California goldfields (*Lasthenia californica*) and arroyo lupine (*Lupinus succulentus*) bloom in this installed meadow in Loomis, CA, using the seed mixes on page 18. *Photo: Billy Krimmel*

SNAPSHOT: *by Billy Krimmel[1] and Haven Kiers[2]*

Creating Structured Native Meadows for Landscapes

Natural meadows are dynamic ecosystems where annual plants (such as wildflowers) change in relative abundance and location every year, blooming and waning within a season. For landscapers, recreating native meadows exemplifies the challenge of striking a proper balance between wild and organized aesthetics. From the perspective of habitat restoration, meadows provide immense value: they produce large amounts of biomass, are highly biodiverse, and are frequented by a diversity of animals, many of which are rare or threatened.

But from the perspective of those working in the landscaping industry, restoring meadows is far more challenging, logistically and aesthetically, than executing the conventional landscapes around which the industry is built. For example, annuals are beautiful when they are growing and blooming, but as the plants senesce and die they remain as dried, standing skeletons while other species begin to bolt and bloom. Large rain events following sowing of seeds can wash seeds out of areas, resulting in bare patches. Maintenance is complicated, and preparation, particularly in large areas, requires surveying, planning, and time.

Despite these challenges, we are hopeful that meadows will emerge as a widespread element in California landscapes. Recreating native meadows in large spaces — public and private — can be cost-efficient and the messiness of the *tangled bank* (see explanation next page) softens when seen from afar. Even in small residential settings, meadows can work well when homeowners embrace the complexity of their landscape (and the task of explaining to their neighbors, "*No, those are not weeds!")* Every meadow has different requirements depending on the project intentions and the constraints of scale, location, and budget. This can be intimidating, but should not deter people from attempting to create native meadows. For those who prefer self-help, Gornish and Shaw (2017) recently published a helpful manual on restoring native grasslands. Also, the California Native Grassland Association and its partners are great resources for working through the challenges of designing, creating and maintaining native meadows. If you are interested in creating a meadow but intimidated by the challenges, reach out to **admin@cnga.org** and we'll do our best to help you out or connect you with someone who can. Please also send pictures of your attempts — successful or not — in creating native meadows, and we'll publish them in subsequent *Grasslands* editions. We would also love to hear about your trials, tribulations and successes.

continued next page

[1]Billy is a CNGA board member, holds a PhD in Ecology, and is the owner of Restoration Landscaping Company, a design/build landscaping firm based in Sacramento, CA.

[2]Haven holds a Master's of Science in Landscape Architecture and teaches landscape design and construction at UC Davis, and at UC Berkeley. She is special project manager at the UC Davis Arboretum, and a Design Principal for Restoration Landscaping Company.

Native Meadows *continued*

A Quick Guide for Creating Structured Meadows

Site preparation

Properly preparing an area for restoration is critical, and is probably the step that most often predicts success or failure. The key element to keep in mind is that once the area is seeded with native species, selective removal of weeds becomes extremely challenging. Differentiating between species before plants flower can be difficult for even an experienced ecologist or restoration practitioner. Therefore, the easiest time to remove weeds from your meadow is before you install the meadow.

Many methods of weed removal are available before the meadow is installed, including solarization, removal by hand, herbicide, mowing, torching, tilling, removing soil, and many more. The appropriate method depends on the species of weeds and the constraints of the project (in particular, scale, timeline, budget, and ability to use herbicides). The first step is figuring out what weeds are already present, and then determining how to control them. The University of California Statewide IPM program (**http://ipm.ucanr.edu/**) is a great resource for most relevant species in California. Regardless of the method, the goal is to create a low-competition environment for the meadow. This is particularly critical when seeds are to be sown in the first season.

On very small scales, another weed control method takes advantage of the fact that root hairs are tiny in comparison of cotyledons and true leaves. This method involves putting cardboard down and covering it with a few inches of soil, then sowing seeds upon the soil. When the seeds germinate, their microscopic root hairs can penetrate the cardboard, assuming it stays wet — this is important — if the cardboard dries, this method will not work. New leaves coming from below the cardboard, however, are unable to penetrate the cardboard and thus suppressed. This approach works well with some weeds but is not sufficient to suppress others such as Bermuda grass (*Cynodon dactylon*), nutsedge (*Cyperus* spp.) and *Oxalis* spp., which will eventually find a way to make it through or around the cardboard. It is important to have supplemental overhead irrigation available for this approach to keep the cardboard moist during dry and sunny periods of the winter.

For larger meadows, a staged preparation and installation is the most common practice. Weeds and thatch are removed as much as possible, and then foundational native plants are planted in the first fall, typically in small sizes such as liners or plugs for the sake of cost efficacy. For the foundational species (typically bunch grasses and some woody perennials) we like to use a matrix design, placing plants at a regular distance from one other. During the first year, weeds that come up can easily be killed because the area within the matrix is still relatively open and accessible (as opposed to filled with germinating wildflowers). If weed control is successful, native forb seeds can be sown the following fall to create a full grassland or meadow. Another advantage of this approach is that it allows the bunchgrasses and slower-growing perennials to establish before encountering competition from the seeded forbs.

Tangled bank is a term coined by Darwin in _On the Origin of Species._

He writes: "It is interesting to contemplate a tangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us".

continued next page

California Native Grasslands Association

PO Box 485
Davis, CA 95617-0485

(530) 902-6009

www.cnga.org

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.

Native Meadows *continued*

Irrigation

Supplemental irrigation is a great tool for successfully establishing a meadow. In addition to supporting thirsty native transplants and seedlings in dry years, it also helps with weed control because supplemental water can stimulate germination and vegetative growth in weeds that can then be killed, especially during the preparation phase. Another advantage is that blooms of native wildflowers can be extended for desired species by supplementing water in the spring and summer.

The two most common setups for supplemental meadow irrigation are overhead sprinklers and a drip irrigation grid. Overhead sprinklers need to be tall enough to throw water over nearby plants, so they should either be attached to risers or on large pop-up bodies that allow them to get at least a few feet above ground level. A drip irrigation grid, on the other hand, involves setting up a grid of inline drip emitter tubing throughout the entire meadow area. With this system, irrigation water is dispersed slowly and relatively homogeneously throughout the entire area. Compared with drip irrigation setups where individual emitters are placed next to each individual plant, the grid setup allows plants to grow anywhere within the grid area, which is necessary for a meadow where seeds are to be dispersed irregularly. The spacing and flow rate depend primarily on the soil type and grade. Manufacturers of these products tend to have good information on recommended specifications based on site conditions. Resources and information for irrigation systems can also be found at CNGA native landscaping workshops.

Plant selection

As with all native landscaping, the starting point for thinking about which species to use should be the local conditions. Ask questions like: What other native plants (if any) grow here, or nearby, already? Is the soil sandy or heavy? What animals are present that might eat the plants? What animals do I want to create habitat for?

Another consideration is the origin (commonly referred to as ecotype) of the plant material to be used. When possible, it's best to use plants that are propagated from individuals collected nearby. Most nurseries and seed suppliers that specialize in native species for restoration purposes keep track of this information. To find the correct ecotype for a given species, we encourage a two-step process. First, use CalFlora (**calflora.org**) to determine the natural distribution of a given species. Next, check with your supplier on what ecotypes they have available and then try to use one from as close to the project site as possible. Hedgerow Farms and others have this information online: (**https://www.hedgerowfarms.com/species-database**).

A common goal for creating meadows is to create habitat for native animals. For best results, think beyond floral traits and pollinators. Having flowers that bloom throughout the season is important — it's just not the whole picture. Other plants traits, like oils and resins produced by plants, are also important pollinator resources (e.g., Rasmussen and Oleson 2000). Also, not all flowers are of equal value for a given pollinator—some pollinators are generalists and use a variety of easily-accessible flowers, while others are specialists and prefer less-accessible flowers to which they are uniquely adapted (e.g., Faegrin and Van Der Pijl 2013). Other elements of installed meadows also have habitat value. For example, dead plants and dry twigs can be important nesting sites for solitary bees, while rocks are important to reptiles for hiding and basking, and piles of wood are used as overwintering sites for beneficial insects. The most effective approach may be to strive for local plant species (with proximal origin locations) and high diversity. This approach is a simple and safe way to ensure you will be creating good habitat for a diversity of native animals.

Aesthetic considerations

No matter how weed-free or species-diverse your meadow, if it doesn't look good, no one is happy. So how do you create functional meadows that are also beautiful? The key is to take a cue from nature itself.

Have you ever sown a "wildflower seed mix" in your backyard and then studied the results? The landscape is evenly distributed with the same mixture of species in a riotous bloom of colors and textures. Although rife with color, the meadow is strangely uniform — one corner looks almost exactly like another. Now picture the wildflowers that bloom along the Coast Range in the spring — long ribbons of purple broken up by great swaths of yellow. There's no such thing as a perfectly randomized mix in nature. Annual wildflowers bloom and typically spread their seeds close by. If the seeds land in conditions conducive to growth, they will colonize and reseed extensively, out-competing other species. In areas where one flower fares poorly, another might thrive and multiply. The result will be a different trajectory of growth across the landscape, with plants settling into spots best suited to their ecological needs.

Aesthetically, our eyes are drawn to these patches and swaths of color — we find more beauty in a meadow made up of a series of discreet repeating modules than in an endless sea of uniformity, no matter how diverse the species mixture. One method we use in adding structure to seeded meadows is to make mixes comprised of a few species that are sown together. Each mix is comprised of species that bloom at different parts of the season, resulting in approximate monocultures at any given time, but changing with the changing seasons (see Mix ideas next page).

When designing your own meadow, consider using the hierarchy of planting created by garden designers Piet Oudolf and Noel Kingsbury (2016). The bulk of the meadow is made up of matrix planting — these are the foundational species — typically bunch grasses that are planted en masse and spread across the site, as described above. Mixed into the matrix in small groups and clumps are primary plants — select perennial forbs that stand out against the relatively neutral backdrop of the grasses and create seasonal interest.

continued next page

Sample species mixes for a 1.5-acre meadow in Loomis, CA — Each mix has a combination of species that will bloom from early spring through fall, with one predominant species blooming in each patch at any given time. Broadcast the mix into a distinct swath in the area to be seeded, to create structure reminiscent of natural blooms.

Mix 1 Elegant clarkia (*Clarkia unguiculata*) | Red ribbons (*Clarkia concinna*) | Sky lupine (*Lupinus nanus*) | Vinegarweed (*Trichostemma lanceolatum*) | Turkey mullein (*Croton setiger*)

Mix 2 California goldfields (*Lasthenia californica*) | California bluebell (*Phacelia campanularia*) | California poppy (*Eschscholzia californica*) | Spanish clover (*Lotus purshianus)*

Mix 3 Slender clarkia (*Clarkia gracilis*) | Common madia (*Madia elegans* var. *vernalis*) | Coastal tidytips (*Layia platyglossa*) | Common gumplant (*Grindelia camporum*)

Mix 4 Arroyo lupine (*Lupinus succulentus*) | Fort Miller Clarkia (*Clarkia williamsonii*) | Coastal tidytips (*Layia platyglossa*) | Common madia (*Madia elegans* var. *densiflora*)

Mix 5 California goldfields (*Lasthenia californica*) | Purple clarkia (*Clarkia purpurea*) | Evening primrose (*Oenothera californica*) | Turkey mullein (*Croton setiger*)

Mix 6 California goldfields (*Lasthenia californica*) | Redmaids (*Calandrinia menziesii*) | Woolly sunflower (*Eriophyllum lanatum*) | Summer lupine (*Lupinus formosus*) | Common madia (*Madia elegans* var. *densiflora*)

Native Meadows *continued*

Annual wildflowers can either fall into the primary plant category, in which case seeds are scattered in large monocultural groups (or mixes as described above) within a grassy matrix, or into another category called scatter plants. While matrix plants add consistency and primary plants add visual interest, scatter plants add spontaneity to a meadow. In this case, seeds of a single species or mix are scattered across the site in patches.

Another area to consider in your meadow design is the edge. This transitional zone between meadow and its neighboring habitat (be it urban infrastructure, commercial development, formal landscape, or a home) is typically an area of flux, with increased sunlight and higher biodiversity (e.g., Harris 1988). Edges create a dramatic foreground to your meadow beyond — use them to introduce seasonal plants, test new species, and highlight variety in color, form, or texture.

As with any garden, it's important to consider bloom time and seasonality of plants. California meadows tend to put on their biggest display in the spring and then fade into the background the rest of the year. That's OK — your meadow doesn't need fireworks for every season. But a little color can go a long way — adding patches of later-blooming *Epilobium* spp., *Solidago* spp., and *Aster* spp. can take a meadow from summer all the way through fall. And consider leaving seed heads and flower stalks for winter interest.

Monitoring and maintenance

Creating a meadow or grassland is not a one-step installation but should be a dynamic, ongoing process that requires attention and effort throughout. Following installation, it is critical that meadows and grasslands are monitored for weeds and that weeds are promptly removed to the extent possible. Hand removal, torching, and spot-spraying with herbicides are effective approaches when the spatial scale is manageable. In larger settings, well-timed mowing or grazing can also be highly effective. In most landscape settings, mowing is more accessible than grazing, and can be used to target problematic species of weeds.

In some instances where invasive weeds are abundant within an already-seeded meadow, it may be necessary to kill entire sections, including the desired plants. The sooner these patches can be identified in the rainy season and killed, the better, because desired seeds may still germinate afterward. This is another instance where having supplementary irrigation is beneficial — it can extend the 'rainy season' longer, allowing native seeds to germinate in areas where invasive species had to be removed early in the rainy season.

The extent to which weeds can be eliminated *prior* to seeds being sown will make the maintenance following seeding immensely easier. Patience pays off. *Now go make a meadow!*

References

Faegri, L., and L. Van Der Pijl. 2013. *Principles of pollination ecology.* Elmsford: Pergemon Press.

Gornish, E.S., and J. Shaw. 2017. "Restoration manual for annual grasslands in California." UC ANR Publication 8575. Accessed February 10, 2018. **https://cnga.wildapricot.org/resources/Documents/Resources/Restoration%20Resources/Grassland_Restoration%20Manual.pdf**

Harris, L.D. 1988. "Edge effects and conservation of biotic diversity." *Conservation Biology* 2(4):330–332.

Oudolf, P., and N. Kingsbury. 2013. *Planting: A new perspective*. Portland: Timber Press.

Rasmussen, C., and J. Oleson. 2000. "Oil flowers and oil-collecting bees." *Scandinavian Association for Pollination Ecology* 39:23–31.