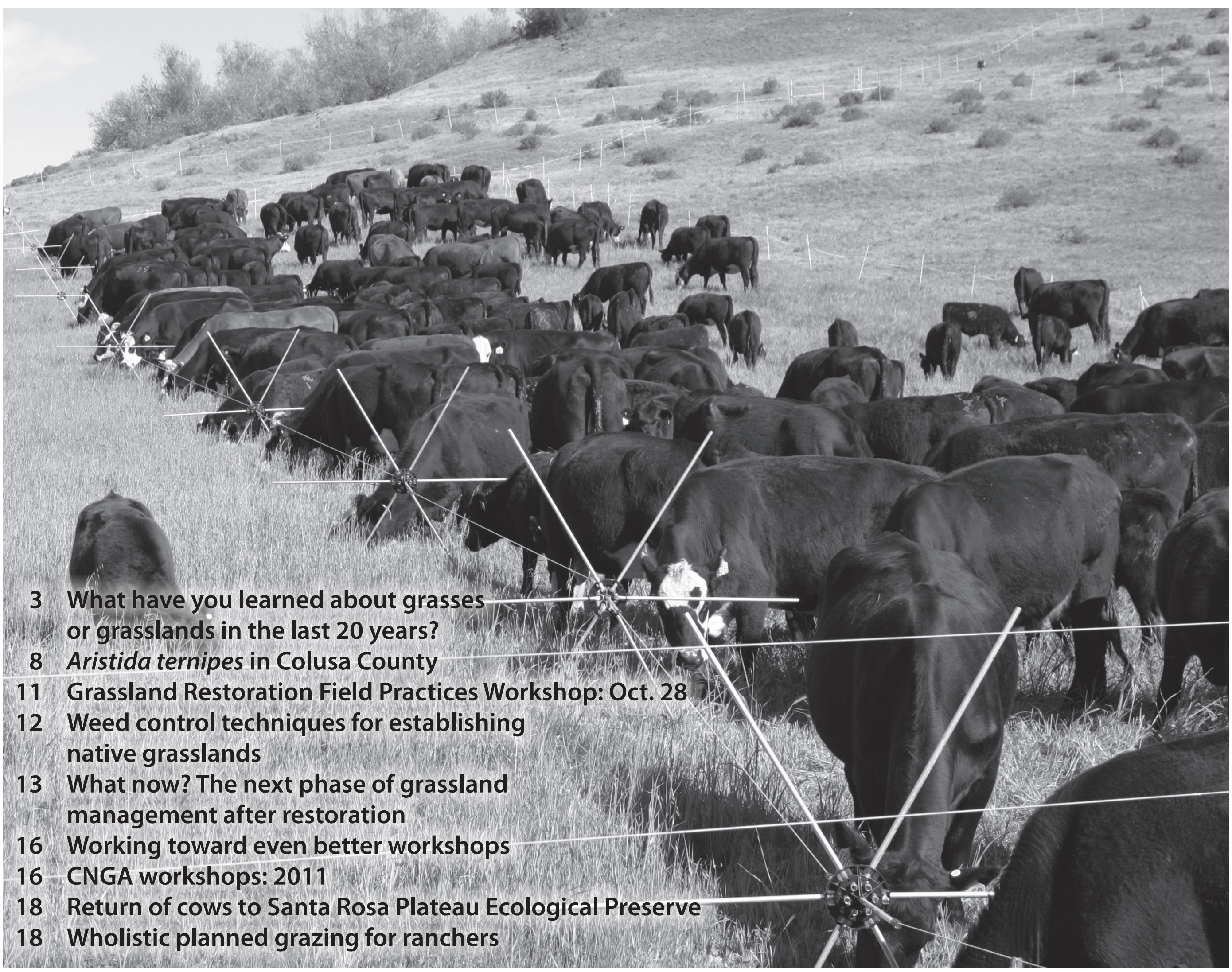
California Native Grasslands Association

Vol. XX, No. 4 | Fall 2010

GrassLands

Published quarterly by the California Native Grasslands Association

The Marin Carbon Project: *Theory in Practice* 3



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.

P.O. Box 8327
Woodland, CA 95776
530-661-2280
admin@CNGA.org | http://www.CNGA.org

CNGA Board of Directors

Officers

Wade Belew, *President*
Sara Sweet, *Secretary*
Jim Hanson, *Treasurer*

At-Large Members

Andrew Fulks	Richard King
Erik Gantenbein	JP Marié
Elizabeth Goebel	Jon O'Brien
Clare Golec	Zachary Principe
Sarah Hoskinson	Christina Smith
David Kaplow	Bryan Young

CNGA Administrative Director
Judy G-Scott

***Grasslands* Managing Editor**
Mary N. Rodgers

For advertising rates and instructions, or membership and other organizational information, contact CNGA Administrative Director: admin@CNGA.org.

For program information related to tours or training workshops, contact CNGA Administrative Director: admin@CNGA.org.

***Grasslands* is published quarterly by CNGA.**

ISSN No. 1540-6857

Grasslands Submission Guidelines

Send submissions to:
Editor: mrodgers@macnexus.org.

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

All submissions are reviewed by the *Grasslands* Editorial Committee for suitability for publication.

Submissions are accepted electronically as e-mail attachments. Contact the editor for formatting specifications.

Submission deadlines for articles:
Winter 2011: Nov. 15, 2010; **Spring 2011:** Feb. 15, 2011; **Summer 2011:** May 15, 2011; **Fall 2011:** Aug. 15, 2010

From the President's Keyboard

Wade Belew

A few days after the July Board of Directors meeting, I took off on what has become a summer vacation tradition for me, traveling and camping by motorcycle. In the last three years I've seen more of this beautiful country than in my whole life prior to motorcycle traveling. I've been to Canada twice, and also to Oregon, Washington, Idaho, Montana, North and South Dakota, Wyoming, Nevada, and Arizona.

While traveling and viewing these magnificent landscapes with the eyes of a botanist, I've come to what may be an obvious conclusion: The grasslands in California are far more degraded and overwhelmed by invasive species than in any of these other states! As you travel from the Central Valley into Northeastern California, around Klamath Lakes and Alturas, you can see the quality of the grasslands improve dramatically. These trips have just reinforced my desire to work toward restoring and stewarding California grasslands.

One place you can still find beautiful stands of native grasses in California is at the Pepperwood Preserve just outside Santa Rosa, where we held our July Board meeting. Pepperwood is a 3,117-acre property just northeast of Santa Rosa that until five years ago had been owned by the California Academy of Sciences. As a means to raise money for their new building in Golden Gate Park in San Francisco, the property was sold to the newly formed Pepperwood Foundation. The Foundation wasted no time in planning and building a world-class, 10,000-square-foot environmental education and research facility, the Dwight Center.

The Board was treated to a tour of the new facility by Pepperwood staff. Besides administrative office space, the building includes two classrooms, a small museum and library, a kitchen, and a herbarium. There are even cubicles and computer space available for visiting researchers or grad students, complete with showers to clean up after a day in the field. The building has many environmentally friendly design features that will qualify for the LEED (Leadership in Energy and Environmental Design) Gold standard.

PRESIDENT'S KEYBOARD, continued on page 3

PRESIDENT'S KEYBOARD, continued from page 2

As we stepped outside the building for an after-lunch walk, we were delighted to see that the building has been landscaped with thousands of native grasses. Leaving the landscaped areas and heading uphill into rich oak woodlands we were amazed at the abundance of natives, including dense stands of California fescue covering thousands of square feet.

At our Pepperwood meeting we discussed future collaborations between our organizations. The Pepperwood staff supports our mission, and is eager to work with us as it will further their own mission. With the new building and abundant native grasses on site, the potential for future workshops and collaboration is endless. To find out more about Pepperwood, including their educational programs and outings that are open to the public, check out www.pepperwoodpreserve.org and you can read an article about the property in the Winter 2008 issue of Grasslands.

Speaking of collaboration, if you know of any similar organization or agency that would be interested in hosting events or presenting workshops, please let me know! wadekb@sonic.net

CNGA's 20th Anniversary:

Tell Us What You've Learned!

For the Winter 2011 issue of *Grasslands,* we are going to focus on CNGA: our past, present, and future. To do this, we would like feedback from our membership. In 150 words or less, please answer the following question:

What have you learned about grasses or grasslands in the past 20 years?

Please send your responses to us at grasslands@cnga.org. If possible, also send a picture of yourself we can publish with your response.

The Marin Carbon Project: Theory in Practice

Jeffrey A. Creque, *Certified Rangeland Manager, California State Board of Forestry, and co-founder, Marin Carbon Project*

Introduction

Global climate change, driven by steadily increasing levels of anthropogenic atmospheric greenhouse gases (GHGs), renders the carbon storage potential of soils of particular importance (IPCC 2007). Indeed, it has been suggested that even a small increase in photosynthetically derived soil sequestered carbon throughout the world's arable lands could significantly reduce atmospheric carbon dioxide (CO_2) levels (Lal 2008 pers. comm.). On the other hand, even if all anthropogenic GHG emissions were halted today, failure to sequester existing excesses of atmospheric CO_2 will result in the persistence of climate destabilizing levels of GHGs in the atmosphere for at least another century (IPCC 2007). Simply put, soil sequestration of atmospheric carbon offers the lowest-cost, lowest-risk option available for reducing current atmospheric GHG concentrations (Follett and Reed 2010), while offering a host of ecological services as co-benefits.

Despite inherently low soil organic carbon (SOC) sequestration rates, the spatial extent of the world's rangelands offers a large carbon storage potential. Although knowledge of SOC sequestration on rangelands is limited, the role of grassland ecosystems in sequestering biospheric carbon, and the theoretical potential for improved grassland management to contribute to the mitigation of global warming via enhanced atmospheric GHG sequestration, gives the question of grassland carbon dynamics—as a principle component of rangeland ecosystem energy dynamics—a new significance and urgency. It was to explore this question on Marin County, California, rangelands that the Marin Carbon Project (MCP) was initiated. The Project Mission Statement reads:

> *In response to the rapid pace of global climate change caused by human activity, the Marin Carbon Project seeks to enhance carbon sequestration in rangeland, agricultural, and forest soils through applied research, demonstration, and implementation.*

Origins of the Marin Carbon Project

California's 2006 climate change legislation, AB 32, the Global Warming Solutions Act, requires the state to adopt regulations by January 1, 2011, to achieve the maximum technologically feasible and cost-effective reductions in GHGs, including provisions for using both market mechanisms and alternative compliance mechanisms.

The MCP began as a conversation around the question of marketing carbon credits derived from sequestration of atmospheric CO_2, as grassland biomass and soil carbon, through improved rangeland management practices under the general rubric of "carbon farming." During this discussion at least two significant obstacles to marketing rangeland-sequestered carbon were identified. First was the extremely low per-acre financial return available under existing market mechanisms, such as the Chicago Climate Exchange (CCX) and, second, the lack of a broadly accepted protocol for the measurement of soil carbon sequestered on rangelands.

This discussion led first to the idea of a "Marin Carbon Market," a local mechanism to help Marin pastoralists and agriculturalists market carbon sequestered as a result of such efforts to Marin industries, residents, and governments as GHG emission offsets at a price that would support the implementation of effective land management practices. This in turn highlighted the need for a scientifically rigorous soil carbon sequestration quantification protocol for verification and marketing purposes (Lal 2007).

MARIN CARBON PROJECT, continued on page 4

MARIN CARBON PROJECT, continued from page 3

To address this need, the fledgling MCP reached out to the University of California for assistance. Dr. Whendee Silver, an ecosystem ecologist and biogeochemist with extensive experience quantifying soil carbon, joined the Project as lead scientist.

A collaborative response

Originally conceived as a mechanism by which improved rangeland management practices on West Marin livestock ranches could be supported by emerging carbon markets, the MCP has evolved into a collaborative research effort involving West Marin ranchers, resource agencies, private rangeland management consultants, and the University of California. Drawing on the local experience of the UC Extension, the Marin Agricultural Land Trust, and the Marin Resource Conservation District, a GIS-based sampling protocol for establishing a carbon baseline for the majority of Marin's rangeland and pasture soils, was designed (figure 1).

The USDA Natural Resources Conservation Service (NRCS) and Marin Organic also recognized the potential for traditional conservation and organic agricultural practices to fall within a carbon sequestration framework and became active partners in the Project, providing administrative, technical, and outreach support. In this way, the MCP emerged as a uniquely diverse and comprehensive coalition of researchers, producers, and Marin agricultural organizations and agencies, working toward the shared goal of effecting atmospheric GHG reductions through land management practices.

Soil Carbon

Soil organic matter (SOM) is approximately 50% carbon. Over the past 150 years we may have lost 50–80% of our topsoil worldwide, and more than one-third of the CO_2 we have added to the atmosphere during that time has come from changes in land use and poor land management, including soil degradation (Lal 2007). California's historical ecological literature contains innumerable references to post-EuroAmerican settlement degradation of the landscape, and California's wetlands, deltas, rangelands, and farmlands all bear witness to historical losses of soil and soil water-holding capacity, suggesting concomitant losses of SOM. This suggests that improved land management practices can reverse this process and result in sequestration of significant amounts of atmospheric CO_2 in soils as SOM.

Restoring, or increasing, SOM offers innumerable ecosystem benefits in addition to helping to slow or reverse global warming. Improved soil water-holding capacity, improved soil fertility, improved soil tilth, improved water quality, decreased need for petroleum-based pesticides and fertilizers in agricultural ecosystems, decreased erosion, and increased production are all well-documented effects of increasing SOM (Post and Kwon 2000). Each of these co-benefits carries with it its own set of GHG offset potentials. Indeed, synergies associ-

MARIN CARBON PROJECT, continued on page 5

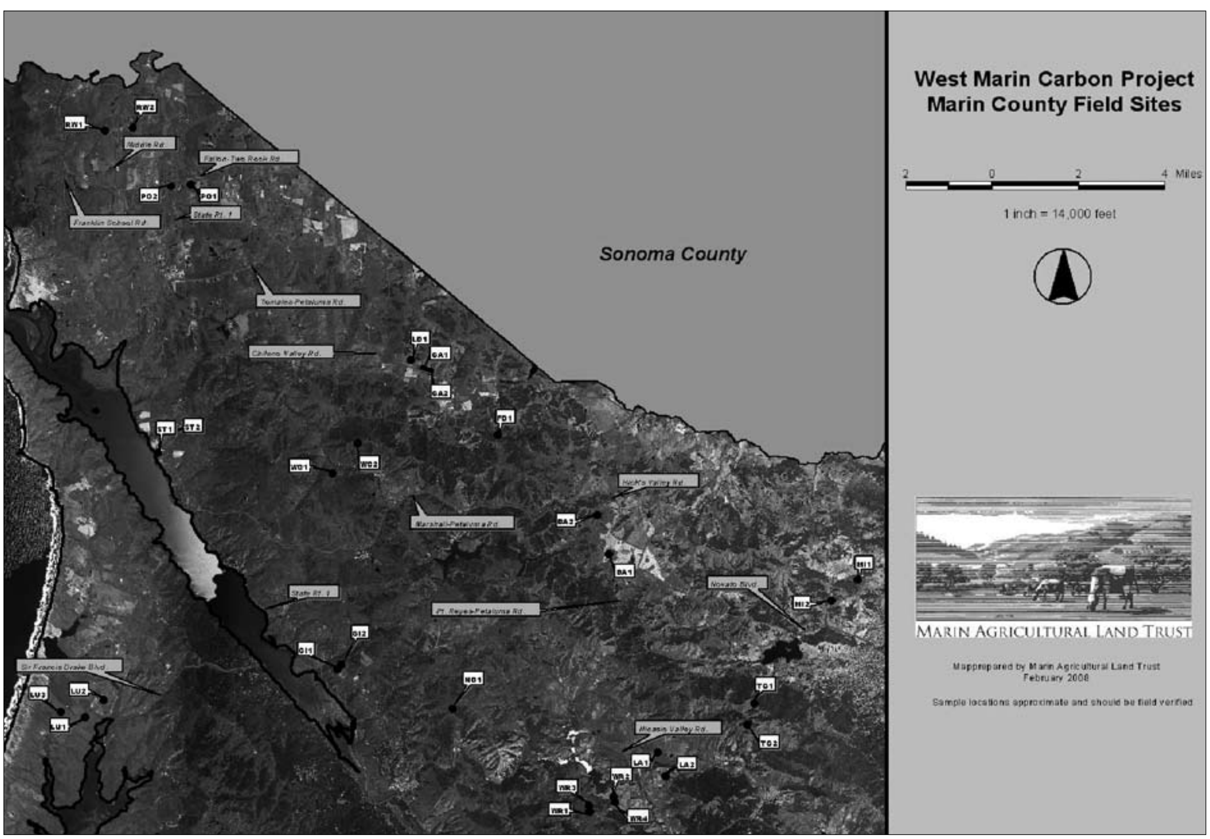


Figure 1. Marin Carbon Project Soil Carbon Sample Design (Credit: Marin Agricultural Land Trust)

MARIN CARBON PROJECT, continued from page 4

ated with increased SOM content may lead directly and indirectly to climate change benefits equal to or greater than that associated with the CO_2 sequestered.

Adding Carbon

Perhaps the quickest and easiest way to increase soil carbon is to simply add organic matter directly to the soil. Marin County dairy and livestock producers commonly apply supplemental organic matter to pastures to enhance forage production. Most typically, Marin's largely grass-based dairies use their rangelands and pastures for distribution of manure, and have done so in some cases for a century or more. Not surprisingly, initial MCP soil survey results revealed significantly higher SOM content in soils with a history of supplemental manure applications when compared with non-supplemented soils (Silver et al. 2010 unpubl. data). These results supported the hypothesis that addition of organic amendments is an effective management strategy for increasing carbon sequestration in Marin's rangeland soils.

To further explore the effects of supplemental applications of organic matter on sequestered SOC, aboveground annual net primary productivity (ANPP) and plant community composition on rangelands, first year MCP trials included applications of composted urban green waste to grazed rangeland sites, both on privately owned rangeland in Marin County and at the University of California's Sierra Foothills Research and Extension Center (SFREC). The decision to use urban green waste compost, rather than the more commonly applied manure, was prompted by the need to apply identical materials to experimental plots at both the Marin County and SFREC sites. Available organic material located within reasonable transport distance of both sites was limited to composted green waste. In addition, compost presented less risk than manure with respect to both nutrient additions and weed introductions to the experimental plots.

Restoration: Soil Carbon and Native Plant Communities

Enhancing soil fertility is often considered antithetical to restoration of California rangeland native plant communities, particularly where those communities are subject to nonnative species invasion. Indeed, first year results from MCP compost application trials showed nearly a 50% increase in aboveground biomass production over that of the control (Ryals and Silver unpubl. data) and a qualitative shift in species composition toward dominance by nonnative annuals. It is important to interpret these preliminary results within the broader context of MCP research, however. Because the compost itself was effectively free of viable seed, this qualitative shift in species composition more probably reflects changes in soil nutrient status and/or water holding capacity than a shift in soil seed bank. In addition, because the experimental plots were grazed by cattle, the increased growth of nonnative species was rapidly and, notably, preferentially removed by grazing cows (Figure 2). Thus, the long-term implications of the compost treatment from a plant community composition perspective are not yet evident. The impact of soil carbon (C) enhancement

MARIN CARBON PROJECT, continued on page 6

Figure 2. Cattle distribution on experimental plots, showing a clear preference for the two compost treated plots (far left and second from right).
Photo: John Wick

MARIN CARBON PROJECT, continued from page 5

on resident plant community composition remains a variable of interest and will be monitored over the anticipated 3-year study duration.

The effect on soil carbon of broadcasting compost over standing vegetation to a depth of about 1 centimeter, however, was quite dramatic. After 1 year, over 90% of the 14 metric tons of carbon applied per hectare remained in the soils of the treated plots. In addition, increased plant productivity on compost plots resulted in additional soil carbon increases from plant biomass. These results, while qualitatively dramatic, were not statistically significant due to the high background variability in soil carbon among both treatment and control plots (Silver et al. 2010 pers. comm.).

Grazing

Livestock grazing is the predominant agricultural land use in rural Marin County and much of California. Despite the widespread and longstanding "…confusion, misinterpretation and uncertainty with respect to the evaluation of grazing systems…." (Briske et al. 2008), among the MCP's principal operative hypotheses are that prescribed livestock impacts offer a practical means of (1) maximizing allocation of ANPP to belowground soil carbon pools and (2) maintaining or increasing plant community dominance by native perennial grasses. The MCP has found that increases in soil carbon resulting from surface applications of compost, a practice somewhat functionally similar to the common practice of manure applications on Marin's rangeland-based dairies, have resulted in significant increases in forage production, suggesting production benefits to livestock producers if soil carbon sequestration can in fact be achieved, by whatever means. In practice, increasing SOM in situ, through improved grazing practices, if possible, will almost certainly provide the greatest net carbon benefit at lowest cost to producers. Of particular interest to the MCP at this stage of understanding, therefore, is the evaluation of different grazing strategies for their carbon sequestration impacts.

Given the generalized doubt among many range professionals (Booker et al. 2010) that changes in management can lead to significant increases in rangeland soil carbon, and the MCP's promising initial results with respect to direct applications of organic matter to rangelands, it seems appropriate to turn to ecological theory for a framework within which to justify the MCP's exploration of management-enhanced carbon sequestration on rangelands and to predict, anticipate, or explain expected results.

State and Transition Models, Vegetation Change, Soil Organic Matter, and Ecosystem Restoration

The MCP sits at the intersection of several contemporary issues pertaining to rangeland ecology and management. In addition to climate change and carbon sequestration, the MCP touches upon the ongoing "range debate" surrounding grazing systems (Briske et al. 2008), and engages State and Transition concepts as applied to rangelands (Stringham et al. 2003; Westoby et al. 1989). Changes in rangeland ecosystem patterns, such as vegetation cover, density, and physiognomy, are known to effect rangeland ecosystem processes or behavior, including rates of evapotranspiration, infiltration, and erosion, among others (USDA 1997; Bartolome et al. 1980). For example, changes in the landscape vegetation mosaic have played an important role in the rescaling of soil and water movement upon, through, and from the Western landscape. Systems theory suggests that ecosystem stability is a result of the tendency of systems to function within a prescribed range of energetic dynamics via a set of both negative (self-limiting) and positive (self-reinforcing) feedbacks (Naveh 1987; Margalef 1968), defining a system "state." A change in the rate of energy flow or flux within or through the system is required to drive that system across a threshold of change, i.e., through a transition, to a new system state (George et al. 1992; Freidel 1991).

In seeking indicators of change in system energy flows and fluxes in California rangelands, one such important indicator, soil carbon, has been largely overlooked (Silver et al. 2010). Though odd, given the importance of soil carbon in moderating rangeland ecosystem dynamics, including rangeland hydrology and ecosystem nutrient cycling, this oversight can perhaps be explained by the historical difficulty of studying belowground processes, and the long history of rangeland research focusing on plant community species composition and aboveground productivity as indicators of rangeland condition and trend (Dyksterhuis 1949).

Managing ecosystems for directional change requires increased energy input, and the importance of soil carbon, as a means of storing solar energy within the grazed ecosystem, is revealed in this scenario. Ecosystem processes ultimately convert solar energy to SOM, and SOM and plant biomass are the most direct avenues for storage of solar energy within the grazed ecosystem. Increasing soil carbon, whether through exogenous inputs of organic matter or endogenous inputs of photosynthetically derived plant material, represents increased energy inputs to the soil ecosystem, providing the basis for a host of positive feedbacks to overall system dynamics and the energy required to drive the system across a threshold of behavior to a new system state.

The capacity for positive feedbacks to result in directional change toward a desired system state pertains, in rangeland ecosystems, to the related questions of carbon sequestration, management of livestock as a powerful ecosystem organizing tool, and ecosystem restoration. Restoration strategies typically include, or result in, increases in system carbon, as soil carbon and/or ANPP in the form of increased

MARIN CARBON PROJECT, continued on page 7

MARIN CARBON PROJECT, continued from page 6

vegetation cover. This potential for rising system energy flows, fluxes, and content tends to be self-reinforcing, as increased productivity results in increased soil carbon sequestration, enhanced soil water-holding capacity, enhanced nutrient retention and cycling, deeper rooting capacity, and further increases in ANPP. In this context, properly scaled disturbance, such as prescribed livestock impacts, can be utilized by system managers, to offer just two examples, as both a negative feedback to limit vegetation growth, and as a positive feedback by facilitating nutrient cycling and allocation of ANPP to belowground biomass and soil carbon.

Conclusion

The MCP sits at the intersection of several current rangeland issues, including climate change, carbon sequestration, the ongoing grazing system debate and State and Transition concepts as applied to rangeland ecosystems. As climate destabilization accelerates, and climate change legislation, including California's AB 32, comes into effect, more and better solutions are needed for achieving atmospheric CO_2 reductions. Most of Marin's agriculture is grass-based livestock production.

Soil carbon sequestration at the global scale provides a uniquely promising potential for climate stabilization. In the current dynamic ecological and socioeconomic context, it offers numerous ecological and economic opportunities for Marin's agricultural producers, many of whom are small family farmers internationally recognized for innovation and leadership in sustainable agriculture and environmental stewardship.

Since its inception in 2007, the MCP has attracted significant foundation support for research establishing a regional baseline for soil carbon on Marin rangelands through intensive sampling of representative soils throughout West Marin's agricultural landscape. Data from this effort have been analyzed and published (Silver et al. 2010) and presented at numerous conferences and workshops. Early results have attracted additional support, enabling development of more intensive sampling and experimental efforts on sites in Marin County and the UC SFREC. At these locations, rangeland management practices, including grazing treatments and compost applications, continue to be evaluated for their impacts on soil carbon, aboveground vegetation production, and plant community composition.

Soil sequestration of atmospheric carbon offers the lowest-cost, lowest-risk option available for reducing current atmospheric GHG levels (Follett and Reed 2010). There is a growing body of evidence that controlled livestock impact can be used as an ecosystem restoration driver within the same landscapes that have been historically degraded by livestock use. Mechanisms by which this process is set in motion are multiple, and the MCP continues to investigate such mechanisms in its evaluations of methodologies for sequestering additional carbon in California rangeland soils. This line of inquiry is supported by promising initial experimental results and a large body of ecological theory, including that underlying rangeland State and Transition concepts.

Literature Cited

Bartolome, J.W., M.C. Stroud, and H.F. Heady. 1980. Influence of natural mulch on forage production on differing California annual range sites: Journal of Range Management 33(1): 4–8.

Booker, K., N. Sayre, L. Huntsinger, B. Stewart, J. Battles, P. Berck, and J. Bartolome. 2010. Opportunities for Carbon Sequestration on Rangelands. Draft 6- 4/23/2010. Rangeland Roundtable Steering Committee, UC Berkeley, Berkeley, CA.

Briske, D.D, J.D. Derner, J.R. Brown, S.D. Fuhlendorf, W.R. Teague, K.M. Havstad, R.L. Gillen, A.J. Ash, and W.D. Willms. 2008. Rotational grazing on rangelands: reconciliation of perception and experimental evidence. Rangeland Ecology and Management 61(1):3–17.

Dyksterhuis, E.J. 1949. Condition and management of rangeland based on quantitative ecology. Journal of Range Management 2:104–115.

Follet, R.F., and D.A. Reed. 2010. Soil carbon sequestration in grazing lands: societal benefits and policy implications. Rangeland Ecology and Management 63(1):4–15.

Friedel, M.H. 1991. Range condition assessment and the concept of thresholds: a viewpoint. Journal of Range Management 44:422–426.

George, M., J.R. Brown, and W.J. Clawson. 1992. Application of nonequilibrium ecology to management of Mediterranean rangelands. Journal of Range Management 45:436–440.

Intergovernmental Panel on Climate Change (IPCC). 2007. Climate change 2007: synthesis report. R.K. Pachauri and A. Reisinger, eds. IPCC, Geneva, Switzerland.

Lal, R. 2008. E-mail communication with Dr. Rattan Lal, Ohio State University.

———. 2007. Soil science and the carbon civilization. Soil Science Society of America Journal 71(5):1425–1437.

Margalef, R. 1968. Perspectives in Ecological Theory. University of Chicago Press, Chicago.

Naveh, Z. 1987. Biocybernetic and thermodynamic perspectives of landscape functions and land use patterns. Landscape Ecology 1(2):75–83.

Post, W.M., and K.C. Kwon, 2000. Soil carbon sequestration and land-use change: processes and potential. Global Change Biology 6:317–327.

Silver, W.L., R. Ryals, and V. Eviner . 2010. Soil carbon pools in California's annual grassland ecosystems. Rangeland Ecology and Management 63(1):128–136.

Stringham, T.K., W.C. Krueger, and P.L. Shaver. 2003. State and transition modeling: an ecological process approach. Journal of Range Management 56:106–113.

U.S. Department of Agriculture, Natural Resource Conservation Service (USDA–NRCS). 1997. National Range and Pasture Handbook. USDA, NRCS, Grazing Lands Technology Institute, Washington, DC. 190-vi-NRPH.

Westoby, M., B.H. Walker , and I. Noy-Meir. 1989. Opportunistic management for rangelands not at equilibrium. Journal of Range Management 42:266–274.

Aristida ternipes in Colusa County

Jack Alderson

In his *Distribution of the Native Grasses of California* (1947), Alan Beetle included *Aristida hamulosa* in the group of native bunchgrasses "whose conspicuous clumps give the California part of the Pacific grassland its characteristic aspect…." In Colusa County both the clumps and the stands of this grass have a characteristic appearance. Here I will review some earlier observations of this grass and report observations that I made in 2004.

Allan Beetle and Gaylord Stebbins, Jr., collected *A. hamulosa* in 1942 on the floor of the Sacramento Valley, 5.5 miles south of Orland (Consortium of California Herbaria 2010). It had been collected west of Orland as early as 1914 by A.A. Heller. In Colusa County it was collected 10 miles west of Williams by Paul Pattengale in 1940, by L.T. Burcham in 1955, and by Beecher Crampton in 1958 and 1963. It has also been collected west of Winters in Yolo County and at the base of the Sutter Buttes in Sutter County, and reported for Table Mountain northeast of Oroville in Butte County and for the Jelly's Ferry area north of Red Bluff in Tehama County (Consortium of California Herbaria 2010).

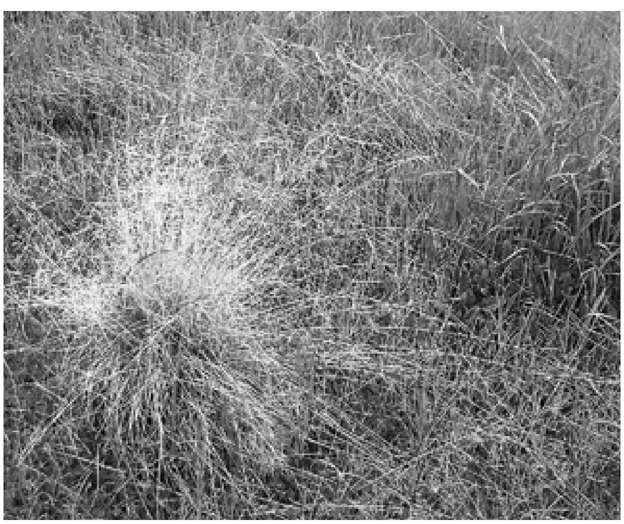


Figure 1. Dormant *Aristida ternipes* plant against background of growing annual grasses (*Bromus* and *Avena*) and forbs (*Erodium* and *Lupinus*) in February, 2005. The 0.96-square-foot sampling ring is standing vertically in the center of the plant.

Beetle's (1947) distribution map shows *A. hamulosa* as being present at lower elevations in these four counties, in the San Joaquin Valley south of the Delta, and along the South Coast. Allred (1992) reviewed the distribution of Aristida in California. He cited specimens for *A. ternipes* var. *hamulosa* from Butte, Colusa, Glenn, Sutter, Tehama, and Yolo Counties in the Sacramento Valley. *Aristida hamulosa* and *A. ternipes* var. *hamulosa* are synonyms for the currently accepted taxon, *A. ternipes* var. *gentilis* (Allred 2005). Beyond California, its range extends across the southwest to Texas and south to Guatemala.

Aristida ternipes is widespread in the Sacramento Valley, but it is not common. It is a grass of dry habitats that reaches the northern limit of its range in the Sacramento Valley. Morghan (2004) suggested that, in part, it was adapted to harsh sites because it uses C_4 photosynthesis and noted its common occurrence on south-facing slopes. She found low levels of soil nitrate nitrogen, phosphorous, and calcium at the sites she sampled. Its affinity for south- and west-facing slopes was recognized earlier by Sampson, Chase, and Hedrick (1951). They also observed that it appeared to be favored by heavy grazing. For its full range, Allred (2005) lists its habitats as dry slopes, plains, and roadsides. It is a deep-rooted perennial (Sampson, Chase, and Hedrick 1951).

W. James Barry (1972) documented a stand of *A. ternipes* in Salt Creek Canyon, Colusa County, in the Central Valley prairie. Although the original publication is somewhat scarce, this site has been widely referenced. It was included in the California Natural Area Coordinating Council's *Inventory of California Natural Areas* (Hood 1976), and referenced in the Terrestrial Vegetation of California (Heady 1977). A map and description of the site have been reproduced in Prairie Relics in California: A Guidebook Based on Dr. James Barry's 1971 Survey and Maps (Dremann 1988). The same map is reproduced in the California Natural Diversity Database (2010) where, following Hood, the site is described as "one of the largest known stands of *A. ternipes* var. *hamulosa*…." Although the mapped area includes a varied topography and orientation, Barry noted that the *A. hamulosa* occurred on a south-facing hillslope.

Figure 2. Lobes of *Aristida ternipes* stand on south-facing slope showing the clear boundaries typical of these stands in Colusa County.

I mapped *A. ternipes* at the Salt Creek Canyon site in 2004. I also mapped stands near Venado, where Freshwater Creek cuts through the same strata of the Great Valley Sequence as at the Salt Creek Canyon site. The Venado site is 2.5 miles north-northeast of the Salt Creek Canyon site. I believe this is the site, described as 10 miles west

ARISTIDA TERNIPES, continued on page 9

***ARISTIDA TERNIPES*,** continued from page 8

of Williams and 10.7 miles southeast of Leesville, where Pattengale, Burcham, and Crampton collected specimens. I have observed *A. ternipes* stands at other locations in the hills bordering the Sacramento Valley but have observed no valley floor sites in Colusa County. Two other well-known locations of *A. ternipes* stands are the canyon where Stone Corral Creek cuts through to the Sacramento Valley east of the village of Sites and the hills west of Antelope Creek, south of Sites. All stands are on south-facing slopes, and all locations have more than one discrete stand. The stands are on rangelands used for winter grazing. Mean annual precipitation is 19–21 inches (Oregon Climate Service 1998).

Aristida ternipes stands are very distinct features in the landscape. They are highly visible because they grow on open slopes, the plants are typically taller and denser than the surrounding vegetation, and, most importantly, the plants are usually seen as individuals. Figure 1 shows an *A. ternipes* plant within a stand of annual grasses and forbs. Because they start growth later than the annual grasses and continue to grow and flower after the annual grasses have senesced, they are often a contrasting color. In Colusa County the stands have relatively sharp edges; there are very few scattered plants outside a well-defined stand. Lobes of a stand near Venado are shown in Figure 2. I mapped the stands by walking around the perimeter with a hand-held Garmin equipped with a receiver for differential correction based on the National Geodetic Survey's network of CORS stations GPS (Garmin International, Inc., 1200 E. 151st Street, Olathe, KS 66062-3426). To find stands at a location, I walked a series of tracks that together provided an unobstructed view of the entire area being surveyed. At the Salt Creek Canyon site I recorded the tracks and compared them to the published map of the site to check the coverage of my search.

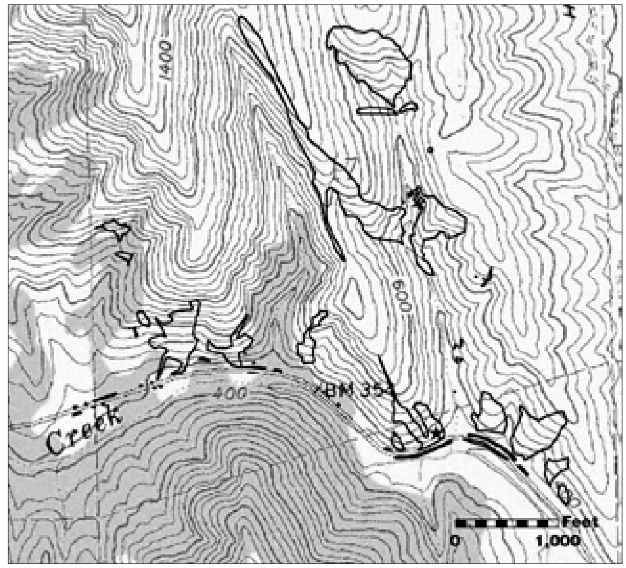


Figure 4. Stands of *Aristida ternipes* mapped in 2004 at the Venado site.

Figure 3 shows the *A. ternipes* stands that I mapped at the Salt Creek Canyon site, together with the area mapped by W. James Barry (as shown in the California Natural Diversity Database 2010). I found four stands of 4.5, 0.4, 12.5, and 0.3 acres, one of which was outside the area mapped earlier. I found three additional sites approximately 1 mile to the north, but I would consider these to be a separate location. The stands that I mapped were on soils mapped as the Millsholm–Contra Costa Association, 30 to 75 percent slopes (Reed 2001). Large areas of the Great Valley Sequence geology in Colusa County are mapped as Millsholm–Contra Costa association soils, and most *A. ternipes* stands that I have seen in the county are on these soils. Millsholm loam is a shallow soil with a gravelly sandy clay loam subsoil. Contra Costa loam is a moderately deep soil with a subsoil of clay loam and clay. Both have weathered from sandstone and shale, and rock outcrops occur as minor components in the map unit. The stands that I mapped are generally on south-facing slopes, but not all south-facing slopes at this location have *A. ternipes*. I found *A. ternipes* only in the western part of the area mapped earlier. The larger, eastern part of the area had a dense cover of annual grasses with very few native grasses of any species. The soils in this eastern part are mapped as complexes of Altamont and Sehorn silty clays. These deep and moderately deep, fine-textured soils are more productive than the Millsholm and Contra Costa soils.

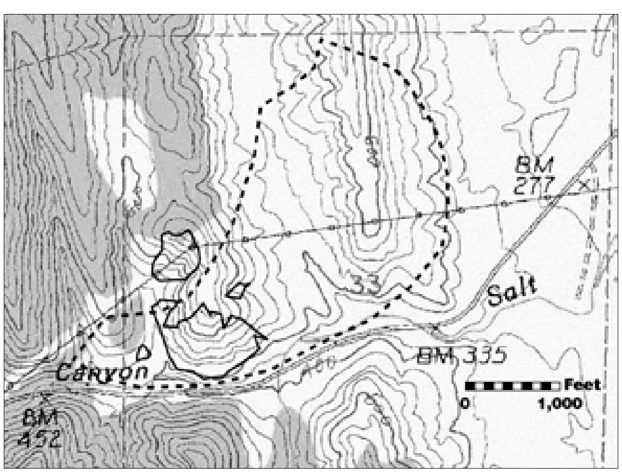


Figure 3. Stands of *Aristida ternipes* mapped in 2004 at the Salt Creek Canyon site shown with the prairie relic mapped earlier by W. James Barry.

At the Venado site I mapped nine stands that were larger than 1 acre and several smaller stands. These are shown in Figure 4. The largest stand was 10.5 acres and the total area mapped was 41 acres. *Aristida ternipes* grows along the roadside in long, linear stands at this site, unlike at other sites that I have seen in Colusa County. Other than along the roadside, the sites with *A. ternipes* stands are similar to those at the Salt Creek Canyon location and at other locations that I have seen in Colusa County. They are on south-facing slopes with soils of the Millsholm–Contra Costa association. The stands occur within larger areas of annual grassland. Although

***ARISTIDA TERNIPES*,** continued on page 10

ARISTIDA TERNIPES, continued from page 9

Quercus douglassi grows on these soils, the *A. ternipes* stands are in open grassland. *Vulpia microstachys, Nassella pulchra, Nassella cernua, Poa secunda, Elymus elymoides,* and *Melica californica* are other native grasses that I found in the grasslands adjacent to the stands. Nassella species were sometimes common within the stands. Although native grasses and forbs were not uncommon, the *A. ternipes* stands and the adjacent grasslands were dominated by nonnative annual grasses.

I sampled the vegetation at one of the Venado stands on May 8, 2004. The stand had been moderately grazed earlier in the spring, and most annuals had completed their growth cycle at the time of sampling. I clipped three 0.96-square-foot rings at four different sampling sites within the stand. The three nonnative annual grasses *Bromus hordeaceus, Avena barbata,* and *Taeniatherum caput-medusae* represented exactly one-half of the total dry weight of the samples. I did not separate the forbs for weighing, but *Erodium botrys,* a nonnative filaree, was the most abundant forb. The total estimated forage was 533 pounds per acre. Although this was a representative stand, *A. ternipes* did not occur in the twelve ring samples. At each of two of the sampling sites I counted *A. ternipes* plants, including fractional plants within the ring, from an additional twenty ring samples. Based on this very small sample, *A. ternipes* was present at a density of about one plant per 10 square feet. Later I sampled two stands at the Salt Creek Canyon location with a 10-square-foot ring counting plants from 20 samples at one stand and 25 samples at the other. The estimated density of plants for these two stands was 2.6 plants and 3.2 plants per 10 square feet.

I was intrigued by the visual patterns of *A. ternipes* on the hillslopes. At the landscape level, plants are clearly clustered in stands. Plants within the stands appeared to be somewhat regularly spaced, but that perception might be simply a consequence of the low density of the plants. I surveyed 622 individual plants in a 60-foot x 60-foot plot within a stand at Venado. The Trimble GPS survey system provides sub-centimeter accuracy. The plot location is shown by a star in Figure 4. A map of the plants is shown in Figure 5, and Figure 6 is a photograph of the general area of the plot. I used an Average Nearest Neighbor test (ESRI 2006) to investigate the spatial structure of the plants. Values greater than 1.0 indicate that the plants are dispersed, and values less than 1.0 indicate that plants are clustered with a minimum possible value of 0 for plants all at a single location, and a maximum possible value of 2.1491 for plants uniformly spaced. For this single plot, the Average Nearest Neighbor statistic was 1.07, indicating a near-random distribution with a weak tendency for the plants to be dispersed. The Z score for the test was high, 3.26. The density of plants within this plot was 1.7 plants per 10 square feet.

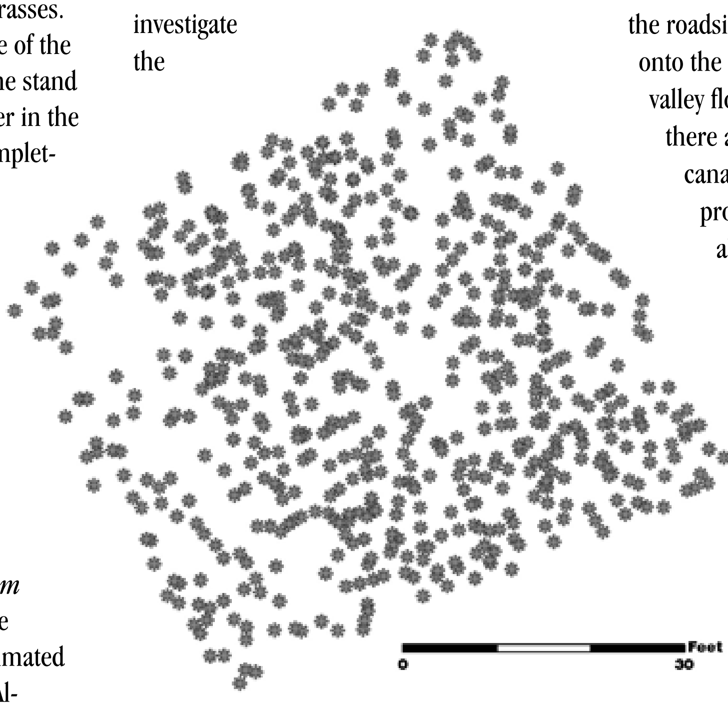


Figure 5. Map of individual plants within a 60 foot x 60 foot plot at the Venado site.

The *A. ternipes* stands that I have seen in Colusa County are more distinctly bounded than those I have seen in other counties. There are stands on south-facing slopes along Hambright Creek west of Orland in Glenn County that are similar to stands I have seen in Colusa County, but within the same area plants are very common along the roadside and even occur on the floodplain of the creek. Farther west on Newville Road stands are common on south-facing road cuts and fills and along the roadside, but do not appear to extend onto the undisturbed slopes. On the valley floor 4–5 miles south of Orland there are stands along an irrigation canal, on lightly used commercial property, in the bottom of an abandoned gravel quarry, and, interestingly, on the south-facing slope of a freeway overpass. East of Chico in Butte County *A. ternipes* grows along the roadside of Highway 32, but does not appear to grow on the slopes. In Dye Creek Canyon in Tehama County it grows on the south-facing slope of the canyon, but as scattered plants rather than in well-defined stands. The plants are most common along a trail that runs up the canyon.

The conspicuous clumps that drew the attention of Alan Beetle are dependent on a growth form and a spatial structure. The primary feature of the spatial structure is density. Individual clumps are not recognizable in dense stands of cespitose (forming mats or growing in dense tufts or clumps) grasses, and individual clumps that are present at very low densities are not recognized as stands. In Colusa County the clumps of *A. ternipes* are quite conspicuous, as are the stands that they form. Some features of their distribution in the

ARISTIDA TERNIPES, continued on page 11

Figure 6. Photo of the general area of the plot surveyed at Venado.

landscape seem obvious, but much remains to wonder about.

References

Allred, K.W. 2005. *Aristida*. In: Flora of North America Editorial Committee, eds. Flora of North America North of Mexico, New York and Oxford Vol. 25, pp. 315–342.

———. 1992. The genus *Aristida* (Gramineae) in California. Great Basin Naturalist 52:41–52.

Barry, W.J. 1972. California prairie ecosystems. Volume I: the Central Valley prairie. State of California Resources Agency, Department of Parks and Recreation, Sacramento.

Beetle, A.A. 1947. Distribution of the native grasses of California. Hilgardia 17:309–357.

California Natural Diversity Database. 2010. RareFind 3, Version 3.1.0 (July 3, 2010, update). California Department of Fish and Game, Sacramento.

Consortium of California Herbaria. 2010. Data provided by participants of the Consortium of California Herbaria (ucjeps.berkeley.edu/consortium/; Aug 14 18:25:20 2010).

Dremann, C.C., ed. 1988. Prairie relics in California: a guidebook based on Dr. James Barry's 1971 survey and maps. Redwood City Seed Company, Redwood City, CA.

ESRI. 2006. ArcMap version 9.2, spatial statistics tools. ESRI Inc., Redlands, CA.

Grimes, J.P. 1979, Plant strategies and vegetation processes. Wiley, Chinchester, Great Britain.

Heady, H.F. 1977. Valley grassland. In Michael G. Barbour and Jack Major, eds., Terrestrial vegetation of California, Wiley, New York.

Hood, L., ed. 1975+. Inventory of California natural areas. California Natural Area Coordinating Council, Sonoma, CA.

Morghan, K.R. 2004. The ecology of *Aristida ternipes* var. *hamulosa* and *Aristida oligantha* in Northern California and Oregon. Grasslands 14(2):8–11.

Oregon Climate Service. 1998. Average monthly or annual precipitation, 1961–90. Oregon State University, Corvallis.

Reed, W.R. 2001. Soil survey of Colusa County, California. Natural Resources Conservation Service, U.S. Department of Agriculture, Washington, D.C.

Sampson, A.W., A. Chase, and D.W. Hedrick. 1951. California grasslands and range forage grasses. California Agricultural Experiment Station Bulletin 724.

Jack Alderson is a ____________________________ and a life member of CNGA.

Grassland Restoration Field Practices Workshop

Thursday, October 28

Fall is the time for planting native grasslands!

Real-world, hands-on experience in grassland restoration.

Tools and techniques for • site preparation • planting • establishment

Applicable to large- and small-scale restoration projects.

- *Be prepared to get dirty!*
- *Physical participation is highly encouraged.*

Instructors: J.P. Marie and Bryan Young

Location: Davis ***Enrollment:*** limited to 50

Registration Fees: • $50 member, • $70 non-member, •$35 student

Registration: Restoration Workshop | Fall 2010

Mail to: CNGA, P.O. Box 8327, Woodland, CA 95776 Secure fax to: 530-661-2280

Name (print/type) ____________________

Org./agency (optional) ____________________

Mailing Address: Street ____________________

City ____________ State ____ Zip ________

Phone ____________ E-mail ____________

Registration Fees : ☐ $50/CNGA members ☐ $70/nonmembers* ☐ $35/students

* One year complimentary CNGA membership included with registration at nonmember rate.

☐ Payment by check made payable to California Native Grasslands Association

☐ Payment by credit card : ☐ Visa ☐ MasterCard ☐ American Express

Card number____________ Expiration date_____/_____

V Code ____________________

Billing Street Address ____________________

Questions? Please contact CNGA by phone/fax: 530-661-2280, or e-mail: admin@CNGA.org.

Weed Control Techniques for Establishing Native Grasslands on the Middle Sacramento River Floodplain

Ryan Luster, *The Nature Conservancy, 500 Main St., Chico, CA 95928, 530/897-6370, rluster@tnc.org*
Fred Thomas, *CERUS Consulting, 2119 Shoshone Ave., Chico, CA 95926, 530/891-6958, fred@cresuconsulting.com*

Abstract

In this experiment we are asking several questions: (1) Is Roundup the most effective herbicide for preparing a site for native grassland establishment? (2) Is Roundup® plus a broad-spectrum broadleaf herbicide more effective in controlling weeds than Roundup® alone? (3) Are two herbicide treatments followed by direct seeding more effective than one herbicide treatment followed by direct seeding? Answers to these questions will help grassland restoration practitioners to better understand the importance of herbicide treatment and timing of direct seeding for successful grassland establishment in abandoned agricultural fields of the Sacramento River floodplain.

Experimental Design

The field in which this trial is being conducted was a prune orchard for 30 years prior to 2001. Beginning in 2001, a series of weed control activities has been implemented to prepare the site for a grassland restoration. These activities have included multiple mowing, aerially seeding a cover crop of bell beans, magnus peas, and Cayuse oats in winter 2002, and multiple herbicide applications. This has been a no-till approach where we will eventually use a no-till seed drill to seed the native grasses and forbs on the proposed 135-acre grassland restoration site (fig. 1).

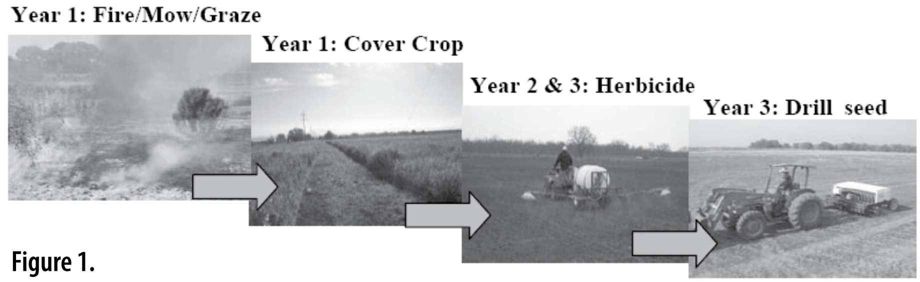


Figure 1.
Weed control activities implemented to prepare site for grassland restoration

The trial plots were laid out on December 2, 2003. Each individual trial plot is 40 ft x 32 ft with 21 plots replicated in two blocks, for a total of 42 plots. See plot layout diagram (fig. 2) for herbicide and seeding combinations and application timing. All plots were seeded with the same native grass seeding mix either on December 18, 2003, or January 22, 2004, using an 8 ft. Truax Rangeland Drill. The seeding mix consisted of 30 percent Elymus glaucus at 10.8 lb/acre, 15 percent Hordeum brachyantherum at 5.4 lb/acre, 20 percent Leymus triticoides at 7.2 lb/acre, Melica californica at 7.2 lb/acre, and 15 percent Nassella pulchra at 5.4 lb/acre. Total seed weight is 36 lb/acre, corrected for impurities and pure live seed, for a total true seeding target rate of 18 lb/acre. Seeds

ARISTIDA TERNIPES, continued on page 13

Figure 2. Plot Layout

Treatment Size: 40 X 32 ft Plot Size: 280 X 192 ft	Block #1			Block #2		
Treatments Sprayed 12/03/03	Plant 12/18/03	Spray Roundup, Plant 01/22/04	Spray Roundup & Goal, Plant 01/22/04	Plant 12/18/03	Spray Roundup & Goal, Plant 01/22/04	Spray Roundup, Plant 01/22/04
Roundup: 1 quart/acre (40 ft)						
Gramoxone: 1 quart/acre + Agridex: 1 quart/acr						
Control						
Roundup: 1 quart/acre + Telar: 1 oz./acre						
Roundup: 1 quart/acre + Transline: 2/3 pint/acre						
Roundup: 1 quart/acre + Goal: 1 quart/acre						
Roundup: 1 quart/acre + 2, 4-D: 1 quart/acre						

Preliminary Results Key March 30, 2004	Very effective	Fairly effective	Somewhat effective	Not effective

SOIL RESOURCES, continued on page 13

WEED CONTROL TECHNIQUES, continued from page 12

acre, and 15 percent *Nassella pulchra* at 5.4 lb/acre. Total seed weight is 36 lb/acre, corrected for impurities and pure live seed, for a total true seeding target rate of 18 lb/acre. Seeds were purchased from Hedgerow Farms in Winters, California, using the closest available ecotypes for each species.

Summary Of Preliminary Results

Plots were evaluated on March 30, 2004, by visually evaluating the overall effectiveness of the herbicide and seeding treatments. Plots planted (December 18, 2003) directly after being treated with herbicide treatments (December 3, 2003) were not successful in controlling weeds. Although the December 18, 2003, herbicide treatments killed the first cohort of germinating weeds, these plots were dominated by second and third cohorts of germinating weeds. Plots planted directly after being sprayed with the pre-emergent Goal (January 22, 2004) were completely devoid of native grasses and weeds two full months after seeding.

The most promising combination of seeding timing and herbicide application occurred in the plots that were first sprayed on December 2, 2003, with Telar and Roundup, followed 48 days later by another Roundup treatment and seeded the same day. As of March 30, 2004, these plots had virtually no broadleaf weeds and only a few scattered ryegrass individuals. The next two combinations of treatments that were equally as effective as individual treatments were: (1) plots sprayed with Roundup on December 3, 2003, then sprayed again with Roundup on January 22, 2004, and seeded, and (2) plots sprayed with Roundup and Goal on December 3, 2003, then again with Roundup on January 22, 2004, and seeded. These plots had very little to no ryegrass but did have a fair amount of broadleaf weeds that will be controlled with a 2,4-D application later in the spring.

The results from the Roundup-only sprayed plots indicate that, in these plots, we do not have Roundup-resistant ryegrass and that Roundup-only herbicide treatments are not as effective as Roundup plus broadleaf spectrum herbicides such as Telar or pre-emergents such as Goal for controlling broadleaf weeds.

WHAT NOW? The Next Phase of Grassland Management After Restoration

Andrew Fulks, *Manager, UC Davis Putah Creek Riparian Reserve*

At UC Davis' Russell Ranch, the property managers spent the last 7 years establishing a healthy stand of native grasses on 380 acres. The property is mitigation for potential loss of Swainson's hawk foraging habitat, as well as burrowing owl nesting and foraging habitat. The grassland was planted in phases with a combination of native grass species. Now that all the fields have at least 3 years of establishment and weed control, it's time to start managing the grasslands for the benefit of the target species.

The original goals for the property went beyond simply keeping the land undeveloped and the grasses short for the birds. The University wanted to restore the former grasslands to also be used as a research site, where students could perform experiments on native grasslands at a scale that would not otherwise be available locally. The restored site was designed to not only have grasses, but also include forb species.

Challenges

The challenges after establishment of the grassland include how best to manage the property for the target species while establishing a forb component, minimizing the increase of broadleaf weeds and non-native annual grasses, and sustaining our established native grasses.

The 2002 Russell Ranch Concept Plan outlined the development of mitigation lands at Russell Ranch. Establishing a forb component has been a part of the Concept Plan since its creation. However, establishing forbs will reduce our ability to use broadleaf weed herbicides, which are commonly depended on for control of weeds like starthistle, prickly-lettuce, and pepperweed, among others. Successful establishment of forbs within an established native grass planting of this scale, in an agricultural area with substantial weed pressure, is still largely unproven.

Both the hawk and owl prefer short-stature vegetation for hunting. For burrowing owl, the grasses around the nest sites have to remain short, or even absent to bare dirt, for the nest site to remain attractive for inhabitation. This presents difficulty in that the grasses can't be maintained short perpetually without killing them. It is desired to allow the grasses to reseed to maintain the viable grassland, but this is in conflict with the need to keep grasses short.

Burrowing owls prefer open areas with squirrel burrows. Russell Ranch is covered in grasses, and ground squirrels were extirpated by previous agricultural operations. The lack of open ground and existing squirrel colonies poses challenges in making the habitat suitable for the owls.

Developing the Management Plan

Development of a management plan was necessary to have clear direction regarding the establishment of forbs and management of the grassland for the target species.

WHAT NOW?, continued on page 14

WHAT NOW? continued from page 13
Experts in rangeland management and grasslands, researchers at the University, land managers, a consultant with expertise regarding Swainson's hawk and burrowing owls, and graduate students with interest in research on restored grasslands, convened several times to give input in the development of the plan.

The group outlined the goals of the mitigation area, management requirements and potential opportunities, and the timeline for implementation. After several iterations, the management approach was created.

Management Approach

Management of the Russell Ranch grasslands will emphasize rotation of treatments within the grassland, centered on core owl nesting areas. To meet the requirements for burrowing owl nesting habitat, a total of 65 acres of grassland must be kept short year-round when owls are present or during the fall and spring when owls may disperse into the site.

The 65 acres will be located in five separate nesting areas, ranging from 6.5 acres to 26 acres, to create variation in soil types and sizes of potential nesting areas. The grasses within each nesting area will be maintained short using a combination of mowing, burning, and grazing. Adjacent to each nesting area, a section of the remaining field will be shortened, creating a larger short-grass block for use by Swainson's hawk and burrowing owl (fig. 1). How each area is shortened will be determined by field conditions. Over the long term, the nesting areas may change if yearly shortened areas develop nesting populations of owls.

The yearly shortened areas will rotate, with the determination of which area of grassland to be shortened each year, depending on the field conditions within the grassland. One area may be shortened 2 years in a row, for example, or another may be shortened every other year, depending on the weeds present, the amount of thatch, ability to access the field due to soil moisture, or other management factors. Figure 1 displays the concept, based on a 4-year rotation cycle, with each sub-field given a year-number.

Although artificial burrows were installed prior to the initial grass plantings, burrowing owls typically inhabit the burrows of ground squirrels. Historically there had been extensive ground squirrel control, and none were living within the project area. Establishing ground squirrel colonies will increase our chances of success in attracting burrowing owls. These colonies will be established by relocating squirrels from other campus areas where they are a nuisance, to the nesting areas in the mitigation lands. Logs and other structures, which squirrels like to burrow under, will be placed in these areas prior to relocation.

Forbs will be introduced into the entirety of each of the owl nesting areas. These areas will be maintained to be permanently short (4 inches or less), which

WHAT NOW? continued on page 15

Figure 1. Russell Ranch Grassland Management Plan

WHAT NOW? continued from page 14

should be compatible with forb establishment, so long as the mowing or grazing is adjusted to allow the forbs to reseed. Forbs species that tend to be shorter in stature (under 12 inches) will be selected. Forbs will be established in these core areas, then allowed to spread into adjacent fields. Forbs will be reseeded over a 3-year period to reestablish the seedbank and to decrease possible effects to the plants from yearly temperature and rainfall variation.

Grazing will be used to manage the stature of the grasses. Perimeter fencing will be installed around mitigation area fields. Cattle would potentially be available March through September, so their timing coincides with the foraging period of the Swainson's hawk. Stocking rates will be evaluated to determine if grazing is impacting rodent prey populations, by checking for evidence of rodent use within grazed and ungrazed portions of the grasslands.

Mowing and/or bailing the grasslands are also tools that will be used to manage grassland height. Mowing costs more than grazing but can usually be timed more precisely and implemented uniformly over a larger area.

Burning is another method to remove thatch and allow for renewed grass growth. Burning is the least expensive of the management tools, but also the most difficult to initiate as burning can only take place during a burn day, as mandated by the Yolo–Solano Air Quality Management District. Burn days are most common during the fall, which is good timing for thatch removal. For weed control, spring burns are most effective, but more difficult to schedule due to air quality constraints. After a burn, the open ground can allow for forb seeding and establishment, but can also lead to establishment of broadleaf weeds, so post-burn effects will be closely monitored and management changed accordingly.

Determining which method to employ to shorten the grasses within an area will be based on a qualitative assessment of the grassland, the availability of staff, equipment, and animals. If the preferred method at the time cannot be used to shorten the grass, we will determine which method can be used that will still meet the objectives. This flexibility will be key as we transition from establishment to operations and management.

Caption

Will it work?

Based on the best information and experience we have, we know that the management framework we have developed is adaptive enough to allow for us to evaluate and modify our management. In a few years we will report back on our progress in establishing forbs within the grassland, recruiting burrowing owls, and keeping our established stands of grasses healthy.

Although success according to the regulatory agencies was the act of creation of the mitigation lands, our determination of success will be based on foraging use of the site by Swainson's hawk, suitable habitat for burrowing owl being created by the squirrels, long-term establishment of forbs, and retention of the established native grasses.

Holistic Planned Grazing for Ranchers: A Workshop Report to CNGA

Richard King, *Poppy Hill Farm, 1675 Adobe Rd., Petaluma, CA 94954; (707) 769-1490*

The vast majority of California grasslands are grazed by domestic livestock—for better or worse, depending on management. CNGA has provided several holistic grassland management workshops in recent years taught by Kent Reeves and/or me. The workshops have ranged from 1 to 3 days, introducing grassland ecological principles and teaching a specific grazing planning process that benefits rangeland health and native species.

Caption

Caption

In March, I took the opportunity to enlist the help of an Australian grazier and friend visiting the USA on holiday. The result? The Yolo County Resource Conservation District and USDA Natural Resources Conservation Service sponsored a workshop for ranchers that provided a simple state-of-the-art process to plan livestock grazing. The purpose of the course was to provide ranchers with a simple planning tool that would enable them to:

1. Produce the maximum amount of high-quality forage on an increasing or sustained basis during the growing season;
2. Ensure adequate forage and/or cover for livestock and wildlife;
3. Effectively deal with droughts;
4. Meet the nutritional requirements of livestock and wildlife;
5. Minimize the stress from moving livestock, both on the animals and on the ranchers;

HOLISTIC GRAZING WORKSHOP, continued on page 19

The Return of Cows to the Santa Rosa Plateau Ecological Reserve in Southern California

Zachary Principe, *Ecoregional Ecologist , The Nature Conservancy*

After a 27 year absence, cattle have been returned to the Santa Rosa Plateau Ecological Reserve. A need for active management of the grasslands and vernal pools was recognized soon after its protection, as a result of thatch buildup and a decrease in native wildflowers. For the last 27 years, fire has been the only large-scale tool used to manage the grasslands and vernal pools.

A need for additional management tools has become necessary in the last decade as a result of two primary factors, human population growth and a decline in native vernal pool plant species.

The setting of the reserve has changed dramatically since 1983 when the adjacent towns were small and the prescribed fires went largely unnoticed. Today the reserve is surrounded by ranchettes and the towns have become cities with a combined population of nearly 300,000. Air quality regulations and concerns over smoke produced by the fires have made it more difficult to use fire.

The vernal pools have largely remained unmanaged since the reserve's creation as a result of the timing of the prescribed fires. Late spring and early summer burns do not carry into the pools, which has allowed decades of thatch accumulation and a species of *Paspalum,* a large perennial grass, to expand and reduce habitat for smaller vernal pool species. As a result, cattle have been reintroduced on a trial basis to assess the response of the grassland and vernal pool flora. Data was collected a year prior to the cattle's return. Data was again collected this spring after 2 months of low intensity grazing.

Although the data has not been analyzed, we anticipate little or no influence of the low intensity grazing on the flora this year because of the short amount of time the cattle were present before data collection. The cattle, however, continued to roam and eat with what appears to be promising results. They preferred the non-native annual grasses through late summer, allowing the native grasses and forbs to flower and set seed. They are also eating the large clumps of *Paspalum,* allowing vernal pool species to co-occur with this much larger species. Alkali mallow, San Diego button celery, and hairy waterclover were all commonly observed growing out of the grazed *Paspalum* clumps.

We are hopefully optimistic that the positive influences we are observing continue and that we have a second viable management tool available to enhance our native species diversity.

HOLISTIC GRAZING WORKSHOP, continued from page 19

6. Coordinate cropping, wildlife, and other land use needs, as well as the personal schedules of those who operate the plan;
7. Build grassland biodiversity above ground and below ground (carbon sequestration, fertility, soil porosity, productivity, native plants, wildlife, etc.) with sunlight and planning.

The course was co-taught by Brian Marshall, who is a long-time rancher/farmer from New South Wales, Australia, and me. I live on the outskirts of Petaluma, California, and raise grass-fattened beef. Both Brian and I use this process to manage our respective grasslands and enjoy teaching others. Both of us are certified educators in Holistic Management® (see next paragraph). The classroom was filled with both ranchers and others who manage rangelands.

Participants learned a step-by-step process that will ensure "livestock are in the right place, at the right time, and for the right reasons." The process sorts through the complexities of managing land, people, and money simultaneously (i.e., reality) by walking through all the variables in an orderly fashion. The result is the ability to develop annual grazing plans that are financially, socially, and ecologically sound—for the rancher, the land, and the greater community.

Developed over several decades by Allan Savory, a Zimbabwean biologist and farmer born in 1935, and utilized by a growing number of ranchers and land managers, holistic planned grazing differs greatly from conventional grazing systems and strategies. It is used in the context of a new decision-making framework, Holistic Management®, ensuring the manager is moving toward, and driven by, how they want their life to be. The framework is also built on ecological processes and how they must function so that the "whole" being managed is successful and sustainable far into the future.

Some of the planned grazing skills emphasized in the course were:

1. Managing the soil surface;
2. Understanding overgrazing and over-resting from the plant's point of view;
3. Animal impacts (other than forage consumption) and how to use them to manage ecosystem processes;
4. Planning grazing periods based on plant recovery periods;
5. Recognizing biological decay vs. oxidation;
6. Why and how separate growing season and non-growing season grazing plans are developed;
7. Animal days per acre as a powerful and useful measurement of land area, stock pressure, and time;
8. Planning backward in time;
9. Monitoring animal performance, plant vigor, and soil surface conditions.

The power of testing proposed actions/decisions in regard to the manager's holistic goal using a simple set of guidelines as a "pilot's checklist" was emphasized. The instructors emphasized that poor animal performance or land performance (or both) can occur when only part of the planned grazing process and greater decision-making framework is used. Brian and I shared our personal experiences and those of others practicing holistic planned grazing. Results ranchers and land managers are seeing throughout the world's grasslands include building soil organic matter, increasing native species and biodiversity, invasive species declining dramatically, increasing productivity, and improving profitability.

Ranch hand Scott Gerber from Petaluma graciously allowed the class to use a working ranch he assists. Each participant developed an annual grazing plan for that land using the step-by-step process. The plan was developed on a single sheet of paper—one step at a time—and the class learned how it ensures discipline, flexibility, and monitoring for both planned and actual grazing.

Using that ranch as an example, the importance of planning on paper to deal with the multiple variables that need attention to develop a sound grazing plan was emphasized. Without such a process and without that single sheet of paper (i.e., a grazing chart planning template adaptable to any ranch or grazed land), the ability to think through and plan grazing to address the complexity of variables will prove overwhelming (e.g., stockwater, poisonous plants, excessive thatch, calving/lambing, bulling, ground-nesting birds, wildlife, plant recovery, labor, animal performance, water quality, declining species, predators, risk of fire, invasive species, eroding land, profitability).

Three publications were provided for the class participants that outlined the overarching decision-making process, the planned grazing step-by-step process, and a more comprehensive handbook that includes the grazing planning, land planning, financial planning, and biological monitoring processes that have proven helpful to so many ranchers and land managers worldwide. Workshops have proven helpful to people wanting to learn and successfully apply these principles and planning processes.

Scott Gerber

Interested in learning more about managing the complexity of California grasslands holistically? Contact CNGA at ADMIN@CNGA.ORG *and suggest what, where, and when would be helpful to you. Thanks!*

Richard King is an employee of the USDA Natural Resources Conservation Service.

S&S SEEDS

**WHOLESALE SEEDS FOR RECLAMATION,
EROSION CONTROL, AND LANDSCAPING**

*Wildflowers • Grasses • Native California Plants
• Trees • Shrubs • Ground Covers*

P.O. Box 1275, Carpinteria, California 93014-1275
phone: (805) 684-0436 • fax: (805) 684-2798
e-mail: info@ssseeds.com

www.ssseeds.com

- *Information about*
  - *our company, our wildflower mixes, and other products*
  - *our reclamation and erosion control mixes*
- *A newsletter about current projects and upcoming events*
- *A sample of our Plant Inventory Database*

(Let us know who you are and how we can help you.)

www.wildflowerseed.com

A source for wholesale wildflower seed
(S&S Seeds LLC, Albany, Oregon)

*California Native Seeds
Wildflower & Grass Seed Mixes
for
Erosion Control, Landscaping & Reclamation*

Pacific Coast Seed INC.

**533 Hawthorne Place - Livermore, CA 94551
(925) 373-4417 Fax (925) 373-6855
info@pcseed.com**

HEDGEROW FARMS

California native grassland seed

- Multiple ecotypes available
- Seed mixes customized for your needs
- Plug plant nursery
- Native grass straw from clean production fields
- Project consulting with years of experience
- Site-specific contract growing
- Educational tours for schools, organizations, agencies, and individuals

**Visit our website or
contact us for more information!**

**Phone: (530) 662-6847
Fax: (530) 662-2753**

**Headquarters: 21905 County Road 88
Winters, CA 95694
Mailing Address: 21740 County Road 88
Winters, CA 95694**

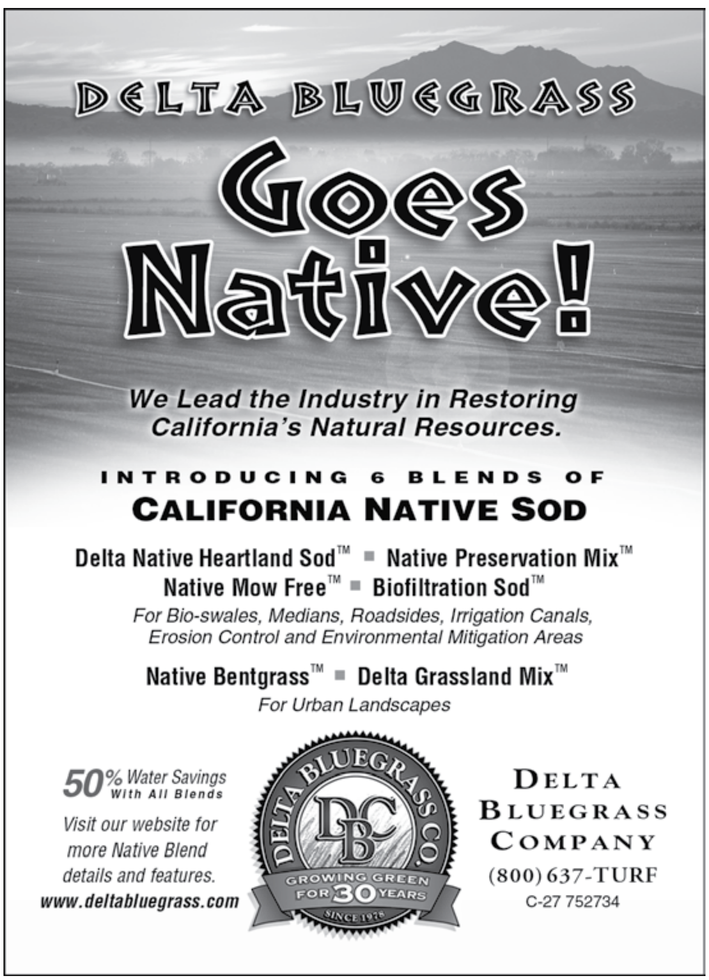
**www.hedgerowfarms.com
info@hedgerowfarms.com**

23195 Maffei Road
Sonoma, CA 95476
Tel: 707 996 6633
Fax: 707 996 6641
LICENSE NO 461167

Hanford
APPLIED RESTORATION CONSERVATION
ARC

Rob de Bree
Nursery Manager
Kat DeDontney
Office Manager
Elkhorn Native Plant Nursery
1957B Highway 1
Moss Landing, CA 95039
831 763 1207 ∵ FAX 831 763 1659
enpn@elkhornnursery.com; www.elkhornnursery.com

SHILLING SEED
Fax (530) 268-3158
10064 Streeter Rd. #5
Auburn, CA 95602
JON SHILLING
www.shillingseed.com (530) 268-3174



CNGA Merchandise Order Form

Phone/Fax: 530-661-2280 **Mail:** P.O. Box 8327, Woodland, CA 95776

Name ____________________

Mailing address ____________________

City, State, Zip ____________________

Day phone ____________ **E-mail** ____________

Item (All prices include tax. Call for combined shipping.)	**Price**	**S/H**	**Qty**	**Total**
CNGA Logo Items				
Sturdy canvas tote, natural w/green logo, 13x15x7 SALE!	$15	$5	__	____
Tees unisex heather-green, short-sleeve (S/L/XXL/XXXL only)	$15	$5	__	____
NEW! Men's cut, natural, short-sleeve (S/M/L/XL)	$20	$5	__	____
NEW! Women's cut, army-green, short-sleeve (S/M/L/XL/XXL)	$25	$5	__	____
NEW! Men's cut, olive green, short-sleeve (M/L/XL/ XXL)	$20	$5	__	____
Long-sleeve unisex, olive green (S/M/XL/XXL/XXXL)	$25	$5	__	____
CNGA Workshop Binders				
Holistic Grazing Planning Principles	$35	$8	__	____
Ecology/Management Vernal Pool Grasslands (supply limited)	$35	$8	__	____
Native Grasses in the Water-Conserving Landscape	$35	$8	__	____
CA Native Grass Appreciation & Identification	$25	$8	__	____
Native Grasses in Restoration and Revegetation	$60	$8	__	____
Posters				
Grasses of CA large poster, 24x36, laminated	$25	$6	__	____
Grasses of CA (CNPS), set of 4, each different, 11x17, laminated	$20	$6	__	____
Grasslands (quarterly journal)				
Complete set of back issues (1991–2010)	$65	$10	__	____
subtotals		$ ____		$____

Total Enclosed $________

Make check payable to California Native Grasslands Association (or CNGA) or you may authorize payment by (circle one): Mastercard / Visa / AMEX

Card # ____________ **Exp. date** ________

V Code ______ **Billing Street Addr** ____________

CNGA Contact List

Judy G-Scott
Administrative Director
P.O. Box 8327, Woodland, CA 95776
Phone/Fax: 530-661-2280 E-mail: admin@CNGA.org

Mary Rodgers
Grasslands Managing Editor
3661 56th St., Sacramento, CA 95820-2342
916-455-0563; E-mail: mrodgers@macnexus.org

Board of Directors

Officers

Wade Belew, President
Cotati Creek Critters; P.O. Box 7511, Cotati, CA 94931
707-694-5086; E-mail: wadekb@sonic.net

Sara Sweet, Secretary
The Nature Conservancy
13501 Franklin Blvd., Galt, CA 95632
916-683-1767; E-mail: ssweet@tnc.org

Jim Hanson, Treasurer
Caltrans: Mitigation and Highway Landscaping
438 49th St., Oakland, CA 94609 (mailing)
510-450-2450 (day); E-mail: greenhectare@yahoo.com

At-Large Members

Andrew Fulks (2010–2011)
UC Davis Putah Creek Riparian Reserve
2723 Ganges Pl., Davis, CA 95616
530-752-0763; E-mail: amfulks@ucdavis.edu

Erik Gantenbein (2009–2010)
3721 Fair Oaks Boulevard, Sacramento, CA 95864
916-709-0045; E-mail: erikg22@att.net

Elizabeth Goebel (2010–2011)
Hedgerow Farms
21740 County Rd. 88, Winters, CA 95694
530-662-6847; E-mail: egoebel@hedgerowfarms.com

Clare Golec (2009–2010)
Caltrans, Eureka Office, Distr. 1
P.O. Box 3700; Eureka, CA 95502-3700
707-445-6322; E-mail: clare_golec@dot.ca.gov

Sarah Hoskinson (2009–2010)
Dept. of Plant Sciences, UC Davis
1210 PES, Mail Stop 1, 1 Shields Ave., Davis, CA 95616
530-752-5609; E-mail: sahoskinson@ucdavis.edu

David Kaplow (2009–2010)
P.O. Box 744, Petaluma, CA 94953
707-769-1213
E-mail: dave@pacificopenspace.com

Richard King (2009–2010)
USDA NRCS; 1301 Redwood Way, Suite 215,
Petaluma, CA 94954
707-794-8692 x120; E-mail: richard.king@ca.usda.gov

JP Marié (2010–2011)
UC Davis Putah Creek Riparian Reserve
376 Mrak Hall, 1 Shields Ave, Davis, CA 95616
530-304-3251; E-mail: jpmarie@ucdavis.edu

Jon O'Brien (2010–2011)
Audubon California, Landowner Stewardship Program
P.O. Box 733, Winters, CA 95694
530-795-0660; E-mail: jobrien@audubon.org

Zachary Principe (2010–2011)
The Nature Conservancy
402 W. Broadway, Suite 1350, San Diego, CA 92101
909-815-2227; E-mail: zprincipe@TNC.org

Christina Smith (2010–2011)
USDA-NRCS, California Plant Materials Center
P.O. Box 68, Lockeford, CA 95237
209-727-5319, x15; E-mail: christina.smith@ca.usda.gov

Bryan Young (2009–2010)
Sacramento Regional County Sanitation Dist.
8521 Laguna Station Rd., Elk Grove, CA 95758
916-875-9273
E-mail: youngb@sacsewer.com

CNGA's Bunchgrass Circle

Life Members

Jack Alderson
Jane Anderson
John Anderson
Fred Ballerini
Sheila Barry
Bob Battagin
F. Thomas Biglione
Jack Booth
Janice Bridge
Cindy Burrascano
Sallie J. Calhoun
Sally Casey
Frank Chan
Vic Claassen
Mike Conner
Anne Corey
Duane Cornett
Charlice Danielsen
James Dekloe
Robert Delzell
Rene di Rosa
Jerome Domurat
Bruce Eisenman
John R. Ekhoff
David Gilpin
F. Thomas Griggs
Jim Hanson
Barbara Herren
Lesley Hunt
Richard Ibarra
Ellie Insley
Joni Janecki
David Kaplow
David B. Kelley
Micki Kelly
Paul Kephart
Charlotte Kimball
Lenora Kirby
Ron Lutsko, Jr.
Rod MacDonald
Garry Mahrt
Eugene Majerowicz
Carolyn Malmstrom
Tamia Marg
Rhonda and Bob Mark
Ron Martinolich
Ruth Mazur
Mary Kate McKenna
Richard Nichols
Paul Ostler
Carol Presley
Peggy Rathman
Paul Reeberg
Diane Renshaw
John Roberts
Warren Roberts
Craig S. Rust
Victor Schaff
Robert Schott
Susan Schwartz
Jon Shilling
Jacob Sigg
Diana Steidl
Robert Stephens
Scott Stewart
Lillian Vallee
MaryAnn Warmerdam
John Wick
Margaret Willits
Jeanne Wirka
David Yam

Corporate Members

***Muhlenbergia rigens* level**

Hedgerow Farms

***Nassella pulchra* level**

Delta Bluegrass • Pacific Coast Seed • S&S Seed

***Poa secunda* level**

Elkhorn Native Plant Nursery • Hanford Applied Restoration and Conservation
Shilling Seed • Sun City Lincoln Hills

Associate Members

American River Parkway Foundation • Andrea Cochran Landscape Architecture
Animal Science Department, California Polytechnic State University, San Luis Obispo
Audubon Canyon Ranch • City of Davis • Contra Costa Water District
County of Orange, RDMD/Harbors, Beaches and Parks • Erdman Farms • Hollister Ranch
Irvine Ranch Conservancy • Los Angeles Chapter, California Native Plant Society
Oak Creek Energy Systems • Orinda Horsemen's Association
Pinnacles National Monument • Sacramento Regional County Sanitation District
San Luis National Wildlife Refuge • Santa Lucia Conservancy
Selby's Erosion Control • Sonoma County Ag Preservation and Open Space
StopWaste.org • Thomas Klope Associates • Truax Company, Inc.
Wildlands, Inc. • Yolo County Resource Conservation District • Zentner & Zentner

Announcing:

New Corporate Membership Packages!

CNGA is proud to introduce improved packages that increase advertising exposure to our corporate members.

Look closely for a couple of other new benefits too, such as the expansion of member registration prices to all employees.

Don't worry, you'll still get CNGA's quality newsletter, *Grasslands,* and those enrolled as employee members keep their voting privileges.

One more piece of good news: CNGA would like to offer current corporate members the chance to switch their benefits to the new packages right away, with no additional charge for the remainder of the current term. Or, consider upgrading to take better advantage of the internet publicity!

New and returning members will automatically receive the updated packages. Check out the cost-effective options below, and start delivering your company message directly to your chosen market.

Membership Application

Detach and mail this form with a check made out to CNGA. | Send to: CNGA, P.O. Box 8327, Woodland, CA 95776. | Students, send photocopy of current ID.

Name ______________________ Title ______________________

Organization ______________________

Street ______________________

City ______________________ State__________ Zip__________

Phone ______________ Fax ______________ E-mail ______________

CNGA members have voting status, and receive the "Grasslands" newsletter, a monthly e-blast, and discounts to CNGA events.

Individual Membership

☐ **Regular member:** $45/year ☐ **Student:** $30/year ☐ **Retired:** $30/year ☐ **Life member:** (one-time payment) $500

Individual Joint Membership

☐ **CNGA + SERCAL*:** $70/year ☐ **CNGA + CAL-IPC**:** $75/year ☐ **CNGA + SERCAL* + CAL-IPC**:** $105

*SERCAL = California Society for Ecological Restoration • **CAL-IPC = California Invasive Plant Council

Corporate Membership

All employees of a corporate member receive member pricing when registering for CNGA events.
All membership benefits are good for one year from the month of purchase.
All included copies of *Grasslands* for each issue will be sent to the main contact at the organization.

☐ **Associate or Agency level:** $125/yr. One calendar year with a text listing below the *Poa* sponsors on the sponsor web page, with the text linked to the member's website*; One calendar year with the same text listing published in *Grasslands* (currently four issues); Three employee memberships**; One subscription to *Grasslands.*

☐ ***Poa secunda* level:** $250/yr. Business-card–sized (129 x 200 pixels) color advertisement below the *Nassella* sponsors on the CNGA sponsor web page, with the advertisement linked to the member's website*; A black-and-white version of the same advertisement published in *Grasslands* (currently four issues); Four employee memberships**; Two subscriptions to *Grasslands* (company may opt for fewer).

☐ ***Nassella pulchra* level:** $500/yr. Quarter-page (256 x 396 pixels) color advertisement below the *Muhlenbergia* sponsors on the CNGA sponsor web page, with the advertisement linked to the member's website*; A black-and-white version of the same advertisement published in *Grasslands* (currently four issues); Five employee memberships**; Three subscriptions to *Grasslands* (company may opt for fewer).

☐ ***Muhlenbergia rigens* level:** $1,000/yr. Half-page (510 x 330 pixels) color advertisement at the top of the CNGA sponsor web page, with the advertisement linked to the member's website*; A black-and-white version of the same advertisement published in *Grasslands* (currently four issues); Six employee memberships**; Four subscriptions to *Grasslands* (company may opt for fewer).

*** If there is more than one sponsor per level, the sponsors will be listed within that level by alphabetical order of the sponsor's name.**
**** Employee memberships include all the benefits of a personal membership, except that a personal copy of Grasslands is not guaranteed.**

California
Native
Grasslands
Association

P.O. Box 8327
Woodland, CA 95776
http://www.CNGA.org

PRSRT STD
AUTO
U.S.POSTAGE PAID
WOODLAND CA
PERMIT NO. 169

RECYCLED
PAPER

Front cover: Directed ungulate impact *Photo: John Wick*
Back cover:CNGA Lanphere Dunes field trip at Annual Conference *Photo: Wade Belew*