Vegetation Management After Fire:

The Use of Natives in Annual Dominated Systems in Central California

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In general, the establishment of California natives in exotic annual dominated systems involves a number of key steps for success. The re- establishment process includes: (1) waiting for annual grass weeds to emerge approximately 5-7 days after the first fall rains, and then managing them either with an herbicide or mechanical treatment. Keep in mind that the plants that colonize after a fire can often be invasive forbs – particularly yellow starthistle – and are not necessarily the types of plants that typically dominate annual grasslands; (2) soon after the "treatment", planting re-vegetation species as seeds or plugs. It is important to choose species based on how well they will accommodate your management goals; (3) in late winter applying some kind of broadleaf weed management and, in early spring, managing grass weeds (with mowing or grazing) while your seeded species are still relatively small. Exotic annual grasses establish quickly and grow rapidly. Targeting them in early spring with mowing or grazing can reduce their ability to outcompete the desirable species.

The choice of what to plant after a fire is as important as understanding the role fire plays in species selection. For example, generally, herbs tend to do better after a burn; however, they also tend to respond less well than grasses to grazing.

Management goals can include increasing forage production, erosion control and enhancing wildlife habitat. Regardless of restoration goal, multiple species should always be used in seeding or planting approaches because it increases resistance to further invasion by weedy plants.

Plant materials used should be adapted to local conditions. The easiest way to acquire suitable plant materials for re-vegetation is from local or federal native nurseries and farms. You can check out the CA native plant link exchange for lists of seed and stock by county and producer: http://cnplx.info or look into the native seed network for resources on the native seed industry by state: http://nativeseednetwork.org.

Although restoration seed mixes should be comprised of functionally dissimilar species (annuals and perennials, forbs and grasses, etc.), mixing annuals (which tend to grow quickly, bloom early, and have shallower roots) and perennials (which tend to grow slowly, bloom late, and have deep roots) in seed mixes can result in a significant decrease of emerging perennials. Planting or seeding perennials earlier than annuals is a good way to encourage germination and root development of perennials in the absence of intense competitive pressure from annuals.

Some general suggestions for how much seed you should be using:

- For seed mixes: seed 9 - 20 pounds of seed per acre. This includes approximately 3 - 7 pounds per acre of easily established, fast growing species and 6 - 10 pounds per acre of slower growing species (e.g. most perennial grasses)
- Large-seeded natives should be broadcast seeded at higher rates (pounds per acre) than smaller-seeded natives
- Forbs should be planted at higher pounds per acre than perennial grasses
- Seeding rates for shrubs are much lower than those for herbaceous species

Resources for seeding California native species:

- Grassland restoration for bumblebee habitat
  http://bumblebeeconservation.org/images/uploads/Resources/BBCT_Land_Factsheet_4_Grassland_restoration.pdf
- Guide to habitat enhancement for birds
  http://www.pointblue.org/uploads/assets/pacvalley/SacValleyHabitatEnhancement.pdf

The establishment stage of seeded natives is extremely vulnerable to the competitive effects of invasive plants, therefore, after the majority of seeding and planting has been conducted, weed management must be maintained to ensure adequate establishment and survival of seeded species. In general, you should plan for a minimum of three years of subsequent weed management.

Below is a list of potential species to consider. These species were chosen based on published literature that highlights their capacity as re-vegetation candidates. General pros and cons associated with each species are listed, as well as suggested seeding rates. Because this information is the result of extensive literature searches and communication with practitioners, descriptions can sometimes appear contradictory, or entirely absent.

Species to consider

- **Yarrow** (*Achillea millefolium*) – Perennial forb that prefers well-drained soils in full sun. 1-2 lb/ac
  - Pros: good butterfly plant, improves soil quality, good for erosion control, drought tolerant, relatively high germination
  - Cons: does not respond well to grazing or mowing, generally found at low density, flood intolerant
- **Spanish lotus** (*Acmispon americanus*) – Late season blooming annual forb. Does well early in the restoration process and then demonstrates low density in subsequent years. 1-2 lb/ac
  - Pros: responds well to grazing, does well in disturbed areas, good for erosion control, good for butterfly habitat, relatively drought tolerant, tolerant of heavy metals, nitrogen fixing, resists fire.
  - Cons: can be weedy, so better not to use near croplands
- **Fiddleneck** (*Amsinckia menziesii*) – Annual forb that requires full sun. 1-2 lb/ac
  - Pros: good pollinator plant, drought tolerant, disturbance tolerant
  - Cons: toxic to livestock, can become weedy, relatively low germination
- **Common fiddleneck** (*Amsinckia intermedia*) – Annual forb that does well in low elevation undisked soil. 1-2 lb/ac
  - Pros: good pollinator plant, has been shown to reduce seed output of *Bromus tectorum*, disturbance tolerant, drought tolerant
  - Cons: toxic to livestock, a poor competitor to some exotic grasses, can become weedy
- **Mugwort** (*Artemisia douglasiana*) – Perennial shade tolerant herb.
  - Pros: good for erosion control, pollinators and wildlife habitat, disturbance, drought tolerant
  - Cons: flood intolerant
- **Narrow leaf milkweed** (*Asclepias fascicularis*) – Perennial herb.
  - Pros: good for pollinators
  - Cons: flood intolerant
- **California Bromegrass** (*Bromus carinatus*) – Perennial grass that prefers clay, loam soils. 1-4 lb/ac
  - Pros: erosion control, rapid establishment, good for use after fire, good forage for cows and wildlife, will attract butterflies, relatively high germination rates, can establish on slopes, high germination.

    - Cons: short longevity, since it is easily spread, this should not be used near crops. When used in mixes, makes sure that this is not a dominant as nothing else will grow
- **Redmaids** (*Calandrinia ciliata*) – An annual forb that prefers well-drained soils.
    - Pros: good for wildlife, can grow in nutrient poor soils, drought tolerant, fire resistant
    - Cons: can be a minor weed in agricultural areas, difficult to establish
- **Owl's clover** (*Castilleja exserta*) – Annual forb. 1 lb/ac
    - Pros: good pollinator plant
    - Cons: difficult to establish
- **Cobweb thistle** (*Cirsium occidentale*) – Perennial forb. 1-5 lb/ac
- **Elegant clarkia** (*Clarkia unguiculata*) – Endemic annual forb.
    - Pros: drought tolerant, good for pollinators, larval host for Clark's sphinx moth, tolerant of most soils (except heavy clay) and habitat types, high germination
- **Saltgrass** (*Distichlis spicata*) – Warm season, sod forming perennial grass.
    - Pros: disturbance tolerant, excellent for erosion control, although it prefers sandy soils, it can grow in clay soils, high survival from transplanting, responds well after a burn
    - Cons: generally avoided by livestock
- **Blue wildrye** (*Elymus glaucus*) – Perennial grass. This species best used as an early seral species and performs well on well-drained upland sites. 6 lb/ac
    - Pros: can do well as an understory species, drought tolerant, good at resisting invasion from yellow starthistle, good establishment, high survival, can establish on slopes, high germination, fast growing
    - Cons: adult plants are only a 'fair' forage species, intolerant of heavy, continuous grazing and shallow soils, takes at least two years to mature in ideal conditions, can be hard to establish, can be weedy, flood intolerant
- **Thickspike wheatgrass** (*Elymus lanceolatus*) – Perennial grass found in a variety of habitats, but does best on well-drained soils. 6-11 lb/ac
    - Pros: erosion control, disturbance tolerant, drought resistant, tolerant to wildfire, good for livestock, does not get weedy, good for resisting invasion by knapweed, strong seedling vigor
- **Big squirreltail** (*Elymus multisetus*) – Perennial grass that prefers well drained soils, good spring forage species. 2-4 lb/ac
    - Pros: drought tolerant, good for erosion control, can grow (and eventually suppress) cheatgrass monocultures, good establishment
    - Cons: low fire tolerance, does not do well as an understory species, takes at least two years to mature in ideal conditions, does not persist
- **Slender wheatgrass** (*Elymus trachycaulus*) – Perennial grass. 2-40 lb/ac
    - Pros: good establishment, fast growing, flood tolerant, can establish on slopes
- **Creeping wildrye** (E*lymus triticoides*) – Water loving perennial grass that uniquely produces long, robust rhizomes. 0.5 - 2 lbs/acre
    - Pros: flood tolerant, fast growing once established
    - Cons: does not establish well
- **California fuchsia** (*Epilobium canum*) – Perennial forb.
    - Pros: relatively drought tolerant, excellent for pollinators
- **Turkey mullein** (*Eremocarpus setigerus*) – Summer annual forb that grows in open, dry areas.
    - Pro: good for wildlife
    - Cons: can be weedy in agricultural areas, can be dangerous for livestock
- **St. Catherine's lace** (*Eriogonum giganteum*) – Endemic perennial shrub.
    - Pros: good for wildlife.

- **California Poppy** (*Eschscholzia californica*) – Annual or perennial forb that does not mix well with *Avena fatua* or *Lolium perenne*. Does well early in the restoration process and then demonstrates low density in subsequent years. 0.5 lb/ac
    - Pros: good for erosion control, encourages pollinators, drought and disturbance tolerant, very adaptable to different soil conditions, high germination rates, cost effective
    - Cons: may be toxic to livestock, can become weedy in some areas, low emergence
- **Idaho Fescue** (*Festuca idahoensis*) – One of the most common and widely distributed perennial grasses in the western US. 20 lb/ac
    - Pros: good for erosion control, good forage species, can grow as an understory species, deer resistant, resists cheatgrass invasion
    - Cons: slow to establish, requires adequate soil moisture, since this is a late seral species, it does not do well with invasives, and should only be used in secondary seeding efforts
- **Small fescue** (*Festuca microstachys*) – Cool-season annual grass that prefers sandy soils.
    - Pros: tolerant of low-nutrient soils, fast growing
- **Red fescue** (*Festuca rubra*) – Perennial grass that prefers well drained (sandy loam) soils. 6-20 lb/ac
    - Pros: can establish on slopes, grazing tolerant, salt tolerant, shows high recruitment once established, relatively drought tolerant, erosion control, wildlife habitat, fire resistant
    - Cons: relatively poor at establishment, not palatable to livestock, can restrict forb growth
- **Gumplant** (*Grindelia camporum*) – Late season blooming perennial forb that is tolerant of both clay and sandy soils. 0.5 lb/ac
    - Pros: grows readily, disturbance tolerant, drought tolerant, good for wildlife habitat, high germination rates, cost effective
    - Cons: can be toxic to livestock, can become weedy in crop areas, can be slow to establish, flood intolerant
- **Hayfield tarweed** (*Hemizonia congesta*) – Annual forb found. 2 lb/ac
    - Pros: Good for pollinators and wildlife, drought tolerant, can tolerate invasives
- **Spikeweed** (*Hemizonia fitchii*) – Annual forb. 2 lbs/acre
    - Pros: disturbance tolerant, good for pollinators
    - Cons: can become weedy, avoided by livestock
- **Meadow barley** (*Hordeum brachyantherum*) – Perennial grass that does best on fine textured soils. 8-40 lb/ac
    - Pros: wide soil tolerance, good establishment, fast growth rate, high survival once established, high value for deer forage in Spring, tolerant of low fertility soils and prescribed fire, does relatively well in the first year of seeding, flood tolerant, can establish on slopes and in ditches, relatively high germination
    - Cons: low to moderate forage value for livestock, can be weedy (do not plant close to agricultural sites), not a good understory species, generally does not last past the first year, relatively non-resistant to invasion, low establishment
- **June Grass** (*Koeleria macrantha*) – Perennial grass that can grow in both full sun and part shade.
    - Pros: relatively drought tolerant; grazing tolerant, fast growing, fire tolerant, good for erosion control, salt tolerant
    - Cons: cannot tolerate clay soils, is negatively affected by nitrogen addition, can be hard to establish
- **Goldfields** (*Lasthenia californica*) – Annual forb.
    - Pros: tolerant of many soil types, good pollinator species, relatively drought tolerant, fire resistant, establishes to high cover
- **Coastal tidytips** (*Layia platyglossa*) – Annual forb found mostly on clay soils. 0.5 lb/ac
    - Pros: good for pollinators, good for wildlife, drought tolerant, salt tolerant

- **Annual lupine** (*Lupinus bicolor*) – Annual forb found in an array of open sandy habitats. 0.30 lb/ac
    - Pros: good pollination plant, does well in disturbed soils, drought tolerant, fire resistant
    - Cons: low natural cover, does not do well with perennials, vulnerable to small rodent herbivory
- **Chick lupine** (*Lupinus densiflorua*) or (*Lupinus microcarpus*) – Annual forb. 4-8 lb/acr
    - Pros: alkaline soil tolerant, drought tolerant, good wildlife habitat.
- **Arroyo Lupine** (*Lupinus succulentus*) – Annual forb that is almost endemic to California. Prefers moist clay or heavy soils in full sun. Higher growth rate in high nitrogen soils. Does well early in the restoration process and then demonstrates low density in subsequent years. 2-4 lb/ac
    - Pros: Good for erosion, excellent pollinator plant, deer resistant, drought tolerant
    - Cons: low germination rate
- **California melicgrass** (*Melica californica*) – Endemic cool season rhizomatous perennial grass that prefers full sun or partial shade in well-drained upland locations. 3-20 lb/ac
    - Pros: erosion control, tolerant of many different soil types, deer resistant, drought tolerant, fast growth rate, fire resistant, endemic to California, robust to invasion
    - Cons: requires good drainage, weak rhizomatous growth, slow growing: can take up to 4 years to mature
- **California melic** (*Melica imperfecta*) – Perennial grass that does best with partial shade. 10 lb/ac
    - Pros: erosion control, grazing tolerant for deer and elk, drought tolerant, fire resistant
    - Cons: irregular germination
- **Douglas' microseris** (*Microseris douglasii*) – Annual forb.
    - Pros: grows well on clay and serpentine soils
    - Cons: responds poorly to grazing
- **Orange monkey flower** (*Mimulus aurantiacus*) – Almost endemic perennial showy shrub that is an important host plant for checkerspot butterfly larvae. Can grow in a variety of soil, even nutrient poor soil. Best on well drained soils.
    - Pros: drought tolerant
- **Deergrass** (*Muhlenbergia rigens*) – Warm season perennial bunchgrass that favors sandy or well drained soils. 4-6 lb/ac
    - Pros: flood tolerant, salt tolerant, drought tolerant, good wildlife habitat, erosion control, relatively fast growing, burn tolerant
    - Cons: mature plants are poor for grazing, can reduce native growth
- **Baby blue eyes** (*Nemophila menziesii*) – Annual forb that is tolerant of moderate shade. 8lb/ac
    - Pros: good for pollinators, drought tolerant
- **Bunchleaf penstemon** (*Penstemon heterophyllus*) – Endemic perennial forb that requires well drained soils.
    - Pros: drought tolerant, good for wildlife
- **California phacelia** (*Phacelia californica*) – Endemic perennial forb mostly found in well drained soils. 0.5 -2 lb/ac
    - Pro: good wildlife habitat, good for pollinators, drought tolerant, cost effective, grazing tolerant, creates copious seeds
    - Cons: flood intolerant
- **Caterpillar phacelia** (*Phacelia cicutaria*) – Annual forb. 0.5 lb/ac
- **Lacy Phacelia** (*Phacelia tanacetifolia*) – Annual forb that tolerates clay soils. 4 lb/ac
    - Pros: drought tolerant, easy to establish, good for pollinators
- **California plantain** (*Plantago erecta*) – Annual forb found mostly on low elevation shallow soils. 3-7 lb/ac
    - Pros: good pollinator plants, erosion control, quick establishment, relatively high germination

    - Cons: not particularly drought tolerant, not flood tolerant, poor competitor with invasive annuals
- **Sandberg Bluegrass** (*Poa Secunda*) – Perennial grass favored by fire, and does well on well-drained upland sites. 2-5 lb/ac
    - Pros: can be drought tolerant, can establish on slopes
    - Cons: does poorly in dry areas but is also flood intolerant, does not readily increase in density
- **Alkali sacaton** (*Sporobolus airoides*) – Warm season perennial grass.
- **Nodding needlegrass** (*Stipa cernua*) – Cool season endemic perennial bunchgrass that doesn't like heavy soil and needs full sun or partial shade. 2-3 lb/ac
    - Pros: drought tolerant, good for erosion control
    - Cons: not fire resistant, not grazing tolerant, flood intolerant
- **Foothill needlegrass** (*Stipa lepida*) - This mostly coastal cool season perennial bunchgrass dislikes heavy (class 2) soil. 2-3 lb/ac
    - Pros: grazing tolerant, long lived, drought tolerant, fire resistant, good for pollinators, erosion control
    - Cons: not fire resistant
- **Purple needle grass** (*Stipa pulchra*) – Cool season perennial bunchgrass. One of the most common clone forming native grass species in California. Likes sandy loam soils, soils with high clay content and well-drained upland sites. Does better in the absence of grazing. 3-10 lb/ac
    - Pros: tolerant of poor nutrient and low moisture soils, strong root systems good for erosion control, highly palatable to livestock, will grow well in dense patches of filaree, once established, has very high survival
    - Cons: very low emergence rate, doesnt do well with annuals, slow growth rate (takes about 3-4 years for this species to reach maturity), not at all fire resistant, flood intolerant
- **Indian clover** (*Tifolium albopurpureum*) – Annual forb often found in clay and loamy soil. 2-3 lb/ac
    - Pros: responds well to grazing, well adapted to a variety of habitats and disturbed areas, low water requirements, blooms long into summer, good for wildlife, good pollinator plant, nitrogen fixer
    - Cons: low cover
- **Bull clover** (*Trifolium facatum*) – Annual forb. Does well early in the restoration process and then demonstrates low density in subsequent years. Will grow in all soils but prefers well drained soils. 2-3 lb/ac
    - Pros: good for livestock, nitrogen fixer
    - Cons: can become weedy, although some studies have found an absolute failure of this species for restoration purposes
- **Clammy clover** (*Trifolium obtusiflorum*) – Annual forb. Does well early in the restoration process and then demonstrates low density in subsequent years. 2 lb/ac
    - Pros: disturbance tolerant, nitrogen fixer, good for erosion control, good pollinator plant
    - Cons: does not appear to establish well
- **Tomcat clover** (*Trifolium willdenowii*) – Low elevation annual forb that prefers heavy soils in full sun. 0.5 lb/acr
    - Pros: Drought tolerant, fast growing, good for pollinators, likes disturbed areas, relatively good establishment success, nitrogen fixer
    - Cons: can become weedy in agricultural fields, provides low cover, vulnerable to herbivory