



California  
Native  
Grasslands  
Association

# GRASSLANDS

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### Mission Statement

*The mission of the California Native Grasslands Association is to promote, preserve, and restore the diversity of California's native grasses and grassland ecosystems through education, advocacy, research, and stewardship.*

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## From the President's Keyboard

# CNGA Continues to Broaden Scope in 2014

by Jon O'Brien, President

Happy 2014! As CNGA's incoming President, I am looking forward to a great year of grassland preservation, restoration, and education.

People familiar with CNGA often associate our organization with one thing: workshops. It is true that CNGA has a proven track record of providing excellent workshops on a multitude of grassland-related topics, including grassland

restoration, monitoring, identification, and range management (and don't forget about the Annual CNGA Field Day at Hedgerow Farms). In addition to workshops, however, CNGA has multiple other committees, staffed by volunteer board members and other CNGA members, who focus on other aspects of grassland ecology and preservation.

CNGA has an active Conservation Committee that focuses on preserving remnant grassland stands in different parts of California. Members of this committee have been active players in preserving remnant grasslands at Point Molate near Richmond, at the site of the proposed Oakland Zoo expansion, and at multiple locations.

CNGA also has an active K-12 Education Committee working to incorporate grassland ecology into science curricula in primary schools. Their goal is to teach kids that grasslands can be wonderful, diverse ecosystems as opposed to "just a field."

In addition to these, CNGA has an active Research Committee focused on identifying and summarizing research related to grassland ecosystems and the ecosystem services associated with grasslands and other native habitats. And then, of course, there is the *Grasslands* Editorial Committee. Members of this committee work tirelessly to put out the journal you are reading right now.

Other new committees are forming in 2014. If you want to become more involved in CNGA's work, contact admin@cnga.org. Volunteers are always welcomed.



### Grasslands Submission Guidelines

Send written submissions, as email attachments, to grasslands@cnga.org. All submissions are reviewed by the *Grasslands* Editorial Committee for suitability for publication. Contact the Editorial Committee Chair for formatting specifications: grasslands@cnga.org.

Written submissions include peer-reviewed research reports and non-refereed articles, such as progress reports, observations, field notes, interviews, book reviews, and opinions.

Also considered for publication are high-resolution color photographs. For each issue, the Editorial Committee votes on photos that will be featured on our full-color covers. Photos are selected to reflect the season of each issue. Send photo submissions, as email attachments, to Ingrid Morken at grasslands@cnga.org. Include a caption and credited photographer's name.

**Submission deadlines for articles:** **Spring 2014** — Feb 15, 2014 **Summer 2014** — May 15, 2014  
**Fall 2014** — Aug 15, 2014 **Winter 2014** — Nov 15, 2014





## Introducing Our New AD!

Please join the Board in welcoming Rebecca Green to CNGA as the new Administrative Director. Rebecca comes with a wealth of administrative experience. We look forward to her applying her excellent organizational skills to the operation of the Association.

Rebecca's most recent work as Deputy City Clerk for the City of Napa has prepared her well for the Administrative Director position. This work polished her organizational skills while providing opportunity for implementing forward-thinking information management projects. Many of these projects included innovative technological solutions to enhance efficiency, effectiveness, communication, and transparency.

Prior to her career in city administration, Rebecca enjoyed many years working as a librarian in various public libraries in California and Colorado. Through this work, she spearheaded many exciting projects, from creating programs and reading groups for adults, to computer literacy instruction. Rebecca's work as Local History Librarian for her home town of South Pasadena, CA produced a variety of products, including a well-used database of historic photos and a documentary film.

Rebecca has a Bachelor's Degree in History from Sonoma State University, and a Master's in Library and Information Management from Emporia State University (Kansas). She is currently pursuing her Doctorate in Transformative Studies at the California Institute of Integral Studies in San Francisco.

We look forward to many positive changes for CNGA in the coming year. Welcome aboard, Rebecca!

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*CNGA extends deep appreciation and thanks  
to the following retiring Board members:*

Mary Fahey \* Erik Gantenbein \* Cathy Little

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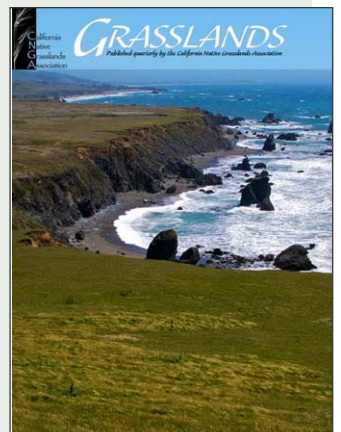
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# A Native Meadow Experiment

by Billy Rhyne, Landscape Architect, Rhyne Designs<sup>1</sup> Photos courtesy of the author.

For years I have been interested in the design and installation of native grass meadows in garden settings. As soon as I moved into my house in Albany (located just north of Berkeley in the San Francisco Bay Area), I saw a great opportunity to experiment with this on my own. Although I am not a grass expert or a horticulturalist, as a landscape architect interested in native plants, I find myself in a position to encourage clients to consider native grass meadows for their yards. Most people have many questions about how it will look, what maintenance is involved, and exactly how best to install it. So I decided to install my own little patch of native grasses and document it closely to get some first-hand experience.

Before getting started, I read up on the different techniques from various books and articles, and reviewed what I learned in a 2010 CNGA workshop “Using California Native Grasses in the Water-Conserving Landscape.” (I hope I didn’t stray too far from what my teachers would have done!) I followed a 6-part process: lawn eradication, soil testing, plant selection, soil preparation, plant installation, and of course, maintenance. As I understand it, the main obstacle to establishing a native meadow is weed control, so that drove a lot of my approach. I have a small back yard, which is relatively flat with good sun exposure, and it was mostly a weedy lawn when I moved in (Fig. 1). After building up beds for other plantings along the perimeter, I defined a rectangular area in the middle for the native meadow, using the “Golden Ratio,” roughly 17 x 11 feet. Then it was time to start getting rid of those weeds.

## Part 1 — Lawn Eradication

Like many lawns, my backyard was really just a collection of grassy weeds, some of them tough to remove. The possible weed eradication techniques I have read about include: 1) rototilling the soil followed by repeated weed kill-offs with herbicides, 2) scraping off the surface lawn, sheet mulching, and installing plants within the mulch, and 3) sheet mulching over the existing lawn followed by spreading seed or installing plugs. Because I wanted to avoid the use of chemicals, I decided to go with option #3. However, I let the sheet mulch sit for a longer time than is usually recommended. My reasoning was that the area should be covered up before the beginning of the rainy season, so that the weeds would not have a chance to grow, with continued coverage until the ideal time for planting in late fall. I was willing to live with an ugly yard for a while to get the best result.

In the fall of 2011, I waited for a good time to install the sheet mulch, and since rain did not occur until the winter holidays I took action then. I started by digging trenches around the perimeter of the area to create a place to weigh down the cardboard. Then I mowed the lawn as low as possible and left the clippings in place. I made a trip to the recycling center and took a pile of cardboard *out* of the recycle

bins. I then laid the cardboard over the lawn, overlapping the edges, and weighted it with rocks (Fig. 2). At the time, I decided that one layer of cardboard would be enough since that is how much I could fit in my car, but I came to regret this later as you will see. The following day I filled up bags with the City of Albany’s free arbor mulch (chippings from the city’s tree-trimming work). After wetting the cardboard thoroughly, I laid down a 1-½” layer of mulch over the area, which is thinner than the recommended 3–4 inches.

As the rains continued into the early spring, I saw some weeds poking up through the cardboard and mulch layers. They were fairly easy to pull, but it indicated to me that I should have made the extra effort to use the recommended two or three layers of cardboard and 3-4” of mulch. My weedy lawn didn’t seem like it was getting completely smothered. I continued to diligently remove weeds and added another inch or so of fir bark mulch. Once the rain tapered off in early April, there were fewer weeds and I felt better about the success of my weed removal efforts.

## Part 2 — Soil Testing

In urban areas where the land has often been worked over for a long time, the soil is likely to be degraded and not ideal for planting. Soil is a living system, full of all kinds of living organisms and complex chemical reactions, what was called the “soil food-web” in the Bay Friendly Landscaping and Gardening Coalition courses I took. The soil in my backyard was definitely degraded, so I decided to do some different types of soil testing to determine how to best amend and prepare it for planting.

In the summer of 2012 I had fun digging a few holes in the yard and did some basic field testing myself, and I also sent a soil sample off for professional laboratory analysis. The basic testing I did on my own included the ribbon test for soil texture, a percolation test, and pH testing with a store-bought kit. The results led me to believe that I had some relatively heavy clay that was low in nutrients and drained

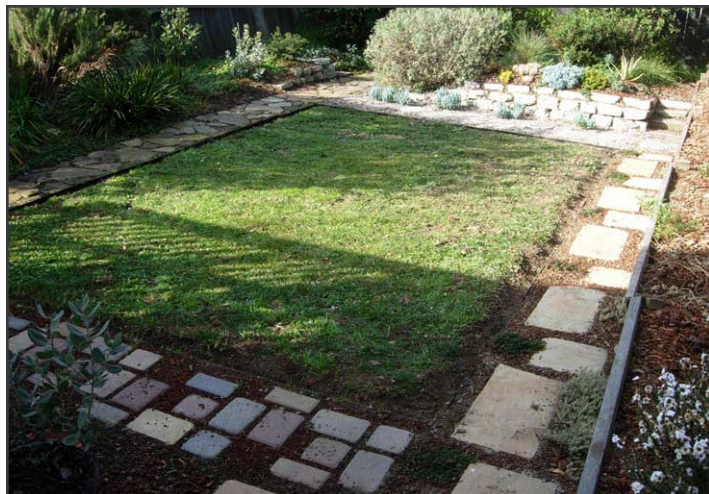


Figure 1. Meadow area before starting project

<sup>1</sup>Billy Rhyne based much of this article on his blog at [www.rhynelandscape.com](http://www.rhynelandscape.com).

poorly due to compaction (not uncommon in my area). However, the results I got from the professional report were a little different – these results classified it as a Sandy Clay Loam with an extremely low pH of 4.7, but it had relatively decent drainage and available nutrients. This report gave very specific recommendations for soil preparation which are discussed in *Part 4 — Soil Preparation*.

Part 3 — Plant Selection

My goal was to re-create a grassy meadow like what existed in this area prior to human impacts, and I also intended the meadow to be a laboratory where I could observe and experiment with many different native plants. I live along the eastern edge of the San Francisco Bay in what was historically a Coastal Prairie so I focused on this plant community. The hilly areas less than a mile away still contain Oak Woodland remnants, so I also considered plants from this community. The plants of the Coastal Prairie are primarily grasses, some small shrubs and numerous wildflowers. The resulting plant list had exciting possibilities, including species like purple needlegrass (*Stipa pulchra*), sky lupine (*Lupinus nanus*), Pacific Coast iris (*Iris douglasiana*), and California poppy (*Eschscholzia californica*).

Narrowing down the choices involved considering the site-specific environment as well as personal aesthetic preferences. Because I focused on plants native to this area, I knew that the plants would be adapted to the local weather patterns and would not need much extra water once established. Aesthetically, I considered the mature size of the plants, what time of year they flower, and when they are dormant. I wanted to provide enough variety so that the meadow would be attractive year round. I also had a few favorites that I wanted to be sure to include.

Since this is an experiment for me to study native plants, I chose not to go with a strictly “restoration” approach where the design would resemble a rectangle of wild prairie cut out of nature. I wanted to have more variety so I could watch and learn about how the different plants grow.

The plants typical of a Coastal Prairie can be divided roughly into three categories: annual/seasonal grasses and forbs, perennial grasses and forbs, and shrubs. Initially I focused on grasses, because for a couple of reasons, I would be planting these first. One was the fact that the cool season grasses I selected start their growth spurt in the early winter. Second, planting the grasses early allows them to begin growing before the spring weeds come up, with the grasses getting maximum growth time before late summer dormancy. Table 1 provides a list of native grasses planted in the meadow.

Although it is optimal to allow the grasses time to establish before doing



Figure 2. Sheet mulching the cardboard in place

other planting, part of the selection process was to decide on some companion plants for the grasses. The possibilities from the local native plant communities included small shrubby plants, herbaceous perennials, and annuals. In the Bay Area, a perennial may not necessarily die to the ground each winter, but it will have a down time. Annuals have a one-year growth cycle, but they can re-seed and come back each year. The perennials are typically available in the nurseries, but the ephemeral nature of annuals makes them less available and less useful as nursery grown plants, so it is best to add them to your garden from seed.

Plant size was an important factor for my meadow since many shrubby plants simply grow too large for my small space and the low grasses I had selected. The other important factor was seasonal variations of flowering time and dormancy; I wanted to be sure to have flowers blooming for as much of the year as possible. The designer in me ended up prevailing over completely staying within the locally native plant community, and I included a few attractive small plants like the sea thrift (*Armeria maritime*). One other factor was the question of availability of these plants at nurseries, particularly the perennials. I was fortunate that the Bay Area has a series of native plant sales each fall that made my plant shopping pretty easy. Table 2 provides a list of the native perennials and wildflowers selected for the meadow.

continued next page

Table 1. Plant List: Native Meadow Grasses							
Botanical Name	Common Name	Water Use	Exposure	Height	Spread	Container Size	
<i>Calamagrostis foliosa</i>	Leafy reedgrass	Mod.	Sun to part shade	12"	24"	4" pot	
<i>C. nutkaensis</i>	Nutka reedgrass	Mod.	Sun to part shade	36"	24"	4" pot	
<i>Deschampsia cespitosa</i>	Tufted hairgrass	Mod.	Sun to part shade	12–24"	24"	4" pot	
<i>D. cespitosa</i> 'Jughandle Creek Dwarf'	Tufted hairgrass	Mod.	Sun to part shade	3–6"	12–18"	4" pot	
<i>Festuca californica</i>	California fescue	Low	Sun to part shade	24–36"	12–24"	2" plug	
<i>F. idahoensis</i> 'Tomaes Bay'	Idaho fescue	Low	Sun	8–12"	8–12"	4" pot	
<i>F. rubra</i> 'Molate'	Red fescue	Low	Sun	12–36"	12–24"	4" pot	
<i>Stipa (Nassella) cernua</i>	Nodding needlegrass	Low	Sun	24–36"	24"	2" plug	

# A Native Meadow Experiment

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## Part 4 — Soil Preparation

Because early rains persisted through the fall of 2012, the soil was too wet to work with until late December. When it eventually dried out, I continued with soil preparation. The thin layer of cardboard laid down the previous year was almost entirely decomposed, so I simply raked up the bark mulch and placed it to one side before amending the soil.

I started by loosening the soil and breaking up the chunks to achieve a finer texture so that I could easily mix in the amendments. The specific recommendation of my soil testing report was to loosen to a 10" depth. This was hard work, and I struggled to get to that depth consistently. However, I could see how it improved the soil texture for plant root growth. One disadvantage to this approach was that weed seeds were brought to the surface, but I felt that amending the soil was more important in this case.

Once the soil was loose, I mixed in the amendments. There are many types of amendments, which vary depending on the needs of the soil. In my case the soil testing report gave specific recommendations for "3 cubic yards of nitrogen-stabilized organic amendment and 110 pounds of calcium carbonate lime per 1,000 square feet of area." Most Bay Area soils will benefit from additional organic matter to help counteract the clay content. This material, which is usually ground up tree bark or coarse sawdust, needs to be nitrogen stabilized to avoid the leaching of nitrogen from the soil (it can actually suck up nitrogen from the soil if it isn't). The lime was an amendment specific to my soil's very low pH. The added lime would raise the pH to the middle range of 5.5–7.0, which the plants prefer. I also mixed in a package of all-purpose organic fertilizer that contained a large amount of beneficial organisms and nutrients. Mainly I wanted to be sure to get some mycorrhizae in the soil, and this mix had three kinds of endomycorrhizae and five kinds of ectomycorrhizae. Without getting too deeply into a very large subject, mycorrhizae are a type of fungi that live on plant roots and form a beneficial symbiotic relationship, helping roots uptake nutrients and water and getting food in exchange. There are many other benefits as well; they are a basic part of a healthy soil food-web that is often lost in urban areas.

## Part 5 — Planting

Once the soil was ready, it was time to put the grasses in the ground. I chose relatively small plants to start with, both because of cost and because they are typically younger, more vigorous, and better able to adapt to a new environment. They do need to be treated gently during planting and watered after installation because they start with

Table 2. Plant List: Native Meadow Perennials and Wildflowers

Botanical Name	Common Name	Water Use	Exposure	Height	Spread	Contain. Size
<i>Achillea millefolium</i>	Yarrow	Low	Full sun	24"	24"	1 gal.
<i>A. m. var. rubra</i> 'Rosy Red'	Yarrow	Low	Full sun	24"	18"	4" pot
<i>Armeria maritima</i> 'Bloodstone'	Sea thrift	Mod	Full sun	8–10"	12"	4" pot
<i>Armeria maritima</i> 'Alba'	Sea thrift	Mod	Full sun	6–10"	12"	4" pot
<i>Eriogonum nudum auriculatum</i>	California buckwheat	Low	Full sun	12–24"	12–18"	1 gal.
<i>E. grande</i> var. <i>rubescens</i>	Red-flowered buckwheat	Low	Full sun	24"	24–36"	1 gal.
<i>Iris douglasiana</i>	Pacific Coast iris	Low	Sun to part shade	12–18"	18–24"	1 gal.
<i>Sisyrinchium bellum</i> 'North Coast'	Blue-eyed grass	Low	Full sun	8"	12"	4" pot
<b>Seeded Wildflowers</b>						
<i>Eschscholzia californica</i> ssp. <i>californica</i>	California poppy	Low	Full sun	12"	18"	Seed
<i>Lupinus nanus</i>	Sky lupine	Low	Full sun	8–24"	9–12"	Seed

such a small root mass. Once the plants were in, I added a thick bark mulch layer, about 3" deep. Mulch is, of course, critical in the garden for many reasons, such as preserving soil moisture, preventing erosion, adding organic matter, and blocking weed growth. I planted the grasses in the middle of January 2013. After a spring and summer of growth for the grasses, I moved on in mid-October to the installation of the perennials, again using small container plants. I also purchased the wildflower seed on the plant list and will install this during the rainy season of 2013–2014 so that I won't have to worry as much about keeping the seedbed moist.

## Part 6 — Maintenance

After planting the grasses, the primary maintenance tasks are weed pulling and watering. Pulling weeds early is critical, and I tried to remove weeds once a week before they got too out of control. When the rains tapered off in early summer, I had very few weeds to deal with, good news for sure! For the first 4–8 weeks after planting the grasses, I watered every couple of days (when rain didn't do it for me). After that, I went to a deep watering once a week, making sure to wet the ground thoroughly out to the edge of the foliage. Next year, the second summer after the grasses were planted, I will limit their watering to dry weeks in the spring and extremely hot spells in the summer and fall.

It has been great to see first-hand how each type of grass grows and changes over the seasons, and a few have become my favorites. The Idaho fescue (*Festuca idahoensis* 'Tomales Bay') is a nice compact size that looked good all summer, improving with the emergence of seed heads in the last few months. The California fescue has thrived overall, but a couple of plants are not as vigorous and may need replacing. The same is true for the reed grasses (*Calamagrostis* ssp.). The red fescue shot up fast and looked attractive while flowering, but it is already spreading by rhizomes and may eventually take over too much of my small plot. The one nodding needle grass (*Stipa cernua*) that I planted ended up being a favorite of the birds, with the ground around it completely pockmarked from what must be birds foraging for the seeds.

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In the garden, native grass trimming is done in place of the grazing and fires that occur naturally in the wild environment. I have read that you shouldn't cut newly planted grasses until the second fall to be sure they have had plenty of time to establish good root systems. I did, however, cut most of the seed heads off the grasses as they started to droop and die on their own and lightly cut back the fast-growing red fescue. An interesting coincidence: On the day I did this trimming, it was a high fire danger day with some small local grass fires, which may imply that my timing was right.

## Conclusion

I have completed about 2 years of my experiment with a backyard native grass meadow, and I'm feeling great about its success! The really hard work is over, and now it's all about keeping after those weeds and doing the appropriate watering and trimming (Fig. 3). For now my intent is to pull any sprouting seedlings from the grasses and keep a relatively "clean" look, but that may change as I see how everything grows together. I can now talk more intelligently with clients about how to develop a native meadow in their yards, with the hardest part being the far shorter timeline for them than I chose to follow. Best of all, I have a fun little plot of native grassland, and I get to watch all the birds and butterflies that come with them!



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Figure 3. The meadow after fall planting



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## SPECIES SPOTLIGHT: Douglas Iris (*Iris douglasiana*)

by Diana Jeffery, CNGA Director-at-Large & Chair, CNGA K-12 Education Committee, [djeffery@sonic.net](mailto:djeffery@sonic.net)<sup>1</sup>. Photo by Doreen Smith

*There is the pale light of dawn, touched with purple and cream, in the Douglas Iris (Iris douglasiana)  
to be found during May and June in the Coast Range Mountains... —Roland Rice 1920*

The English name *iris* stems from the Greek word for rainbow, and California's native iris blossoms do not fail to fulfill that colorful promise. Douglas iris flowers are usually light blue-violet, but can range from reddish-purple to deep blue-purple or sometimes pure or creamy white to light yellow (Keator 1990, Harlow and Jakob 2003, Bornstein et al. 2005). The range of colors within the species is from natural hybridization (San Francisco Botanical Gardens 2009). Some natural hybrid populations of Douglas iris have been given their own names, such as the *Marin iris* of the Coast Ranges north of San Francisco (Harlow and Jakob 2003).

Douglas iris is 1 of 11 iris species native to the Pacific Coast of North America. The group is called the *Californicae* series or Pacific Coast Native (PCN) iris. PCN irises are small, compact plants with basal fans of leaves arising from underground stems called rhizomes. Douglas iris is found in open grasslands and at the edges of forests. It is common in windswept coastal grasslands where its creeping tuberous rhizomes spread, often forming hardy clumps of dark green sword-like leaves. Some Douglas iris clumps are a single clone that can be hundreds of years old (San Francisco Botanical Gardens 2009, Society for Pacific Coast Native Iris 2012).

Douglas iris stems are branched, and each branch bears from 1–3 blossoms that open one at a time from early to late spring (Keator 1990, Harlow and Jakob 2003, Bornstein et al. 2005). Each iris flower consists of three upright petals called *standards*, an outer whorl of three spreading petal-like sepals called *falls*, and an inner whorl of petal-like stigmas that hide the stamens underneath (Bornstein et al. 2005).

The PCNs are “beardless” irises. This means that colorful veins decorate the falls rather than the bushy beard-like tufts seen in most garden varieties of iris. Both beards and veins act as nectar guides, visual cues that guide pollinators to the nectar and pollen. The pattern and colors of veins can vary among and within species (Parsons 2013). Douglas iris flower falls typically have purple veins that radiate from the hidden nectary and highlight a yellow pathway leading directly to the nectar supply inside. Douglas iris is an important nectar-producer for insects that forage in the cool, windy conditions along the Pacific Coast. In grasslands at Bodega Bay in Sonoma County, Douglas iris nectar supports long-tongued,

nectar-collecting native bees from three genera: *Habropoda*, *Bombus*, and *Anthophora* (Uno 1982).

The closest relatives of PCN iris are the *Sibericae* series, a group that today ranges from Japan, China, the Himalayas, and central Europe and France (Society for Pacific Coast Native Iris 2012). This means that PCN iris ancestors probably migrated to the North American Pacific Coast by way of the Bering Strait that lies between Russia and Alaska, crossing the grassland steppe land bridge that forms during Ice Ages when sea levels are low.

Douglas iris hybridizes readily with other PCN iris species, and it is likely that natural hybridization is responsible for the 11 species that are now recognized (Lenz 1958, Raven and Axelrod 1995, Harlow and Jakob 2003). Over time, populations adapted to local conditions and evolved their own characteristics (Society for Pacific Coast Native Iris 2012). Today, the PCNs are distributed from southern Washington to southern California. Eight species of the eleven PCN species are endemic to California, meaning they only occur within California (Raven and Axelrod 1995, Parsons 2013). Douglas iris is the most widespread of the PCNs, occurring along the Pacific Coast from Coos Bay, Oregon, to Santa Barbara County (Cosgrove 1978).



Douglas iris is named for David Douglas, the Scottish botanist/explorer/naturalist who sent the first seeds of a Pacific Coast native iris (*Iris tenax*<sup>2</sup>) to England in 1825. Scottish Naturalist Archibald Menzies was probably the first European to collect Douglas iris. The first humans to appreciate PCN irises were the native people who inhabited the North American Pacific Coast. Native Americans in California valued Douglas iris for its flowers, which were woven into dance wreaths by the Kashaya Pomo and crushed in hot water for body paint by the Potter Valley Pomo (Goodrich et al. 1980, Welch 2013). Potter Valley Pomo used the leaves to line underground ovens (Welch 2013), and Yokio women wrapped their babies in the soft green leaves to keep the young ones cool and hydrated while the women gathered manzanita berries during the hot summers (Chesnut 1902). A very weak leaf tea was drunk by the Coast Miwok “to clean the stomach” (Kelly 1996). Some PCN iris species, particularly *Iris macrosiphon*, were highly valued for the two fine strong fibers that run along their edges. Chesnut (1902) reports that string and rope made from Douglas iris fibers

*continued next page*

<sup>1</sup>Diana Jeffery is a plant ecologist who received a Ph.D. in 2007 from UC Davis. Since then, she has continued her work with the rare and endangered plant, showy Indian clover (*Trifolium amoenum*), at Point Reyes National Seashore. She is lead author of the California's Coastal Prairies website: [www.sonoma.edu/preserves/prairie/](http://www.sonoma.edu/preserves/prairie/). <sup>2</sup>*Iris tenax* is distributed in Oregon and southern Washington with a separate race in the Klamath Mountains of northern California ([www.pacificcoastiris.org/frameworkld.html](http://www.pacificcoastiris.org/frameworkld.html)).



was “exceedingly pliable” and that Indians at the Round Valley Reservation in Mendocino County called it *deer rope* as it was especially valuable in making snares to catch deer.

All PCNs are considered species of horticultural merit, but Douglas iris is highly valued by gardeners because it is less finicky than other PCNs to transplant, easier to grow, and relatively pest-free. PCNs work well as ground covers, in rock gardens, and are considered deer- and rabbit-resistant. There are several excellent references on growing PCNs, and many varieties and hybrids are readily available in nurseries.

Some ranchers, however, consider Douglas iris an aggressive weed. Douglas iris has evolved defense characteristics that protect it from grazing and trampling. It is said to be toxic if ingested, although poisoning is rare because the leaves are bitter and unpalatable. The biggest problem is that the prolonged trampling that occurs in heavily grazed pastures weakens forage-quality plants, which stimulates the iris to spread and form dense stands that exclude other meadow plants and pasture grasses, thus becoming a problem to ranchers (CDFA 2013). There is some evidence that the iris may spread even under light-to-moderate levels of grazing (Huntsinger et al. 2007).

Harlow and Jakob (2003) report that agricultural commissioners in North Coastal counties found that Douglas iris was not a significant problem in rangeland. If it is a problem however, there are remedies. The California Department of Food and Agriculture (2013) website stresses that iris is a natural component of the meadow system and should not be eradicated. It gives these recommendations to control iris:

✱ *The best solution is to develop a grazing management plan to prevent excessive meadow utilization.*

✱ *Determine the iris distribution on your property by making a map with a rough estimate of the number of iris plants in each population.*

✱ *Monitor the populations to see if they are increasing or decreasing. Rapid increases may mean that the pasture is overused. Make modifications to the grazing plan.*

✱ *If iris dominates the pasture, plants can be hand dug. Leave the roots exposed in the sun to dry. Do not graze the area until the area has been recolonized by other plants.*

Richard King, CNGA Board Member, rancher, and holistic management instructor, recommends developing a grazing management plan that does not focus solely on iris, but one that prevents overgrazing of all the herbaceous perennials. King’s view is that plant stress from prolonged grazing and trampling of the palatable plants changes community dynamics far more than trampling the iris. Pasture plants need adequate recovery periods to fully restore vigor above and below ground. Prolonged grazing and trampling reduces the competitive ability of the more desirable plants, which allows iris patches to expand. These are some of his recommendations:

✱ *Describe what you want the site to look like and how the ecosystem processes must function to create and sustain such a site.*

✱ *Increase the productivity and vigor of high-quality perennial range forage species palatable to livestock. This requires planned grazing to minimize overgrazing of plants, minimizing excessive thatch accumulation, and maintaining good soil cover year-round.*

For more information on grazing management, sign up for the CNGA’s 2014 workshop titled “Improving Land Health and Profitability — A Workshop for Ranchers,” Richard King, instructor. Dates and location to be announced.



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# To P or Not to P? Effects of Phosphorus Level on California Native Grasses

by Taraneh M. Emam, Department of Plant Sciences, UC Davis,  
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## Introduction

Fertilization is sometimes used in restoration, but it can have negative side effects. In preparation or maintenance of restoration sites, the use of fertilizer may increase invasion by undesirable plant species. Addition of nutrients to California grasslands has been shown to reduce plant community diversity, and increased or fluctuating resources facilitate invasion by non-native plants (Kolb et al. 2002, Zavaleta et al. 2003, Harpole and Tilman 2007, Davis et al. 2013). Both native and non-native plant species generally respond positively to increased nutrient levels when grown by themselves. However, when grown in a mixture, invasive plants may be able to use these resources to outcompete native plants (Claassen and Marler 1998, Vasquez et al. 2008). In many restoration sites, fertilization with nutrients such as phosphorus (P) may not be necessary and may instead be harmful. Plant-available P varies widely by soil type and land use. In agricultural and rangeland sites throughout California, plant-available P is often very high, averaging 85 ppm (Singer 2003). Some soil types have much lower plant-available P. Plant-available P in serpentine-derived soils ranges from 1–53 ppm, with an average of 11 ppm, at over 200 sites tested throughout the state (S. Harrison, unpublished data). However, naturally nutrient-limited soils such as those derived from serpentine support unique native plant communities adapted to these conditions, and fertilization of these sites can alter these communities or lead to invasion (Huenneke et al. 1990).

During native plant propagation, high nutrient availability (either due to fertilization or to high fertility of potting soils used in nurseries) may also have negative consequences. High levels of plant-available P reduce the formation of symbiotic relationships between plants and arbuscular mycorrhizal (AM) fungi (Treseder 2004). These plant-fungal mutualisms provide increased access to water and nutrients, protect roots from pathogens, and improve soil

stability and carbon storage (Smith and Read 2008). AM fungi are efficient scavengers of soil P, and when plant-available levels of P are low, many plants (including grasses) rely on AM fungi to provide P in exchange for plant carbon. However, when available P is high, plants may “shut off” symbiosis with AM fungi (Smith and Smith 2011). Allowing seedlings to form symbioses with beneficial AM species during propagation can improve subsequent growth of native grasses in restoration sites, and fertilization with P may inhibit AM colonization during this period, or shift the fungi in roots to less beneficial species (Johnson et al. 2010). The AM species that colonize plants during early growth tend to remain dominant in plant roots even after transplanting to field sites (Mummey et al. 2009); therefore, it is important to promote beneficial AM symbioses during nursery propagation.

This study was conducted to identify the level of P at which several California native grasses reach maximum biomass when provided with other necessary nutrients and soil biota such as AM fungi. Knowing the minimum amount of P required to achieve greatest biomass of native grasses can help determine whether fertilization is necessary or unnecessary at a particular site or during plant propagation. Limiting P fertilization during propagation and site

*continued next page*

## Key points

- ✱ Use of fertilizer during grassland restoration can increase invasion by non-native species and reduce the formation of beneficial associations with mycorrhizal fungi.
- ✱ To reduce the risk of negative effects, it may be helpful to know the nutrient requirements of California native grasses.
- ✱ A greenhouse study was performed to determine the amount of phosphorus (P) required to achieve peak biomass for four California native grasses.
- ✱ Grasses were fertilized once per week with solutions of 0, 16, 31, 47, and 62 ppm P.
- ✱ The grasses tested had significantly higher biomass when fertilized with a solution of 16 ppm P compared with a 0 ppm solution, but biomass did not continue to increase significantly at higher levels of P.
- ✱ It is important to consider the potential impacts of fertilization, and fertilize only when necessary.



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## To P or Not to P? *continued*

preparation can encourage formation of beneficial AM symbioses and reduce invasion by non-native plants.

### Methods

Four California grassland species (Table 1) were grown at five levels of P to determine the level at which grasses experience P limitation. Grass seeds were purchased from Hedgerow Farms, Winters, California.

Table 1. Scientific and common names of grasses used in this study

Scientific name	Common name	Site of collection	Growth form
<i>Elymus glaucus</i>	Blue wildrye	Yolo County: Fiske Creek	Perennial
<i>Festuca</i> (prev. <i>Vulpia</i> ) <i>microstachys</i>	Small fescue	Yolo County: Fiske Creek	Annual
<i>Poa secunda</i>	One-sided bluegrass	Yolo County: Fiske Creek	Perennial
<i>Stipa</i> (prev. <i>Nassella</i> ) <i>pulchra</i>	Purple needlegrass	Napa County: Napa/Sonoma Marsh	Perennial

Grasses were grown in a mixture of 10% serpentine-derived soil (Henneke series, collected from McLaughlin Natural Reserve) in sterile sand and perlite, to minimize background P level and provide a source of soil microbes. "Conetainer" pots (Steuwe and Sons) were sown with several seeds and subsequently thinned to one plant per pot. Pots were arranged in 2 blocks, with 5 pots per P level per block. Five fertilizer solutions were created with P concentrations of 0, 16, 31, 47, and 62 ppm, using a modified Hoagland's solution (a commonly used solution that provides all necessary macro- and micro-nutrients; Epstein and Bloom 2005) as base fertilizer solution to supply other nutrients (Table 2).

Table 2. Concentration of macro- and micronutrients in base fertilizer solution

Element	N	K	Ca	S	Mg	Cl	B	Mn	Zn	Cu	Mo	Fe
Concentration (ppm)	224	235	160	32	24	1.77	0.27	0.11	0.13	0.03	0.05	2.79

Plants were grown from March 9, 2012 to June 7, 2012 in the UC Davis Orchard Park greenhouses under conditions typical for growth of native grasses in California's Central Valley. Fertilizer solutions were added until pots reached water-holding capacity once per week, and pots were watered daily. Except for *Poa secunda*, at least some individuals of all species had begun flowering at the conclusion of the

experiment. Root and shoot biomass was harvested, oven-dried, and weighed. Samples of soil were collected at the end of the experiment, dried, and submitted to the UC Davis Analytical Lab for Olsen-P analysis to determine the amount of plant-available P in soils for each P level tested. Statistical analyses were conducted using SASO 9 (Statistical Analysis System) software. ANOVA was performed on log-transformed total, shoot, and root biomass, followed by Tukey HSD (honestly significant difference) tests where appropriate.

### Results and Discussion

Plant biomass and plant-available soil P levels are described in Figure 1. P level significantly influenced total biomass ( $F$  [ratio of variance between treatments to variance within treatments] = 18.55,  $P$  [probability that difference between treatments is due to chance alone] = 0.008, where  $P < 0.05$  is considered statistically significant). This was due mostly to effects of P level on shoot biomass ( $F = 15.7$ ,  $P = 0.01$ ); P level had a marginal effect on root biomass ( $F = 4.73$ ,  $P = 0.08$ ). Total biomass and shoot biomass were significantly smaller in the 0 ppm treatment than all other P levels, but there was no difference among the higher levels of P. Maximum total biomass occurred in the 31 ppm treatment. Different species had significantly different shoot biomass (shoot  $F = 15.1$ ,  $P = 0.012$ ), and species marginally affected root and total biomass ( $F = 5.26$ ,  $P = 0.071$ ;  $F = 5.65$ ,  $P = 0.063$  respectively). However, differences in root biomass may have been minimized due to being constrained by pot size. Interaction between P level and species was not statistically significant; all species exhibited similar responses to the P levels, indicating that P requirements were similar for these native grasses.

In this study, nitrogen and other nutrients were supplied at sufficient levels to ensure that plants only experienced P limitation, but in field sites co-limitation of other nutrients such as nitrogen is likely to be an important factor and may further reduce P requirements (Craine and Jackson 2009). Another consideration is that P is particularly important for seed production, which was not measured in this study. Therefore, plants may have been limited by P in ways not detected by measuring biomass alone.

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During propagation, limiting excessive levels of available P in nursery-grown native grasses may be important to encourage beneficial symbioses with AM fungi. During restoration activities, fertilization of low-nutrient sites can increase susceptibility to invasion by non-native species, and fertilization should not exceed the minimum requirements for sustaining native plant growth. In many California soils, plant-available P is higher than the levels at which native grasses reached peak biomass in this study, and fertilization is not necessary. However, in soils where levels of available P are much lower (such as serpentine-derived soils), minimizing the impact of fertilization may also be important to protect unique native plant communities, as increased nutrient availability can drastically alter community composition and increase invasion by non-native plants (Huenneke et al. 1990).

## Conclusions

The California grasses *Elymus glaucus*, *Festuca microstachys*, *Poa secunda*, and *Stipa pulchra* have relatively low P requirements when other nutrients are available in sufficient amounts, and they quickly reach a plateau above which excess P does not increase biomass. When possible, testing soil nutrient levels and avoiding excess fertilization may help reduce invasion by non-native species and promote beneficial mutualisms with mycorrhizal fungi.

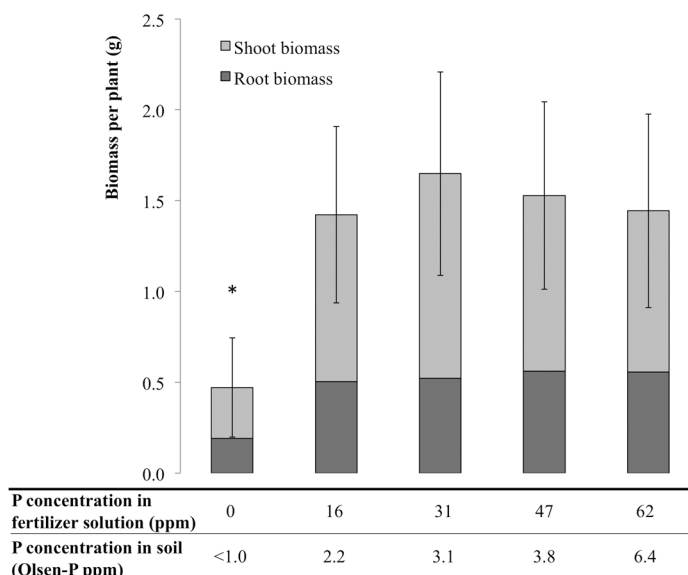


Figure 1. Total biomass per plant (with shoot and root biomass stacked), averaged across all species. Table shows fertilizer solution P concentration and soil P concentration at the end of the study. Error bars indicate standard error for total biomass; asterisk indicates statistically significant difference between total biomass at 0 ppm level and other levels ( $P = 0.008$ ). There were no significant differences in response to P level by the different species or among P levels higher than 0 ppm.



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# Visiting a California Grassland: *Point Pinole Regional Shoreline*

by Ingrid Morken, Landscape Architect, WRA, Inc.,  
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Point Pinole occupies a 2,315-acre peninsular parkland surrounded by San Pablo Bay to the north, west, and south and the city of Richmond to the east. Its geographic position in the San Francisco Bay affords stunning views of the bay waters and the coastal hills across the bay, including Mount Tamalpais. To reach Point Pinole Regional Shoreline, visitors can park at the trailhead, cross a pedestrian bridge over the railroad tracks near the entrance, and from there access the park's 12 miles of trails. A popular trail loop starts at the Bay View Trail just below the bridge, follows the southwestern shoreline of the point, and then loops around to the paved Pinole Point Trail through the middle of the park back to the bridge. The Bay View Trail traverses grassland meadows that sit between tidal marshes and eucalyptus groves (Fig. 1). Even in late fall when the grasses are mostly golden, the grasslands offer a sense of spaciousness and beauty against the expansive backdrop of the bay.

Owned by the East Bay Regional Park District, the park opened in 1973 and has a rich cultural history in addition to its distinctive ecological setting. Prior to European settlement, Native American residents of the Ohlone tribe built camps near the point where they would gather crabs, mussels, oysters, clams, and fish. By the late 1700s, Spanish settlers occupied the land and grazed longhorn cattle and sheep. From 1880 to 1960, the current parkland was used for industrial purposes; dynamite and gunpowder manufacturers existed here and produced 2 billion pounds of dynamite during this time (EBRPD 2013). These products were shipped from a pier extending from Point Pinole, and remnants of this historic pier still exist today, sitting alongside a new pier that visitors can access.

Despite the park's history, native grasslands can still be found on the property, composed of such species as purple needlegrass (*Stipa*



Figure 1. Bay View Trail at Point Pinole Regional Shoreline Park, November 2013

*pulchra*) and California oat grass (*Danthonia californica*), both bunchgrasses. The native perennial grass creeping wildrye (*Elymus triticoides*) is also present. These grasslands begin just above the tidal marshes and flank the hillsides of the point. Eucalyptus trees were historically planted in parts of the existing park to help provide a barrier from potential explosions from the dynamite manufacturers that once occurred on the property (EBRPD 2013).

Just south of Point Pinole Regional Shoreline exists Breuner Marsh, where plans are underway by the East Bay Regional Park District to restore historically filled tidal marshes and coastal prairie on the property. An extension of the San Francisco Bay Trail will also be built through Breuner Marsh, connecting the southern end of Point Pinole to Goodrick Avenue in Richmond. Construction of this project is slated to begin in 2014. Upon completion of the Breuner Marsh restoration project, visitors to Point Pinole will have access to more trails, vistas, and coastal grasslands near the bay.



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# CNGA's Bunchgrass Circle

As a nonprofit organization, CNGA depends on the generous support of our Corporate and Associate members. Ads throughout the issue showcase levels of Corporate membership (\$1000, \$500, \$250). Associate members (\$125) are listed below. Visit [www.cnga.org](http://www.cnga.org) for more information on joining at the Corporate or Associate level.

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***Special Insert —  
CNGA Spring 2014  
Workshop Schedule***

Front cover: Goat Rock Beach at Sonoma Coast State Park looking south towards Bodega Head. *Photo: Jim Coleman*

Back cover: Johnny jump ups (*Viola pedunculata*) within Coyote Ridge grasslands in Santa Clara County. *Photo: Aaron Arthur*

