over native species.

First, of the wetland weed species in Table 1 that spread by seed (all except giant reed), their seed has a broader tolerance of acceptable germination sites than native canopy species. Almost all native canopy species have short-lived seed (the seed of willows survives no more than 24 hours) which must be deposited on moist sites of bare earth in full sun to effectively germinate. However, Table 1 seed reproducing species can successfully germinate on a variety of sites ranging from wet to dry, full sun to partial shade, and acidic to highly alkaline. Many can germinate on the surface or even when buried by flood debris, making them much more likely to establish than the natives which require more specific ecological conditions for their seed to germinate. Finally, unlike native riparian trees and shrubs, the seed of the most dominant weed species often remain viable for long periods of time—for palms sometimes more than a year. This allows them to germinate whenever conditions are right no matter the season.

Second, seed amounts and dispersal mechanisms can be crucial to plant invasions. Native canopy cover species rely for the most part on

producing copious amounts of wind born seed. While some Table 1 species reproduce in this manner (tamarisk and pampas grass), the most dominant either do not reproduce well from seed (giant reed and ludwigia) or rely on water or animal distributed seed for dispersal. Except for pampas grass and tamarisk, even the amount of seed produced by these species is considerably less than that of the natives. In this case the flexibility derived from longer-lived seed, combined with dispersal mechanisms that favor seed deposition under existing native canopy rather than on sites without cover, provides the clear advantage to weed species for expanding into areas of existing native cover.

A final highly effective mode of dispersal is through vegetative reproduction where parts of existing plants are either able to break off and wash down stream to new invasion sites, or where a species is able to gradually expand its patch coverage by clonal spread. Several native willow species possess both of these characteristics, although their potential for spread through flood dispersion is relatively low.

In contrast, giant reed, the most pernicious of the Table 1 weed species, is highly effective at both these means of spread. Clonally it will gradually increase patch size. Its root structure is much denser than willow clones, which allows these patches to effectively exclude any other canopy species from the area occupied by the patch (unless the species is already established before the spread takes place). Similarly, while giant reed can be spread by broken-off canes rerooting, its most effective way of invading new riparian sites is by means of large root mats uprooted during major flood events. The root mats are then washed downstream to new entrapment sites where local sediment covers them, allowing regrowth. Ludwigia is also most commonly spread by floating mats breaking

loose during flooding and being washed downstream, where they reroot through either soil or water.

Seedling Shade Tolerance. One of the single most important characteristics allowing the Table 1 weed species to dominate riparian woodland canopies is the shade tolerance of their seedlings. Only coast live oak (a marginal wetland species) and to a lesser degree western sycamore have any seedling shade tolerance among the natives. On the other hand, all of the evergreen weed tree species (including palms) as well as giant reed and pampas grass (which are also evergreen) have highly shade tolerant seedlings. Many of these species eventually reach heights greater than the surrounding native canopy, which they gradually shade out. Once these species come to dominate wetland canopies, natives are unable to re-establish until the weed canopy cover is damaged, dies, or is eradicated. Since the weed species are generally long-lived compared to natives the opportunity for native re-establishment is low. Shade tolerance is also the chief reason why animal vector and flood spread of weed species seed into existing riparian woodlands is such an effective invasion strategy, since shade tolerant seedlings germinate in the riparian understory and then later shade out shade intolerant natives.

Growth Rate and Continuity.

One of the best-known ways weed species use to out-compete natives after disturbance is by their fast growth rate. All the species listed in Table 1 share this common trait and in most cases can reach mature canopy height in one to five years in unshaded areas. Giant reed is especially known for its growth rate. The author has personally measured giant reed rhizomes growing at greater than six inches per day. Pampas grass and tamarisk are also known for their rapid maturation rates. However, fast growth rate is less of a competitive advantage in wetland areas because all native riparian species also pos-

sess this characteristic. Where it becomes an advantage ecologically is by its lack of interruption. All native riparian species (except coast live oak, which is a marginal wetland species) go deciduous for brief periods during each winter. The only Table 1 species to experience dormancy is tamarisk. All others continue to grow year-round, although their growth slows during the short-day portions of the year when the natives go deciduous and stop growth altogether.

Resilience After Flood Disturbance or Fire. Table 1 weed species are also considerably more resistant to flood and fire disturbance than are native canopy species. Of the native canopy species, only coast live oak and to a lesser degree western sycamore dependably resprout after fire. In contrast, all Table 1 species except ludwigia dependably resprout immediately after fire damage either from their trunks or crowns.

In addition, while Table 1 species are tolerant of temporary flooding in ways similar to riparian canopy species, they are generally more resistant to disturbance by flood erosion since their root systems are either deeper (tamarisk, broadleaf trees) or more extensive (e.g., palms, pampas grass, giant reed) than the natives.

These weed species are also more tolerant than most native canopy species of drier conditions and thus variations in water table depth during droughts. Tamarisk, in particular, uses its deeper root system during desert droughts to out-compete native desert wash trees and shrubs. But most of the Table 1 species can be equally happy growing on drier upland sites as within high water table areas, whereas willows—a major dominant in most riparian woodlands—would die under such conditions. Even the floating aquatic ludwigia is equally happy establishing in drier canopy understories along the shoreline.

Broader Tolerance of Poor Soil Conditions. The final ecological



Brazilian pepper and palm tree infestation mapped on the lower San Diego River for future eradication.

characteristic that favors the invasion of the weeds in Table 1 into wetland canopies is their tolerance of a higher level of alkalinity than native canopy species. Some species such as pampas grass and tamarisk are particularly competitive in highly salty soils and will take over in such areas because native seedlings cannot survive. This characteristic is particularly important where there are high evaporation rates, as in Southern California, because salt remains on the soil surface as water tables recede during the hot summer months.

CONCLUSIONS

In conclusion, it is the combination of these ecological growth characteristics which the Table 1 species share that appear to provide them with superior competitive abilities in wetlands over native species. They remain a problem in urban wetlands because they are continually being used for ornamental or commercial purposes, sometimes despite local ordinances against such practices. In addition, once established in a watershed they are easily spread by water and animal vectors into riparian canopy areas where their competitive ecological characteristics allow them to take over.

It is clear that as long as this

practice persists, active and continuous weed management programs will be required to prevent the eventual dominance of these species in urban wetlands. The San Diego River Master Plan represents an essential first step in assessing the extent of the invasive weed problem in the urban wetland areas of San Diego, as well as in providing strategies for its future management. The result of this mapping effort provides an important and first quantitative assessment of the amount and extent to which highly invasive exotic weed species have established in Southern California urban wetlands based on the San Diego River example, which we believe to be typical. In addition, we hope to have made a strong case for the comprehensive planning of watershed habitat restoration including the design of defensible restoration sites (usually from the top of the watershed down), eradication of all major invasive weed species present, and finally, the importance of continuing weed management funding after initial restoration.

For references and more information please contact the author.

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Douglas irises (*Iris douglasiana*) and California thrift (*Armeria maritima* ssp. *californica*) nestle between lava-rock boulders and a narrow stairway in the rockery at the Fleming garden in Berkeley, California. All photographs by B. O'Brien.

A NATIVE PLANT GARDEN IN THE BERKELEY HILLS, PART TWO

by Jenny S. Fleming

The following is a continuation of the article reprinted with permission from Rancho Santa Ana Botanic Garden. The original publication is: Fleming, Jenny S. 1997. A Native Plant Garden in the Berkeley Hills. In *Out of the Wild and Into the Garden II: California's Horticulturally Significant Plants*. 1995 Symposium Proceedings. Rancho Santa Ana Botanic Garden Occasional Publications #2. Pages 218-225.



The Fleming meadow and rock garden, as seen in 1993.

In a period of exceptionally heavy rain in the spring of 1958, a large section of the concrete rail driveway wall collapsed in a muddy ooze. We found that Scott's well-engineered wall would not resist the opening of an old, hidden, generally inactive creek bed. We decided to have the heavy clay trucked away and we rebuilt the wall with back-fill of large angular "quarry run" crushed rock for better drainage. I waded into the mud to rescue my prized dogwood tree and planted it on the lower, stable bank. To plant this wall I spent many hours applying clay mud between the rails,

as our rock fill does not support plant roots.

Near the street at the top of the wall I placed a western leatherwood (*Dirca occidentalis*) a rare San Francisco Bay endemic shrub, hoping it would be appreciated by knowledgeable passers-by. I admit that few people notice this jewel; for us its early blooms announce the coming of spring.

At the top of the driveway beyond the rail wall is the poured concrete stairway that constitutes the main entry to our house. We have faced the concrete with lava fieldstone set in mortar, now covered with moss and lichen, and planted with California polypody (*Polypodium californicum*), mist maidens (*Romanzoffia californica*), and live-forever (*Dudleya caespitosa*). As I had no tools to press soil into the tiny, rough crevices, I

pushed the mud with fingers and attempted to persuade the plants to cling in the vertical wall. It is not easy to water this area, so I purposely used summer dry plants.

From the landing halfway up the front stairs, you can step through a redwood gate to a path along the top of the driveway wall or climb a rock stairway to the living level—house, patio, and meadow. On the slope above the rail wall are three large trees: a coast redwood (*Sequoia sempervirens*), an incense cedar (*Calocedrus decurrens*), and a beautiful tree long gone from California. The latter is the dawn redwood (*Metasequoia glyptostroboides*) which thrived in what is now California over ten million years ago, and I thought it would be interesting to plant one near its two relatives. The fall color of this ancient deciduous redwood is a bright rusty brown and adds interest to a green landscape.

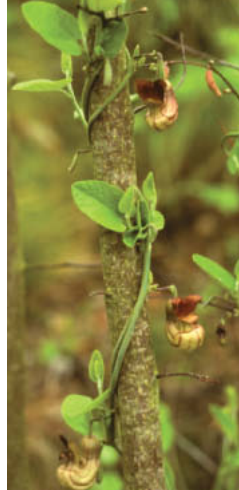
I am fond of vine maple (*Acer circinatum*), an elegant small tree with gold or red autumn leaves and in good scale for small gardens. I have planted two in this bank, one in deep shade and one in part sun. Also in half-day sun on a steep portion of this bank is a young dogwood (*Cornus nuttallii*), a difficult tree to keep alive in captivity. It may thrive for a few or many years, then suddenly collapse in early summer. The cause of early death is probably root crown rot. The root crown of dogwood should be checked often for any soil or mulch buildup and gently cleared, preferably with a stream of water.

Under the trees grow western bleeding heart (*Dicentra formosa*), false lily-of-the-valley (*Maianthemum dilatatum*), a white *Trillium chloropetalum*, native iris hybrids and, on the sunny edge, a clump of leopard lily (*Lilium*

pardalinum). My prize in this area, a gift from Jim Roof, is an unusually beautiful *Trillium chloropetalum*—claret red with white throat. Because its color is so clear and strong, I have twice raised and divided it to spread in my garden and to share with friends. I plan to dig a bulb once again to give to a qualified and interested nurseryman for propagation and dissemination.

About 1958 we planted a gallon-sized giant sequoia (*Sequoiadendron giganteum*) near the northwest corner of the patio level in deep fill retained by another concrete rail wall. This has become a garden giant, which we estimated was over 13 feet around and 80 feet tall. It is a beautiful specimen with classical conic shape and silvery green foliage. Scott trained a Dutchman's pipevine (*Aristolochia californica*) up and around the trunk of the sequoia to display the unique flowers. Beautiful but thirsty, the sequoia root network confounds my efforts to maintain a mountain meadow a few feet to the southwest.

Originally our meadow was a dichondra lawn, which worked well for the swing set. When the time came that our girls no longer used the apparatus, we decided a plain lawn of grass or dichondra would be uninteresting. We undertook to establish a mountain meadow, using low-land plants. We tilled the soil as deeply as we could, put in irrigation lines, and added a huge amount of good topsoil and mulch so we could mound and contour. We mixed in about twenty percent by volume of rock wool to gopher-proof the



Dutchman's pipevine (*Aristolochia californica*).

area. This has been highly successful and we have used the same method in other plantings up the hill. Fiberglass insulation scraps from construction projects serve the same purpose—"gopher food," as we call it. Although the little buggers occasionally probe the meadow and similarly protected areas, they

quickly decide to pursue their fortunes elsewhere and do virtually no damage.

From a plant sale at Strybing Arboretum, I obtained a Marin County form of red fescue (*Festuca rubra*) and spent one year growing a large patch elsewhere on the property until I had enough to plant the small—about 350 square feet—meadow. In the fall, David Bigham, a friend and landscape architect with a strong interest in natives and especially grasses, divided the fescue into tiny rooted sprigs and planted them in the prepared meadow area. At this time I also planted about 100 bulbs of Ithuriel's spear (*Triteleia laxa*) and a few dozen each of golden brodiaea (*T. ixioides*) and camas (*Camassia quamash*). I continue to add spring color using buttercup (*Ranunculus californicus*) and meadowfoam (*Limnanthes douglasii*). As the roots of the giant sequoia have invaded the meadow and used much of the moisture, I now must irrigate the area through the summer. We mow the meadow with grass shears in early October, every year.

[See the next issue of *Fremontia* (Volume 34, No. 4) for the final installment of this delightful and informative journey through the Fleming garden.]

Contact the author through Bart O'Brien, Rancho Santa Ana Botanic Garden, 1500 N. College Avenue, Claremont, CA 91711. bart.obrien@cgu.edu

The Fleming mailbox, surrounded by lush native woodland plants.



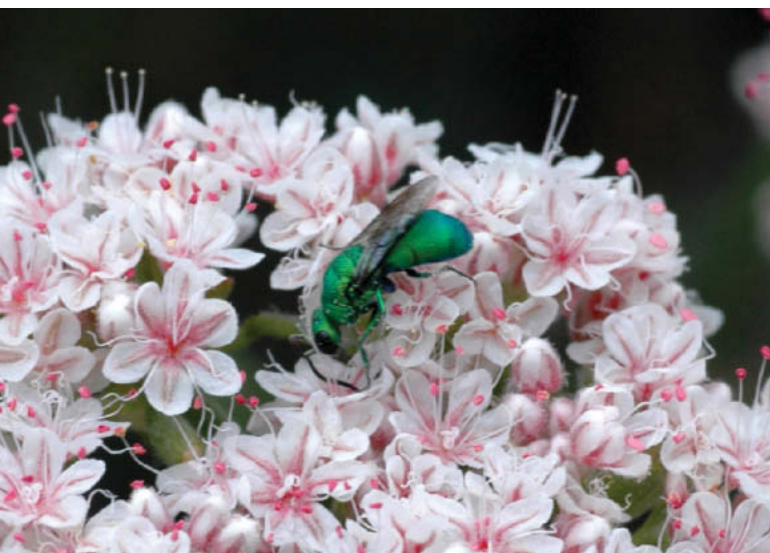


An impressive subalpine field of mountain bistort (*Polygonum bistortoides*) with flower-visiting sawfly.

BOTANICAL DELIGHTS OF THE SIERRA NEVADA

Photographs by Linda Ann Vorobik

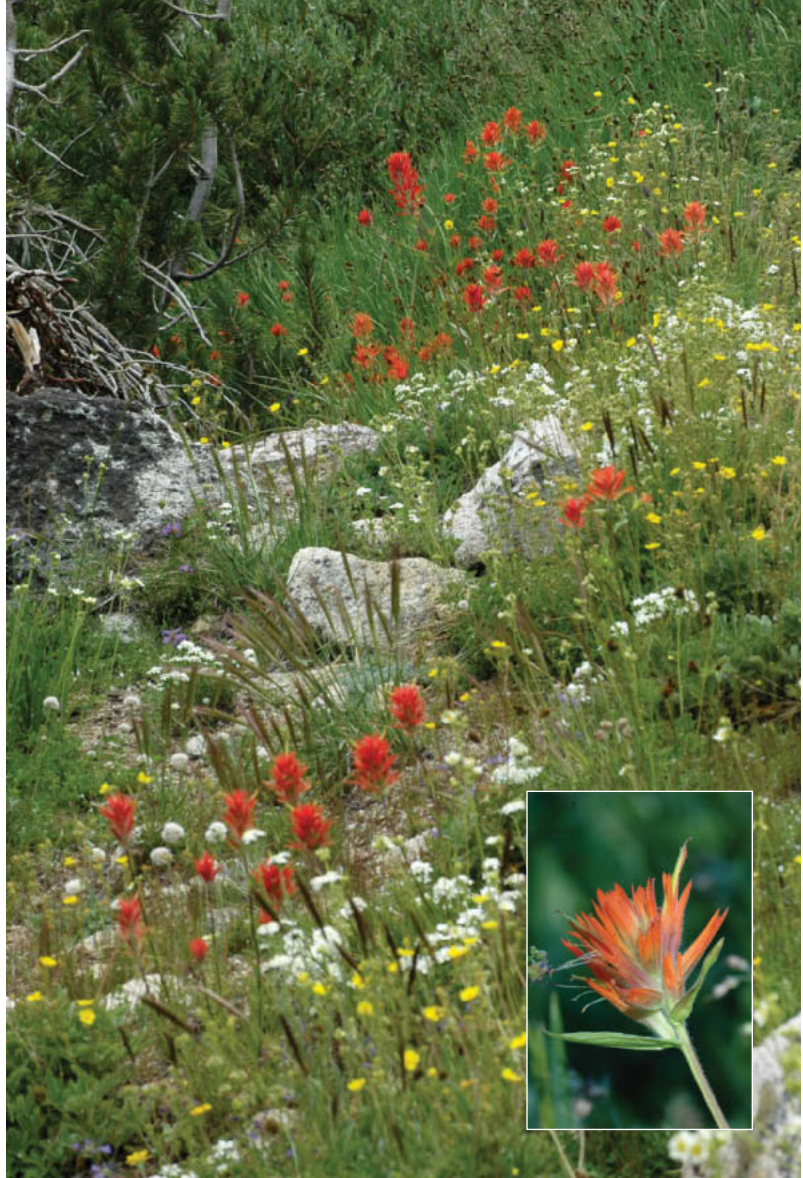
Every day in the field I have a moment that assures me it is a gift to be alive and in the Sierra Nevada. Many of these moments come from animal sightings of the smallest, but not insignificant, kind. This should be another excellent year in the mountains, worthy of revelry in plants, insects, and ecosystems until late in the season.



ABOVE RIGHT: Long-horned beetle visiting corn lily (*Veratrum californicum*).

• ABOVE LEFT: Long-horned beetle drinking from desert buckwheat (*Eriogonum nudum*). • BELOW RIGHT: Painted lady enjoying a patch of wild onions (*Allium* sp.). • LEFT: Cuckoo wasp visiting the flowers of California buckwheat (*Eriogonum fasciculatum*). Although this buckwheat may not be the most attractive plant, it is extremely common in California and is an important food plant for insects.





It is only fitting that I, as a watercolorist and more especially, a lover of puns as well as plants, present images of a variety of paintbrushes (species of the genus *Castilleja*). Only a few out of the approximately 20 plus species of the Sierra are shown here.



CLOCKWISE FROM TOP LEFT: *Castilleja lemmonii*, from Little Lakes Valley. Named for the collector Lemmon, and not its color! • *C. minor*. A relatively uncommon annual species that grows in moist areas. Seen at Mono Lake in saline soils; this image taken from the southern Sierra near Kennedy Meadows. • *C. miniata* from near Carson Pass. This species is very common in subalpine wet meadows and along streams. • *C. angustifolia*, from near Bodie. This species is common within the lower sagebrush zone of the eastern Sierra, and is part of a large and quite variable complex. Some know it as *C. chromosa*, a name which better describes the awesome red color of flowers and bracts. • *C. applegatei*, from Sonora Pass. Note the wavy leaf margins, a distinguishing feature of this paintbrush. • *C. linearifolia* from Rock Creek, Inyo Co. Usually with salmon-pink inflorescences.



BOOK REVIEW

California's Frontier Naturalists, Richard G. Beidleman. University of California Press, 2006. 484 Pages, 41 illustrations. Hard cover price \$39.95.

Many members of the California Native Plant Society may be familiar with the names *Fremontodendron*, *douglasiana*, or *Eschscholzia*. But who were the taxonomic namesakes and what were their contributions?

Here is your chance to learn answers to these and many other questions from a newly published book by Richard Beidleman. In a work that surely qualifies as a labor of love, he chronicles California history from naturalist to naturalist, starting with La Pérouse's visit to Monterey in 1786. Along the way we refresh our knowledge of the state's natural history within the context of world events involving England, Spain, Russia, Mexico, and the brash newcomer, the United States of America.

I was particularly drawn to the chapter on Archibald Menzies, who

collected during Captain George Vancouver's explorations of the American west coast in the mid 1790s. Among the type specimens he gathered (original specimens used to define a newly discovered species) were those of the California quail, California condor, and California redwood. He also collected what is now known as the Monterey pine. The journals of Menzies filled five volumes, resulting in, among other things, 14 California taxa—according to the index of plant names—bearing the species epithet *menziesii*. If you throw in synonyms and subspecies, the total comes to 50 taxa.

California's Frontier Naturalists continues with a recount of the days of the overland expeditions such as those of John Charles Frémont, the railroad surveys, and the closing days of the American frontier. These chapters introduce us to the names of David Douglas, Thomas Nuttall, Thomas Coulter, Karl Hartweg, and others.

As is typical throughout the book, Beidleman provides us with interesting insights into the interactions between the various groups of explorers, such as the English and their Spanish hosts. Surely there is no other single geographic area with such a rich history of its natural history.

California's Frontier Naturalists is easy and fascinating reading. It will enhance the reader's existing appreciation for favorite plants as they discover the who, what, and where of many of their discoveries.

For example, did you know that *Darlingtonia* was collected as a quick-grab by botanist William Brackenridge while he and other members of the Wilkes expedition were fleeing angry Native Americans? Or did you know the decades-long story of how *Eschscholzia californica* became our state flower by signature of Governor George Pardee? In spite of valiant leadership by botanist Sarah Lemmon, Pardee's predecessor, Governor Henry Gage, had refused the request, stating, "I do not think the adoption of a state flower is a proper subject for legislation." Gage's view appears to have run against popular opinion, considering the March 3, 1903 front-page headline in the *Oakland Evening Enquirer* which stated: **Golden Poppy Is Our Emblem**. Beidleman then explains that it was Senator Smith who introduced the legislation. The news article goes on to tell how Oakland resident Mrs. G.L. Lemmon was "the one largely responsible" for the statewide campaign and that Senator Smith presented her with the bald eagle quill-feather pen used by the governor in signing the bill.

The late 1890s saw the end of our nation's frontier adventures and the advent of our own home-grown naturalists and their supporting institutions, such as the University of California, Leland Stanford Jr. University, and the California Academy of Sciences. These and other greatly informative stories are covered in the latter chapters of this book.

Dan Cheatham
East Bay Chapter

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CONTRIBUTING PHOTOGRAPHERS

Brad Burkhart. See contributors list, back cover.

Liz Chattin. See contributors list, back cover.

Julie Christian is a botanist with the Santa Monica Mountains National Recreation Area.

Julie Evens is the lead vegetation ecologist for the California Native Plant Society. She manages a variety of projects to characterize vegetation statewide.

Willis Linn Jepson was the first botanist at the University of California, Berkeley, and the namesake for *The Jepson Manual*, and the Jepson Herbarium. His photographs were presented for use in *Fremontia* by Richard Beidleman from the archives of the Jepson and University Herbaria, University of California, Berkeley.

Bart O'Brien is the incoming *Fremontia* editor and is co-editor of this issue, Senior Staff Research Associate at Rancho Santa Ana Botanic Garden, and co-author of the recently released, award-winning book, *Native Plants for the Garden*, published by Cachuma Press.

Linda Ann Vorobik edited *Fremontia* for the past six years, is co-editor of this issue of *Fremontia*, and is a professional botanist and botanical illustrator. The *Fremontodendron californicum* artwork that graced *Fremontia*'s masthead from 2001 through 2005 was created by Linda and first appeared in 1993 in *The Jepson Manual*, J. Hickman, Editor (used here with permission from the Jepson Herbarium, UC. © Regents of the University of California). We are deeply indebted to Linda for her many years of service to CNPS, and look forward to her future contributions to *Fremontia* in her new capacity as a member of the Editorial Advisory Board.



MATERIALS FOR PUBLICATION

Members and others are invited to submit material for publication in *Fremontia*. Instructions for contributors can be found on the CNPS website, www.cnps.org, or can be requested from the next *Fremontia* Editor, Bart O'Brien at bart.obrien@cgu.edu or c/o Rancho Santa Ana Botanic Garden, 1500 N. College Ave., Claremont, CA 91711.

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FROM THE EDITOR

Do you notice a change in this mailing? The California Native Plant Society is using its funds in the most cost-effective manner by mailing the *CNPS Bulletin* and *Fremontia* as a combined unit. This change also allows the society to print the *CNPS Bulletin* in color.

This is my farewell issue as editor and the issue to welcome Bart O'Brien as co-editor of *Fremontia*. I introduce him, his expertise as a horticulturist, and his latest award-winning book on page 2. Bart will begin as sole editor with the next issue of *Fremontia*. Welcome Bart!

As appropriate to the season, the first article of this issue recreates a journey through what is now Yosemite

National Park, not by current-day travelers, but rather by Willis Linn Jepson, John Muir, and others, in 1909. The article includes a selection of photographs taken by Jepson. The journey is related by archivist Beidleman, whose excellent new book, *California's Frontier Naturalists*, is reviewed on page 24. Also, look on pages 22–23 for a selection of plant images from the Sierra by Vorobik.

Our series of articles assembled and edited by the Vegetation Program's Julie Evens and Todd Keeler-Wolf continues with an article by Chattin, Rubin, and Magney, describing their project in Ventura County, highlighting the importance and utility of mapping vegetation at a more detailed level

than has previously been done. Next, Brad Burkhart presents his successful revegetation project on the San Diego River. It is inspiring to see how an urban landscape can be transformed from a site full of weeds to one full of native plants, thus welcoming both wildlife and people.

The last article continues the three-part series describing Scott and Jenny Fleming's home garden, a lovely landscape full of beautiful native plants. I hope that you are out enjoying your native plant garden, or hiking the Sierra, or working on a revegetation project. But if not, enjoy reading. To you, readers, my fond farewell as *Fremontia* editor.

Linda Ann Vorobik

CONTRIBUTORS

Richard G. Beidleman, PhD, is emeritus professor of ecology at Colorado College, Colorado Springs, research associate at the Jepson Herbarium, instructor for the Jepson workshops, UC Berkeley, and author of *California's Frontier Naturalists*, recently published by UC Press.

Brad Burkhart is principal of Burkhart Environmental Consulting, a firm specializing in habitat restoration projects. He has focused on habitat restoration for over 20 years, managed a native plant nursery, completed and monitored conceptual and construction plans for habitat restoration projects, and taught native plant landscaping and restoration.

Dan Cheatham is probably best known for the Cheatham & Haller habitat classification system that was developed, with Professor Robert Haller, in the 1970s for use by the University of California Natural Reserves System and served as a forerunner of vegetation classification systems in use today.

Liz Chattin is a conservation biologist who has worked with the US Geological Survey, National Forest Service, and National Park Service on inventory and monitoring projects. She currently works on grant projects focused on improving Ventura County's review and protection of biological resources.

Jenny S. Fleming is one of the founding members and a long time Fellow of CNPS. Throughout her long horticultural career, Jenny and her garden have provided inspiration and plants to innumerable gardening enthusiasts.

David Magney is principal of David Magney Environmental Consulting and has a thorough knowledge of California flora with over 20 years of field experience. He is president of the Channel Islands Chapter of CNPS.

Lorraine Rubin has worked on environmental programs for the County of Ventura for the last 17 years. She worked in water conservation, recycling, and for the last four she has been writing and administering grants for the County.



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