California Native Grasslands Association

GRASSLANDS

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SPECIAL ISSUE:

Drought Management

California Native Grasslands Association

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

Conserving Water with Native Grassland Species *by Jon O'Brien, President*

The drought in California continues. Key reservoirs in northern California are at low levels, and the snowpack in the Sierra Nevada is only 24 percent of average. Additional rainfall this spring is still possible, but we would need multiple major storm systems to dramatically improve the drought conditions. The City of Sacramento is calling for a 20 percent reduction in water use for each household. The Governor has declared a drought State of Emergency and has asked citizens to conserve water statewide. Caltrans is running a campaign on their billboards encouraging people to conserve water due to the severity of the drought; in fact, they are reducing irrigation of their own landscapes by 50 percent. Californians are being asked to use less water in their homes, and more importantly, to cut down on watering their lawns and other landscaping, as irrigation accounts for over 50 percent of average household water use.

One major way to reduce water in your landscaping is, of course, to install more drought-tolerant plants. This can be in the form of planting native, drought-tolerant trees and shrubs instead of standard, high-water-use species, xeriscaping with rocks and cacti in areas where appropriate, and/or using California native grassland species instead of the traditional lawn.

Replacing high-water-use, traditional turf grass lawns with native grassland species can be a great way to reduce water use and create an aesthetically pleasing, colorful landscape. California native grassland species are beautiful, and by planting a mix of grasses and herbaceous flowering plants, one can end up with blooming flowers and color for most of the year while also attracting butterflies and other important pollinators.

In addition, after many native grassland species are established, they need little if any irrigation other than what occurs naturally from winter rains. Grassland species do vary in their water requirements; talk to your local native plant nursery to determine which species will work best in your area. The key is making sure the plants have enough water initially to establish their roots. This can be accomplished by installing the plants early in the rainy season so they receive as much natural rainfall as possible, or by initially using a temporary irrigation system to ensure establishment.

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.

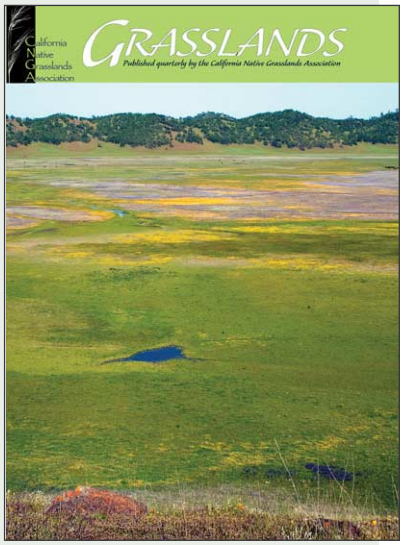
Also considered for publication are high-resolution color photographs. For each issue, the Editorial Committee votes on photos that will be featured on our full-color covers. Photos are selected to reflect the season of each issue. Send photo submissions, as email attachments, to Ingrid Morken at grasslands@cnga.org.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

Submission deadlines for articles: **Summer 2014** — May 15, 2014 **Fall 2014** — Aug 15, 2014 **Winter 2015** — Nov 15, 2014 **Spring 2015** — Feb 15, 2015

Now more than ever, it is important for all citizens of California to do what they can to reduce water use. And using native grassland species is one way to do this. This issue of *Grasslands* features two articles on water conservation: one on sustainable landscape installations at UC Davis that use native grassland species and one that addresses the effects of drought on California rangelands.

If you are interested in learning more about using natives in urban and suburban environments, I encourage you to attend the CNGA workshop "Natives in the Built Environment" at UC Davis on May 22 (see p. 10 for registration form, or go to **www.cnga.org**). If you cannot attend the CNGA workshop but would like to learn more about saving water in your landscape, consider contacting your nearest native plant nursery to find out which native grassland species might work best in your area. Past issues of *Grasslands* can also be a great resource, as there are multiple articles on this topic. Also, feel free to contact CNGA at admin@cnga.org, and ask to be directed to a Board member who can help you get more information on using native grassland species in your home environment. Be sure to indicate in what part of the state you live.

In this issue



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** for more information on joining at the Corporate or Associate level.

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Note to Our Readers

The following article has been adapted from a project proposal (originally titled Redefining the Campus Landscape: A Sustainable Approach*) written in 2011 by Andrew Fulks and submitted to the University of California Davis (UC Davis) Department of Campus Planning. Fulks' vision was to selectively convert labor- and water-intensive landscapes on the UC Davis campus to alternatives that are more sustainable and labor-conserving by removing turf lawns, planting natives, and installing drip irrigation. The Department of Campus Planning accepted the proposal in 2011, and several projects are already under way on the UC Davis campus.*

This proposal can serve as a model or template for other campuses, business parks, and large public spaces in California and beyond. By systematically looking at labor- and water-intensive landscapes, institutions have the opportunity to reduce labor and water use on landscapes, while creating outdoor spaces that have more aesthetic appeal.

Figure 1. UC Davis Quad in the core campus

Figure 2. Hyatt Place Hotel landscape uses dwarf coyote brush, a low-water use native cultivar, as groundcover.

Redefining Public Landscapes for Drought Management:

Benefits of Planting Natives and Implementing Low-Maintenance Design Strategies

by Andrew Fulks[1], Assistant Director, UC Davis Arboretum and Public Garden; and Director, Putah Creek Riparian Reserve and Campus Naturalized Lands, amfulks@ucdavis.edu

Photos courtesy of the author unless otherwise indicated.

Background

The University of California Davis (UC Davis) campus is over 5,500 acres. Nine hundred acres sit north and east of Interstate 80 and State Highway 113 ("core campus"). These 900 acres are more manicured and intensively maintained than the remaining campus lands, since the core campus grounds were designed for mowed turf grass lawns and widely available shrubs (Fig.1).

Lawn comprises 128 acres of the core campus landscape, with shrubs, groundcover, and decomposed granite surfaces comprising 118 acres. While easy to maintain, lawns require frequent maintenance and substantial water in relation to other landscape types. Water cost has not been previously included in the calculation of maintenance cost of these lawns, which has led to the perception that lawns are the best landscaping solution. In addition to relatively high water requirements, lawns require frequent mowing and a fleet of mowers, 64 miles of edging, and continual leaf pickup within lawn areas.

Refining the Campus Landscape

Redefining the Campus Landscape has been a process by which landscape types, uses, visibility, activity level, and maintenance workload were analyzed to help make informed decisions about distribution of resources. The process provides a roadmap for future design, redesign, management, and maintenance of the campus lands. This process and analysis can be used to identify campus landscapes that are good candidates for conversion and to prioritize areas that require more attention due to increased use and visibility. Converting landscapes can have many desirable results, including reduced expense, reduced water use, and modification of the campus aesthetic to a "California Central Valley" style. This modification also gives the campus a greater sense of identity and place.

Objective

Redefining the Campus Landscape builds on the UC Davis "Physical Design Framework" planning effort. The continuing objective of the process is to reduce amounts of inputs into the landscape, while increasing the aesthetic, sustainability, and ecosystem services of the campus lands (Fig. 2). Implementation of this objective makes UC Davis a leader in sustainable landscape design and maintenance practices.

[1]Andrew Fulks is Vice-President, CNGA Board of Directors. He is a registered Landscape Architect in the State of California, #4237.

Landscape Analyses

The *Redefining the Campus Landscape* approach began with an analysis of the core campus landscape. This process included an initial inventory of existing campus landscape types, uses, visibility, and levels of activity using the campus Geographic Information System (GIS). Landscape types were first mapped within the core campus region (Fig. 3). Lawn comprised 52 percent of the core campus, while shrubs, groundcover, and decomposed granite comprised the remaining 48 percent.

Each area within the core campus was then mapped for the type of use, which helped determine visitor activity levels within each area. Based on the amount of activity that each campus landscape received, an activity level was then assigned a ranking from 1–10, with 10 being the highest level of activity. The activity ranking was subjective, based on knowledge of the campus and of projected activities for each area under the campus framework plan.

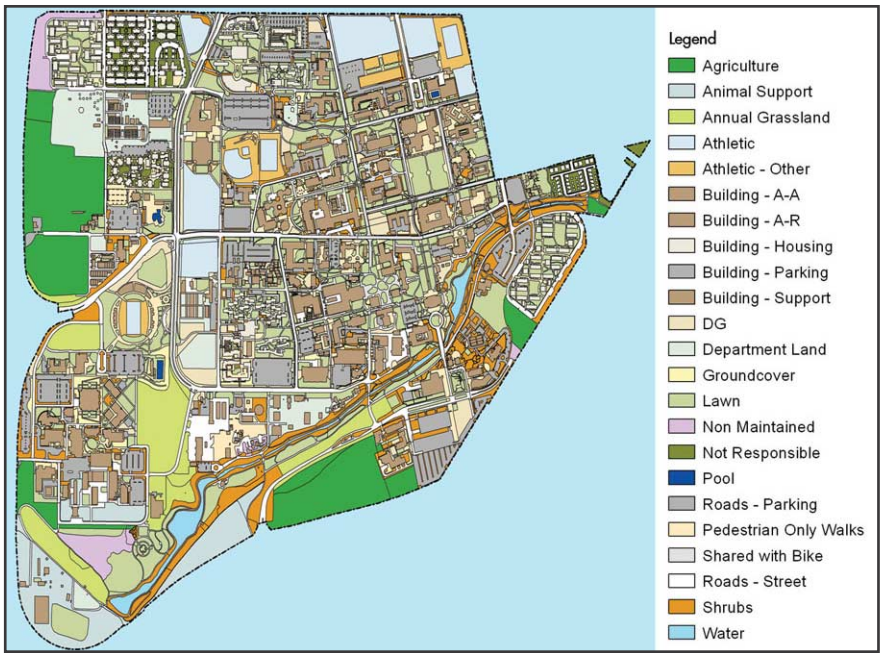

Figure 3. Map of UC Davis landscape types

Core campus areas were also assigned a value for visibility. Areas with greater visibility for the campus community and visitors are areas of potentially greater maintenance need. Areas with lower visibility were deemed opportunities for landscape conversion to lower-maintenance landscape types.

The next analysis step was to classify core campus areas into "low," "medium," and "high" categories for future management. Management categories were determined on the basis of combined rankings for areas from the visibility and activity analyses (Fig. 4). Central campus areas with low visibility and low activity levels were ranked lowest on the management map, while areas with intermediate visibility and activity levels received a medium management rank. Areas with high visibility and high activity levels received the highest management rank.

Finally, potential areas for landscape conversion were investigated with greater detail. All areas within a low or medium management level were evaluated as to existing maintenance costs and costs under a new management regime or conversion type. For example, by overlaying areas of turf with low-ranked areas, potential areas of turf conversion were identified and evaluated. Existing costs, conversion costs, and future savings amounts were also developed.

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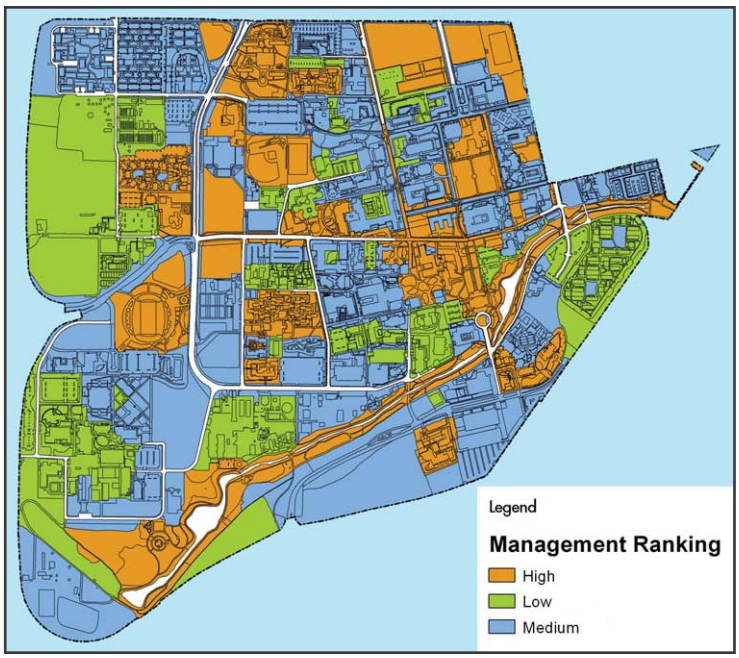

Figure 4. Management ranking map shows different levels of management needed on campus, based on use and visibility.

Redefining Public Landscapes *continued from page 4*

As a result of this process and analysis, several categories of projects were developed (Table 1). These include the following:

- Convert turf edge to decomposed granite or replace turf with low-water-use plants installed several feet from edge.
- Replace shrubs and groundcovers that grow larger than their planting areas. This reduces or removes the need for frequent pruning.
- Remove and replace lawn areas with alternative, low-water-use plants. This reduces frequency of maintenance, equipment costs, and water use.

Initial Conversion Projects

Initial changes in maintenance and conversion projects are slated for low-ranked areas derived from the management analysis. This allows for fine-tuning of new management methods, redirection of cost savings into high-ranked management, and educates the campus community regarding the change in management and landscape types.

Three initial conversion projects were selected, based on the landscape analyses described above and also on the existing workload required by each site. Diversity of project types was also a

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Table 1. Project Categories and Alternatives for Sustainable Landscapes

Project Category		
Replace lawn edges in low-use areas with decomposed granite, or install plants far enough from edge to eliminate need for using herbicides or mechanical means for managing edges.	Replace shrubs and groundcover that require pruning with smaller shrubs or less-spreading groundcovers that will not exceed the space available within the planting area.	Replace lawns, which based on location, do not have substantial public use, with no-mow, meadow, or native grassland. This replacement will reduce water use and frequency of maintenance.
Existing Condition		
 This turf area next to the bike path at La Rue Road and the Rec Pool requires frequent mowing and edging, but it is not usable as a lawn.	 The courtyard at Hunt Hall contains shrub foundation plantings of mock orange. This variety of shrub grows too large for the space provided, which blocks visibility of the windows, and requires frequent pruning.	 This patch of lawn in front of the Mondavi Institute is less than 50 square feet, yet requires frequent mowing and edging. Frequency of maintenance can be reduced and landscape attractiveness increased by changing the turf to a meadow, no-mow lawn, or bunch grasses.
Alternative Condition		
 Ornamental grasses in front of the Student Health Center require less water, less maintenance, and are an attractive alternative to lawn.	 The dwarf varieties of mock orange planted in front of the Human Resources Administration building require little, if any, pruning.	 Small, drought-tolerant shrubs reduce maintenance and water use and increase resources for beneficial insects. This planting in front of the UC Davis Law School addition features native grasses, lavender, and western redbud, creating a uniquely Central Valley aesthetic.

Figure 5. "Before" view of La Rue Median

Figure 6. "After" view of La Rue median, following conversion to native and low-water-use plants. *Photo: Katie Hetrick*

factor. Each of these sites demonstrates a different type of conversion, including conversion to meadow by change in management, conversion to meadow by re-planting, and conversion from turf to shrubs and groundcover. Two of these projects have been implemented.

La Rue Median Project

The La Rue Median project was chosen because maintenance of the center grass median requires $25,000 in labor costs each year (Fig. 5).

Before: Maintaining the median requires shutting down a lane of traffic on each side of the road during each mowing event, which adds to labor costs. In fact, the La Rue median is one of the highest cost-per-square-foot maintenance areas on campus. Conversion projects aim to convert all high-frequency maintenance areas within the La Rue corridor, creating a unified look along this major campus roadway and reducing frequency of maintenance and water use. Conversion will include removal of turf and replacement with mulch, groundcover, and low-growing shrubs. Conversion is projected to save from $12,000–$24,000/year, and pay for itself in 3–14 years depending on the type and configuration of replacement vegetation and mulch. Options include removal of the turf and replacement with mulch; trees and mulch; or trees, shrubs, and mulch (Table 2).

After: Two sections of the initial 1-acre area were completed by January 2014 (Fig. 6). The labor savings were immediate, as the need to mow weekly was eliminated. The look of the corridor has also improved, and numerous positive responses from community members and campus staff and faculty have been received.

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Table 2. La Rue Median Projected Costs and Savings

Existing Maintenance Costs/Year: **$25,000**

	Mulch Only	Shrubs and Mulch	Trees and Mulch	Trees, Shrubs, and Mulch
Conversion and 3-Year Establishment Cost	$65,360	$89,663	$132,000	$168,100
Post-Establishment Maintenance Cost/Year	$410	$4,651	$8,800	$12,864
Yearly Cost Savings after Establishment	**$24,590**	**$20,349**	**$16,200**	**$12,136**
Payback Period (Years)	2.6	4.4	8.1	13.8

Redefining Public Landscapes

continued from page 6

Arboretum Project

Before: Next to Shields Grove at the west end of the UC Davis Arboretum is a 2-acre lawn. This area receives minimal use and is a prime candidate for conversion (Fig. 7). The adjacent Shields Grove has native grassland meadow as an understory planting (Fig. 8). This meadow would be extended to cover the entire 2 acres, reducing mowing frequency from weekly to once annually. Converting the arboretum lawn into a non-irrigated meadow is projected to save over $3,300/year in annual maintenance costs and to pay for itself in less than 7 years (Table 3).

After: As of 2014, the project has been implemented, and the second year of maintenance has begun (Fig. 9). This project is following a similar trajectory as other native grassland restoration projects, namely the need for weed and exotic annual grass control during the first few years of establishment. Some areas have immediate native grass cover, and others are more dominated by non-natives, in particular Bermuda grass and fescue. Both of these grasses were components of the original turf. The water and labor savings have been immediate. The overhead watering schedule was reduced from several times a week to only a few times per year. Most native grasslands do not require watering at all, but as this area was adjacent to an established oak collection in the arboretum, it was necessary to apply water to keep the trees alive that had become established under the previous lawn condition. The long-term plan for the meadow is to observe which areas do well and which do poorly, and to develop remediation design for these areas. This area will also be used as a "laboratory," in which to test a variety of methods to establish and manage a native grassland area adjacent to more intensive park-like landscapes.

Table 3. Arboretum Meadow Projected Costs and Savings

Existing Maintenance Cost/Year	**$5,737**
Conversion and 3-Year Establishment Cost	$21,739
Post-Establishment Maintenance Cost/Year	$2,405
Yearly Cost Savings After Establishment	**$3,332**
Payback Period (Years)	6.5

Figure 9. "After" view of meadow conversion at Arboretum

Figure 7. "Before" view of 2-acre Lawn in UC Davis Arboretum

Figure 8. Native meadow in Shields Grove

Figure 10. "Before" view of Sprocket Bikeway

Sprocket Bikeway

Before: The Sprocket Bikeway, located northeast of Wickson Hall, is within a low-use and medium-visibility area (Fig. 10). The turf area is approximately 1/3 acre, making it a candidate for conversion to a meadow. The initial management strategy is to allow the grass to convert naturally, by cessation of mowing. This conversion project will reduce the frequency of maintenance and watering, saving an estimated $2,200/year in maintenance and pay for itself in less than 1 year (Table 4).

Table 4. Sprocket Bikeway Projected Costs and Savings

Existing Maintenance Cost/Year	**$6,469**
Conversion and 3-Year Establishment Cost	$1,900
Post-Establishment Maintenance Cost/Year	$3,925
Yearly Cost Savings After Establishment	**$2,287**
Payback Period (Years)	0.8

After: Conversion to a meadow will change the aesthetic. People may not be accustomed to or understand the reasons behind the change. An interpretive sign will be added that will explain the cost savings, water savings, design, and sustainability goals of the project. A similar project is in place at the Plant and Environmental Sciences Building.

[Note to readers: As of 2014, the Sprocket Bikeway conversion will not proceed as described above. It has become part of the larger storm water master plan for the campus, wherein detention basins will be created within the Sprocket corridor. The labor and water savings will still occur, but the conversion will be much different than the initial report envisioned.]

Conclusions

The conversion of high-maintenance landscapes to lower-maintenance landscapes at UC Davis is expected to produce cost savings. For two of the three pilot projects outlined above, the following savings are projected (conversion of Sprocket Bikeway landscape is undergoing revision, and numbers are not yet available):

- Converting the La Rue Median from lawn into a lower-maintenance landscape could save between $12,000–$24,000/yr.
- Conversion of the Arboretum lawn into a non-irrigated meadow will yield over $3,300 in annual maintenance cost savings and pay for itself in less than 7 years.

Replacing high-water-use and high-labor-use landscapes with native grasses, trees, and drought-tolerant shrubs has proven to save both water and labor. Careful analysis should be done before conversion to determine the most appropriate design and solution for conversion of a particular space. Land managers need to be aware that while water savings will be realized soon after project completion, labor savings may take longer to realize while the new landscape is establishing. Establishment costs should be included in projected labor expenses.

By envisioning your particular institutional objectives, designing maintenance requirements into the plan, and carefully selecting plant species for the converted areas, landscapes can help conserve natural resources, add to the beauty and sense of place for your institution, and lead to labor and water savings. With both tightening budgets and the current California drought, conversions like those described here are key solutions for dealing with current and future challenges for land managers and institutions.

Drought Effects on Rangeland Plants, Forage Production, and Management

by Michelle Cooper[1], Conservation Easement Stewardship Associate, Marin Agricultural Land Trust (MALT), mcooper@malt.org

According to interpretations of tree-ring growth patterns, the current drought is the worst that California has seen in approximately 500 years. Although Marin County received a merciful 10–12 inches of much needed precipitation during the second week of February 2014, the drought is far from over and is threatening grasslands which provide critical rangeland habitat for livestock. Stock ponds and reservoirs have recharged a bit, perennial grasses are perking up, and a late wave of annual grass germination is greening up the hills, but we still have only received approximately one third of the average rainfall for this time of year. As of February 27, 2014, the California Department of Water Resources reported the state-wide snowpack water equivalent was at 6 inches, or only 24 percent of the average for this date. This was a considerable improvement, however, from the previous survey on January 30, 2014, which found the snowpack's water content at just 12 percent of average for late January. Sadly, the National Weather Service gives odds of just 1 in 1,000 that precipitation levels will be up to "normal" by the end of this water year (September 30, 2014). The negative effects of drought on forage production are already evident in rangelands throughout the region, and California's dry season is still over 6 months out. How does this drought affect rangeland plants and forage production? And what management principles will best address the situation in the months and years to come?

Grassland plants are well adapted to minimize damage caused by unfavorable conditions. Mild drought stimulates the regulation of water loss and uptake, allowing the maintenance of relative water content in plant leaves, thereby causing little to no change in photosynthetic capacity (Yordanov et al. 2003). This allows plants to produce an adequate level of carbohydrates to stimulate growth of roots, which in turn collect and deliver enough water and minerals to maintain active photosynthesis and continued shoot production. However, severe drought decelerates cell division, decreases enzyme levels, and may eventually cause plants to stop producing chlorophyll. Transpiration and photosynthesis are hindered as leaf stomata close to reduce water loss. Root and shoot growth is inhibited, perennial grass buds may fail to produce tillers, and seed production is greatly reduced or entirely halted. Plants enter senescence, and thus, forage production is drastically reduced and eventually ceases. During severe drought conditions, some plants may ultimately die.

The amount and frequency of above-ground biomass removal from rangeland plants by livestock significantly affects the extent to which

[1]Michelle Cooper joined MALT in 2013 and is responsible for assisting with the monitoring of MALT-protected farmlands. She also represents MALT in local and regional organizations, activities, and projects related to land stewardship and conservation planning. She serves on the Board of Directors for the California Native Grasslands Association.

drought impairs the potential for future forage production. With plant growth already slowed down due to water stress, it is especially important to allow for appropriate recovery periods between bouts of above-ground biomass removal in order to allow plants enough time to regenerate new vegetative material. Without enough leafy green material to harvest the solar energy needed for photosynthesis, root production is greatly inhibited. Under these circumstances, plants can wilt and die even when soil moisture is relatively abundant at 6–8 percent (Hanselka and White 1986). Although a considerable challenge during periods of drought, managing stocking rates in order to prevent overgrazing is the number one management recommendation in order to protect forage plants and sustain production moving forward.

Overgrazing of individual plants––defined as grazing regrowth before plants have an adequate recovery period––can contribute to the overutilization of rangelands and a lack of sufficient soil cover. This can further compound negative impacts to rangeland health, especially during periods of drought. Insufficient levels of residual dry matter (RDM) or soil cover result in a high percentage of bare ground and exposed soil. Maintaining adequate levels of RDM is imperative in order to slow water runoff and enhance the infiltration and percolation of water into the soil. A residual vegetative layer also reduces soil surface temperatures, thereby reducing evaporative water loss. Without this protective ground cover of residual vegetation, erosion and topsoil loss is amplified when a substantial rain event finally transpires. By following recommended grazing management principles and developing a sound drought management plan that minimizes overgrazing of plants and maintains good soil cover, recovery from drought will occur more readily when the rain returns.

Recommended grazing management principles during drought conditions include:

- Do not deplete monetary resources in an effort to feed your way out of a drought.
- Match stocking rate to changes in available forage.
- Set a critical date to begin implementing a culling policy.
- Increase rest periods between biomass removals of growing forage plants.
- Maintain adequate soil cover.
- Increase efficiency of pasture utilization.
- Develop livestock water.
- Create a drought management plan.

All of these actions are much easier to write down on paper than to implement. However, with proper stewardship and extremely good livestock management, plant performance and forage production can be maintained and even improved in California rangelands well into the future.

References

Hanselka, C.W., and L.D. White. 1986. "Rangeland in dry years: Drought effects on range, cattle, and management." *Livestock and Wildlife Management during Drought*, R.D. Brown, ed. Kingsville, Texas: Caesar Kleberg Wildlife Research Institute, Texas A&I University.

Yordanov, I., V. Velikova, and T. Tsonev. 2003. "Plant responses to drought and stress tolerance." *Bulgarian Journal of Plant Physiology*. Special Issue: 187–206.

Photo: George Salvaggio

Native Grasses in the Built Environment

Enjoy a bicycle tour of numerous urban gardens, water gardens, stormwater features, and landscaping that use native and drought-tolerant grasses for aesthetic and erosion control enhancements. Learn species mixes for particular situations that can be applied to your areas.

May 22 9:00 am – 4:00 pm

Location: UC Davis

Fees: $130 CNGA members / $150 Non-members / $85 Students

Instructors: Andrew Fulks, *Manager, UC Davis Putah Creek Riparian Reserve*; Ingrid Morken, *Landscape Architect, WRA, Inc.*; JP Marié, *Steward, UC Davis Putah Creek Riparian Reserve*

Continuing Education Credits: 6 CEUs pending approval by SRM

Introduction to Grass Taxonomy and Identification

This 1-day workshop presents the basics of identifying grasses using the new *Jepson Manual*, in addition to focusing on the identifying characteristics of common native and non-native grass species. We will learn about California's grassland ecology, the qualities of specific native grasses for restoration, and become skilled at recognizing the basic groups and common species by working with plant samples in the classroom. We will then go out into the field at Point Reyes National Seashore to find and identify common species in the field. Participants are encouraged to bring along a copy of the new *Jepson Manual*, a hand lens, and some forceps if they have them. Otherwise, all identification tools will be provided.

June 14 8:30 am – 5:30 pm

Location: Point Reyes Station

Fees: $130 CNGA members / $150 Non-members / $85 Students

Instructors: Michelle Cooper, *Conservation Easement Stewardship Associate, Marin Agricultural Land Trust*; Jon O'Brien, *Environmental Resources Associate, Yolo County Flood Control & Water Conservation District*

Continuing Education Credits: pending approval

Registration Form: CNGA Spring Workshops | 2014

Mail to: CNGA, P.O. Box 72405, Davis, CA 95617 Fax to: 530-297-0500

Participant's name (print or type please) _____

Participant's organization/agency (optional) _____

Mailing Address _____ City _____ State ____ Zip _____

Preferred phone _____ _____ Preferred e-mail _____

FEES:	***CNGA members***	***Non-members***	***Students w ID***
May 22 ***Native Grasses in the Built Environment*** *(UC Davis)*	❍ $130	❍ $150	❍ $85
June 14 ***Introduction to Grass Taxonomy & Identification*** *(Point Reyes Station)*	❍ $130	❍ $150	❍ $85

Make check payable to California Native Grasslands Association, and send to address above, or

Pay by credit card (check type): ❍ Visa ❍ MasterCard ❍ American Express

Card number _____ Expiration date_____/_____

Street address for card _____ Zip Code _____

Questions concerning registration?

Please contact CNGA by calling 530.297.0050, or email: admin@cnga.org.

Not a member? That's easy to fix! *You can also join online at www.cnga.org*

CNGA members have voting status, and receive the quarterly *Grasslands* publication, discounts at workshops, and monthly email news.

- - - - Detach and mail this form with check made out to CNGA. Send to CNGA, P.O. Box 72405, Davis, CA 95617 - - - -

Individual Membership

❒ **REGULAR:** $45/year
❒ **SUSTAINING:** $60/year
❒ **JOINT CNGA+SERCAL:** $80/year (save $10)
❒ **STUDENT:** $30/year *Please send photocopy of current ID.*
❒ **RETIRED:** $30/year
❒ **LIFE:** (one-time payment) $500

Corporate Membership and Benefits

All employees of a corporate member receive member pricing when registering for CNGA events. All membership benefits are good for 2014. All copies of *Grasslands* will be sent to the main contact at the organization.

Name _____

Title _____

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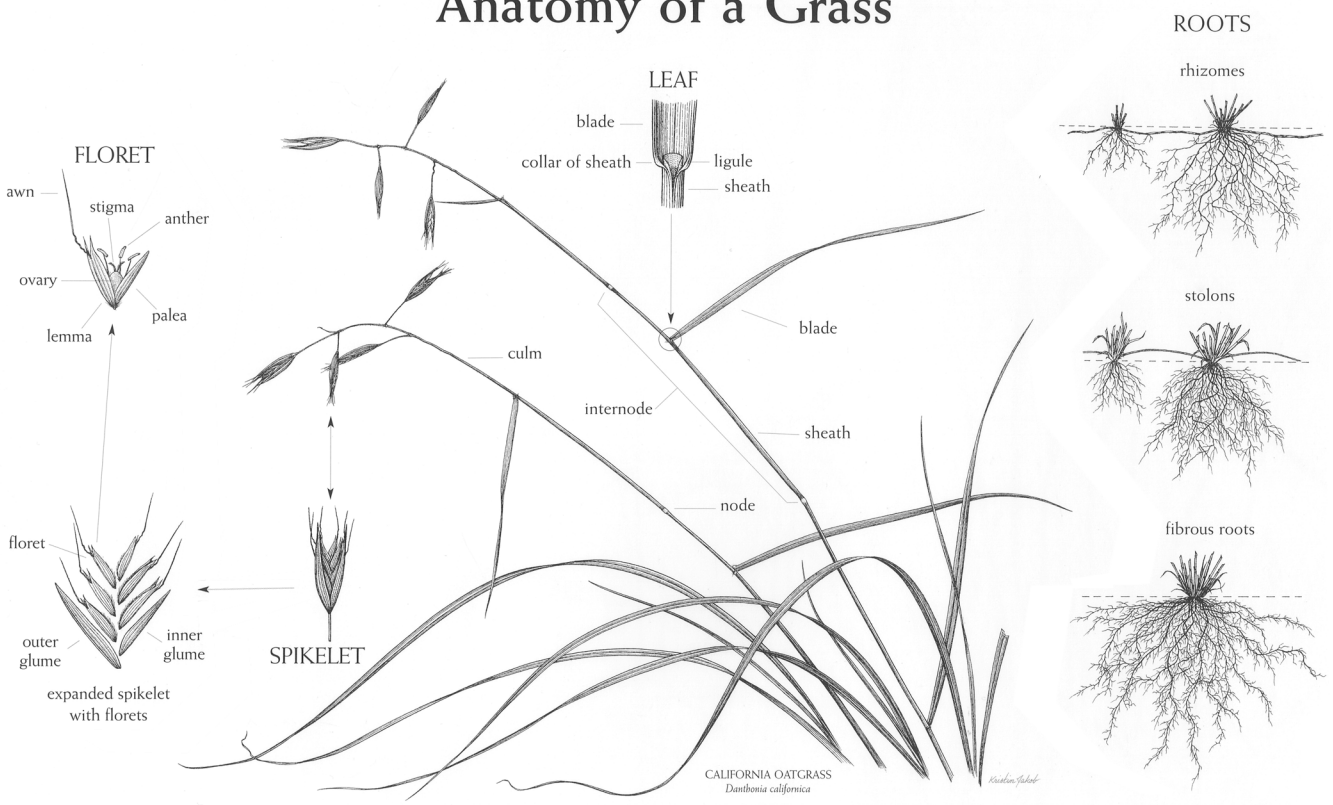
	Membership Level	Annual Cost	Online (color) Ads w/link to member website[1]	*Grasslands* (b&w) Ads currently 4 issues per year	Employee Memberships[2]	*Grasslands* Subscriptions[3]
❒	*Muhlenbergia rigens*	$1,000	Half page (570 x 330 pixels) at top of CNGA sponsor page	Half page (7.625 x 4.375) 300 dpi jpeg, tif or pdf file	6	4
❒	*Stipa pulchra*	$500	Quarter page (256 x 296 pixels) below *Muhlenbergia* listings	Quarter page (3.75 x 4.375) 300 dpi jpeg, tif or pdf file	5	3
❒	*Poa secunda*	$250	Bus.-card size (129 x 200 pixels) below *Stipa* listings	Bus.-card size (3.5 x 2.25) below *Stipa* listings	4	2
❒	*Associate*	$125	Text listing below *Poa* sponsors for 1 calendar year	Text listing published in *Grasslands* for 1 calendar year	3	1

[1]If there is more than one Corporate member per level, the members will be listed alphabetically. [2]Employee memberships include all the benefits of a personal membership, the organization determines the recipients of Grasslands *subscriptions. [3]Company may opt for fewer subscriptions.*

Anatomy of a Grass



Awn A bristle-like appendage, usually a continuation of the mid-nerve of the lemma or the glume

Blade The laterally expanded portion of a grass leaf

Collar The outer side of a grass leaf at the junction of the sheath and blade, often lighter colored than the surrounding tissue

Culm A grass stem, usually hollow except at the ordinarily swollen nodes

Floret Individual flowers bracted by a lemma and palea

Fibrous A type of root form

Glumes Pair of bracts at the base of a spikelet

Internode The culm (stem) segment between two nodes

Leaf The sheath and blade of a grass

Lemma The lower of two bracts surrounding the grass flower (see *palea*)

Ligule An outgrowth from the leaf sheath. Because they vary in size, shape, and texture, they are used in the identification process.

Node The joint of a culm (the "knees" of a grass stem)

Palea The uppermost of two bracts surrounding the grass flower (see *lemma*)

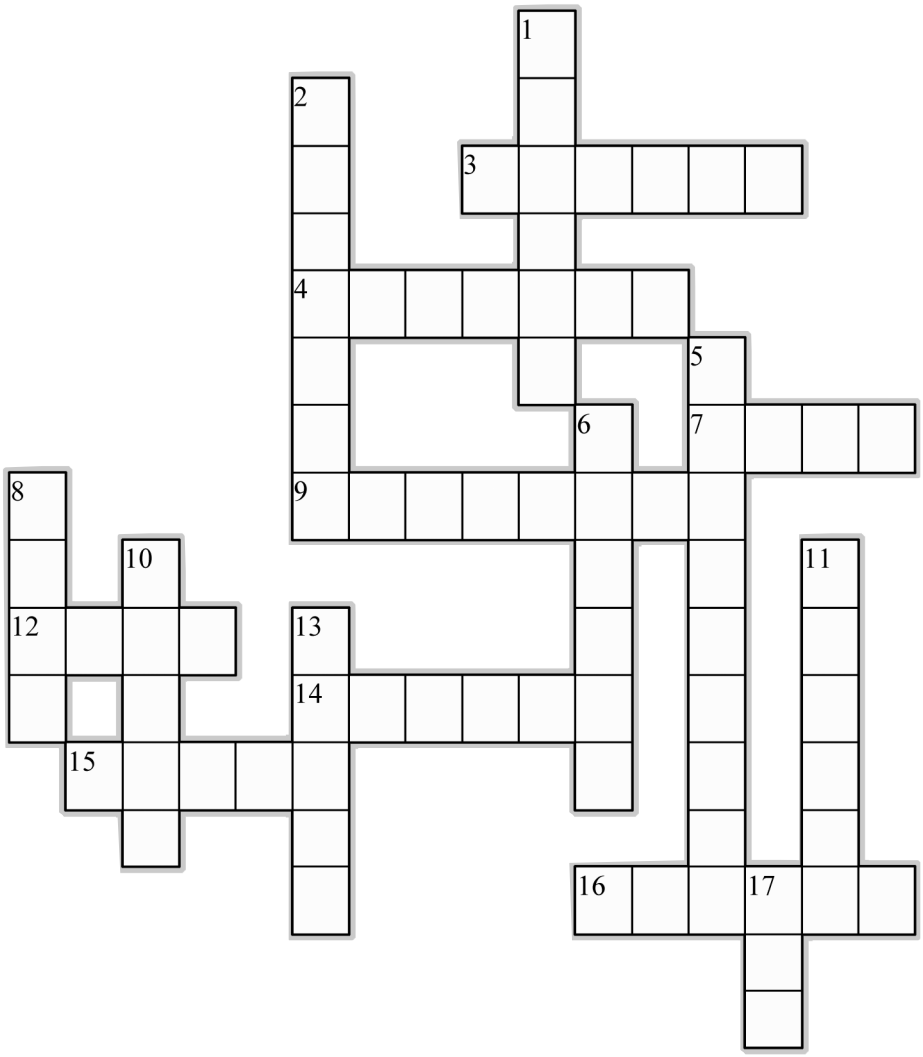
Rhizome A creeping underground stem

Sheath The basal portion of the leaf that surrounds a grass stem

Spikelet The basic unit of a grass inflorescence consisting of two glumes and two or more florets

Stolon Stems that lie upon the ground and root at the nodes or at least bend over and root at the tip

CALIFORNIA NATIVE PLANT SOCIETY



Crossword puzzle prepared by the CNGA Education Curriculum Committee, March 2014, and created on Crossword Maker (TheTeachersCorner.net)

Across

3. The outer side of a grass leaf at the junction of the sheath and blade, often lighter colored than the surrounding tissue
4. A creeping underground stem
7. The joint of a culm (the "knees" of a grass stem)
9. The basic unit of a grass inflorescence consisting of 2 glumes and 2 or more florets
12. The sheath and blade of a grass
14. An outgrowth from the leaf sheath. Because they vary in size, shape, and texture, they are used in the identification process.
15. The lower of two bracts surrounding the grass flower (see *palea*)
16. The basal portion of the leaf that surrounds a grass stem

Down

1. Stems that lie upon the ground and root at the nodes or at least bend over and root at the tip
2. A type of root form
5. The culm (stem) segment between two nodes
6. A pair of bracts at the base of a spikelet
8. A grass stem, usually hollow except at the ordinarily swollen nodes
10. The uppermost of two bracts surrounding the grass flower (see *lemma*)
11. Individual flowers bracted by a lemma and palea
13. The laterally expanded portion of a grass leaf
17. A bristle-like appendage, usually a continuation of the mid-nerve of the lemma or the glume

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Don't miss CNGA's May & June Workshops
See pages 11 & 12

Front cover: Spring in Bear Valley. *Photo: Jack Alderson*

Back cover: Vernal pool in Tehama County dominated by popcorn flower (*Plagiobothrys* sp.). *Photo: Cathy Little*