Guidelines for Choosing a Restoration Plant Palette and Collecting Native Plant Materials[1]

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Abstract

One of the first tasks in restoration planning is determining the appropriate native plant species and associated quantities. Species with the greatest prevalence at the restoration site, collectability, heat, sunlight and disturbance tolerance, germination and reproduction rate, large growth habit, soil retention qualities, nitrogen fixation, wildlife habitat value, and weed competitiveness were the main traits considered and desired. After this analysis is completed, a listing of on average twenty different species is generated, along with seeding or planting rates per acre for each species. Once this palette of species is developed, the locations from which the native plant material will be harvested and guidelines for those collections should be determined.

Keywords: chaparral restoration, Angeles National Forest, seed collection, native plant palette

Introduction

Wildland vegetation restoration, especially arid land restoration, requires multi-year planning to ensure that the correct native species are obtained and effectively utilized. One of the first, and probably most important, steps in beginning restoration planning is to determine the native plant species that will make up the planting palette. The palette is a suite of species that are the most appropriate plants to utilize for revegetation purposes. This intention of this paper is to provide guidance on methods for 1) selecting a successful plant palette; 2) determining the amount of seed or container plants needed for a site; and 3) sustainably harvesting wildland seed and cuttings. A "lessons learned" section also highlights challenges that can arise and techniques for moving forward.

Planting Palettes

The native species present in the vicinity of the proposed restoration areas are used as a reference for proposed seed, cutting and container plant palettes. When determining which plant species to use at a site the species with the greatest prevalence, collectability (*e.g.* not extremely sticky, spiny, or rash inducing), heat, sunlight and disturbance tolerance, germination and reproduction rate, large growth habit, soil retention qualities, nitrogen fixation, wildlife habitat value, and weed

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[1] A version of the paper was presented at the Chaparral Restoration Workshop, Arcadia, CA, June 17-20, 2013.

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competitiveness are the main traits considered and desired. To maintain plant species diversity on the site an average of 20 different species are typically listed in the plant palette, with the rationale that probably only 10-15 of these could be collected/grown given logistical and environmental hurdles. After testing a wide variety of species on restoration sites with different aspects, elevation, disturbance levels and vegetation a group of "workhorse" species which have the most consistent success emerged. A sampling of these species is provided in Table A for seeding restoration techniques and Table B for container planting. An example of a plant palette for mixed chaparral is provided in Table C.

In order to determine the amount of seed, cuttings and/or container plants that were needed for a restoration site, the most important factors considered are the projected amount of collectable material, existing non-native plant cover in the vicinity, soil compaction, annual precipitation and potential for unauthorized vehicle traffic. The amount of seed needed is determined in Pure Live Seed (PLS) pounds. PLS represents the percent of the gross seed weight composed of viable seeds. PLS is determined by performing both purity and germination tests. On the ANF the amount of PLS pounds needed on a restoration site varied from around 15 pounds on riparian sites to 35 pounds on desert transition chaparral sites. On average mixed chaparral sites received 30 PLS pounds. Determining quantities of container plants is discussed in the paper "Restoration in type converted and heavily disturbed chaparral: Lessons learned" of this General Technical Report.

Lessons Learned-

- It is important to create seeding palettes using PLS pounds, not bulk seed pounds, as much of the bulk poundage is not viable and will not provide any canopy cover for the restoration site. PLS rates vary widely by species and by season, so it is best to have the PLS percentage tested for each year's collection. The gross average PLS percentage for these restoration sites was around 30%, meaning the bulk rate of seed applied to the restoration site needed to be roughly three times greater than the PLS pounds required for the site (1 pound PLS=3.3 pounds bulk).
- If seeds which require some sort of pre-treatment (which will not naturally occur on the site) for germination must be used, ensure they have indeed received that treatment. Standard methods for overcoming seed coat dormancy include scarification, stratification, soaking in hot/cold water, chilling, heating, exposure to different kinds and durations of light, chemical treatment, and combinations of these. Examples of common species that require pre-treatment are chamise, manzanita, ceanothus and yerba santa.
- In the plant palette be sure to include species that act as nitrogen fixers, such as species in the pea (Fabaceae) family.
- Do not include fire following species in the planting palette unless money and time are not an issue. These plants are typically very difficult to propagate, especially under wildland restoration conditions.
- Have large plant palette species lists (in the 20's), knowing some will drop out due to environmental conditions or logistical hurdles.
- Over-collect by around 20% of the needed PLS rate. This will provide contingency for species that end up having low germination rates and build seed stores for remedial plantings.

Table—A. Workhorse plant species for restoration by seeding of chaparral ecosystems on the Angeles National Forest, California.

Species	Common name.
Acmispon glaber	deerweed
Ambrosia acanthacarpa	annual bur-sage
Artemisia californica, A. tridentata	California sagebrush, big sagebrush
Astragalus filipes	threadstalk milkvetch
Atriplex canescens	four-wing saltbrush
Bromus carinatus	California brome grass
Elymus elymoides	squirreltail grass
Eulobus californicus	California suncups
Encelia actonii, E. californica, E. farinosa	encelia
Ericameria nauseousus	rabbitbrush
Eriogonum fasciculatum	California buckwheat
Helianthus gracilentus	slender sunflower
Peritoma arborea	bladderpod
Poa secunda	perennial bluegrass
Salvia apiana, S. mellifera, S. leucophylla	white, black and purple sage
Salvia columbariae	chia sage
Stipa coronatum, S. lepida, S. pulchra, S. speciosa	needle and thread grass
Vulpia microstachys	Pacific fescue

Table B—Workhorse container plant species for chaparral ecosystems restoration on the Angeles National Forest, California.

Species	Common name
Adenostoma fasciculatum	chamise
Arctostaphylos glandulosa, A. glauca	Eastwood manzanita, bigberry manzanita
Artemisia californica, A. tridentata	California sagebrush, big sagebrush
Atriplex canescens	four-wing saltbrush
Cercocarpus betuloides	birchleaf mountain mahogany
Encelia actonii, E. californica, E. farinosa	encelia
Ericameria nauseousus	rabbitbrush
Eriodictyon crassifolium	yerba santa
Eriogonum fasciculatum	California buckwheat
Hesperoyucca whipplei	chaparral yucca
Malacothamnus fasiculatus, M. fremontii	chaparral mallow
Peritoma arborea	bladderpod
Salvia apiana, S. mellifera, S. leucophylla	white, black and purple sage
Sambucus nigra ssp. *caerulea*	elderberry

Table C—Example of plant palette for a mixed chaparral restoration site (includes seed and container plant rates) on the Angeles National Forest, California.

Species	Common name	Seed or container	Pure live seed pounds/ac. containers/0.5 ac.
Achnatherum coronatum	giant needlegrass	seed	1
Acmispon glaber	deerweed	seed	2
Adenostoma fasciculatum	chamise	seed	1.2
Adenostoma fasciculatum	chamise	container	100
Ambrosia acanthicarpa	annual bur-sage	seed	0.5
Arctostaphylos glandulosa ssp. *glaucomollis*	Eastwood's manzanita	container	50
Ceanothus leucodermis	chaparral whitethorn	container	50
Cercocarpus betuloides	mountain mahogany	container	40
Corethrogyne filaginifolia	common sand aster	seed	0.2
Cryptantha intermedia/C. muricata	popcorn flower	seed	0.2
Eriastrum densifolium	shrubby eriastrum	seed	0.3
Eriodictyon crassifolium	yerba santa	container	100
Erigeron foliosus	leafy daisy	seed	0.3
Eriogonum elongatum	long-stemmed buckwheat	seed	0.5
Eriogonum fasciculatum	California buckwheat	seed	4.5
Eriogonum fasciculatum	California buckwheat	container	100
Eriophyllum confertiflorum	long-stemmed golden yarrow	seed	1
Hazardia squarrosa	saw-toothed goldenbush	seed	0.3
Hesperoyucca whipplei	chaparral yucca	seed	3
Hesperoyucca whipplei	chaparral yucca	container	50
Heterotheca grandiflora/H. sessiliflora	telegraph weed/golden aster	seed	1.3
Lotus scoparius	deerweed	seed	2
Malacothrix saxitalis	slender-leaved malacothrix	seed	0.2
Malocothamnus fasiculatus/M. fremontii	lax-flowered bushflower	seed	0.5
Melica imperfecta	coast range melica	seed	1
Phacelia cicutaria	caterpillar phacelia	seed	0.5
Poa secunda	perennial bluegrass	seed	2.5
Prunus illicifolia	holly-leaved cherry	container	40
Salvia apiana	white sage	seed	2
Salvia columbariae	chia	seed	1
Salvia mellifera	black sage	seed	3
Salvia mellifera	black sage	container	75
Sambucus nigra ssp. *caerulea*	elderberry	container	20
Vulpia microstachys	Pacific fescue	seed	3
Total			30 lbs, 625 containers

Plant Material Collection Guidelines

All cuttings and seeds should be collected from sources in the local area. The use of local plant materials, which are adapted to local conditions, increases the likelihood that the cuttings and seedlings are successful and at the same time maintains the genetic integrity of the local ecosystem (Erickson et al. 2003, Rogers & Montalvo 2004). Local in this case means within a five mile radius of the same HUC6 watershed of the restoration site. Care should also be taken to ensure that plant materials are from within 500-1,000 vertical feet of the elevation of the site. On the ANF in a few circumstances when sources were limited, this radius was extended to ten miles for more widespread herbaceous species that were likely to be genetically homogeneous. Following is a list of the native plant material collection protocols that were developed:

- For each species in a permitted seed mix, seed should be obtained from several (more than two) populations within the permitted collection area. A different population is defined here as two populations that have a very low chance of exchanging genetic material with each other. In other words they are separated by distance or a geographical barrier. To make this determination it is often necessary to have some knowledge of the species' main pollinators and their movement capabilities.
- Seeds must be collected from at least 35 different, well dispersed individuals in a population. A record should be kept of the estimated number of individuals sampled.
- No more than 25% of the total seeds of an individual can be taken, with the exception of areas that have all vegetation removed by project activities.
- Significant damage (such as cut limbs or crushing) to the parent plant should not be incurred during seed collection.
- Seed heads may be cut off just below the inflorescence; however, cutting shears must be sterilized between project areas to prevent disease spread.
- Seeds must be mature at time of collection. This is highly dependent on the plant species and weather, but in general runs from April through late December.
- Dry seeds should be collected into bags or plastic bins and then transferred into breathable (paper, cloth or poly) bags. Fleshy seeds should be collected directly into plastic bags.
- Seeds should be stored temporarily in a cool, dry (best to use desiccants) state in breathable (not plastic) containers and labeled with the species name, date collected, location collected (latitude/longitude, UTMS), name of collector, average elevation, and Project name.
- To the extent feasible, harvest cuttings from plants outside the migratory bird nesting season (February 1–August 15). If activities must be performed during the breeding season, the crew must take precautions to avoid nests in the work area. If active nests are observed, the supporting vegetation must be excluded from any type of

collection or cutting. A minimum 10 foot exclusionary buffer is recommended.

- Take cuttings only from healthy, vigorous plants that are in a dormant state (typically late November-late February depending on elevation).
- Collect the cuttings within 24 hours of anticipated planting or propagation. All cuttings should be placed (the entire cutting) in water until planting time. Cuttings that are allowed to dry out shall not be used.
- Do not collect from more than 25% of the plants in a given area and do not remove more than 25% of any individual plant.
- Cuttings shall be done with sharp, sterilized tools (to minimize spread of disease) and approximately 6–24 inches in length and will range from 0.5 to 1 inch in diameter.
- Cut the top of each cutting square at the nodes, above a leaf bud and the base below a leaf bud at an angle of approximately 45 degrees in order to be able to tell the correct orientation of the cuttings for planting (angled cut placed down).
- Trim leaves and branches from the cuttings flush with the stem to encourage rooting success.
- Cuttings should be labeled with the species name, date collected, location collected (latitude/longitude, UTMS), name of collector, average elevation, and Project name.
- Whole plants or bulbs can only be removed from a site for later transplanting if they are likely to be destroyed by site disturbances.
- Avoid weedy areas in order to prevent seed contamination and the spread of non-natives. Areas showing signs of vegetation type conversion to non-natives (i.e. greater than 100 ft^2 areas estimated to have over 25-30% non-native canopy cover) shall not have seeds/cuttings collected.
- Off road vehicle driving is not allowed for collection. Vehicles must stay on designated, unvegetated roadbeds.
- Before entering the ANF vehicles must be washed if they have driven off of paved roads. Vehicle washing should include the wheels, undercarriages, bumpers and grill portions of vehicles. Tools/equipment that have been utilized off ANF lands or in weed infested areas shall also be cleaned prior to moving to a different site.

Lessons Learned-

- Start seed/cutting collection at least two years (preferably 3-4 if the restoration site is over a few acres) in advance of when the plant material is needed at the restoration site. In light of the current California drought conditions it is best not to rely on only one season of collection, as plants are stressed and seed production is typically lower than normal.
- A determination of what is “local” plant material is often subjective, but preserving genetic integrity and using plants best adapted to the restoration site must be considered a priority.
- Wildland plant material collections are often very difficult given terrain and questionable availability (especially for native grasses in

chaparral habitats). Bulking seeds by growing it out as a crop in a farm-like fashion is often a preferred alternative so some environmental variables such as lack of water can be controlled. Protocols for bulking should be followed: 1) only seed collected from the wild should be utilized to grow the first crop; 2) species with the potential to hybridize or the same species from different geographic locations should be separated far enough to prevent cross-pollination; and 3) seeds produced from bulking should not be utilized to grow the next crop so that genetic traits specific to the restoration area can be preserved.

- Adequate long term seed storage is of great importance if seeds are going to be kept more than three years. In this case seeds should be stored in cool temperatures (around 40F) and low humidity (6-7 % moisture), but seed specific requirements should be followed. It is also important to protect seeds from rodents, insects and mold/fungi for both long and short term storage.
- If seed/cutting collecting can be done prior to a site being disturbed consider collecting more than 25% of the seed or the plant (for cuttings) in the actual disturbance footprint, as these plants will likely be destroyed by construction activities.
- Transplanting bulbs and whole plants has been tried four times over the past five years on the ANF. Transplanting of whole plants was only tried if the plant was a perennial, under 2-3 years of age. The reasoning for only transplanting young plants is that older plants typically have longer, more developed root systems, which are more easily damaged. Overall both transplanting of bulbs and whole plants was only marginally successful (around 10% survival when outplanted). This was most likely due to human error in transplanting (*e.g*. cutting roots, over/under watering, incorrect soil medium), but also may not be feasible given environmental requirements that are not understood or difficult to mimic.

Acknowledgements

I would like to thank Mark Borchert and Jan Beyers for their insightful comments on this manuscript.

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