California
Native
Grasslands
Association

GRASSLANDS

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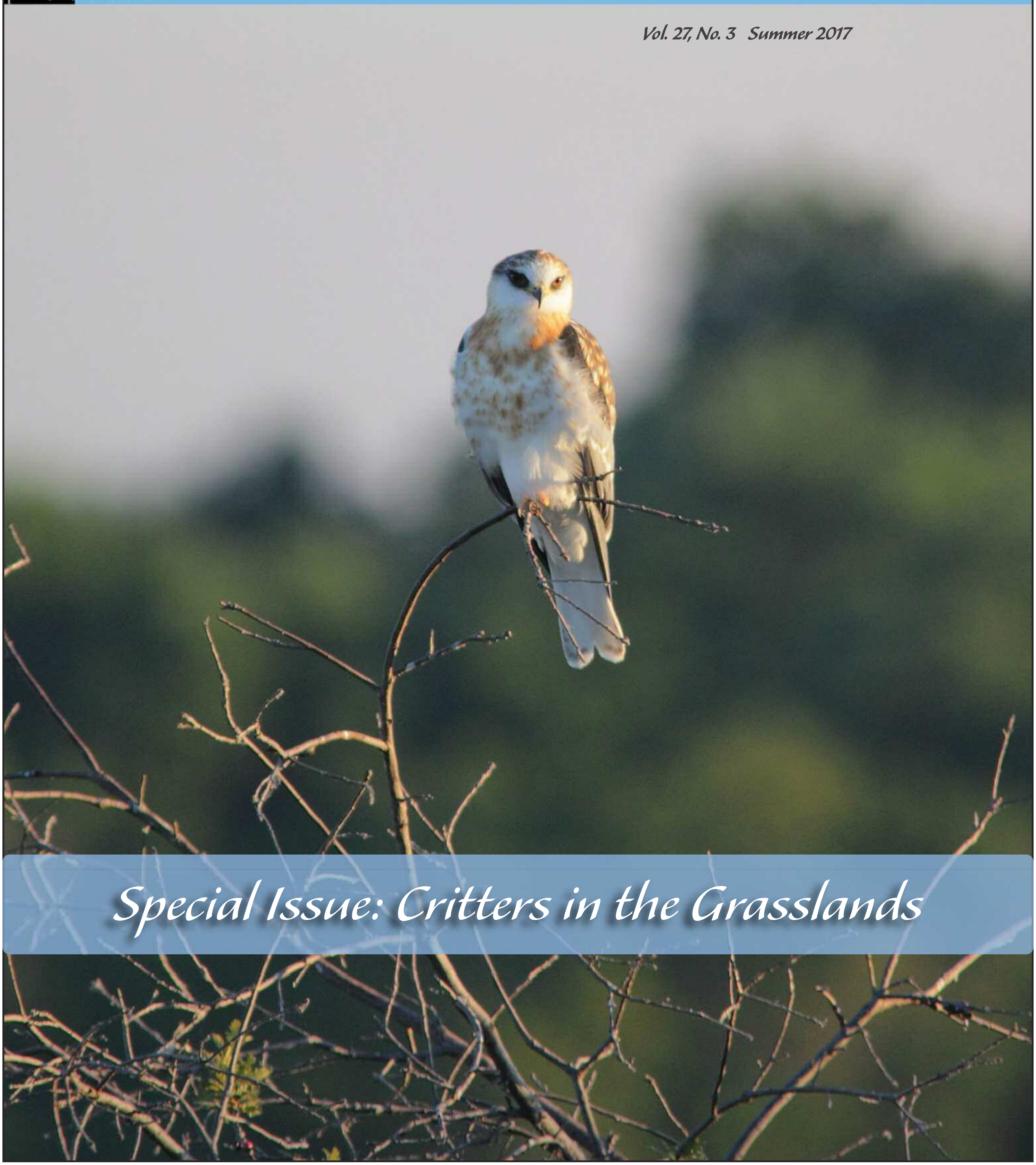

Special Issue: Critters in the Grasslands

California
Native
Grasslands
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Mission Statement

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

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From the President's Keyboard

What a spring season it has been! Following a very wet winter and spring, we have seen an amazing super bloom of forbs this year. The Carrizo plain in particular looked like a picture perfect landscape. Grasses have done very well too and it looks like we are back to a "normal" timing and pattern of life cycle. After 5 to 6 years of drought and being in a wait-and-see mode, it was a relief to see how well our native plants adapted to the drastically changing climate. Climate change is a reality, whether local and short-term, or global and long-term, as shown in many scientific and non-scientific reports. Although we might see a shift in species, I am confident that our native grasses and forbs will continue to do well as they have done for many centuries, as long as they can survive the invasion of non-native noxious species and pests. One important component of grassland ecosystem is its fauna. Reptiles, rodents, mammals, etc. Read some great articles about "crawling things" in this edition of *Grasslands*.

CNGA would like to thank Elise Gornish, who was chair of the Workshop Committee, for services to our organization. We wish her luck and happiness in her new life out of state. We also welcome our three new Board Members, Kristina Wolf as the Chair of the *Grasslands* Committee, Jaymee Marty from Marty Ecological Consulting, and Pat Reynold from Hedgerow Farms. We are all looking forward to working with them.

Our CNGA Board members have been very busy this spring representing our organization at various events, including the California Rangeland Conservation Coalition, San Francisco Plant and Garden Show, SERCAL annual conference, CNGA Plant ID workshop and the 10th annual Field Day at Hedgerow. Look on our website, like our Facebook page, or follow us on Twitter @CAGrasslands for more upcoming workshops and events. Also look for us at the Cal-IPC conference where we are planning on chairing a grassland session.

Lastly and most importantly, I would like to personally thank all of you who donated to CNGA during the Big Day Of Giving. Your generous support allowed us to raise over $4,600 this year that will go towards our programs. That is a record high for us, with the help of some matching funds, and we hope to raise more next year to assist us in developing and delivering quality workshops and products.

Happy summer!

JP Marié, President

CNGA Announces New Individual Membership Levels

Prairie Partner Memberships enrich the diversity of programs CNGA provides, much like the wildflowers they are named for enrich grassland diversity.

Redmaids: $125/year
Join at this level and receive a CNGA hat!

Baby Blue Eyes: $250/year
Join at this level and receive a CNGA t-shirt!

California Poppy: $500/year
Join at this level and be invited to special members-only hikes!

Goldenbanner: $1,000/year
Join at this level for an invite to a CNGA Board thank-you BBQ!

Join us *anytime* online at cnga.org

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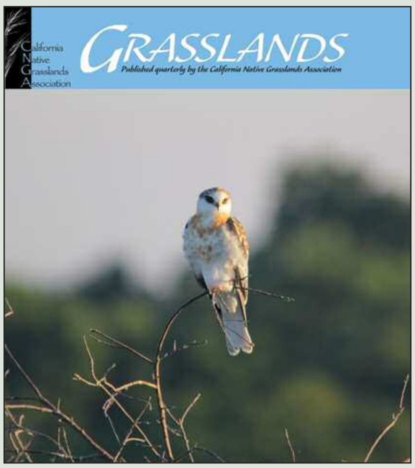

Grasslands Submission Guidelines

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. Contact the Editor, Kristina Wolf, for formatting specifications: **grasslands@cnga.org**.

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 Kristina Wolf at grasslands@cnga.org. Include a caption and credited photographer's name.

Submission deadlines for articles:

Fall 2017: 15 Aug 2017 ❊ **Winter 2018**: 15 Nov 2017 ❊ **Spring 2018**: 15 Feb 2018 ❊ **Summer 2018**: 15 May 2018

Upcoming Workshops from CNGA

Nuts and Bolts of Restoration and Revegetation Using Grasses and Graminoids

Friday, July 21, 2017, 9:30am–4:30pm ❊ Winters Fire Department Training Room, 700 Main Street, Winters

This full-day classroom course will acquaint landowners, land managers, agency personnel, contractors, consultants, and others with proven techniques and strategies for restoration and revegetation using native grassland species. Expert instructors will cover topics including: ❊Site evaluation ❊Species selection ❊Site preparation ❊Planting techniques ❊Weed control and ❊Long-term management. This is the first workshop in series of two (see Field Practices workshop below)

$150/CNGA members | $175/Non-members | $95/Students with ID

Cal-IPC Symposium: Grassland Invaders

Riviera Palm Springs Resort, October 24–27, 2017

CNGA will host the "Grassland Invaders" session featuring speakers from around the state. Join us in Palm Springs and for some of the latest news in grassland research. Check the symposium schedule for exact day and time of our session. Conference registration fees and online registration at **http://cal-ipc.org/symposia**

Coming in the Fall:

Grazing and Top Soil Health

Field Practices: Hands-on Restoration Implementation and Maintenance

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

Look for more workshops and updates on our website:
www.cnga.org

Mark Your 2018 Calendars:

California Native Plant Society 2018 Conservation Conference

Los Angeles Airport Marriott, Workshops & Field Trips January 30–31, Conference February 1–3

CNGA will offer a grass identification workshop, "An Introduction to Grass Identification: You Can Totally Do This!" Get full details — including workshop and conference registration fees — at **conference.cnps.org** or go to our website at **cnga.org**.





Clockwise from far left: Figure 1. Female crab spider with large prey. Figure 2. Crab spider lying in wait under a petal. Figure 3. Crab spider ambushes prey from between petals. Figure 4. White Misumena on a blue flower; do insects spot her as easily as we do? Figure 5. Female crab spiders are much larger than their mates.

SPECIES SPOTLIGHT:

Crab Spider: *Grasslands Predator Hiding in Plain Sight*

by Jeffery T. Wilcox, Managing Ecologist, Sonoma Mountain Ranch Preservation Foundation

All I wanted to do was immortalize this tiny hunter and its incredible prize in a photograph. How could this furtive little acrobat hide from me in plain sight, isolated as it was on a buttercup (*Ranunculus californicus*), in the middle of a grassland? Yet each time I focused in on the crab spider (*Misumena vatia*) with its prey, it scuttled around the yellow bloom just enough to escape my shutter. And the spider managed this deft avoidance with only half its complement of eight legs, because the other half were holding on to the much-larger wheat stem sawfly (*Cephus cinctus*) it had just captured (Figure 1). After several minutes of frustration, I realized that the spider was winning the intelligence contest and I'd need a strategy to get that photo. I removed my backpack and left it on the ground, hoping the crab spider would perceive it as threat. It worked; the spider retreated again as I circled around the flower but then stopped cold when it saw the backpack. Confronted with a threat on each side, it froze in place. I got the photo, but I'd had to resort to trickery. This was my first encounter with a crab spider and I was impressed. I had to know more about this little wonder.

In grassland ecosystems, which cover more than 40% of Earth's land surface, grasses comprise the greatest number of species, but many other plant types grow there as well. To fully appreciate the species diversity within a grassland, you need only stroll through it and observe closely, noting the seasonal changes and distributions of plants. Crab spiders are common predators in grasslands, and they conduct their action-packed lives in plain sight, atop a succession of wildflower species that bloom as the seasons change from spring to fall. A wide distribution, conspicuous habitat, and easily observable traits make this species attractive to researchers (Morse 2007).

Crab spiders are sit-and-wait predators, ambushing insect prey that visit flowers. They belong to the group of spiders (Thomisidae) that derives its common name from its members' tendency to scuttle sideways like a crab. They possess two large, raptorial forelegs with which to grab prey, and powerful venom with which to subdue it. These two adaptations allow them to capture prey much bigger than

continued next page

Crab Spider *continued*

themselves. In the way of all spiders, they employ external digestion, which means they do not have to physically break down their prey to consume it—so prey size is not such a limiting factor for feeding, either. They inject their prey with digestive enzymes that reduce the useable parts to liquid, which the spiders then siphon from prey as if drinking through a straw, leaving the prey looking much as it did prior to capture. (Look closely in a grassland and you'll see these exoskeletons hanging, ghostly, where they died.) Female crab spiders are larger than males; this allows them to capture and consume larger prey than their male counterparts, thereby attaining even greater size. More about why this matters in a moment.

Crab spiders "conceal" themselves from prey in two ways. First, they may take a position under the petal of a flower, between blooms, or under leaves (Figures 2, 3). The second means of concealment may have to do with the ability of both sexes to change their color (females, more conspicuously) over a few days' time. Yellow and white are the most common colors for *Misumena*, and to the human eye these colors appear to approximate the color of the blooms on which the spiders hunt (Morse 2007). Most insect prey, however, see light differently than we do; whereas we might easily spot a white *Misumena* on a blue flower (Figure 4), insects perceiving ultraviolet wavelengths might mistake the spider for a strongly patterned flower part (Heiling et al. 2003), if they see it at all. The ability of crab spiders to play off the background color of their hunting grounds conceals them in plain sight...and gets them closer to their prey.

Some research suggests that sexual selection may have caused spiders to evolve to change color. Théry (2007) determined that color changes in crab spiders were triggered by the visual spectrum of the reflected light of their background, and that pigments from digested prey were used by the crab spider to change its color. Théry hypothesized that a highly pigmented female may be more attractive to males because her coloration is indicative of her hunting ability and overall fitness. Size matters in mate selection too; larger females produce larger litters (Morse 2007). Males that choose larger females increase their chances of passing their genetic material on to more offspring (Figure 5), and those offspring have better odds of surviving to adulthood, breeding, and perpetuating the male's genes (Fritz and Morse 1985; Morse 1989; Morse 2007).

For most of her life, a female crab spider aggressively defends her territory, keeping males and other females from the flower on which she hunts. Only at the end of her second year does she allow male spiders into her territory. She might mate with more than one male, but the male that mates first has a much greater chance of fertilizing the majority of eggs the female produces. When the female is ready to lay eggs, generally in late summer, she descends the plant stalk to locate a choice leaf; she then bends the leaf tip back and secures the folded-over end with silk, forming an envelope-like cocoon. She deposits her eggs inside the envelope and guards them closely until they hatch, in about 3 weeks. Adult females do not survive their second winter. After guarding her eggs until they have hatched and her spiderlings have dispersed, the female crab spider's two-year life cycle ends. The young pass the remaining fall by hunting for appropriate-sized prey such as thrips (Thysanoptera), aphids (Aphididae), and dance flies (Empididae) among the leaf litter (Morse 2007). The larger they can get before the first frosts arrive, the better their chances of surviving the winter until a wider choice of prey becomes available as Spring arrives. A diet of nectar and/or pollen may get them through lean times until prey is more abundant (Vogelei and Greissl 1989).

Adult *Misumena* don't travel much more than a few meters within their feeding areas. A crab spider's success comes down to its ability to choose a piece of real estate on which flower species bloom in succession throughout the spring, summer, and fall growing seasons. The ability of a female crab spider to choose a foraging patch likely to provide abundant prey may determine the success of next generations, as well (Morse 1993). Ideally, the patch the female chooses for herself is of a quality to sustain some or all of her offspring in their own quest for food. If the spiderlings find their mother's patch lacking in resources, they can move, but moving comes with its own risks. Crab spiderlings, like the offspring of other spider species, *can* disperse great distances by ballooning, but that leaves the quality of landing-place resources entirely to chance.

This dynamic effort to thrive is taking place right under our noses every year. In my patch of Sonoma County, I see the first crab spiders of the year in the March flush of buttercups. As successive flower species erupt through the spring, I see the spiders on wild hyacinth (*Dichelostemma capitatum*), yarrow (*Achillea millefolium*), and mule ears (*Wyethia mollis*); then, in summer, on yellow mariposa lilies (*Calochortus luteus*); and finally, on the harvest brodiaea (*Brodiaea elegans*) of fall.

All you need to do in a grassland is look closely.

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Rough-legged Hawk. *Photo courtesy Ed Harper*

Ferruginous Hawk. *Photo courtesy Ed Harper*

California's Central Valley: *A Winter Paradise for North America's Raptors*

by Edward R. Pandolfino[1]

Even avid birders are often surprised to learn that California's Central Valley is home to North America's highest abundance and greatest diversity of wintering raptors (Root 1988, Pandolfino 2006, Pandolfino and Suedkamp-Wells 2009). At least 20 different raptors are easily found in the valley in winter (Table 1). Our resident Red-tailed Hawks (*Buteo jamaicensis*), Northern Harriers (*Circus cyaneus*), and American Kestrels (*Falco sparverius*) are joined by a large influx of individuals of these same species that breed elsewhere, but are attracted to the region due to mild winters and abundant prey. Other species are found here only in winter—Merlins (*Falco columbarius*) coming from the boreal forests of Canada and Alaska, Ferruginous Hawks (*Buteo regalis*) from the Great Plains, and Rough-legged Hawks (*Buteo lagopus*) making the long migration from their arctic breeding grounds.

Several years ago, Zach Smith and I noted that despite the Valley's obvious importance to wintering raptors, very little was known about which habitats the various species were using. Given that the Valley has seen massive conversions of wildland to vineyards, orchards, and urbanization in recent decades (California Dept. of Conservation 2008, Cameron et al. 2014), we considered it crucial to understand habitat use by these birds to help influence conservation policies. Quantity and quality of winter habitat is particularly important for raptors: For many species, less than half of all fledged birds survive their first winter, making winter survival a key driver of population maintenance (Newton 1979, Johnsgard 1990).

We established a set of 19 roadside transects, largely through open country, throughout the Central Valley (Figure 1). We recruited a group of qualified volunteers to survey those routes at least once per month (December through February) for three consecutive winters from 2007 to 2010. We characterized habitat along each route at half-mile intervals so that each raptor observation could be placed in a specific habitat type (see Pandolfino et al. 2011a for a full description of methodology). Survey routes were selected to be representative of the habitats available in the Central Valley (Figure 2). Results of these surveys have been published in several papers (Pandolfino et al. 2011a, Pandolfino et al. 2011b, Pandolfino and Smith 2011a-f, Smith and Pandolfino 2011). Below, I summarize some of our findings, especially as they apply to the Central Valley's grassland habitats.

Habitat associations

Grasslands: We found three species, Ferruginous Hawks, Rough-legged Hawks, and Prairie Falcons (*Falco mexicanus*), almost exclusively in grasslands (Figure 3). Indeed, all three species showed significant positive associations only with grassland. It is important to note that these grassland specialists tend to avoid vineyards, orchards, and urbanized areas. In California, tens of thousands of hectares of grassland have been, and continue to be,

continued page 8

[1]Ed Pandolfino has served as president of Western Field Ornithologists and vice-president of San Francisco Bay Bird Observatory. He has published dozens of papers on status and distribution of birds and co-authored *Birds of the Sierra Nevada: Their Natural History, Status, and Distribution* (U.C. Press 2013). 1328 49th Street, Sacramento, CA 95819, **erpfromca@aol.com**.

Table 1.

Species | Winter CV Status | *Primary Winter Habitat*

HAWKS

Osprey | Fairly Common | *Lakes & Rivers*

White-tailed Kite | Common | *Grasslands, wetlands/ flooded rice, open habitats*

Bald Eagle | Fairly Common | *Wetlands/flooded rice*

Northern Harrier | Common | *Grasslands, wetlands/flooded rice, open habitats*

Sharp-shinned Hawk | Fairly Common | *Riparian, residential/rural*

Cooper's Hawk | Common | *Riparian, residential/rural*

Red-shouldered Hawk | Very Common | *Riparian, residential/rural*

Swainson's Hawk | Very rare[1] | *Grasslands, open ag habitats*

Red-tailed Hawk | Abundant | *Grasslands, wetlands/flooded rice, open habitats*

Rough-legged Hawk | Uncommon | *Grasslands*

Ferruginous Hawk | Uncommon | *Grasslands*

Golden Eagle | Uncommon | *Grasslands*

OWLS

Barn Owl | Common | *Grasslands, open habitats, rural*

Western Screech-Owl | Fairly Common | *Riparian*

Great Horned Owl | Common | *Riparian, woodland/savanna, open habitats*

Burrowing Owl | Uncommon | *Grasslands*

Long-eared Owl | Rare[2] | *Open woodlands*

Short-eared Owl | Uncommon | *Grasslands, wetlands, open habitats*

FALCONS

American Kestrel | Common | *Grasslands, open ag habitats*

Merlin | Uncommon | *Wide variety of open habitats, residential*

Peregrine Falcon | Uncommon | *Wetlands/flooded rice, some urban sites*

Prairie Falcon | Uncommon | *Grasslands, open ag habitats*

Note: ag = agricultural

[1]Except for small year-round population in the Sacramento/San Joaquin Delta

[2]Small numbers may winter along the foothill edges of the Central Valley (CV)

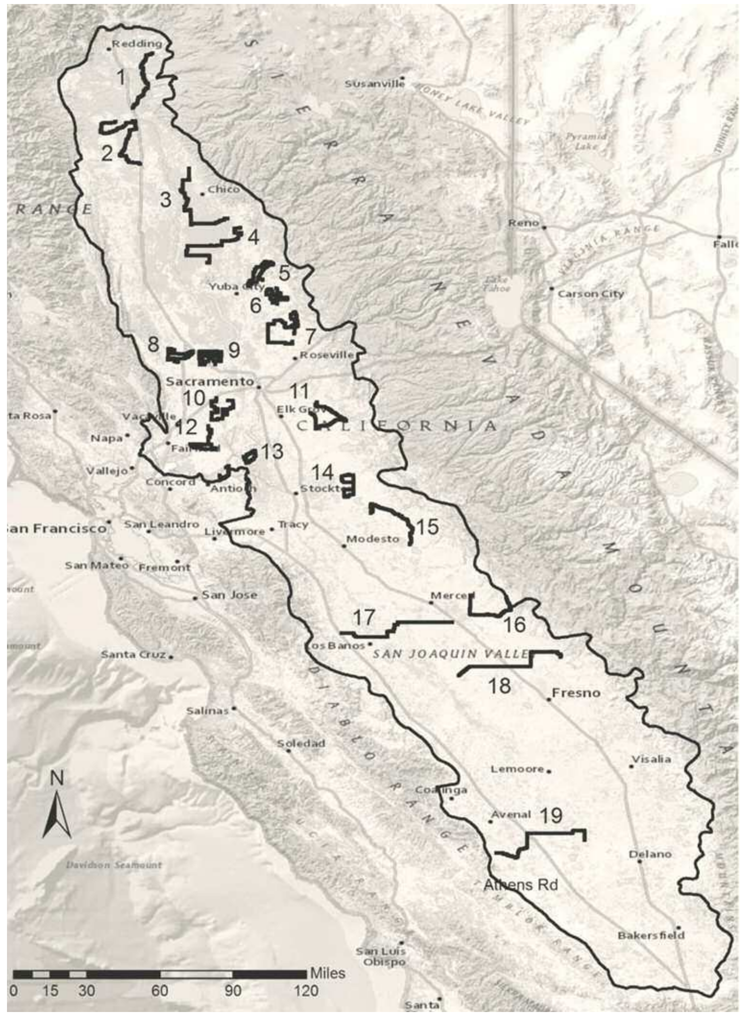

Figure 1. The 19 survey routes from which we assessed habitat associations of diurnal raptors wintering the Central Valley of California, 2007–2010.

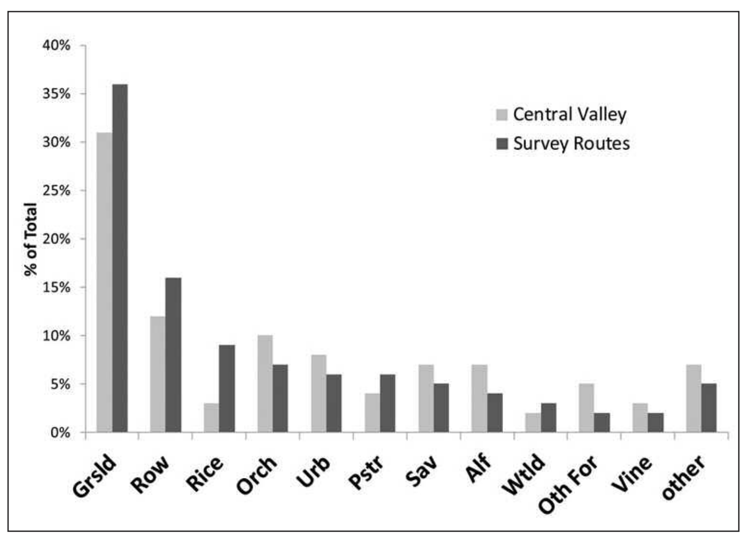

Figure 2. The proportion of habitat types in the Central Valley as a whole versus those sampled during our surveys. Grsld = grassland; Row = row crop (mostly plowed dirt in winter); Rice, (mostly flooded in winter); Orch = orchard; Urb = urbanized; Pstr = irrigated pasture; Sav = savanna; Alf = alfalfa; Wtld = wetland; Oth For = other forage (mainly hay and winter wheat); Vine = vineyard; other = variety of other habitats present in small amounts.

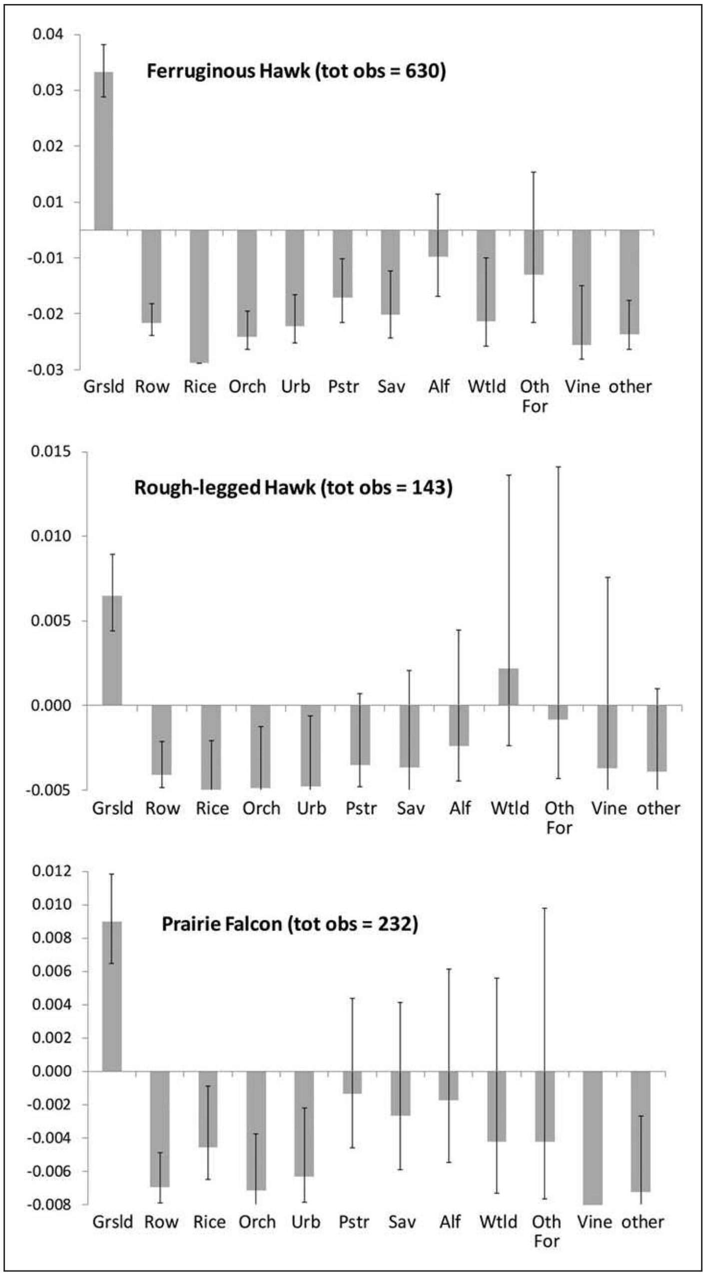

Figure 3. The difference between observed density and expected density (assuming random distribution among available habitats) for the Ferruginous Hawk, Rough-legged Hawk, and the Prairie Falcon for each habitat type surveyed.

NOTE: Figures 3 and 4 display some of the results of our surveys. For each, the Y-axis is the difference between the observed density (numbers of bird/40 ha) and the density one would expect to observe if the species were randomly distributed among the available habitats. If the value is above zero, that indicates that the species was found in that habitat more often than expected by chance. Error bars represent 95% confidence intervals. Total obs = total of all observations over all routes, all years. Therefore, if the value is positive and the error bar does cross the zero line, that indicates a significant positive association with that habitat type (preference). Conversely, if the value is negative and the error bar does not cross zero, that indicates a significant negative association (avoidance).

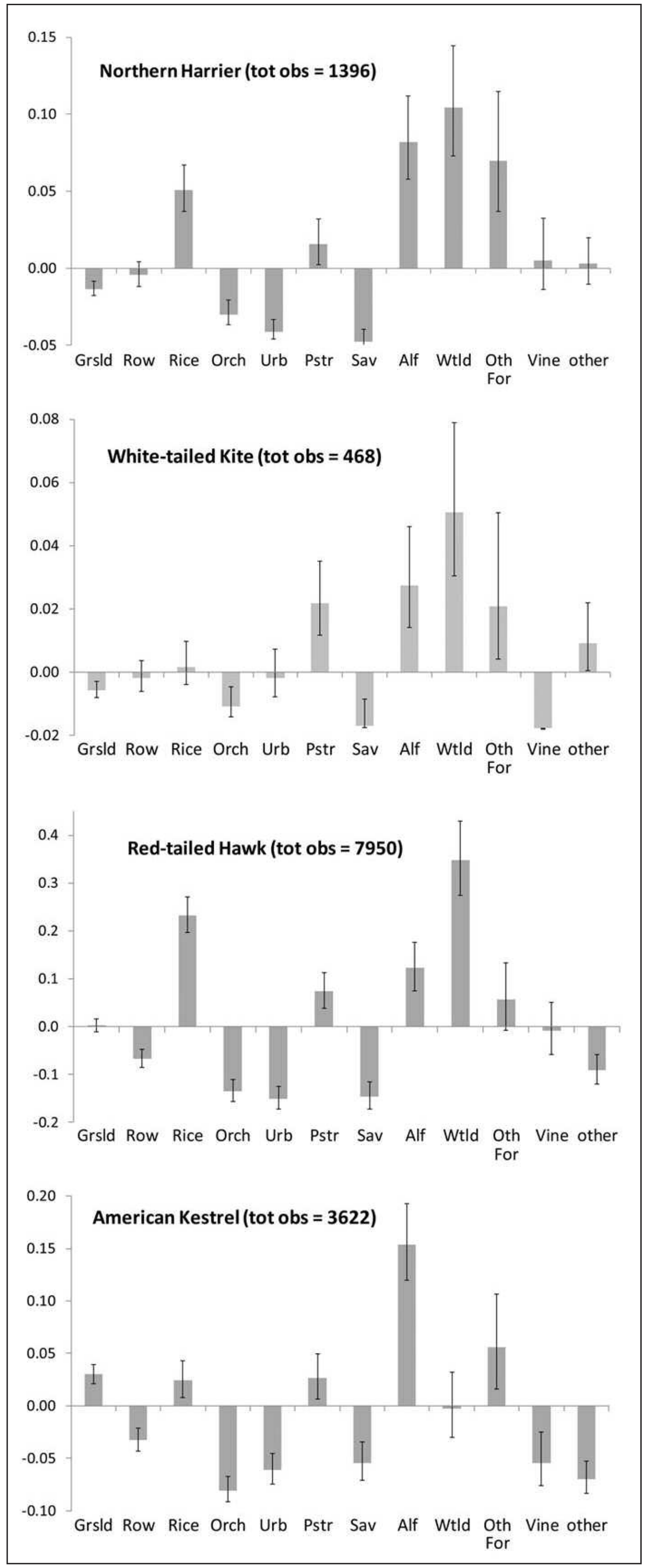

Figure 4. The difference between observed density and expected density (assuming random distribution among available habitats) for the Northern Harrier, White-tailed Kite, Red-tailed Hawk, and American Kestrel for each habitat type surveyed.

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converted to these incompatible land uses (Cameron et al. 2014). While red-tails use grasslands as well, they showed no particular preference for grasslands, using them about as often as one would expect from random distribution.

Wetlands: Northern Harriers and White-tailed Kites (*Elanus leucurus*) both showed a strong preference for wetlands (Figure 4). Harriers were also positively associated with flooded rice fields, and both species selectively used alfalfa, irrigated pasture, and forage crops. Although this figure suggests a negative association with grassland, both species are often found in grassland. The explanation for this apparent discrepancy is discussed later. Red-tailed Hawks, the ultimate habitat generalists, were positively associated with several habitat types, but most strongly with wetlands (Figure 4), which was somewhat of a surprise to us.

American Kestrel: This tiny falcon is the subject of much concern, as their numbers show steady, long-term declines in the Central Valley (Pandolfino 2006) and throughout the species' range (Sauer et al. 2008, Farmer and Smith 2009, Smallwood et al. 2009), with no clear cause determined. While several of the raptor species we surveyed showed a positive association with alfalfa, none was a strong as for the American Kestrel (Figure 4). Other open habitats such as grassland, irrigated pasture, and forage crops also had positive associations, but none to the extent of alfalfa. Alfalfa supports a thriving community of small rodents and insects, and the frequent harvests that occur throughout the year in our area expose these prey items to opportunistic kestrels.

Since it is easy to differentiate between male and female kestrels, we also compared their distributions by habitat and determined that in winter, female American Kestrels dominate higher-quality habitats (alfalfa and other forage crops in particular) in the Central Valley (Figure 5; Pandolfino et al. 2011b). This is consistent with other studies throughout North America (see citations in Pandolfino et al. 2011b) that show females occupying the best habitats in winter, with males relegated to more marginal habitats.

An honorary raptor: The Loggerhead Shrike (*Lanius ludovicianus*), while not a raptor, exhibits raptor-like behavior, preying on lizards, small birds, rodents, and large insects. Loggerhead Shrikes have also shown long-term declines in the Central Valley (Pandolfino 2008) and throughout their range (Morrison 1981, Peterjohn and Sauer 1995). Therefore, we included them in our raptor surveys and determined they were positively associated with grasslands as well as irrigated pasture and alfalfa. As with nearly all the species surveyed, they avoided orchards and urbanized areas.

To graze or not to graze: We also characterized grassland habitats on survey routes as grazed or ungrazed. The ungrazed grassland constituted a very small subset of our grasslands and were characterized by tall, weedy vegetation. In comparing raptor use of grazed and ungrazed grasslands (Figure 6), we found that the grassland specialists, Ferruginous and Rough-legged Hawks, strongly preferred *grazed* grasslands, likely because these species find prey exclusively by sight. In contrast, White-tailed Kites and Northern Harriers both preferred ungrazed, grasslands over grazed lands. This preference likely explains why harriers and kites did not show a positive association with grasslands, since so little of the grasslands we surveyed were ungrazed. The ability of Northern Harriers to use these ungrazed habitats is probably due to the fact they hunt close to the ground in low patrol mode, often using sound in addition to sight to find prey. White-tailed Kites are typically hover predators and, like kestrels and some other raptors, likely use their ability to see into the ultraviolet spectrum to detect the urine scent trails left by small rodent prey (see Honkavaara et al. 2002).

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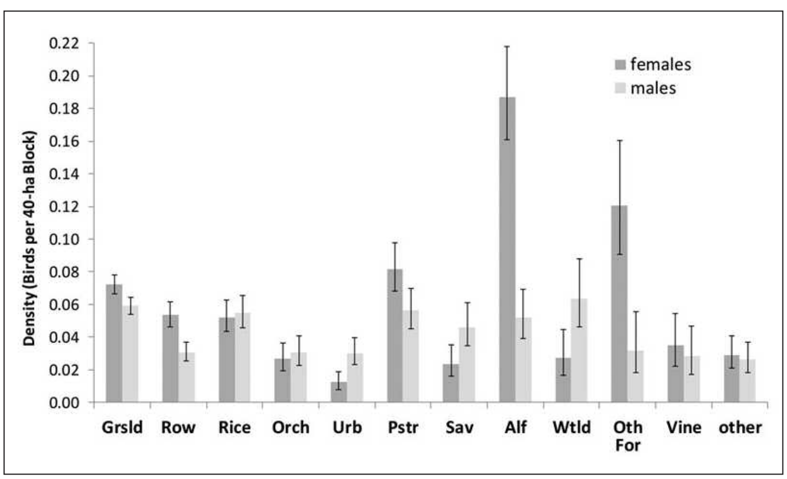


Figure 5. Comparison of density of female vs. male American Kestrels for each habitat type surveyed. Error bars represent 95% confidence intervals.

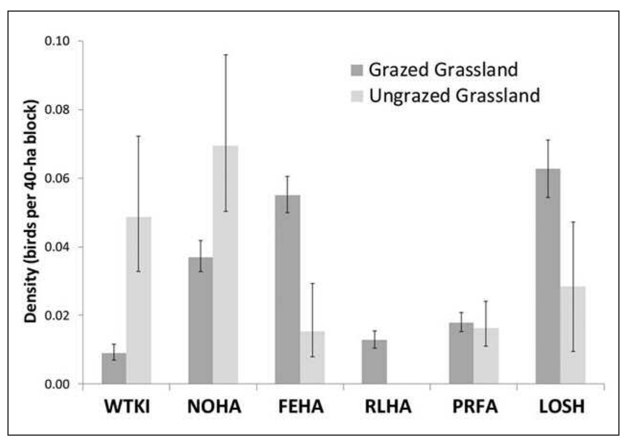


Figure 6. Comparison of density (birds per 40-ha block) in grazed versus ungrazed grasslands. WTKI = White-tailed Kite; NOHA, Northern Harrier; FEHA = Ferruginous Hawk; RLHA = Rough-legged Hawk; PRFA = Prairie Falcon. Error bars represent 95% confidence intervals.

GETTING TO KNOW GRASSLAND RESEARCHERS: Valerie Eviner

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

I primarily work on California grasslands, working to understand:

How they function (what are the key controls that determine their productivity, resilience, response to change), and how they contribute to multiple ecosystem services

How the key species in California's grasslands vary in dominance depending on environmental conditions and management, and what are the consequences of changes in vegetation diversity and composition? (e.g. what are the differences between a native and exotic-dominated grassland?)

How can we manage and restore grasslands for suites of goals, including key species and multiple ecosystem services? How does our management need to change depending on annual weather, and site-specific environmental conditions?

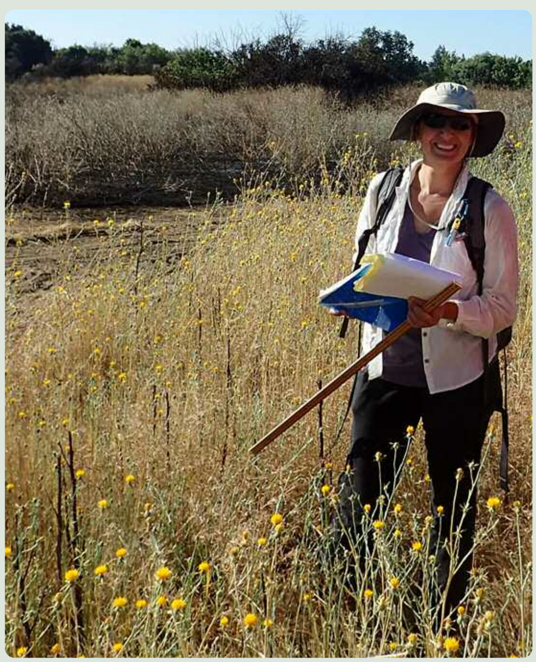
How will these grasslands change with a changing environment? How can we manage them to better mitigate environmental changes, or enhance their resilience to these changes?

Who is your audience?

My work has always focused on simultaneously addressing cutting-edge ecological questions, while addressing key management questions- so my audience includes researchers and managers.

Who has inspired you, including your mentors?

So many people, for so many different reasons. Many scientists who have researched the cutting edge questions of ecology, while applying them to critical societal and environmental challenges- both through their direct research, and through leading important synthesis efforts and local to global scales. Folks like Terry Chapin, Pamela Matson, Hal Mooney, and many more. Folks who have built strong communities to share their experiences, and improve the effectiveness of management and policy—the many leaders of CNGA over the years, the leaders of California Climate and Agriculture Network. Folks who have contributed a lot to science, while generously giving their time and energy to teaching and outreach, who manage to maintain a sense of enthusiasm and wonder on a daily basis. Kevin Rice is the perfect example of this rare combination.



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"?

Hopefully it is, and will continue to contribute in many ways. From a "research nerd" perspective, better understanding the mechanisms controlling these grasslands can give us the insights we need into improving their current management and restoration, and into developing different priorities and approaches for future conditions. But one of the most gratifying parts of working with CNGA is collaborating with managers to not only find "on the ground" solutions to current management challenges, but to use their decades of experiences and wisdom to develop new ideas about how these grasslands and controlled. Currently, we're working on a database of California grassland management and restoration projects, to bring together manager experiences from hundreds of sites, to answer questions like: what is the most effective management for a given goal, and how does that change on the coast vs. in the valley vs. in the foothills? How does that vary in wet years vs. dry years?

Why do you love grasslands?

I came to California to do my PhD in ecology, and initially chose to work on grasslands because they responded quickly to changes- so were convenient for a student trying to learn something in a dissertation project that lasted a few years. Honestly, as an ecosystem, I thought grasslands were quite boring before I started working in them. And then I came to love them! Their smaller stature (compared to forests) allows you to "get to know them" and witness the complexity they contain in those layers of grasses and wildflowers. From year-to-year dramatic changes in which plant species dominate, to noticing that certain species look completely different when they are growing alone vs. in competition, to seeing the richness of insects and small mammals and frogs and lizards and birds—I'm constantly learning new things about how the system works and who the important players are- and as a nature nerd, it feels magical to be privy to all of the "secrets" that nature reveals on a daily basis.

A Winter Paradise *continued from page 8*

Prairie Falcon. *Photo courtesy Ed Harper*

Conservation Implications

Most of these raptors are positively associated with grasslands and nearly every species avoided orchards, vineyards, and urbanized habitats; this has serious implications for a region where grasslands are being rapidly replaced by those three less suitable habitats. With the exception of some grasslands that harbor listed species, these conversions generally occur without any regulatory oversight. Nearly all these lands are working cattle ranches, creating a natural link between preservation of grassland raptor habitat and maintenance of cattle ranching as a viable enterprise in our region. This link helped inspire the creation of the California Rangeland Coalition (**carangeland.org**), an organization dedicated to finding common ground between cattle ranching and conservation of grassland habitat.

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Figure 1. Bears in high mountain grasslands. Trinity Alps, CA. *Photo courtesy the author*

Game Species Management and Economics of Hunting Enterprises in California Grasslands

by Jeffery W. Stackhouse[1], Gregory A. Giusti[2], and Luke T. Macaulay[3]

Grassland as habitat for game species

California grasslands and oak savannas play an important role in providing habitat for a rich variety of plants and animals (Meyers et al. 2000). Of the myriad species that occur in California grasslands, game species are one of the most economically significant due to their value for wildlife watching and hunting. Due to economic and cultural importance, managing these species is of interest to private landowners, land trusts, and land managers, as well as local, state, and federal officials. This article provides a primer on the important game species that occur on California grasslands, and describes game management on grasslands and the economics of hunting enterprises.

Because game species often move across many vegetation types, we discuss game species that occur in three grass-dominated vegetation types: 1) continuous grassland areas, including annual grasslands and coastal grasslands; 2) savannas, oak savannas, and mixed oak-conifer grasslands; and 3) shrublands such as sagebrush-steppe, mixed chaparral, and desert ecosystems that include interspersed grasses. We define game species as wild animals for which seasons and bag limits for hunting have been prescribed and which are harvested under state or federal laws, codes, and regulations. Game species are generally broken into categories of big game (e.g., elk, deer, pigs, bear), small game (e.g., tree squirrels, rabbits), and upland game birds (e.g., quail, pheasant, turkey). Here we focus mainly on big game, but also discuss common upland game bird hunting.

Today, approximately 50% of California is considered by the USDA to be pasture and rangeland (Agricultural Issues Center 2009). These vast areas are particularly important in their provision of food resources for game species. Grasslands provide big game, such as deer and elk, forage from grasses, forbs, and browse. Popular game bird species rely on grasslands for nesting cover, as well as grassland seeds and insects that supply nutrition for survival and growth. Grasslands are often interspersed with a mosaic of woody species that provide additional habitat resources, such as hiding cover and acorns from oaks.

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Grassland management and disturbance

Grasslands across the United States have evolved with disturbance (Barry et al. 2006), and ongoing disturbance is required for the maintenance of many grassland habitats. Historically, Native Americans managed California's landscapes with fire to maintain grasslands and shrublands on the landscape for their value as food production and attractants to game animals (Anderson 2005, Barry et al. 2006, Lake 2017). Burning creates openings in brush and shrub canopies and can temporarily increase the quality of ungulate forage by removing old, decadent forage and allowing fresh regrowth of grasses and forbs the following year (Dasmann and Dasmann 1963, Longhurst et al. 1979). Early European settlers continued to use fire until the middle of the 20^{th} century and introduced other disturbances such as livestock grazing and clear-cut forestry practices which created and maintained open grassland areas.

Today, fire has been abandoned due to liability concerns, increased regulations, a culture of fire-suppression, and air quality concerns, among other constraints (Quinn-Davidson and Varner 2012). Combined, these changes have resulted in a shift toward a more homogenous landscape with increasing shrub and conifer encroachment into grasslands. While these changes have resulted in increased woody cover, they have negatively affected game species populations such as deer and quail, which benefit nutritionally from early-seral vegetation found in recently disturbed grasslands (Higley 2002).

Management actions to enhance game species

A suite of tools is available to grassland managers to improve habitat values for a variety of game species (Table 1). In general, these tools remove old, decadent plant materials and allow new growth that can be beneficial for most game species, and will enhance hunting opportunities. Managers should consult with their local cooperative extension advisor or other natural resource managers (e.g., Natural Resources Conservation Service, United States Fish and Wildlife Service, California Department of Fish and Wildlife, California Department of Forestry and Fire Protection, or natural resources consultant) to determine the best timing and approach to meet their particular goals.

Economics of hunting

California rangelands are recognized for the economic value they provide to the ranching community via livestock production, but the value of these lands for recreation, particularly hunting recreation, is often overlooked. Recent research has found that hunters across the U.S. spend approximately $1.5 billion annually to access private land for hunting (Macaulay 2016). In California, many landowners have built business enterprises around hunting opportunities, including opportunities to reduce nuisance species such as feral hogs *(Sus scrofa)*. Returns from hunting operations vary significantly due to the wide variety of amenities, management effort, quality of hunt, and membership of hunting leases. Most landowners who incorporate

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Table 1: Management practices for enhancing game species habitat in grasslands

Practice	Impact
Fire	*Can reduce woody encroachment and reset shrub communities to an early-seral state, providing a mosaic of habitat types, and reduce undesirable, late-phenology, invasive herbaceous species (Biswell et. al. 1952, Biswell 1961).*
Grazing	*Can increase forb production in grasslands (Hayes and Holl 2003), which are a preferred forage for deer and quail.*
Leaving cover	*Mosaics of dense woody cover intermixed with herbaceous or early-seral shrubland communities are an important habitat feature for wildlife, as it provides cover from predators and refuge during extreme weather events (Dasmann 1950).*
Oak planting/maintenance	*Due to the invasion of annual plants in California grasslands, changes in grazing regimes, and altered fire regimes, many oak species in California are lacking regeneration. Any effort to increase the diversity of oak demographics to ensure their persistence on the landscape is beneficial to rangeland ecosystems and wildlife by providing acorns, cover, and a longer growing season for herbaceous plants under the oak canopy (Giusti and Schmidt 1996, Dahlgren et al. 2003).*
Forestry	*Forest managed for more open stands with herbaceous or shrubland understories can provide better habitat for game species. Thinning, burning, and mechanical treatments are commonly used to treat dense forest stands (Rochelle 1992).*
Chemical	*When weather or permitting processes limit the use of fire, chemical control can provide an excellent surrogate for treating undesirable plant species.*
Mechanical	*When fire or chemical treatments are infeasible, and where slopes permit, mechanical treatments are beneficial for resetting woody species communities to an early-seral stage.*
Predator management	*Coyotes and black bears are a significant predator of deer fawns, particularly during the first 30 days of life (Conger and Giusti 1992, Wittmer et al. 2014). Managing coyote populations to reduce fawn predation has been noted by some to be an important tool for increasing deer recruitment, while others argue that coyote control can disrupt ecosystem dynamics with little effect on the overall fitness of deer populations.*
Game management	*California land managers generally do not gather sufficient information to adequately manage deer populations. Knowledge of population parameters, including sex ratio, female survival, and fawn survival, is important for making management decisions, such as whether a population's growth rate can be increased by culling female deer that are not fawning (Macaulay 2015). There are several techniques for gathering this information for game species, including road surveys, spotlight surveys, and camera traps, as well as documenting harvest and the ages of harvested deer. Research has shown that culling female deer at Hopland Research & Extension Center enhanced buck harvest, presumably by increasing fawn survival and increasing buck-to-doe ratios (McCullough 2001).*

Game Species Management *continued*

hunting leases into their operations can achieve regular economic returns between $1 to $10 per acre, which can stabilize highly variable returns from the livestock industry (Macaulay 2015).

Game species of interest

Deer: The staple of California big game hunting is deer (*Odocoileus hemionus* subsp). In California, mule deer populations are split into six subspecies (Higley 2002, CDFW 2017). Each subspecies consumes mixed diets of highly digestible forbs, shrubs, and acorns, with grasses often composing less than 5% of their diet (Hoffman and Stewart 1972, Robinnette et al. 1977, Longhurst et al. 1979, Anderson and Wallmo 1984, Gogan and Barrett 1995). Although each subspecies has slightly different habitat preferences, open grasslands with water resources and some level of tree or shrub cover are important for robust deer populations.

A common misperception is that deer compete directly with cattle for forage year-round, but in fact, the competition is seasonal. Deer compete seasonally for high-quality forbs, but only in areas of high deer densities does competition negatively affect livestock production — commonly in areas of high deer densities and on inland irrigated pastures and hay fields. Another common misperception is that moderate cattle grazing is detrimental to deer populations. Does select areas of increased cover for fawning and often concentrate in riparian areas for fawning cover (Loft et al. 1984). Moderate grazing, however, can enhance deer forage by reducing grass cover, allowing greater production of highly-palatable forbs, an important component of deer diets from early spring through senescence (Gogan and Barrett 1995, Hayes and Holl 2003). Winter and early spring cattle grazing reduces grass cover and allows for legumes to establish; in fact, more stands of nitrogen-fixing legumes, like clovers, have been lost by too light of grazing than by heavy grazing (George and Clawson 1987). Likewise, retaining oaks on rangelands for wildlife is often thought to decrease rangeland production for livestock, but a study by Dahlgren et al. (2003) showed that removal of oaks provides only short-term increases in herbaceous production, and that retention of oaks enhances soil quality, increases net productivity, and enhances overall herbaceous species diversity.

Elk: California is unique in that it has three of the four North American elk species, all of which prefer different habitat types. All three are predominantly grazers with varying levels of browsing depending on season and habitat conditions (Findholt et al. 2004). Tule elk (*Cervus canadensis nannodes*), endemic to California, once roamed the state in numbers close to half a million (McCullough 1971). They are commonly seen in blue oak (*Quercus douglasii*) and valley oak (*Q. lobata*) savanna habitats from the Pacific Coast to the Central Valley. Roosevelt elk (*C. canadensis roosevelti*), the largest-bodied of the three elk species in California, are coastal elk, and range from California's north coast to Canada. They often prefer the fog belt of the ocean during hot summer months, but also frequent Oregon white oak (*Q. garryana)* and California black oak (*Q. kelloggii*) savannas and lush coastal pastures. Rocky Mountain elk (*C. canadensis nelsoni*) were transplanted into northeastern California by the California Department of Fish & Wildlife (CDFW) as a game species for hunters. California's Rocky Mountain elk utilize rangelands, and are found in a variety of habitat types including open ponderosa pine forests, high mountain meadows, and sagebrush-steppe. Like deer, all species of elk in California seek mixed habitats of forage and cover and prefer areas with low levels of human disturbance (Huber et al. 2011).

Tortenson et al. 2002, studied elk economic impacts to cattle ranches in Montana where they found cattle herd size, gross margin, and available forage decreased significantly ($P < 0.05$) as elk numbers increased, and cattle herd size could increase 7 to

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Game Species Management *continued*

32% with 100% removal of elk from the 5 ranches they studied. Although elk compete with cattle for forage resources and can be detrimental to ranch infrastructure, bull elk are valuable as a trophy-hunted species, which can recover some of the cost of lost forage and infrastructure damage if sufficient tags can be obtained (Torstenson et al. 2002).

Pigs: Feral hogs (*Sus scrofa*) (a.k.a wild pigs) frequently create large areas of exposed soil from rooting during forage activities on rangelands. This bare and open soil is readily available for the quick establishment of exotic or invasive species. The health of California grasslands could be greatly enhanced by reducing the size of feral pig populations (Tierney and Cushman 2006). Although opportunistic hunting alone is not likely to eliminate feral hog populations, a sustained hunting and depredation effort may deter pigs from certain areas and reduce damage to grasslands (Waithman et al. 1999). Furthermore, if ranchers and landowners can receive income from hunters for providing this service, the earnings could be used for on-ranch improvements to offset pig damage to infrastructure and rangeland health. Although feral pigs can be found in mixed habitat types, including forests, some of California's highest pig densities are, and will likely continue to be, in the oak savanna grasslands surrounding the Central Valley (Sweitzer and Van Vuren 2002, McClure et al. 2015).

Black bear: Black bear (*Ursus americanus*), although commonly associated with forested areas, they frequently forage in oak savanna and high mountain meadow systems (Figure 1). Bears commonly grub and dig in grasslands in search of food stuffs including fungi, grasses, forbs, and large quantities of insect prey in grasslands. With the recent ban on the use of hounds in California without a coupled law allowing the use of bait, bear populations are expected to increase. Additionally, bears are significant predators of deer fawns, and likely have a negative impact on deer populations (Conger and Giusti 1992, Wittmer et al. 2014). Without the use of hounds or bait, targeting bear for economic hunting opportunities proves challenging.

Other big game: Bighorn sheep (*Ovis canadensis* spp.) and pronghorn (*Antilocapra americana*) have relatively small populations in California, yet are of significant interest as game species. Both species primarily inhabit shrubland-steppe systems of eastern California, and for private landowners in these areas, have economic viability as a game animal. The CDFW strictly limits the number of tags available for bighorn sheep and pronghorn antelope, as their objectives are to increase population numbers. Similar to elk, the CDFW allocates tags through a random lottery where hunters pay annually for a chance to be issued a tag. If drawn, hunters can pursue the game species for which they were awarded tags. Since tags are in short supply (often once in a lifetime), many tag recipients are willing to spend extra money for private land access to ensure they harvest an animal of their desired size.

Upland game birds: Upland game birds provide excellent recreational opportunities for outdoorsmen in California. Wild turkey (*Meleagris gallopavo*), chukar (*Alectoris chukar*), dove (*Zenaida* spp.), and pheasant (*Phasianus colchicus*) are some of the state's most popular upland bird quarry. Each of these species prefer specific habitat types (Table 2). Turkeys tend to like grasslands with suitable tree cover for roosting, and adequate tall grass or brush nearby for nesting efforts. Chukar benefit from some of the nation's worst grassland invaders, annual brome (*Bromus* sp.), and are known for living on steep ridges with ample rock cover for escape from predators. Doves, among California's fastest fliers, present a great challenge for hunters of all age classes and abilities. Most successful dove hunts in California grasslands

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Table 2: California grassland game animal occurrence

	Habitat preference			
California grassland game animals	**Grasslands**	**Savannas**	**Shrublands**	**Mixed habitats**
Roosevelt Elk *(C. canadensis roosevelti)*	✦	✦	✧	✦
Rocky Mt Elk *(C. canadensis nelsoni)*	✧	✦	✦	✦
Tule Elk *(C. canadensis nannodes)*	✦	✦	✧	✧
Bighorn Sheep *(Ovis Canadensis* spp.*)*	✧	✳	✦	✳
Mule Deer *(Odocoileus hemionus* spp.*)*	✧	✦	✧	✦
Black-tailed Deer *(O. hemionus columbianus)*	✧	✦	✦	✦
Pronghorn *(Antilocapra americana)*	✧	✳	✦	✧
Wild Pig *(Sus scrofa)*	✧	✦	✦	✦
Black Bear *(Ursus americanus)*	?	✧	✦	✦
Rabbits *(Lagomorpha* spp.*)*	✦	✦	✦	✧
Turkey *(Meleagris gallopavo* spp.*)*	✧	✦	✦	✦
Sage-Grouse *(Centrocercus urophasianus)*	✳	✳	✦	✳
Pheasant *(Phasianus colchicus)*	✧	✳	✧	✧
Chukar *(Alectoris chukar)*	✦	✳	✧	✳
Band-tailed Pigeon *(Patagioenas fasciata)*	?	✦	✧	✦
Dove *(Zenaida* spp.*)*	✦	✦	✧	✦
Waterfowl *(Anseriformes* spp.*)*	✧	✳	✳	✳

✦ Frequent Occurrence ✧ Moderate Occurrence ? Questionable Use Patterns ✳ Unexpected Sighting are in areas with trees and available water during the early September hunt. Pheasants prefer areas adjacent to farmlands with adequate food cover and large expanses of tall grasslands for nesting cover (Stackhouse 2013). Some of California's worst weeds for farming enterprises are a welcome sight to a wild pheasant in the Central Valley.

Conclusion

California is a state of diverse habitats, expansive landscapes, and ample opportunities for outdoor enthusiasts. With a decrease in vegetation management, prescribed fire, and timber harvest in public land management, and increased human populations in the state demanding more hunting, the best opportunities for successful hunts are on private lands. Now more than ever before, hunters are paying for access to hunt private lands, and landowners across the state have opportunities to provide access to hunters for economic benefit, although such access often comes with some management responsibilities for the landowner. California's grasslands provide some of the best hunting opportunities in the state, and properly managed livestock operations can enhance wildlife habitat and subsequent hunting opportunities. Ranching and hunting enterprises are anything but mutually exclusive. As historic ranches are asked to support additional family units (i.e. parents plus the addition of their adult children's families), hunting can be a great way to diversify a ranch business portfolio and provide additional income for another family unit on the home ranch.

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Announcing a New *Grasslands* Series: Native Landscaping Snapshots

by Billy Krimmel[1], photos courtesy the author

Introduction

The purpose of this series is to explore the potential for habitat restoration through native landscaping, and the value that using natives adds to landscapes by connecting them to larger contexts (e.g., habitat restoration, science education, resource conservation, etc). As part of this series, in each edition of *Grasslands* we will include a snapshot that digs into a portion of this large topic, from broad trends to highlights of interesting species interactions, species of conservation interest, and do-it-yourself tips for creating your own native garden. We will first provide a brief background and touch on some of the major themes for this series.

State of the industry

Americans spent $83 billion on landscaping in 2016, the industry growing at 5.1% annually over the previous five years (IBISWorld 2017). Not all this money went to planting and maintaining plants (e.g., think barbeques and patios), but it was directed towards enhancing the outdoor experience in urban and suburban areas, which comprise around 54% of land in the continental United States. With another 41% of our land dedicated to agriculture, 'natural areas' (those we have not converted to urban, suburban or agricultural uses) comprise only about 5% (Tallamy 2008). Imagine the $83 billion we spend each year on landscaping being prioritized toward creating native habitat as the primary means to enhance the outdoor experience. Imagine the 54% of our land that we've altered being pushed in the direction of supporting native bees, birds, and other wildlife, rather than just being 'decorative'. The impact of human population growth would look a lot different.

Landscaping is not often thought of as a means to a conservation or restoration end. Very few ecologists or conservation biologists are in the landscaping industry because they tend to focus on the untouched or about-to-be touched areas, rather than urban or suburban areas. Meanwhile, the landscaping industry pushes forward, using its resources to create experiences centered around aesthetics (e.g., colors, textures, and shapes) and nostalgia (e.g., British gardens and Grandma's roses), but with little conceptual

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[1]CNGA Board member. Billy holds a PhD in ecology and is the owner of Restoration Landscaping Company, a design/build firm based in Sacramento that is dedicated to creating habitat in urban and suburban areas.

emphasis on how creating native habitat can contribute to experiences. There is a wide gap between landscape designers and ecologists and how each group thinks about the value of their work.

On the other hand, there are a growing number of individuals and organizations dedicated to bridging this gap. In California, because of an extended drought and resulting water restrictions, many homeowners are replacing lawns with plants that require less water. Public marketing campaigns and financial incentives have helped promote this. As homeowners are compelled to consider the environmental impacts of their gardens via water usage, they also may consider other ways to control their impact for a common good, like using native plants that require little water and create habitat for wildlife. As landscape designers and contractors embrace more sustainable practices, they may see added value that native plants (as opposed to non-native but still drought-tolerant alternatives) provide through habitat restoration and a window into nature's fascinating evolutionary ecology.

The garden meta-population

People generally do not think about their gardens as being part of an ecosystem. The scale of a backyard can feel miniscule compared with the vast mountain ranges and watersheds we imagine when we think about ecosystems. But the sum of these small patches of habitat created by native gardens can add up to a resilient ecosystem that supports native wildlife—a garden meta-population. Understanding this allows home and business owners, landscape designers, and contractors to take part in something special and impactful when they plant natives.

Science in your front and back yards

The home garden is where most people engage on a daily basis with plants. In gardens we observe insects and birds, enjoy floral colors, get our hands dirty handling soil, plants and mulch, and contemplate the interactions taking place between the different organisms. One of the amazing components of using native species in gardens is that these interactions carry added meaning due to their evolutionary history with the other species with which they interact. Plants create a vast assortment of chemical products with a wide array of functions that interact with microbes, other plants, insects, and other animals in important ways.

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Native Landscaping Snapshots *continued*

An insect walking around on a plant with which it has co-evolved interacts with myriad chemical cues that carry meaningful information about, for example, the plant's nutritional state, its level of chemical defense, whether or not other insects have been there recently, and many other time-sensitive types of information—very specific cues that are perceived by specialized receptors in the insects' antennae that are adapted to those particular cues (e.g., Fatouros et al 2012). Plants have been shown to signal to each other—in particular to closely-related individuals—when they are under attack by insect herbivores. They do so by releasing volatile compounds that are perceived by nearby plants, which then have a chance to boost up their own chemical defenses to reduce the negative effects of imminent herbivory (Karban et al 2000).

Plants can also signal to predators when they are being eaten by herbivores (e.g., Kaplan 2010), a loose mutualism in which both parties benefit; the predator gets its prey, and the plant gets its herbivore killed. These interactions are often very species-specific; plants respond to specific salivary contents present in herbivores that eat them (Tian et al 2012), for example, and in other instances plants signal specific parasitic wasps of the particular herbivore (e.g., an insect) eating them (e.g., Walling 2000). Evolutionary history between plants and insects is what enables the specific signals and responses in these interactions.

By placing native plants in gardens, observations we make of plants interacting with native insects, birds, and other plants take on new meanings, make more sense, and provide learning opportunities. Young children can create experiments where experimental treatments involve moving insects around between plants, and data collection can be as simple as counting the number of herbivore-chewed leaves on plants from various experimental treatments (a simple way of ascertaining how experimental treatments affect how desirable a plant is to herbivores). A large number of fascinating studies have been published on plant-insect interactions that involve simple methodology and materials, and can be observed with the naked eye and replicated in native gardens for school projects, citizen science, or exploration grounded in scientific context.

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Seeking a new style

Gardens have long been a type of status symbol. Neatly-manicured lawns and shrubs in the front yard demonstrate the organization and resources of the homeowner. By and large we have mimicked British gardens in California, favoring lush lawns reminiscent of English hillsides rather than our own native plants, despite the tremendous amount of inputs (fertilizer, and water, in particular) needed to keep them alive here. Breaking out of this conventional style of gardening can be difficult, and homeowners can be reticent to do something that looks different from what exists in the rest of the neighborhood. So how do we transition the statement a garden makes into something that creates habitat? What elements of the conventional garden do we discard, and which ones do we keep?

Maximizing a garden's habitat potential often means maximizing the number and diversity of native plants in the garden—filling in the spaces with plants that provide habitat for critters. This can be somewhat at odds with expectations of neatness, and some people react adversely to gardens they deem "overgrown," which often means that plants are touching each other. Fortunately, gardens like those in many UC Arboretums provide beautiful examples of how to create full, yet organized assemblages of plants. In addition, annual native garden tours organized by the California Native Plant Society and other organizations offer homeowners examples of how to design habitat gardens that look nice and meet their needs. Landscapers need not sacrifice aesthetics or organization to create a native habitat garden—neatness and habitat are not mutually exclusive. Achieving this requires combining knowledge and skills derived from ecological and restoration with those from landscape-design fields. Linking ecology, evolution, and habitat restoration into other concepts at play in landscape designs can add more context, natural history experiences, and value.

Resources and rebates

In an attempt to catalyze the transition from conventional gardens to native gardens, the state of California, together with local municipalities and water providers, have been offering rebates for home and business owners to replace their water-intensive landscapes with more drought-tolerant designs. These rebates (generally around $2 per square foot, and up to $2,000 for homeowners, and more for businesses) have been offered concurrently with media campaigns aimed at showcasing examples of drought-tolerant gardens and providing information on the water usage of these gardens compared with conventional ones.

Conclusions

There is tremendous potential to restore functional habitat to cities and suburban areas by changing the way we landscape. There are also considerable challenges, and overcoming the inertia within the industry to change their products, styles, and methods will take time. It's hard to say how much people will continue to replace their lawns with more sustainable landscapes now that the drought emergency has passed, but creating native gardens for the sake of habitat restoration is a conservation goal that has nothing to do with the drought. That said, we seem to have an increasingly interested audience within the landscape design and architecture fields when we talk about creating context, stories, a sense of place, and connection with the garden and greater ethical and environmental movements. For homeowners, the option of owning an aesthetically-pleasing, environmentally-friendly landscape is an appealing option in terms of cost and aesthetics, and is competitive with traditional gardening methods. Please let us know what you want to learn about or discuss within this broad topic.

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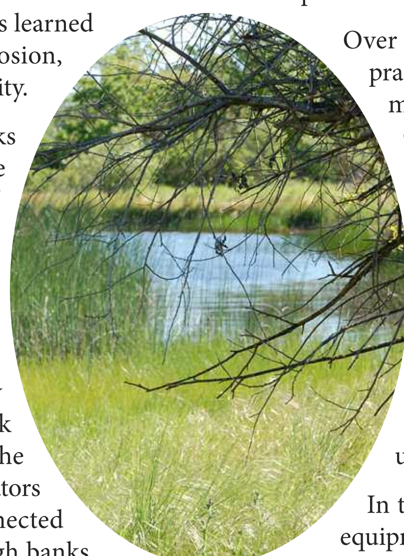
Figure 1. Board member and ecologist Jaymee Marty describes riparian restoration along Union School Slough (photo by Phil Hogan, NRCS).

Inset: Figure 2. View to constructed pond and plantings (photo by Phil Hogan, NRCS). *Photos: Phil Hogan, NRCS*

Highlights from CNGA's 10th Annual Field Day at Hedgerow Farms

by Jim Hanson, Member, CNGA Board of Directors[1]

Hay ride tours, field walks, and talks by leading grassland experts filled CNGA's April 22nd Field Day at Hedgerow Farms. Organized around the theme "Essential Elements: Lessons from a Decade of Field Days," over one hundred participants traveled farm roads to see and hear about some of the lessons learned using native grasses and forbs to control erosion, maintain water quality, and conserve biodiversity.



Riding on trailers through shaded canal banks and native grassland production fields, we learned about the benefits and management of planting hedgerows of bunchgrasses, sedges, and forbs along roadsides, canal banks, and farm edges. Then, winding through maturing riparian woodlands, Bryan Young, Chris Rose, and Hedgerow Farms founder, John Anderson, shared some of the practical wisdom they gained in the 1990s while planting valley oak (*Quercus lobata*) acorns and seedlings on the banks of the Union School Slough. Using excavators and bulldozers, they created a series of connected gravity-fed ponds along formerly farmed slough banks. Native riparian trees with a lush understory of sedges, rushes, grasses, and shrubs now shoulder the canal. Initiated to increase groundwater recharge and bring back wetland habitat, the site is habitat to ducks, pheasants, deer, beavers, otter, and other grassland and wetland wildlife (Figures 1 and 2).

With vast waving fields of purple needle grass (*Stipa pulchra*) as a backdrop, Mary Schiedt of Yolo Audubon explained how meadow larks, grasshopper sparrows, and many other birds rely on grasslands for breeding and foraging. Scheidt touched on how mowing heights and timing can be varied to benefit grassland birds. Don Hildebrant of the California Hawking Club described how Harris Hawks are used to control small mammal populations in production fields.

Over lunch, eight respected grassland ecology and practice experts delivered short talks with take-home messages drawn from their work: soil scientist Vic Claassen, ecologist Valerie Eviner, weed specialist Joe DiTomaso, restoration landscaper Billy Krimmel, USFWS Refuge Manager Joe Silveira, Pacific Coast Seed's David Gilpin, rangeland specialist Richard King, and Corey Shake, biologist for Point Blue who works with the Rangeland Watershed Initiative to improve ecosystem health on rangeland. Among the display tables, assembled by local non-profit conservation organizations, several carried useful information on planting for pollinators.

In the afternoon our group toured the seed-sorting equipment and the demonstration garden constructed by Hedgerow Farms staff to show a sampling of the over 100 northern California native species grown at the farm. Planting trials are being carried out to evaluate different methods in establishing narrow leaf milkweed (*Asclepias fascicularis*).

Marking its tenth year, the CNGA Field Day at Hedgerow Farms harvested a wealth of information from the speakers, the participants, and the many living farm trials constructed over the years to support wildlife and pollinators... a wealth that we will need to draw and build upon as we gear up to deal with climate change and its affects on our work in preserving grassland diversity for the decades ahead.

[1]Jim is a Bay Area landscape architect active in conservation of native plant communities, especially grasslands.

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Front cover: White-tailed Kite (*Elanus leucurus*) in Elk Grove at the Bufferlands surrounding the Sacramento Regional Wastewater Treatment Plant. *Photo: Ryan P. Bourbour, UC Davis*

Back cover: Columbian Black-tailed Deer (*Odocoileus hemionus columbianus*), also known as Mule Deer, at Gualala Point Regional Park. *Photo: Jim Coleman*