California
Native
Grasslands
Association

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Mission Statement

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

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From the President's Keyboard

In addition to being a grass nerd, I love mythology. January, the month that starts the new year, is likely named for Janus, the two-headed god of portals, beginnings and endings, transitions. Whatever name we give it, and whether or not we consider it the start of a new decade, the start of the year is an opportune time to look back at what has been and forward to what may be.

We end 2019 strong and hopeful. Thanks to the generosity of members and donors we're able to offer more scholarships for GRASS grants and student-rate attendance at CNGA workshops for "lifelong learners," volunteers of other organizations committed to spreading grassland knowledge. Long-time board members have retired, and we're so thankful for their service (see the feature on page 12), and for the incoming members committed to continuing our mission to promote, preserve, and restore the diversity of California's native grasses and grassland ecosystems through education, advocacy, research, and stewardship.

The State of California has committed to valuing biodiversity and reducing the threat of catastrophic wildfire. Grasslands may figure into these plans but we need to ensure native grasslands are valued as essential to biodiversity and not bulldozed for fuel breaks or used as compost dumping-grounds. We need to ensure degraded sites are restored, that people can recognize and appreciate the biodiversity around them as essential to their own well-being and that they are a part of nature, not apart from it. Hindsight is 2020, foresight is priceless, and insight is something CNGA works to provide in all its offerings.

Andrea Williams, President

Meet the 2020 CNGA Board of Directors:

Officers

President: Andrea Williams
Vice-President: JP Marié
Secretary: Michele Hammond
Treasurer: Jodie Sheffield

New Directors-at-Large (2020–2021):

Chad Aakre (returning after a hiatus), Sarah Gaffney, Haven Kiers, and Leticia Morris

Returning Directors-at-Large for another term (2020–2021):

Robert Evans, Richard King, Billy Krimmel, and Patrick Reynolds

Continuing Directors-at-Large (2019–2020):

Emily Allen, Kendra Moseley, Dina Robertson, and Kristina Wolf (Alternate)

We extend our thanks, appreciation, and best wishes to retiring Board Members:

Jennifer Buck-Diaz (2015–2019), Jim Hanson (2007–2019), Jeffery Wilcox (2016–2019), Christopher Gardner (2018–2019), and Felix Ratcliff (2018–2019)

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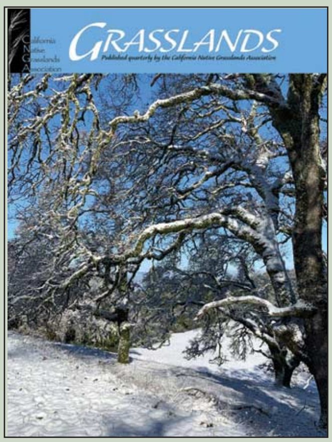

Grasslands Submission Guidelines

Send written submissions, as email attachments, to **grasslands@cnga.org**. All submissions are reviewed by the *Grasslands* Editorial Committee for suitability for publication. 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. Send photo submissions (at least 300 dpi resolution), as email attachments, to the Editor at grasslands@cnga.org. Include a caption and credited photographer's name.

Submission deadlines for articles:

Spring 2020: 15 Feb 2020 ❊ **Summer 2019**: 15 May 2020 ❊ **Fall 2020**: 15 Aug 2020 ❊ **Winter 2021**: 15 Nov 2020

Upcoming CNGA Workshops & Events

March 2020

Landscaping with Nature Workshop

Sacramento location, TBD

April 17, 2020

CNGA's 13th Annual Field Day at Hedgerow Farms

April 29–May 1, 2020

Grasslands Session and Workshop at SERCAL 2020 Annual Conference

Monterey Regional Park District HQ in Carmel Valley (Monterey) — Registration begins in early March at **sercal.org**

June 2020

Grassland Vegetation Monitoring, Methods, and Techniques

Location TBD

We will send out announcements when registration opens for 2020 events, or you can check for updates on our website.

Get the latest workshop info at:

cnga.org

Register online

or contact Diana Jeffery at **admin@cnga.org** or 530.902.6009

Above: Site 6 consistently has the largest population of Santa Cruz tarplant in Wildcat Canyon Regional Park.
Inset: The flower heads are a composite of yellow ray flowers surrounding disk flowers with red to dark purple anthers.

SPECIES SPOTLIGHT: *by Michele Hammond*[1] *Photos courtesy of Seleney Sanchez*

Santa Cruz Tarplant (*Holocarpha macradenia*)

Tarplants add a wonderful sense of native smell and color to the late summer and fall grassland. I have always been fascinated by the phenological changes in species composition that I see throughout the year while hiking and working in my local parks. Purple needlegrass (*Stipa pulchra*) and California oat grass (*Danthonia californica*), native perennial bunchgrasses, turn shades of brown and gold with the non-native annual grasses as the coastal prairie dries out. Native summer annuals like the Santa Cruz tarplant (*Holocarpha macradenia)*, add bright yellow sunflowers with glorious sticky, resinous scents to the late summer grassland. This tarplant species was historically found in coastal prairie grassland on terraces along California's coast from Marin to Monterey Counties. As the coast developed and changed, the last refuges of the Santa Cruz tarplant have been found in the hills around its nominal city, Santa Cruz. Introduced populations of this rare tarplant are found in the East San Francisco Bay Hills and Wildcat Canyon Regional Park. The Santa Cruz tarplant was listed as California state endangered in 1979 and federally threatened in 2000.

[1]Michele Hammond is the Botanist at the East Bay Regional Park District and on the Board of CNGA. **mhammond@ebparks.org**

Identification

In Wildcat Canyon, an East Bay Regional Park in the hills above the city of Richmond, July is the best month for hikers to find a dense cluster of blooming Santa Cruz tarplant. Other mid-summer wildflowers, growing with the Wildcat population, are the native hayfield tarplant (*Hemizonia congesta* var. *luzulifolia*) and a non-native German chamomile (*Matricaria chamomilla*); two annual sunflowers that have white petals that differ from the yellow blooms of the Santa Cruz tarplant.

Tarplants are in the sunflower plant family, *Asteraceae*, the largest vascular plant family in California. An older name for this family is *Compositae* because the typical sunflower inflorescence is a composite head of two kinds of flowers; however, from a distance, the head appears to be a single flower. The ray flower's corolla is a single strap-like petal. The other kind of flower is called the disk flower, which lacks large petals in the corolla. Disk flowers occur in the center of the classic sunflower with ray flowers surrounding the disk. Another trait of California's tarplants is its smelly and sticky glands that grow throughout the vegetative parts of the plant. The

continued next page

Santa Cruz Tarplant *continued*

shape of the glands and where they grow on the phyllaries, leaves, or stem is used to determine the species of tarplant.

Santa Cruz tarplants are classic sunflowers with flower heads containing yellow ray flowers surrounding disk flowers with red to dark purple anthers. The glands appear as resin-filled pits at the tips of leaves and peduncle bracts (growths below the flower head). On fantastic and healthy specimens, this tarplant has distinctive tight clusters of flower heads at the end of multiple stems.

Introductions

In the early 1980s, the Santa Cruz tarplant was introduced several times and in different parks within the East Bay Regional Park District and adjacent East Bay Municipal Utility District. These introductions attempted to save what was thought to be the last population of this species from certain destruction or extirpation by commercial development. A group of native plant champions, spearheaded by Neil Havlik, collected mature plants and spread them out in protected park areas. They chose similar grassland conditions to the original location that became a shopping mall. In at least two different years and more than 30 sites, the tarplant was seeded into Sobrante Ridge Regional Preserve, Tilden and Wildcat Regional Parks, and properties owned by East Bay Municipal Utility District. The introduced populations continue to grow in only three locations, all of which are in Wildcat Canyon. Only Site 6, near Mezue trail, has a consistently large population that appears to be viable for years to come. This introduction story is a reminder of the importance of preserving intact rare plant communities.

Management

Non-native annual grasses are in constant competition with the Santa Cruz tarplant for light and water resources. Cattle manage this grass biomass year-round for the park by preferring to eat grass over the sticky and smelly wildflowers. It is well known that native grasslands in California need a managed disturbance regime to remain diverse and intact (Barry *et al.* 2015, Bartolome *et al.* 2014, Beck *et al.* 2014). Prescribed burns and cattle or sheep grazing are the most common methods land managers use to remove the annual grassland biomass that grows especially dense along the coast. Livestock grazing management has been shown to be effective in maintaining the diversity of native grassland species (Bartolome *et al.* 2013, Hayes and Holl 2003). The Wildcat Canyon population of Santa Cruz tarplant is actively managed with cattle grazing from November through June. Artichoke thistle (*Cynara cardunculus*), an aggressive non-native invasive, is a historical threat to the grasslands in Wildcat but has been locally eradicated from the tarplant sites. Part of the yearly monitoring of this rare tarplant includes an assessment of invasive plants and any other new threats.

Monitoring the Santa Cruz tarplant in July 2019.

Where to find Santa Cruz tarplant

The best time to spot this tarplant is in late July or early August in Wildcat Canyon Regional Park along the bottom of Mezue Trail. There is a natural growing population also accessible to the public in the City of Santa Cruz at Arana Gulch Park.

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California Native Grasslands: A Historical Perspective
A Guide for Developing Realistic Restoration Objectives

by Sheila Barry[1], Stephanie Larson[2], and Melvin George[3]

Since this article was first published in 2006, reducing the mass, height, and cover of non-native annual plants is increasingly recognized as essential to maintaining habitat for many of California's native species (Gennet et al. *2017, Bartolome* et al. *2014). Although historic events led to the dominance of non-native annuals on California's grasslands, today climate change (Chaplin-Kramer and George 2013), air pollution (dry nitrogen deposition, Fenn 2010), catastrophic wildfire, and poor grazing practices (including lack of grazing) are all contributing to the continued dominance of non-native plants. Knowledge of the site's history and capabilities and constraints are still key to developing management strategies that control non-native species and create space for native plants and animals on California's grasslands. — Sheila Barry*

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Editor's Note: Some of the species scientific names have changed since this article was first published. Current names are in brackets; subsequent references using the first letter of the genus have been changed to reflect the new names (e.g., *S. pulchra*).

California's grasslands cover approximately 25% of the state, either in open grassland, oak woodland, or savanna. Although they are largely dominated by nonnative annual species, they provide essential hydrologic functions (capture, storage, and safe release of water), important wildlife habitats (Giusti *et al.* 1996), and repositories of native flora diversity. Around 90% of species listed in the Inventory of Rare and Endangered Species in California (Skinner and Pavlik 1994) inhabit California's grassland ecosystems. In addition to their important ecological values, California's grasslands provide forage for range livestock, a leading agricultural commodity in the state. Despite its value for native biological diversity and range livestock, California grassland habitat is increasingly reduced in acreage and quality not only because of conversion to cropland and residential and urban development, but also because of invasion by woody species and continued nonnative species invasion. Invasion by woody and nonnative species often occurs on conservation lands, which have been protected from grazing and other disturbances.

Conservation land managers are increasingly aware that acquisition alone doesn't necessarily result in conservation. They recognize that, without management, California grassland habitats can be degraded by accumulating mulch and domination of undesirable species, such as black mustard (*Brassica nigra*), fennel (*Foeniculum vulgare*), medusahead (*Taeniatherum [Elymus]caput-medusae*), coyote brush (*Baccharis pilularis*), or Harding grass (*Phalaris tuberosa [aquatica]*). Although these species can be controlled with mowing, prescribed fire, herbicides, cultivation, or livestock grazing, deciding on realistic management and restoration goals, followed by an effective management plan, are difficult first steps.

Here we review the history of animal and human impacts that led to the current composition and condition of California grasslands. We also include a history of restoration and management efforts on California grasslands. This history may help land managers recognize the difference between past uncontrolled grazing practices, which undoubtedly assisted in the invasion of our grasslands with nonnative species and degraded the resource as a whole, and today's use of managed grazing as a resource management tool. An understanding of California native grassland history should also help land managers identify realistic restoration goals. We conclude with a discussion of considerations to assist land managers in identifying measurable restoration and management objectives.

Historical Perspective: Animal and Human Impact on California's Native Grasslands

For millions of years, California's original grasslands were grazed, browsed, and trampled by now-extinct megafauna, which included medium to large

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California Native Grasslands: A Historical Perspective *continued*

herbivores, such as ground sloth, bison, camel, horse, mammoth, mastodon, and ox (Edwards 1996). Undoubtedly, the combined influence of these large herbivores, the activity of smaller mammals, and fire played an important role in the development of California's native grassland species. When the megafauna became extinct some 10,000 years ago, pronghorn antelope (*Antilocapra americana*), black-tailed deer (*Odocoileus hemionus*), tule elk (*Cervus elaphus nannodes*), grizzly bear (*Ursus arctos*), and small mammals, such as California ground squirrel (*Spermophilus beecheyi*), gopher (*Thomomys* spp.), rabbit (*Sylvilagus* spp.), and kangaroo rat (*Dipodomys* spp.), continued to impact California's grasslands.

Early reports from explorers indicate that vast herds of grazing animals in the Central Valley rivaled the numbers of bison on the Great Plains. McCullough (1971), for example, estimated a population of 500,000 tule elk in aboriginal central and western California. The specific impact of these grazing animals on the grasslands is difficult to discern, because these animals are not obligate grazers but rather browsers and/or grazers, consuming broadleaf plants, woody plants, and grasses (Wagner 1989). Also, the Central Valley's early grassland landscape included significantly more wetlands, including riparian woodlands, freshwater marshes, and vernal pools. If, for example, tule elk, which prefer marshy areas, consumed large amounts of wetland plants, their impact on mesic native grassland species may have been limited (Wagner 1989).

The Central Valley's early grassland landscape included significantly more wetlands, including riparian woodlands, freshwater marshes, and vernal pools.

Whatever the impact of grazing animals on native grasslands following the extinction of the megafauna, human impact became significant when intensive management of grasslands, or prairies, began. Native Californians burned, dug, tilled, and pruned native vegetation to maintain the biological resources they used for food, medicine, and construction materials (Blackburn and Anderson 1993). Early expeditions in California made note of the open grasslands managed by the native Californians:

> *Within the forests, at all elevations from sea level to the top of the ridges, there were small open patches, known locally as "prairies," producing grass, fern, and various small plants. Most of these patches if left to themselves would doubtless soon have produced forests, but the Indians were accustomed to burn them annually so as to gather various seeds. These prairies were of incalculable value to the Indians, not alone for their vegetable products, but also for the game found upon them.*
>
> — Summary of an encounter with remnant prairies in Humboldt County by R. Mc Kee expedition of 1851 (Loud 1918).

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Site objectives include reducing annual grass biomass, target residual dry matter 1,000–1,500 lbs and reducing herbaceous plant height <12 inches to maintain and enhance native grasses (California melica, Purple needlegrass) and native forbs (Johnny jump ups).

These open, productive prairies described by early explorers began to change with the arrival of Spanish settlers some 200 years ago. Fires were suppressed, livestock (i.e., cattle, horses, and sheep) were introduced, and hunting nearly exterminated the elk, pronghorn antelope, and deer. Although the Spaniards never extended their livestock management into the Central Valley, the Native Americans drove domestic livestock into the valley. By 1819, the native Californians were breeding their own stock and their herds started to grow. Many of their cattle and horses escaped and formed large uncontrolled herds of feral animals. Reports from the 1830s and 1840s mention the San Joaquin prairies swarming with wild horses and Sonoma County abounding with wild cattle and horses (Wagner 1989).

An actual ranch industry in California did not develop until the discovery of gold in 1848. Ranchers began shooting wild horses, rounding up cattle and elk, and breeding their own herds. Herds of cattle were driven in from the east to build up numbers to support the growing demand for meat after the Gold Rush. From 1850 to 1880, excessive numbers of livestock grazed California's rangelands, including 3 million cattle and 6 million sheep. These numbers decreased temporarily during a devastating drought from 1862 to 1864, when from 200,000 to 1,000,000 cattle may have starved (Wagner 1989). Although today the number of cattle on California's rangelands approaches the late 19th century population level (2.9 million), the number of sheep have substantially declined, to less than a half million.

To increase the chances of grassland restoration success, it may be prudent to focus restoration effort on coastal and upland sites, where rainfall and rainy season length are greater, and to avoid sites with shallow soils.

A significant change in vegetation coincided with the arrival of domestic livestock and the growth of the ranching industry; nonnative grasses and forbs spread throughout California's coastal prairies, foothills, and valleys (Burcham 1956). Although nonnative species, such as the annual forb filaree (*Erodium cicutarium*) were present in California before settlement in 1769 (Mensing and Bynre 1998), the vast majority of nonnative species invaded and spread in the late 18th and early 19th centuries (Hendry 1931). Over the past 200 years, the nonnative species have become the most abundant plants across California's grasslands.

Although dominance of nonnative species and the accompanying decline in native grassland species have been attributed to uncontrolled livestock grazing, several other factors, including tillage for crop agriculture, fire suppression, elimination of land management by Native Americans, climate change, and competition from nonnative species have played an important role in the conversion. Some researchers have concluded that nonnative, annual grasses are so competitively superior that they could have displaced native grasses solely through competition and greater seed production (Heady 1977, Bartolome and Gemmill 1981, Murphy and Ehrlich 1989). Regardless of which factors were responsible for the decline of native-dominated grassland, in most regions of the state, native species are now only a minor component of the grassland flora, comprising less than 1% of the standing grassland crop.

Historical Perspective: Restoration Efforts and Management for California's Native Grasslands

Although efforts to restore native grasses to California's grasslands are relatively recent, beginning with the conservation movement of 1970s, range scientists and agronomists have long been interested in improving California's grasslands. University of California, Berkeley, agronomist Dr. P. B. Kennedy began testing native and exotic perennial grasses and legumes in 1912. He was searching for alternative forage species to improve California's rangelands for livestock production (Kay *et al.* 1981). His relative success with establishing nonnative perennials over native perennials led to the introduction of smilo grass (*Oryzopsis miliacea [Piptatherum miliaceum]*) and Harding grass (*Phalaris tuberosa [aquatica]*) in California.

Sampson and McCarty (1930) were also interested in perennial grasses for rangeland improvement. They studied purple needlegrass (*Nassella [Stipa] pulchra*) because of its palatability, nutritional value when dry, and long green forage period. They also considered the impact of grazing on perennial grasses by conducting clipping studies. Based on their clipping studies, they concluded that purple needlegrass plants would fully recover and produce seed under moderate grazing intensity in the fall and winter, whereas late spring grazing could injure the plants.

The University of California's interest in improving California's rangelands continued in the 1940s. The University of California, Davis, hired agronomist, R.M. Love to find replacement forage species, and he spent 15 years testing native perennial grass species, including *Nassella [Stipa]* spp., *Melica* spp., *Danthonia californica, Agrostis* spp., *Bromus* spp., *Elymus* spp., and *Sporobolus* spp. (Kay *et al.* 1981).

Love also considered the impact of grazing on these species. He seeded perennial grasses and legumes and studied the effect of spring grazing treatments with sheep. He found that early intensive grazing before the annuals headed out reduced the competition and resulted in the most vigorous perennials, which included purple needlegrass (*S. pulchra*) and nodding needlegrass (*S. cernua*) (Love 1944). He later devoted special attention to needlegrass species (Love 1951, 1954). Love's research led him to select two strains of purple needlegrass and nodding needlegrass to be certified by the California Crop Improvement Association in 1948 (Love 1948). Lack of interest in the public and private sectors kept these certified strains from being widely planted in California rangelands. Nonnative perennial grass species,

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such as Harding grass and orchard grass, proved to be easier to reseed and more palatable to livestock (Kay *et al.* 1981).

Meanwhile, other researchers acknowledged the naturalized annual-dominated grassland in California and began learning about appropriate grazing management practices for this grassland ecosystem (Bentley and Talbot 1951, Love 1945). They studied how to manage annual grasslands for vegetation composition (Heady 1956) and for soil protection and forage production (Bartolome et al. 1980). They also began studying grazing strategies to control invasive, less-desirable exotic species, such as foxtail barley (*Hordeum jubatum*), medusahead (*Taeniatherum [Elymus] caput-medusae*), and yellow starthistle (*Centaurea solstitialis*).

Interest in restoration has renewed interest in understanding how to establish and manage native California grassland species. Research projects focused on restoring native perennial grasses have reaffirmed the challenge of their establishment, especially from seed (Dyer *et al.* 1996, Stromberg and Kephart 1996). Other studies have determined that the more abundant and faster-growing annual grass species can form dense stands, monopolize resources, and restrict the growth and survival of perennial grass seedlings (Bartolome and Gemmill 1981,; Dyer *et al.* 1996, Dyer and Rice 1997, Hamilton *et al.* 1999, Brown and Rice 2000). A comprehensive review of native grassland research conducted throughout California attempted to quantitatively evaluate the potential for use of grazing and prescribed fire as tools to enhance native grass populations (D'Antonio *et al.* 2001). Unfortunately, they found only a few studies that examined the impact of grazing and fire on native plants, and many of these studies lacked replication of treatment or controls to be included in a quantitative analysis.

Identifying Realistic Restoration Goals

Many conservation efforts on California grasslands have focused on the goal of restoring grasslands to some pre-settlement condition. This goal has proven to be unrealistic because not only is it difficult and costly to establish native perennial grasses, there is also uncertainty about the historical composition and extent of California native grasslands. One popular theory suggests that California's pristine prairie was dominated by purple needlegrass (Clements 1934). Clements came to this conclusion by observing nearly pure stands of purple needlegrass along railroad rights-of-way.

The theory that many of California's current grasslands were formerly dominated by woody vegetation and not "pristine" prairie (Cooper 1922) has been less popular, but is receiving growing scientific support (Hamilton 1997). Cooper noted numerous examples where repeated burning, often intentionally, was sufficient to eliminate woody vegetation and replace it with weedy annuals. Some annual grassland sites may have in fact previously been dominated by coastal scrub (Hopkinson and Huntsinger 2005) or native annuals (Solomeschch and Barbour 2004) and not perennial bunchgrasses.

Given the uncertainty about the assemblage of native plants on a given site, restoration project planning must be characterized by clear thinking and fact-finding that leads to feasible goals and measurable objectives. Questions that might help planners define restoration goals and objectives include:

- What do you hope to achieve?
- Is your objective to maintain the native perennial species that currently exist on the site or is it to increase the vigor and density of the existing native perennial species?
- Are there native perennials that do not currently exist on the site that you would like to add?
- Are there specific exotic or woody species that should be targeted for control?

During fact-finding, project planners must determine if the goals and objectives are feasible based on current knowledge:

- Are your objectives achievable given the capabilities, constraints (soil depth, rainfall, etc.), and history of the site?
- Are there proven restoration practices that will allow the project to successfully reach restoration objectives?
- Can these practices be applied to the proposed restoration site?

Site capabilities and constraints. Vegetation stand establishment, productivity, and longevity are greatly influenced by site characteristics. Rainfall and soil moisture-holding capacity must be sufficient to support the establishment and maintenance of a native perennial stand. Although we may have incomplete knowledge of the rainfall requirements of native perennials, we know from rangeland improvement research in the 1940s and 1950s (Jones and Love 1945, Bentley *et al.* 1956) that seedings of native and exotic perennials and annuals have been more successful when annual rainfall exceeds 20 inches and soil depth is at least 24 inches. A shorter dry season (longer rainy season) may also improve perennial grass restoration success (Jackson and Roy 1986). To increase the chances of grassland restoration success, it may be prudent to focus restoration effort on coastal and upland sites, where rainfall and rainy season length are greater, and to avoid sites with shallow soils. Soil surveys, published by the USDA Natural Resources Conservation Service (NRCS), contain information about soils and ecological sites that can be helpful in determining site capabilities and constraints. NRCS offices throughout the state can be found under the U.S. Government listings in the telephone directory.

Site characteristics also influence the practices that can be applied to manage for native perennials. Native grass seed producers have proven that native grasses can be grown using normal farming practices (tillage, irrigation, fertilization, and weed and pest control). Dryland farming practices can also be used to grow native grass seed. However,

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California Native Grasslands: A Historical Perspective *continued*

many sites suffer from the "toos." They are too steep, too rocky, too dry, too salty, or too wet for application of normal farming practices. On these sites, seeding practices and weed and brush control practices become more limited. On some sites, vegetation management may be limited to manipulation of fire and grazing.

Site History. Knowledge of historical land uses may be helpful in understanding the site's herbaceous composition, including seed bank, and determining appropriate management practices. For example, on the Hastings Natural History Reservation near Monterey, the frequency of native perennials depends on whether the site has been cultivated. Few native perennials grow on sites that were cultivated before 1937; on sites that have not been cultivated, native perennials, such as purple needlegrass, comprise up to 37% of the total aboveground standing crop (White 1967). Increasing native grass cover on sites that have been cultivated may require reseeding as well as vegetation management. Because seeds of native perennials no longer reside in the seed bank on many annual-dominated sites (Rice 1989), seeding or plug planting accompanied by management of invasive annual plants will be required on most sites, especially inland sites.

Measurable objectives. Development of specific objectives will help project managers determine what practices to apply in the project; furthermore if the objectives are measurable, not only will be it be clear what should be monitored but also if progress is being achieved. For example some measurable objectives might be:

- Reduce medusahead to <15% of the groundcover.
- Eradicate Harding grass.
- Increase purple needlegrass cover to at least 20% of the groundcover.
- Maintain coyote brush cover at <5%.

With measurable objectives stated in this manner, project managers can develop a management plan, practices, and strategies that have been shown to successfully reach these objectives (see "Examples of Measureable Objectives" sidebar). Past experience and science-based information should be the basis for selecting restoration practices. Measurable objectives also define what elements a manager needs to monitor to demonstrate practice effectiveness and project progress. Monitoring also helps the manager recognize the need to make management changes in response to changing conditions. With a restoration planning process that includes measurable objectives, implementation of effective practices, and monitoring, restoration projects can be successful.

Examples of Measurable Objectives

Reduce medusahead to less than 15% of the groundcover. This objective will be achieved by burning pasture #3 late in May when medusahead is still green and most other annuals are dry. The burn will be conducted in cooperation with the California Department of Forestry and Fire Protection.

Maintain coyote brush cover at less than 5%. This objective will be achieved by maintaining a seasonal grazing program. Cow–calf pairs will graze the property from November to June.

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MEET A GRASSLAND RESEARCHER **Maddie Nolan**

madeline.nolan@ucsb.edu

Ph.D. Candidate, Ecology, Evolution, and Marine Biology, University of California, Santa Barbara

What is your study system? What are your primary research goals?

My research and dissertation are focused on grasslands in Southern California with an emphasis on those occurring in the coast range mountains. My primary research goal is to understand how climate change will impact the establishment and resilience of native grassland species and to explore how current grassland restoration techniques can be modified to improve grassland restoration in the future. I am particularly interested in asking applied questions with the hope that my research can be directly used by practitioners to help improve the success of restoration efforts. For this reason, my research is heavily focused on the native perennial bunchgrass, purple needlegrass (*Stipa pulchra)*. This species is widely used throughout California in grassland restoration efforts and is often the dominant species that is planted. Therefore, it is imperative that we understand not only how climate change will impact the establishment of this specific species but also what practical steps practitioners can take to improve the likelihood that restored populations of this species will persist into the future. While I am focused on perennial bunchgrass, I am also interested in understanding how climate change will impact the establishment of a diverse array of native grassland forbs such as *Dichelostemma capitatum*, *Bloomeria crocea, Plantago erecta*, and *Eschscholzia californica*. Because while restoration efforts are often focused on establishing native perennial grasses, such as purple needlegrass (*S. pulchra*), these grasses are only one species within an incredibly diverse and speciose ecosystem. Therefore, to truly restore native grasslands, we need to not only establish native grasses but also the native forbs that coexist with them in natural ecosystems. It is my hope that my research will help practitioners understand what impacts the establishment of common native forbs and suggest ways in which to increase the presence of these species in restoration projects.

Who is your audience?

My research is geared both towards ecologists, particularly those who are also doing applied restoration ecology, as well as restoration practitioners who are restoring native grasslands in California. While I am primarily interested in applied questions and doing research that can be directly used by practitioners, I am also interested in using restoration as a way to test basic ecological theory which can further the ecological science that is at the heart of restoration ecology.

Who has inspired you, including your mentors?

My first exposure to the world of land management and restoration was in my hometown of Columbus, Ohio. Immediately after I graduated from Ohio State University, I was at a loss at what to do with my life. On a whim, I decided to volunteer for the natural resource division of the local Metro Parks. It was here that Carrie Morrow, who was the assistant director of natural resource management, introduced me to the world of science-based land management. Carrie introduced me to habitat restoration and really motivated me to pursue a career in land management. I decided to go to graduate school in ecology and environment science because of her. I would also not be where I was without the mentorship of Drs. Bradley Cardinale and Carla D'Antonio. Brad was my advisor for my master's degree at the University of Michigan, and he was instrumental in teaching me how to actually do science professionally. He took a chance by agreeing to work with me, despite my limited experience in ecology and for that I am grateful. Carla is my current advisor for my Doctoral degree at UC Santa Barbara and introduced me to grassland restoration. She is an amazing role model and teacher and I cannot thank her enough for how much she has taught me about restoration ecology.

How has or will your research align with the mission of CNGA "to promote, preserve, and restore the diversity of California's native grasses and grassland ecosystems through education, advocacy, research, and stewardship"?

The chief purpose of my research is to improve conservation, restoration, and management of native vernal pool plant species. Specifically, I aim to develop and improve protocols for rare plant species surveys and enhanced community diversity estimates that can be used to prioritize vernal pools for management. Additionally, I hope my experimental-based investigations of adaptation will be used to guide vernal pool conservation and restoration decisions that are backed by experimental evidence. Lastly, not only do I

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CNGA Salutes Contributions of Retiring Long-term Board Members

As we welcome a new Board for 2020, we would like to share with you our indebtedness to and appreciation of the contributions made by out-going Board members who completed two or more terms.

Jennifer Buck-Diaz
Sacramento and the Sierra foothills (Director 2015–2019)

Many of you may know Jennifer from her work with CNPS on the Grasslands Initiative, a program to map and identify associated grassland species across California.

Jennifer was instrumental in developing the CNGA GRASS Scholarship program (now in its second year) that awards research grants of $500 to undergraduate and graduate students. She also served as Treasurer and on the Grasslands committee.

Jennifer is continuing her valuable work with CNPS characterizing grass and forb lands in California.

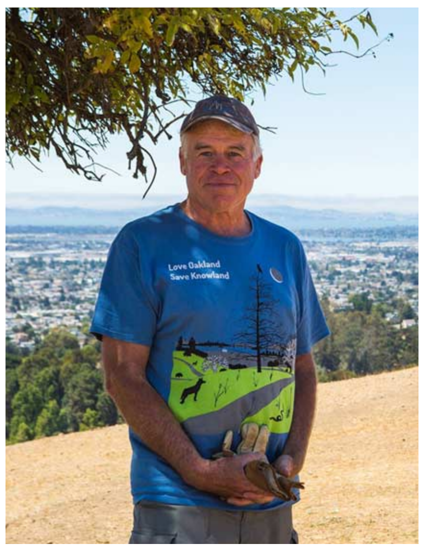
Jeff Wilcox *Sonoma County (Director 2016–2019)*

As the Managing Ecologist of the Sonoma Mountain Ranch Preservation Foundation, Jeff has direct, hands-on experience with grassland management and grassland ecology. Prior to joining the Board, Jeff regularly contributed articles on vertebrate species that are dependent on grasslands. Throughout his tenure on the Board and as a member of the Grasslands committee, Jeff shared his experience with grassland management, including fire, grazing, weed management, and habitat enhancement. His contributions to this area of expertise will continue.

Jim Hanson *San Francisco Bay Area (Director 2007–2019)*

Jim Hanson (pictured below) joined the CNGA Board of Directors in 2007. Since then, he has filled many roles and taken on many tasks vital to our mission, including: Treasurer (2008–2010), President (2012–2013), New Front Yard program (inception and planning, contributor and editor of booklets, and workshop instructor), Conservation Committee (2011–2013), Conservation Chair (2014–2019), and frequent contributor to *Grasslands* journal.

As Conservation Committee Chair, Jim worked to promote conservation of native grasslands with CNPS, Sierra Club, and other partners on projects including coastal prairie conservation at Point Molate and the UC Field Station, Richmond; Tesla Park, Livermore; Knowland Park Zoo expansion, Oakland; Sibley/McCosker and five other East Bay Regional Parks Land Use Plan Amendment/DEIR's; Berryessa Snow Mountain National Monument, Lake County; Big Tejon Ranch Centennial Project, Los Angeles; wrote comments on the CalFire vegetation treatment program and met with CalFire grantees stemming from Governor Newsom's emergency vegetation reduction projects.



The pace of development in the Bay Area is keeping Jim busy, but he will continue to contribute to Board activities, saying "we need to stop the loss of small and large intact native grasslands…for one, we've barely scratched the surface on how they help infiltrate rainwater and store carbon in the soil."

MEET A GRASSLAND RESEARCHER *continued*

advocate for vernal pool grasslands through professional and academic meetings, but also through outreach and education at public events, and K-12 and community field trips to the UC Reserve. One of the greatest privileges I've been given is the opportunity to work with local educators to develop the Next Generation Science curriculum based on vernal pool phenomena for public schools in the Central Valley.

Why do you love grasslands?

I originally was attracted to grasslands because they are such a diverse ecosystem and I have always been interested in understanding why species coexist with one another. Grasslands in California are particularly diverse, and I am fascinated with how so many different species can coexist together. I am also equally interested in understanding invasion dynamics, and, unfortunately, California grasslands are notorious for being heavily invaded by exotic annual grasses. For me, it is a perfect ecosystem to study because I can explore my interests in biodiversity and community assembly as well as understand how some species are able to fundamentally alter a community.

Unraveling the Plant-insect Interactions Taking Place in Your Native Garden *by Billy Krimmel[1] and Haven Kiers[2]*

One of the key reasons native landscaping is so important ecologically is that native plants provide food and habitat for native insects, which then gets transferred to larger animals up the food chain when the insects get eaten. For gardeners, the interactions between plants and insects are often most observable in their yards, but it can be difficult to make sense of these interactions without some basic tools. This article lays out a basic protocol and tools for unraveling these fascinating interactions. The first step of understanding plant-insect food webs is the foundation of coming up with hypotheses for scientific research.

Why come up with hypotheses? Certainly, this is not the only way to understand what kinds of interactions are taking place in your garden; you could simply look up the known ecology of the plants and animals present and leave it at that. But what if you see something that is not known or fully understood? There are so many species of plants and insects and even more types of interactions between them, and as a result, there is a lot that we do not know. Citizen science is emerging as an important way to generate scientific data and to bring a wider diversity of ideas into the ecological sciences. If you have children, hypothesis generation in this context — where traits and interactions are observable through touch, feel and smell — is a fun and accessible entry into the scientific process. The general methodology of observation, hypothesis generation, and testing can be applied to any scientific field.

Step One: Choose a plant to focus on and observe it

You may have a variety of plants in your garden, some native, some non-native. The first step is to identify a plant-insect system that is both interesting and readily observable. What makes it exciting depends both on your personal interests and on what is happening in your garden. For example, you may love your California poppy plant and want to know how it interacts with insects, but if none or very few insects are on it in your garden, it will be difficult to observe such interactions. Some insects can be more difficult to observe. Native pollinators, for example, tend to have narrow windows each day when they are active; thus trying to observe a pollinator in the middle of the day when it is only active during sunrise will yield little results. So, take a look at plants during a time of day when you will be able to observe them regularly and focus on the insects you see during that time.

Observing plants and insects can be done in many ways, but here are two of my favorite methods:

1. Watch. Watch, watch, and keep watching. Don't be afraid to crawl around or just sit down next to a plant for a while (think of this as a mini-meditation break!). Try to look closely at various parts of the plant, including under the leaves, as this is where insects often hide and lay eggs (Figure 1). Put your face within a foot or two of the plant and look through it stem-to-stem in a methodical way to ensure consistency in observation from plant to plant. If you see an insect on a plant, try to figure out what it's doing. Is it feeding? Is it grooming? Is it mating? Or is it trying to hide from you? What part of the plant is it on (e.g., leaf, stem, flower bud, etc)? Is this consistent for most of the insects you see? Are the insects alone or in aggregations (groups)? If there is an aggregation, are the sizes similar, or is there variation? Are they all adults, or are there immatures also? Keep your eyes open for eggs as well — many can be seen with the naked eye. Insect eggs tend to be white or off-white, and the shape of the egg can be indicative of the type of insect that laid it. Next, look for signs of plant damage (e.g., cut leaves, asymmetrical leaves, splotching, crinkling of leaves, girdling of stems, etc). These can be useful clues for what is stressing the plant and what is causing the different types of damage. Frass — caterpillar and beetle poop — can be very helpful clues, especially when the insects themselves may be cryptic. Plants can also catch diseases from insects feeding on them as well as soil pathogens. Diagnosing what is causing plant damage is a fun exercise and, in many ways, is similar to how human pathologists diagnose disease and sickness in humans. Although this method of simple observation takes time, it consistently yields the most informative insights.

2. Collect. Use a beat net (Box 1) or tray and tap plants with a stick to knock insects off the plant and onto your net or tray. This method is fun and can yield a lot of insects that might have been hard to see by just looking at the plant. Insects like thrips, minute pirate bugs, plant bugs, stilt bugs, assassin bugs, crab and jumping spiders, tiny caterpillars, and other cryptic insects can be found this way. It is also a great way to get rough counts of the number of a given type of insect on a plant, especially when a standard sampling protocol is used. This is a great method for sampling a wide range of plants when time is an issue. It can also be an easy way to engage children, as you'll see a lot more insects in a shorter amount of time compared with watching the plants. As you start to get a sense of what insects are on certain plants, make sure to also pay attention to signs of plant stress and insect damage on the plants. Are there correlations between the insects you find and the types of damage to the plants? Do any insects, in particular, correlate with strong signs of plant stress? Is one insect only around when another type of insect is? Are any insects eating each other when they fall in your net or tray? This can be particularly informative; since this sampling method forces insects into an open, shared space, predation interactions can be encouraged and observed. But importantly, these can also be unrealistic if the insects have means

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[1]Billy is a board member of CNGA. He has a PhD in Ecology from UC Davis and is founder and owner of Miridae, a Sacramento-based native landscape design-build firm. [2] Haven, a newly elected board member of CNGA, is an Assistant Professor of Landscape Architecture at UC Davis.

Unraveling the Plant-insect Interactions Taking Place in Your Native Garden

continued

of avoiding each other on their shared plant. If you see predation in your net or tray, you'll want to check that it actually occurs on the plant, by looking for the same insects on plants and watching them.

Once you have observed plants that have reliable populations of insects on them, choose one or two to focus on. Ideally, your chosen system should be one in your garden that has multiple plants of the same species, with at least one abundant insect species on them (ideally multiple) and, for extra points, some form of common plant damage. The reason that plant damage is useful is that it can provide insight into what insects are good or bad for the plant, which informs the interpretation of how plants may be selected evolutionarily to support or defend against the insects.

Now that you have a system (or two!), spend more time observing and sampling it. Start coming up with some basic hypotheses as to what is doing what. If you see large aggregations of a certain insect on plants that look stressed, you may hypothesize that those insects are harming the plant. If you see certain insects (especially predators) on plants that seem particularly healthy, you may hypothesize that those insects are beneficial to the plant. If you see certain predatory insects or spiders on plants only when there are large numbers of herbivores (e.g., aphids, whiteflies, caterpillars), you may hypothesize that these predators are feeding on the herbivores.

Look for other important clues — do you see eggs on the plant? If you see aggregations of both juveniles and adults, then they are likely feeding and reproducing on the plant — this is the basic definition of a 'host plant'. If you only see adults, they may just be temporarily feeding or looking for mates. Pay attention to the type of damage on the plants. Can you see actual chewing damage (e.g., holes in leaves or flower buds, abrasions to the stems, etc)? What kind of mouthparts do the insects you are observing have (e.g., chewing mandibles like caterpillars and beetles, or piercing-sucking mouthparts like aphids and other true bugs)? Does the damage you observe on the plant correlate with the mouthparts of the insects you observe? In some cases, it can be obvious when an insect feeds on a plant. Caterpillars and beetles are great examples because you can see them feeding on the plant and damaging it directly. Other insects, like thrips and most bugs (Hemiptera), cause damage that tends to manifest as leaf splotching and crinkling. See Box 2 for information on different types of insect mouthparts and the corresponding plant damage they cause.

Dead insects can be great clues too, as can shed exuviae (exoskeletons) on the plants (Figure 2). Are you seeing a lot of dead insects on plants? Is it usually the same kind? Is it one of the species you also observe alive on the plant or on something else? When you see dead insects, what else do you see? These observations can provide clues as to whether there is significant predation by one insect on another in your plant-insect system. Understanding how an insect died simply by observing

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Figure 1: Stink bug eggs on the underside of a leaf. Stink bugs tend to lay eggs in groups, while some other insects will lay them singly. *Image from WikiMedia Commons*

Box 1: A beat net is a great tool for sampling insects on an individual plant basis. It is essentially a shallow canvas net that is placed below a plant while the plant is tapped with a stick. The tapping causes many insects to drop off the plant, landing in the shallow net for quick observation, identification or collection. Beat nets are also great for collecting seeds from some species of plants. Evening primrose (*Oenothera elata* ssp. *hirsutissima*, left) being sampled using a beatnet. Stilt bugs (*Jalysus wickhami*, right) in beat net after tapping plant with a stick. *Photos courtesy Billy Krimmel*

Box 2: Insect mouthparts can be categorized into two broad groups. The first is the piercing-sucking type of mouthpart common in bugs (Hemiptera) like aphids and (left) this nymphal plant bug (*Dicyphus hesperus*). Insects with this kind of mouthpart often cause leaf crinkling, such as the woodmint (*Stachys bullata,* right) that had previously been fed upon by *D. hesperus*. The other broad category of mouthparts are chewing mouthparts, such as those of beetles and caterpillars, which are more common and whose damage to plants is more obvious.

Unraveling the Plant-insect Interactions Taking Place in Your Native Garden *continued*

the corpse is difficult, and often some further experimentation or observation is needed to get a better sense of the cause of death. Exuviae are used to determine whether multiple generations of insects are growing on the plant. For insects like bugs that do not have a larval stage, juveniles are similar in form to adults but smaller, and they shed their exoskeletons when they grow, leaving exuviae on the plant.

Figure 2: Live stilt bugs (*Jalysus wickhami*) next to two shed exuviae, hanging off the left side of the plant (evening primrose, *Oenothera elata* ssp. *hirsutissima*). *Photo courtesy Billy Krimmel*

Finally, use your observation skills to pay attention to observable plant traits. Is your focal plant fragrant? If so, does it smell stronger when touched? Does it have hairs on the leaves, buds and/or stems? If so, are they clingy, and do they have debris or dead insects stuck in them? When you break a leaf, does it squirt out white latex? Do you see more or less of these traits on plants with higher or lower abundances of the insects you are observing? These are all important clues into how the plant may defend itself from insect herbivores.

Step Two: Do some preliminary research on your plant and insect species

Now that you've spent some one-on-one time out in the garden with your plant and its insects, it's time to identify the species in your system and learn about their basic natural histories. For the sake of this essay, I'm going to assume you already know the species of plant. Start by using Calscape (**www.calscape.org**) or Calflora (**www.calflora.com**) to determine your plant's natural growing range. This can give you a better idea of whether your plant naturally grows near your garden and will give you a sense of how likely it is that the insects that usually live on it will actually be in your garden.

Identifying insects can be intimidating at first, but there are some great resources available, especially if you live near a land grant university that has extension staff. In order to get an insect identified by a

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professional, it's important to collect it and prepare it properly so that once the professional has it, she can identify it efficiently. The best first step here is to call your local extension. Explain your goals and intentions, and ask whether they could help and, if so, how they would like the specimens prepared. Sometimes this involves sticking a few in some alcohol (especially for small insects), and in other cases, it's more helpful to mount the insect on an insect pin and keep it dry. In either case, the insect will need to be killed, unless the extension staff person says that live specimens are acceptable. For common insects, a photo is often sufficient.

If you are interested in learning how to identify insects yourself, a great place to start is BugGuide (**bugguide.net**), a free website with lots of pictures of insects and basic natural history and taxonomic information. "Seek" by iNaturalist is another good way to automatically identify insects (**www.inaturalist.org/pages/seek_app**) It's important to note that it is not always necessary to identify an insect to the level of species to know what it is doing; in fact, in some cases, this is not even possible, as many insect species have not yet been described. You may even discover a new species! In general, getting the identity to a level beyond family is important in order to understand its life history. Sub-family or genus are very informative, as feeding behavior tends to be the same for insects within these groups.

Once you know your plant species and some taxonomic information on your insects, do some quick internet research. Google the species of plant and one insect at a time. Make sure to check Google Scholar to see if these species pop up in any published research. Search for the insects and plants on BugGuide to see if other people have observed them and if so, what they noticed. See if there is information on Wikipedia or other free, reliable resources on the plant and insects, and read through what is known about their ecology and natural history. You may find some fascinating information and generate some ideas as to what is going on in your plant-insect system.

Unfortunately, peer-reviewed primary research papers are usually difficult or expensive to access unless you have an affiliation with an institution that subscribes to these. There are several open-source publications available, which are free to the public, but not all are as rigorously vetted as conventional publications. Luckily, the authors of peer-reviewed publications are also owners of the content and can send you PDFs of their papers for free. You just need to email them directly, or if you're lucky, they may have links to papers on their webpages. Even if you can't find all the original articles that are relevant to your plant/insect system, reading through the abstracts (which are free) can be very helpful.

Step Three: Come up with some research questions

This is a fun step in the process. What do you think is going on in your system? What insects are using the plant as a host? Which are herbivores? Which are predators? Which are likely causing damage to the plant? Which are likely helpful to the plant? How does the plant defend itself from the herbivores? You don't need to ask or answer all these questions, but perhaps some seem likely or obvious in your system. Or you may come up with more specific questions, like how do males of a species find mates, or how does a species of insect hide from predators? These questions can be re-written into hypotheses very simply.

The point here is to come up with simple *questions that can be answered through observation and/or experimentation.* For example, if your question is *Which insects are causing damage to the plant?*, your hypothesis may be *We hypothesize that the caterpillar is causing damage to the plant by feeding on its flower buds.*

Don't worry about revolutionizing the field of science for your first hypothesis. Keep it simple. Your priority should be coming up with a hypothesis that you can resolve through simple observation and/or experimentation. As you become comfortable with this process, you can begin asking questions aimed at advancing the field, but first, you need to get a sense of what questions can be answered and what gaps in understanding exist.

Step Four: Collect data to test your hypothesis

Now that you have some hypotheses, it's time to collect data that will support or reject them.

Here are some examples of simple, testable hypotheses, and what information is needed to test them:

Example 1 Hypothesis: *We hypothesize that INSECT SPECIES 1 uses PLANT SPECIES as a host.*

Information needed: Are juveniles and adults both commonly found on the plant species?

Example 2 Hypothesis: *We hypothesize that INSECT SPECIES 1 causes damage to PLANT SPECIES.*

Information needed: Does the insect feed on the plant? How so? Is this type of damage observed on plants? Is it more common when more of the insects are seen on the plant? Can you replicate this damage by putting insects on the plant in controlled conditions? For extra points, if you can demonstrate that the insect causes a reduction in seed set for the plant, you can then conclude that it is reducing the plant's evolutionary fitness (i.e., reproductive output), which is the currency of evolution.

Example 3 Hypothesis: *We hypothesize that INSECT SPECIES 2 is beneficial to PLANT SPECIES by preying upon INSECT SPECIES 1.*

Information needed: Is *INSECT SPECIES 1* harmful to the plant (see example 2)? Is *INSECT SPECIES 2* found where *INSECT SPECIES 1* is found? Is *INSECT SPECIES 2* known to feed upon, or scare away, *INSECT SPECIES 1*? Have you observed *INSECT SPECIES 2* feeding on or scaring away *INSECT SPECIES 1*? Some experiments could be helpful to

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further understand what is going on, such as caging *INSECT SPECIES 2* on plants with *INSECT SPECIES 1* and observing whether there is a resultant decline in *INSECT SPECIES 1* — note that a control would also be needed in which *INSECT SPECIES 1* is caged without *INSECT SPECIES 2*. This 'control' would be used to compare with the 'treatment' in order to understand how the cage might also affect the interactions between *PLANT SPECIES* and *INSECT SPECIES 1*.

The ease of testing your hypothesis comes down to the way in which you ask your research question and word your hypothesis. The key here is that you want to collect data that supports or rejects the hypothesis, and you want to make sure you are using some kind of standard data collection protocol when collecting the data. Hypotheses can be tested with observational data and also with experimental data. Experimental data tends to be more powerful because you can manipulate specific variables, so you know that the factors you manipulate cause the changes you see, but in some cases, observational data can be more realistic because you are observing interactions in their natural settings. The best research often includes both: observational data gives a holistic sense of field conditions, and experimental data can isolate individual factors.

Statistics are often needed to turn the data you've collected into a result. This is because the world is a messy, complicated place and no matter how good your observations are or how well you control conditions in an experiment, you will not see the same result every single time. But perhaps you usually do see the same outcome; statistics are a scientist's way of defining "usually". We won't go very far down this rabbit hole, but in general, simpler questions can be answered through simple statistics.

Conclusion

Native landscapes are beautiful and full of fascinating stories — some known and others untold. The more you learn about what is happening in these miniature ecosystems, the more special they become. This basic methodology of observation, question generation, and data collection is the foundation of science in any field, not just ecology. But ecology offers a uniquely accessible door into science, especially when it occurs in your backyard. Interactions can often be seen with the naked eye. Relevant plant traits can be touched, smelled, counted. Think about helping your kid do an ecological study in your backyard for next year's science fair or use these tips to unravel some of the mysteries unfolding in your garden! For further reading on making ecological observations and testing hypotheses, check out the book *How to do Ecology* by Karban & Huntinger.

MEET A RANCHER **Julie Finigan Morris and Joe Morris**

Owners & Founders of T.O. Cattle Company in San Juan Bautista, California

Describe your operation and ecosystem

T.O. Cattle Company operates on the central coast, in San Benito and Monterey counties. We lease four different ranches totaling more than 10,000 acres. We are a cow-calf, stocker operation managing our herd as well as cattle owned by others during winter months. We direct market beef from our herd under the Morris Grassfed brand to happy customers throughout the state and have been doing so for almost 30 years. We are one of the original direct-marketed 100% grassfed beef companies in California.

The ranches we manage are classic California landscapes: golden, grassy hills dotted with live oak trees. We also have brushy, coast ranges with deep forested canyons where redwood trees grow and native, perennial bunch grasses thrive.

What are your primary goals as a steward of the land?

Our primary goal has always been a healthy water cycle where streams and rivers flow, rain can soak into the places where it falls, and native, perennial grasses are able to thrive and multiply. We see cattle as an important tool in promoting soil health. We use low-stress handling techniques to move our herds often, preventing overgrazing. Recently Joe attended the Soil Health Academy at Chico State University where he was inspired to use more high-density stocking rates to jump-start microbial life in the soil. We're implementing some of these techniques this winter and excited to see results in coming months as the grasses really begin to pop.

What tools do you use to manage the land? What tools do you wish you could use, but can't (if any)?

As mentioned above, cattle are our main tool. We also use horses and our team of border collies to move cattle from one field to the next. We have a couple of four-wheel drive quads we use when needed to transport fencing materials or reach hard-to-get-to areas of a ranch. Human creativity is also a huge part of our operation. We are always looking for new information and inspiration from others in the field and have learned a tremendous amount from people like Gabe Brown, Nicole Masters, Peter Donovan, and Allan Savory.

What partners do you work with?

Partnerships are crucial to T.O. Cattle Company. As a small company, we depend upon the collaboration and support of many different partners. We've worked closely with **Point Blue Conservation Science** to monitor plants and wildlife on the ranches we lease. We work with the **Soil Carbon Coalition** to measure our carbon sequestration levels. We are members of the **American Grassfed Association**, who is doing important policy work in Washington D.C. to protect the integrity of the grassfed label. We are on the Farmers and Ranchers Advisory Board of the **California Climate & Agriculture Network** (CalCAN), another important policy group working in Sacramento to ensure that regenerative agriculture is supported as a response to climate change. We are active supporters of our local **San Benito Agricultural Land Trust.** For the past five years, we've run cattle on the **Paicines Ranch** in Paicines, California where we've seen increases in bird counts and native grasses. We also work with the **Grassfed Exchange** to educate and encourage young ranchers interested in regenerative agriculture. We are also members of the **Community Alliance of Family Farmers**, the **California Agricultural Leadership Program**, the Farm Bureau and the **Cattlemen's Association**. We work with **Soil Centric**, an advocacy group focused on giving young farmers and ranchers a path to get involved in regenerative agriculture. Julie also sits on the newly-formed **California Cattle Council**, a trade group aimed at informing and educating the public about the ecological and health benefits cattle, beef and dairy can provide. It takes a village and we're happy to work with so many inspiring and innovative people to keep California's rural landscapes productive and healthy.

Who has inspired you, and how?

There's probably not enough space to answer this question! One of our original mentors and inspirations is the wildlife biologist **Allan Savory**, who founded Holistic Management International and pioneered the holistic decision-making model we follow. In a nutshell, the model is a process in which you ask what the social, economic and ecological outcomes will be of every decision you make. This process has guided us from the beginning and trained us to use systems thinking when we manage our business, our land and animals, and even our personal lives. We've also been inspired by **Dave Pratt**, the former head of Ranching for Profit, an educational program for ranchers. Pratt pushed us to think of T.O. Cattle Company as a business rather than a hobby we love. He has inspired us to plan for the future and create a profitable business that can both support us financially and also help us to realize our goals of responsible land stewardship and good food production.

Wendell Berry is a poet, essayist, and farmer whose writings have inspired us ever since Julie was assigned to read him in high school, and Joe stumbled across his book, *The Unsettling of America*, while looking for a James Baldwin book in the library as a high school teacher in 1989. Joe's grandfather, **John J. Baumgartner** (**"J.J."**) introduced him to ranching as a child on their family's ranch in San Benito County. J.J. grew up on his family's Santa Margarita Ranch

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Left: This photo of a *Stipa pulchra* plant was taken in January of 2014 when there was virtually no annual grass germinated — the height or depth of the drought. Right: Pastured cattle at Pacheco State Park. *Photos courtesy Julie and Joe Morris*

MEET A RANCHER *continued*

(now Camp Pendleton) and it was there he learned the culture of the vaqueros and land stewardship he passed on to Joe. Countless other people are doing great work to preserve California's rangelands and we feel very fortunate to be part of that community.

How does the work you do on the land relate to the mission of CNGA "to promote, preserve, and restore the diversity of California's native grasses and grassland ecosystems through education, advocacy, research, and stewardship"?

We get up every day and go to work on the mission of CNGA. From our work with cattle, policymakers, trade groups, student field trips, scientists and our customers we feel like we've devoted our lives to restore and promote California's native grassland ecosystems.

Why do you love grasslands?

Grasslands hold so much promise. They are a carbon sink that can pull carbon out of the air, store it deep underground, and provide cover for the world below our feet: as vast and diverse as the oceans. Managed properly, grasslands can solve the most pressing and urgent issue facing mankind: climate change. What's not to love?

Any final/closing take-home nuggets, advice, quotes, etc., you would like to include or share?

At the risk of sounding like we're self-promoting, it's hard to ignore the attacks on cattle in much of the general public. Cattle are blamed for everything from global warming (*they're not alone on this!*) to heart attacks (*also wrong – grassfed meat is a nutrient-dense super-food.*) If there's one thing we'd like readers to take away it's this: "It's not the cow, it's the how." Managed well, cattle are an integral part of a healthy ecosystem. My mantra regarding fake meat: "They build factories, we build soil!" So go enjoy a grassfed steak, knowing that it supports native grasses.

Is Funding Always Worth the Cost?

by Jeffery Stackhouse[1] and Lenya Quinn-Davidson[2]

Explaining medusahead. *Photo courtesy Lenya Quinn-Davidson*

Prescribed fire is widely recognized as one of the most cost-effective and ecologically appropriate tools for reducing hazardous fuels, maintaining grasslands and woodlands, and restoring California's many frequent-fire habitats, yet its use remains limited by a long list of barriers, which have been identified over time through various studies and surveys. Through this work, funding has been identified time and again as a major impediment to prescribed fire, and we are finding through our community-based prescribed fire work in California's North Coast that although this is true, there are two disparate sides to the funding impediment. The more common narrative is that a lack of funding is limiting good work. We are finding that the opposite is also true: the seemingly involuntary focus on funding, and the many strings by which funding is attached, has the power to limit or delay good work in major ways. This article describes two potential pitfalls of prescribed fire funding, and encourages landowners and other land managers to consider the question: is funding always worth its cost?

The ideas described in this article come from our work with the Humboldt County Prescribed Burn Association, a cooperative group of landowners and community members who work together to plan and implement prescribed burns on Humboldt County's private lands. Over the last two years, the work of the HCPBA has been widely recognized as beneficial and effective, and projects have started attracted funding from various agencies and collaborators. But after this fall, when various HCPBA projects were delayed or held up by funding-related issues, we're learning that funding may not always be worth the cost—not to the funder, but to the project.

Environmental compliance: The National Environmental Policy Act (NEPA), the California Environmental Quality Act (CEQA), and the other compliance hurdles standing in the way of our agency partners trying to complete good fire projects become our hurdles once we accept state and federal funding. We have found that when it comes to funding, each project should be uniquely considered. It's important for the landowner and the funder to ask whether the project is big enough or complex enough to require major financial support. In many cases, a prescribed fire project in a simple fuel type (like grass or woodland) will require little to no ground disturbance during preparation, and can be implemented with minimal equipment and little cost, especially in an area with a community-based prescribed burn association. For projects like these, and even for some simple burn units in more complex fuel types, there is little incentive to enter into a contract or cost-share program with a federal or state agency that requires in-depth pre-burn environmental compliance work. It is often more efficient and cost-effective to move ahead without funding.

Qualifications: Qualifications are an important consideration for landowners seeking funding for their prescribed fire projects. Agencies, and even some non-governmental organizations, often require that projects meet federal standards, in the same way they would if the agency were implementing the project itself. In many cases, federal funding requires that a federally qualified Prescribed Fire Burn Boss Type 2 (RXB2) lead the burn; however, private RBX2s are in short supply, often have to travel from afar, are expensive to hire, and have busy schedules that don't allow

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[1] University of California Cooperative Extension, Humboldt and Del Norte Counties, Eureka, CA; Livestock and Natural Resources Advisor; California Certified Rangeland Manager #113. Stackhouse is a wildlife biologist and range ecologist with research experience in a wide variety of habitats. His current research program focuses on woody encroachment of prairies and finding economically viable options for resetting late seral habitats to promote biodiversity and early seral beneficial forage plant species for livestock and wildlife. [2] University of California Cooperative Extension, Humboldt, Mendocino, Siskiyou, and Trinity Counties, Eureka, CA; Area Fire Advisor. Quinn-Davidson has a background in fire ecology and social science and is interested in the effects of fire suppression on biodiversity in California's fire-adapted ecosystems and in empowering Californians to bring fire back into the land management toolbox.

Is Funding Always Worth the Cost? *continued*

landowners to adapt to burn windows as needed. Likewise, depending on the size of the project, hiring an RXB2 may, in the end, cost more than the landowner receives from the funding agency. In other cases, federal funding may mean that everyone on the burn meets the federal standard for an entry-level firefighter (Firefighter Type 2), which can be a barrier to entry for the landowner and their community partners. For some complex in-season burns, these kinds of qualified leaders and crews can be critical for success; for more simple burns, or winter burns, we recommend proceeding without funding to maximize your flexibility to meet narrow weather windows and keep the options more open.

We do not fault the funding agencies, nor the landowners seeking support, but the cost of outside funds are real and need to be part of the initial conversation. The ultimate cost of funding is time. More time for planning, more time for surveys, more mitigation of risk (more unit preparation, more dozer lines, more water resources, more engines, more people, hiring of federally qualified burn bosses, etc.), more constraint of implementation timing/prescription, more stakeholders, more fear, more headache.

In Humboldt County, our agency partners—like the Natural Resources Conservation Service and CAL FIRE—have been some of our most important allies. However, the larger fire, conservation, and landowner communities need to question the default assumption that all good work requires outside funding. There is a large amount of gray area in the planning and implementation of any project. Most would agree that any amount of state funding would likely be wasted on a four-by-four burn pile project in someone's back yard. Most would also agree that a 10k acre burn should likely not only have agency funding, but also agency support and involvement. It is the middle ground that stands in question: the 20-acre grassland burn, the three to five-acre understory burn, the five slash piles or 30 hand piles. Where is the line and at what point is the cost of time, agency resources, and loss of precious burn windows not worth the per acre or per pile benefit? There are too many acres, too much fuel, too many projects, to ever miss a burn day in California. Let's continue to collaborate and find strategic ways to deploy funding programs, knowing that not all projects require big state and federal dollars. Sometimes just a neighbor helping a neighbor, free of charge, is all you really need.

Project collaborators on site visits to understand burn objectives and required regulatory measures to meet environmental quality act requirements to conduct state/federal funded private land burns.
Photo courtesy Lenya Quinn-Davidson

CNGA's Bunchgrass Circle

A Special *Thank You* to our Bunchgrass Circle Members!

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Inside: ***Unraveling the plant-insect interactions taking place in your native garden***

Front cover: A rare significant snowfall on the Mitsui Ranch, in the oak savanna of the Inner Coast Range of Sonoma County near Petaluma. *Photo: Jeffery T. Wilcox, Managing Ecologist, Sonoma Mountain Ranch Preservation Foundation, Former CNGA Board Member*

Back cover: A seed production field of *Melica californica* (California oniongrass) at Hedgerow Farms in Yolo County. Taken during the CNGA Field Day, 2019. *Photo: Emily Allen, CNGA Board Member*