NATIVE WILLAMETTE VALLEY PRAIRIE AND OAK HABITAT RESTORATION
SITE-PREPARATION AND SEEDING

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Rev. December 2013

Note: These are techniques that we have tried or learned about from other sources. For a full list of site prep and seeding techniques, please see **Appendix A p. 23.**

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PRAIRIE HABITAT

DEFINE THE STARTING CONDITIONS:

1) Remnant prairie with a significant population of native plants
2) Meadow with a significant population of native plants
3) Meadow with a few natives only
4) Uncultivated old fields and pasture with few or no natives
5) Cultivated agricultural field
6) Highly disturbed and/or steep areas where erosion is a concern (excavated, logged etc.)
7) Bare patches for native pollinators

SITE PREPARATION:

1&2: Remnant Prairie or Meadow with significant population of native plants

Use herbicide only in weedy areas with few or no natives. These areas can be planted with plugs of native plants in the fall, or seeded if the area is relatively weed-free. In the native-rich areas, you can spot-spray, or use mechanical control methods such as weed-eaters, and pruners.

Many of our native remnant sites are rich in forb diversity but lack native grasses; or the native grasses are few. In this is the case, you could use a grass-specific herbicide to target the non-

native grasses, then enhance the site by adding native grasses and more forbs as the non-native component is reduced. The Institute for Applied Ecology conducted research that addresses the efficacy of the grass-specific herbicide Poast as a restoration tool in prairie remnants. Please see the following link for more information.

http://www.appliedeco.org/conservation-research/prairie-restoration-research

In general, care must be taken any time herbicides are used to remove unwanted vegetation. The space created may fill in with undesirable species, so it's imperative that the desired plant material be put in place to fill that space as quickly as possible. Initial findings of the study indicate one of the most difficult non-native grasses to eliminate is creeping bentgrass (*Agrostis spp*.) [see # 4 and 5 below]. The native fine-leaved bunchgrass Roemer's fescue (*Festuca roemeri*) and California oatgrass (*Danthonia californica*) have some tolerance for grass herbicides depending on the time of application and the age of the plants, but you should do careful trials in your project site.

3: Meadow with few natives only

Decide if it's less expensive and troublesome to lose the few native species present and then, in possible, reestablish them from seed or plants. For example, many old fields have yarrow and buttercup, but little else. Since these species are widely available, you can focus your efforts on preparing a site substantially reduced of weeds, and re-seed or re-plant them. If possible, you can also collect seed from these populations before site-preparation. For preparation suggestions using herbicides, see #4 and 5 below.

An option for adding diversity to the site without herbicides is solarization of small patches and interplanting plugs of native species, but this increases cost and can be tedious work.

4&5: Uncultivated fields and cultivated fields with few or no natives

Herbicide

Use the broad-spectrum systemic herbicide glyphosate for AT LEAST two seasons to kill existing vegetation and reduce the weed seed bank. This should be applied as soon as you the site is accessible. Suggested application rates are 2 quarts/acre in cool weather and 1 quart/acre in warm weather [1 – 2% glyphosate solution]. For tough, perennial grasses the first application can be as high as 3 quarts/acre. The addition a non-ionic surfactant [at 1 qt/100 gallons of water] is recommended. But a combination surfactant with ammonium sulfate Class Act® [at 2.5 gal/100 gallon of water] will also increase the efficacy of the glyphosate. Herbicide should be applied three times per year [fall, spring, and the following fall] at a MINIMUM. Timing of the herbicide application is crucial. It is desirable to eliminate weeds before they flower. To emphasize, it is important to realize that the weed seed bank is will never be exhausted. The seed drill will invariably dredge up weed seed no matter how "clean" the field may seem post-herbicide application.

Most grasses will be killed in one season. A second season application is desirable due to the persistence of hard-seeded species such as clover and vetch, glyphosate resistant **deep-rooted** or **rhizomatous** forbs such as Queen Anne's lace, St. John's-wort, Oxeye daisy, and Canada thistle, and annuals such as sow thistle, crane's bill, mustard, and speedwell that take advantage of the vegetation-free space and emerge the second season.

Hard to kill perennial forbs can be treated with a broadleaf herbicide. The most effective broadleaf chemical for these species is triclopyr (Garlon). The West Eugene Wetlands vegetation manager Paul Gordon (2013 pers. comm.) has found a May-June spot treatment of 1.5% triclopyr with the addition of 0.5% aminopyralid (Milestone) works exceptionally well on curly dock, sheep's sorrel, wild carrot, St. Johnswort, scotch broom, blackberry, oxeye daisy and

bachelor button. Hand-pulling or tilling these species is note recommended due to their persistent rhizomatous root character.

Cultivation vs. Herbicides

Cultivation is not necessary in the age of no-till drills. Tillage only brings weed seed to the surface and dormant weed seed that has been built up in the soil for generations will never be exhausted.

A 2005 restoration site-preparation forum hosted by the Lane Council of Governments and attended by restorationists, researchers, water and soil scientists, and farmers concluded that the best way to prepare a pasture or agricultural field for native prairie seed reintroduction is herbicide application for at least two years without cultivation. Or, if you must till, do it ONCE and then start the herbicide regime. If bare soil is a concern, plant a cereal cover crop such as wheat, oats, or barley in September to control winter erosion and suppress weeds. According to The Oregon State Extension Service (see **Appendix A** below) cover crops "protect the soil surface, smother weeds, …and scavenge nitrogen from the soil before it is leached below the root zone by winter rains."

Problem weedy grasses - Bentgrass, Velvetgrass, Tall oatgrass, and Rattail fescue

In old fields and pasture the aggressive, non-native perennial grasses **bentgrass**, **tall oatgrass** (*Arrhenatherum elatius*), and **velvetgrass** (*Holcus lanatus* and *Holcus mollis*) can be the greatest threat to successful native plant reestablishment. Velvetgrass can be a problem especially in wetter cultivated fields due to seed persistence in the soil.

These grasses often fill back in on restored sites even after the native grasses have established. They threaten the "bunchgrass" prairie structure (which allows open ground for nesting sites, forbs, and native pollinator habitat) if not **aggressively** scouted and spot-sprayed each season. The most common grass-specific herbicides used in restoration work are: fluazifop (Fusilade), sethoxydim (Poast), and clethodim (Envoy, Select 2EC, and Section). Choosing native graminoid species that show resistance to these herbicides is discussed in later sections.

Another scourge of restoration sites is **rattail fescue** (*Vulpia myuros*). This annual grass takes advantage of bare soil after herbicide treatment and can quickly fill the space as the natives try to establish. One grass-specific herbicide (**clethodim**) is effective if used repeatedly while the grass is young. Poast and Fusilade are ineffective herbicides on rattail fescue. There are a couple of pre-emergent herbicides labeled for this species on non-crop/restoration lands but care must be taken to understand the mode of action, the chemical specificity, and soil life of pre-emergent herbicides. Some control can be obtained using contact (non-systemic) herbicide such as **diquat** (Reward) as long as there are not native annuals present. Again, the target weeds need to be young, coverage complete, and application repeated. Non-herbicide control of this species is very difficult.

For native seeding options that allow herbicide treatment for the problem species see Option 3, Grass Weeds, Possible Solutions below.

Good Site-Preparation and Follow-up Management are Critical:

Many native species (both grasses and forbs) are slow to establish. They need a site free of other vegetation in order to germinate unimpeded and to flourish. Most bunchgrasses and perennial forbs grow slowly and don't set seed until their second season (some forbs not until the third or fourth.) They are poor competitors.

Once the prairie species are established, it is critically important to burn the site every 2 – 5 years to remove thatch. If you can't burn, mow. Burning, however, is the most effective tool to

maintain native prairie. Willamette Valley prairie species evolved with fire. Fire reduces the competition from thatch and woody species, stimulates the root crowns of the native grasses and forbs, and reopens the site for native annual species. Burning yearly is not recommended because it increases the abundance of weedy, non-native annual species and noxious perennials such as Canada thistle and tansy ragwort. It is also desirable to augment the area with new native seed and/or plants after burning or mowing to tip the competitive balance toward a sustainable native stand.

A note on mowing: If there is heavy residue from mowing, it should be removed from the site. Thatch reduces the vigor of native plants. If the site is open, options include swathing and baling the straw or using a silage harvester that cuts and discharges it into a trailer. If this is not an option, then use a mulching mower to hasten that decay.

6: Highly Disturbed Sites

If the site has been disturbed by earthmoving equipment it is absolutely **essential** to not let it lie fallow. Both erosion and the tendency of weeds to occupy bare soil emphasize the need to establish a desirable living plant cover on the soil as soon as possible. If the goal is to re-vegetate the site with native plant species, try to allow any weed seeds that might be present to germinate, and then spray them with glyphosate. Species to be sown should be fall and/or winter germinating grasses and forbs that compete well with non-native species.

Native species are **extremely** small, even those that germinate in the fall or winter, so they will NOT hold soil on sloped sites. It might be advantageous on **erodible** sites to either 1) sow a summer cover crop such as Sudan grass at about 70 lbs/acre, then mow and bail it when in flower or 2) sow an early-fall **nurse crop** of a spring cereal grain such as **oats** at about 20-30 lbs/acre (apply glyphosate if possible before sowing). Sowing the spring grain in early-fall will ensure it establishes good roots and holds the soil during the fall and early winter. Spring grains usually freeze out in winter. Oversow the area in October with native seed. If the nurse crops do not freeze out, mow them in early-May to a height of 6-8 inches, well above the native annual forbs. Barley has also been recommended due to its lack of regrowth if mowed. Winter wheat is fine as a cover crop before seeding as long as it is killed before sowing natives but wheat should never be used as a nurse crop due to its potential root **allelopathic** effects.

7: Bare areas for native pollinators

In all cases above, some bare patches should be retained in order to provide vital pollinator nesting sites. Most native bee species nest in bare soil. The best sites to retain would be cut banks or areas by fallen trees and snags that face the morning sun. To keep the area free of vegetation, herbicide can be applied early in the morning or late in the evening when the bees are in their nests. For more information on native pollinator conservation see **Appendix A.**

NATIVE SEEDING ORDER OF GRASSES AND FORBS:

OPTION 1 – GRASSES AND FORBS TOGETHER
OPTION 2 – FORBS FIRST, GRASSES LATER
OPTION 3 – GRASSES FIRST, FORBS LATER

There are many possible ways to approach native seeding after site-preparation. On our sites, we have had the most success with Option 1 (multiple herbicide applications following by seeding forbs and graminoids at the same time). These sites have the greatest establishment rate and highest diversity of native species several years later. Other restoration professionals are using Option 2 in former grass seed fields or in order to establish high quality, forb-rich pollinator habit. Option 3 is becoming less popular due to the difficulty in establishing forbs in

the dense stand of grass. All native seed is best sown in the fall to ensure any seed stratification needs are met. Many native seeds need 2-12 weeks of cold-moist pre-treatment to germinate.

OPTION 1

If the site is very clean (when the top layer of weed seed has been reduced considerably) grasses and forbs can be sown at the same time [this might be the case in grass seed fields with little residual seed, fields and pastures with multiple herbicide applications, or areas solarized for a long period].

The advantages to this method are **numerous:**

1) Every square inch of is occupied by a **native** seed.
2) Every seed has the best chance of establishing.
3) There is little competition from existing vegetation (native or non-native).
4) A diversity of species can be sown including species that need a long seed stratification period over winter.

Sowing the seed

A. Broadcast forbs and drill grasses:

Broadcast the forbs using a hand-crank spreader, a large spinner-spreader pulled by an ATV or tractor (rented at your local farm store), or a seed drill removing the seeding tubes from drill openers so that the tubes dangle while spreading seed, or by hand. If this option is chosen, the forbs should be sown at a higher rate than drilling due to diminished soil contact and possible predation from field mice and birds (see below for sowing rate suggestions). Drill grasses **over** the broadcast seed, or press into the soil with a cement or water drum roller (although this disturbs the soil and could increase weed pressure).

When we first used this method in 2008, we drilled *Festuca roemeri* in upland areas and *Danthonia californica* in wetter areas, then broadcast-seeded forbs in both plots. Surveys in summer 2009 and winter 2010 indicated that the *Festuca roemeri* area had the highest cover of both native grass and forbs (see **TABLE 1** photos 1A and 1B below). This native grass germinates in the fall so it was able to establish with or before the forbs. *Danthonia californica* needs 12 weeks of cold-moist stratification to germinate, and did not establish well. Many native and weedy forbs germinated in the fall (especially the annuals) and competed with the desired native grass (1C). Follow-up surveys in the winter of 2010 showed very little establishment of *Danthonia* (1D). The low cover of grass allowed short-lived perennials such as Lupinus rivularis to cover large areas of the site (1E), but by summer of 2013 most of the area was dominated by non-native velvetgrass and a low cover of native forbs (1F).

TABLE 1 - Option 1: Broadcasting forbs and drilling grasses – Fall 2008 seeding

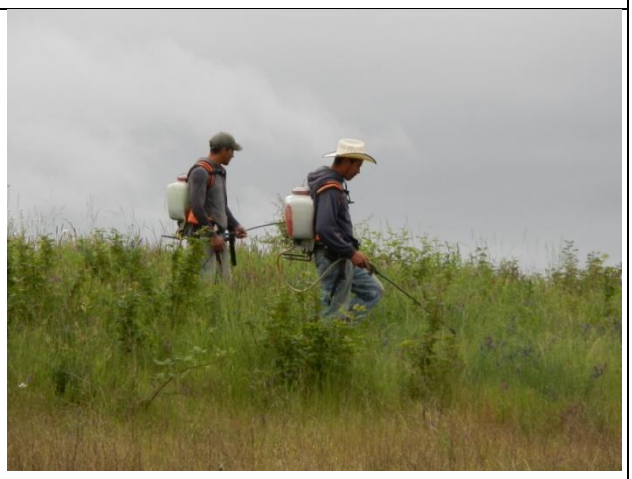
	
1A Summer 2009: *Festuca roemeri* with annual forbs the summer after sowing	1B Winter 2010: *Festuca roemeri* (arrows) and abundant native perennial forbs (pictured: *Sidalcea campestris*, *Prunella vulgaris* var. *lanceolata*, *Eriophyllum lanatum*, *Clarkia* sp., *Potentilla glandulosa*, and *Lotus purshianus*).
	
1C Summer 2009: *Danthonia californica* area with native and non-native annuals (pretty, but poor native grass establishment)	1D Winter 2010: Two Small tufts of *Danthonia californica*. These were difficult to find due to low abundance and annual weedy forbs in high density.

	
1E Summer 2010: *Lupinus rivularis* dominates the second summer.	1F Summer 2013: Non-native velvetgrass dominates the plot, some hearty perennial forbs persist but *Lupinus rivularis* requires less competition and died out.

"Plan B" - Due to the persistence of non-native perennial grasses even after two years of site preparation, in fall of 2010 we chose to seed only graminoid species that would tolerate a grass-specific herbicide. The area had been a former Perennial bentgrass grass crop field so we knew the grass would be persistent. Wetland areas were sown with a mixture of sedges, rushes and forbs (**TABLE 2** 2A and 2B below). Upland areas were sown with the fine-leaved bunchgrass *Festuca roemeri* which shows documented resistance to Fusilade and Poast (due to its fine leaves and tough cuticle). *Carex tumulicola* and *Luzula comosa* (grass-like but not in the grass family) and forbs were also sown due to their herbicide resistance. Since theses desirable natives are grass-herbicide resistant, Fusilade was applied once the fall after seeding and once again spring 2012 (2C) and the invasive forbs tansy ragwort, Canada thistle, and bird vetch (*Vicia cracca*), spot-treated with clopyralid (2D). By year 3 (2E and 2F), many of the perennial forbs and Roemer's fescue have reached flowering size. (Please see the following link for more information on grass-specific herbicides use in restorations).

http://www.appliedeco.org/conservation-research/prairie-restoration-research

TABLE 2 Option 1: Broadcasting forbs and drilling grasses – Fall 2010 seeding and choosing graminoids that tolerate grass-specific herbicides

	
2A Summer 2012: Wetland area forbs establishment rate high; many flowers blooming (pictured: perennial forbs *Ranunculus orthorhyncus* and *Lomatium nudicaule,* and the annual *Plagiobothrys figuratus.* *Grindelia integrifolia* also bloomed late summer.	2B Summer 2012: *Carex* spp. established well in wet areas.
	
2C Summer 2012: Perennial bentgrass yellowing after Fusilade treatment.	2D Summer 2012: Spot treatment of invasive forbs using backpack sprayers and clopyralid.

	
2E Summer 2013: Upland areas have stron establishment of *Festuca roemeri* and perennial forbs.	2F Summer 2013: Upland areas with perennial forbs (pictured: *Lupinus albicaulis*, *Sidalcea malviflora*, *Potentilla gracilis*, *Achillea millefolium*, and *Eriophyllum lanatum*).

B. Drilling grasses and forbs in alternate rows:

Place the grass seed in every other hopper in the "fluffy seed" box and calibrate to your desired sowing rate. In the "small seed" box (used for granular seed) block off (with duct tape) the holes to the tubes that the grass seed will be going through. Then calibrate the openings to give you the desired seeding rate for the forbs. The calibration would be the tricky part and may entail cutting the forb seed with a carrier (see part C below for suggestions).

C. Broadcast seeding grasses and forbs together:

If no drill is available, broadcast seeding can be effective. Medium-grade vermiculite from a horticultural supply source works well as a carrier to dilute the seed in the drill. For details on carriers and application methods, please refer to "Seeding Rates and Methods" in the **Native Seed, Restoration Resources** section of our website.

This method is NOT recommended in **late-winter** if you are using slow growing bunchgrasses such as *Festuca roemeri*. This perennial grass may establish slowly because it is easily crowded out by faster to establish native forbs and weeds.

D. Drilling grasses and forbs together:

Most native Willamette Valley grasses and some forbs germinate in the fall, but many species need weeks of cold/moist stratification. It is **unwise** to drill both grasses and forbs together since the early germinating species will out-compete those that establish later. This is not the case with Midwest prairie species, which germinate in the spring.

E. Drilling grasses separately in one direction and forbs in another:

This disturbs the ground twice so it doubles the risk of exposing new weed seeds to light which enhances their unwanted germination.

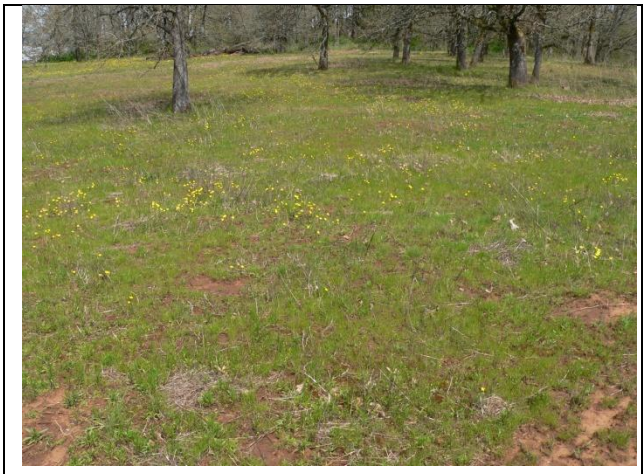
Option 2 – forbs first, then grass

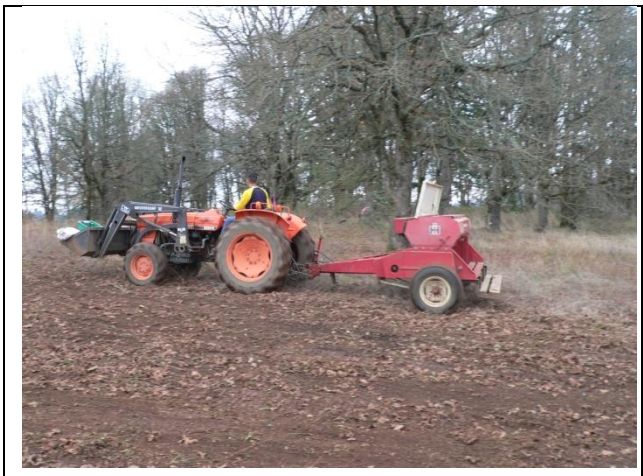
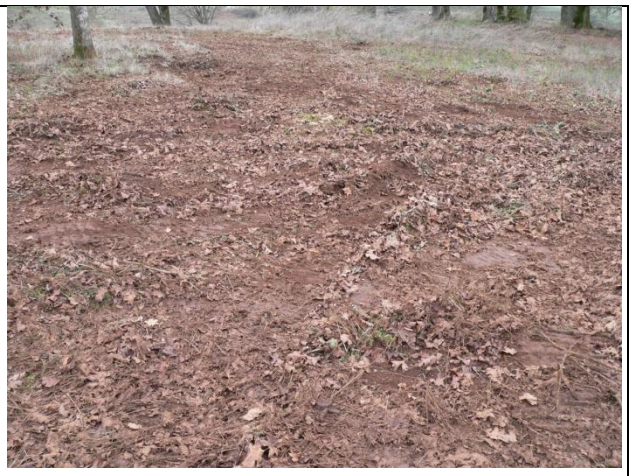
This method might be desirable in fallow grass seed fields where non-native grasses may still be a problem after initial site preparation. It may also work well if a high native forb diversity for pollinator habitat or bare areas for ground-nesting birds such as streaked horned lark are the restoration goal. This allows additional growing season(s) where grass-specific herbicides such as fluazifop, sethoxydim, or clethodim can be applied.

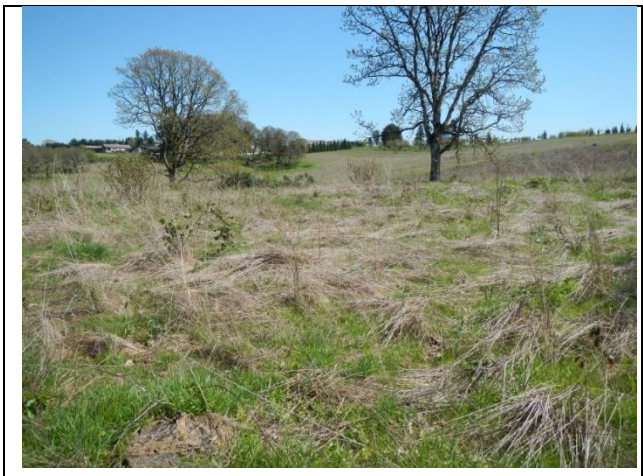
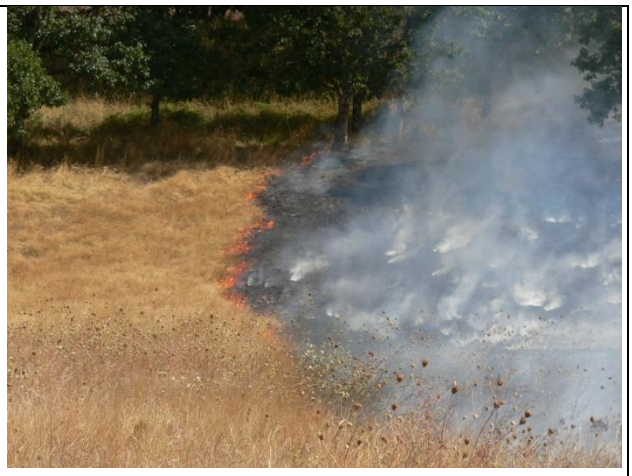
Benefits of Option 2:

- We used this method fall 2006 on fallow **upland pasture** treated with glyphosate for two years that still had persistent bentgrass and velvetgrass. **TABLE 3** Photos 3A and 3B show the meadow the second spring after seeding. We then applied clethodim (Envoy) one time that summer (2008), and this gave the native forbs more resources to establish without a lot of grass competition. We sowed *Festuca roemeri* fall 2008 in what seemed like a sparsely vegetated area (3C and 3D) but the establishment rate was extremely poor (see the problems with option 2 section below). By 2010, both the grass-herbicide application and the lack of native grass establishment resulted in a high density of flowering native forbs (3E) with both *Iris tenax* (3F) and *Camas leichtlinii* flowering only 4 years after sowing due to less completion from grasses. In more competitive situations, it can take these species many years to produce flowers. By the summer of 2013, the site had a moderate density of the original pasture grasses (3G) but still an adequate stand of perennial native forbs. However, the thatch build-up suppressed flowering, so a prescribed burn was done in the fall (3H).

TABLE 3 Option 2: Forbs first - Fall 2006 seeding

	
3A Spring 2008 – *Ranunculus occidentalis* in bloom.	3B Spring 2008 – *Lupinus albicaulis* emerging in its second year of growth.

	
3C Fall 2008 – Drilling seed of *Festuca roemeri.*	3D Fall 2008- Leaves and thatch impeded soil contact by the drill in some areas.
	
3E Summer 2010 – Perennial forbs abundant (pictured: *Lupinus albicaulis*, *Achillea millefolium*, and *Eriophyllum lanatum*).	3F Summer 2010 - *Iris tenax* flowering 4 years after sowing.

	
3G Spring 2013 (7 years after sowing) - Meadow is now a mix of non-native grasses and native forbs.	3H Fall 2013 – Meadow gets its first prescribed burn to reopen the site and help the reduce thatch suppression of the native forbs.

Problems with Option 2:

- **Too much space early:** The lack of competitive grasses also allowed a high establishment rate of invasive forb species such as St. John's wort, tansy ragwort, and Queen-Anne's lace. Rattail fescue also thrived. The large acreage and limited labor to control unwanted species made follow-up management difficult. **Note:** this problem may not be as great on **wet prairie** sites due to hydrological inhibition of many weedy forbs.

- **Rattail fescue**: Early the second summer, Clethodin was applied to control non-native grasses which helped control the perennial grasses but it was ineffective on rattail fescue. This annual grass species must be sprayed early and often due to its fine-leaves, which don't effectively absorb the chemical.

- **Not enough space later**: The next problem with this method was the *Festuca roemeri* sown two years after the forbs established poorly. The site was occupied with vegetation (seedlings of native and weedy annuals, established perennials, and rattail fescue). Consequently, there was not enough room for this very slow growing upland grass to germinate and thrive. The same results would be expected if we had seeded other slow growing bunchgrasses such as *Poa secunda* and *Koeleria macrantha*.

Possible Solutions:

- If it is still desired to sow forbs first (in areas where grasses need to be controlled) it would be best to sow only perennial forbs in low density, aggressively control rattail fescue early, aggressively control invasive forbs, and increase the native grass sowing rate to 50-100 seed/ft.

Option 3 - Sow grass first, then forbs a year or more later [This was the most common method used by restoration professionals until a few years ago].

If the site is relatively free of established weedy grasses but non-native forbs are still a problem (common in **pastures** and some **fallow agricultural fields**), you can seed grasses only the first year, then overseed with native forbs a year later. This will allow additional growing seasons where a broadleaf herbicide can be applied (make sure the grasses are at least 3-5 blades before applying). Some herbicides, such as 2,4-D are completely effective on a relatively small group of weeds. Depending on the weed species, it might be advisable to use a wider spectrum herbicide (see **Appendix B** for suggestions).

a. For upland prairie, native bunchgrasses can be sown as a mix, with the majority of the mix (90%) comprised of slower growing bunchgrasses: *Festuca roemeri* (Roemer's fescue)*, Poa secunda/scabrella* (pine bluegrass), and *Koeleria macrantha* (prairie junegrass). The quickly establishing species *Elymus trachycaulus* (slender wheatgrass) and *Elymus glaucus* (blue wildrye) 10-15% of the mix. If the aggressive native grass, *Bromus carinatus* (California brome) is used, it should be **no more** than 2-5% of a mix. Because brome will set seed the first summer and cover the area with grass seed. That would leave little room for forbs to germinate.

b. *Danthonia californica* (California oatgrass) is a special case and should be planted in monoculture plots (see photo below). This grass **does not germinate until late-February/early March** and may not germinate well if sown with the grasses listed in part "a", which germinate in fall. This also allows an additional application of glyphosate mid-winter which will further reduce non-native species and assure less competition for the late-germinating *Danthonia*. If erosion is a concern, it can be sown with a SMALL amount of *Deschampsia elongata* (slender hairgrass) which germinates in the fall but is not very aggressive. Suggested sowing rate for *Danthonia californica* is 8-10 lbs/acre (drilled).

Problems with Option 3 **1a: Annual and Grass Weeds**

- When these native grasses are sown in the fall, non-native annual (especially rattail fescue) and perennial grasses in the seed bank will germinate in the fall and early winter at the same time as the native grasses. Since the herbicide window for glyphosate has closed there is nothing to do but watch the non-native grasses set seed the following summer and add even more weed seed to the site. The broadleaf herbicide used will have no effect on the grasses; thus, when you sow your forbs the following fall, they are in heavy competition with the weedy grass seed load now more abundant in the native grasses.

- This problem became apparent when we compared areas sown using the fall-germinating grass mix with areas sown using a mono-culture of the spring germinating *Danthonia californica* (California oatgrass) at our Jefferson Farm restoration site (**TABLE 4**, 4A and 4B below). We were able to apply glyphosate in February just before the germination of the *Danthonia*, and most non-native grasses were eliminated. This produced a much cleaner site on which to sow forbs that fall.

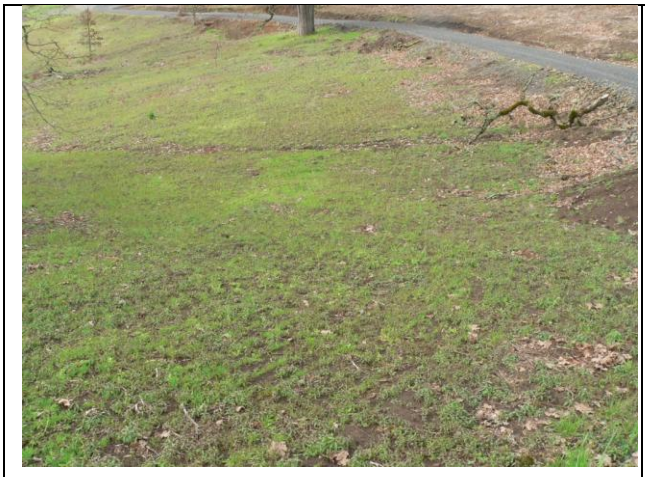
Possible Solutions:

- Sow the early-germinating native grasses in late winter if you can get onto the site. This would allow one more late fall/early winter application of glyphosate to kill grasses (and other weeds) after they germinate and greatly reduce the amount of grass weed seed

the newly seeded forbs must compete with the following fall and winter. However, it is important to not sow the native grasses too late since 1) they need a short cold period in order to germinate and 2) the longer they have to grow, the healthier and more persistent that stand of grass with be during the summer dry months. In addition, to avoid a dense stand of native grass and give more room for forbs the following year, sow the grasses at a lower rate [15 seeds/ft drilled, or 30 seed/ft broadcast]

- Sow species that tolerate grass-specific herbicides (see Option 1 for details).

TABLE 4 Option 3 – grasses first then forbs –Grasses seeded Fall 2006

	
4A March 2007: Dense stand of native grass that germinated in the fall with non-native annual forbs and non-native annual grasses between the drill rows (Contrast to 4B.)	4B March 2007: Good establishment of *Danthonia californica* that germinated just after applying glyphosate in February. Almost no vegetation remains between the rows of grass.

Problems with Option 3 Seeding Forbs:

- We had hoped to drill the forb seed the fall after sowing grasses, but we had to broadcast the seed instead. Forb establishment was poor in the grass mix area (**TABLE 5**, 5A and 5B) due to heavy germination from the non-native grass in the seed bank as well as the dense stand of native grass! In the *Danthonia californica* areas (5C) the forb density was moderate. The forbs did the best where grass density was low or non-existent (5D). It was evident that more **exposed soil** and a lower level of competition are needed in order to establish a good stand and high diversity of native forbs

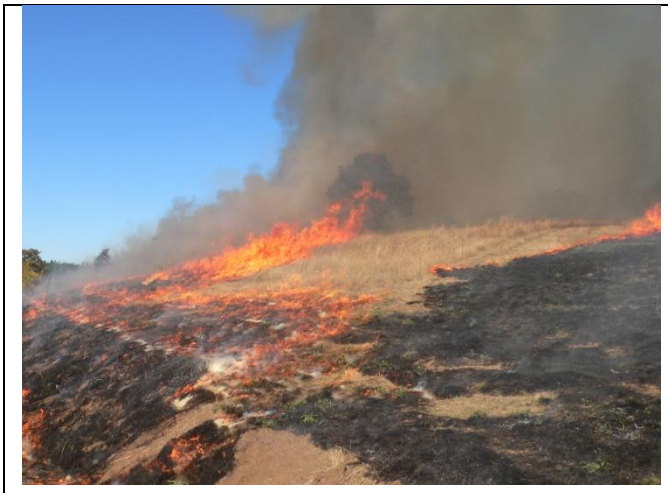
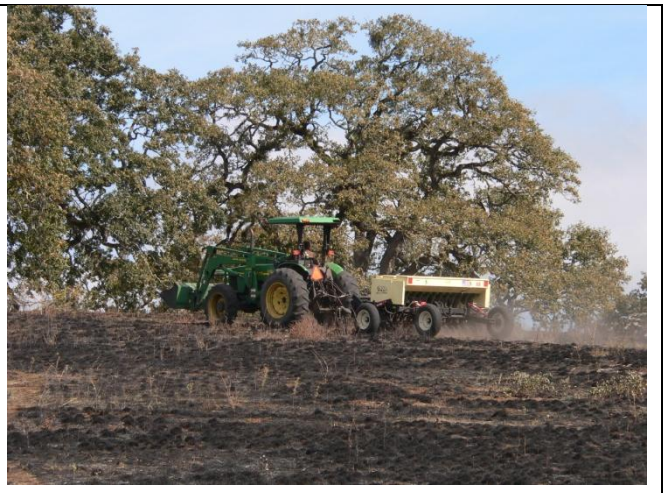
TABLE 5 Option 3 - grasses first then forbs – Forbs seeded fall 2007

	
5A May 2009 *Festuca roemeri* plot area showing no established forbs.	5B June 2011 – *Festuca roemeri* plot area (right) with a hand seeded band of *Eriophyllum lanatum* adjacent to the plot along the gravel road. Very few forbs established in the dense stand of native fescue.
	
5C May 2009 higher density *Danthonia californica* showing moderate forb establishment	5D March 2009 **low** density *Danthonia californica* showing robust forb establishment

Possible Solutions:

- Drilling instead of broadcast seeding: If you must seed into a one-year-old native grass stand it would be best to use a **no-till drill** and use species that germinate in early to mid winter. If forb seed is to be sown after the first year, the site must be re-opened to give the seed exposed soil to germinate. Both **burning [best]** and **mowing** the site before to the second native seed application are good methods for exposing more bare soil. This is also a good method to add more species diversity to an established prairie (**TABLE 6**, 6A-E).

TABLE 6 Option 3 –Burning exposes soil for native forb seeding and reduces competition from thatch.

	
6A Fall 2009 - prescribed burn.	6B Fall 2009 – no till drilling additional forb seed.
	
6C Spring 2010 - reduced thatch allowed annuals such as *Collinsia grandiflora* and *Plectritis congesta* to put on a colorful show.	6E Spring 2013 - slower growing forbs sown fall 2007 in *Danthonia californica* plot have matured to flowering size (pictured: *Aquilegia formosa*, *Ligusticum apiifolium*, and *Sidaclea campestris*)

NATIVE SEEDING: WHAT TO SEED AND HOW TO APPLY

Note: Make sure not to sow seed at a too high rate. There is a fine line between taking up soil space as a defense against weeds and getting a good native stand. Natives can compete too much with each other (especially annuals when perennials are trying to establish).

- FOR SEEDING CALCULATIONS, PLEASE SEE OUR WEBSITE **RESTORATION RESOURCES** PAGE

Drilling vs. Broadcasting

Seeding rates should be based on the following: 1) Site conditions, 2) Individual species seeds/lb, and 3) how many seeds/ft are desired. For sites that have existing vegetation or a

weed seed bank, it would be wise to sow up to 60 seeds/ft TOTAL. For clean sites, the rate can be reduces to 24 seeds/ft.

Benchmark seeding rates.

(1) For **drilled** seed, the suggested sowing rate is 5 – 10 lbs/acre for large seeded grass species and 1-5 lbs/acre for small-intermediate seeded forbs and grasses. Drill seed to a maximum depth of ¼". Mulching is not recommended for drilled seed due the necessity of light for most native prairie species to germinate.

(2) For seed that is **broadcast** or **hydroseeded** this rate should be about twice the rate of drilled seed (this allows for seed predation, loss due to erosion, desiccation, and poor soil contact). Seed size (seed/lb) should be taken into consideration with higher rates used for large seeds and lower rates for small seeds. **Seed mixes** can be calculated to take into account the seeds/lb of species desired. For broadcast seed, light mulch may be applied, but it must be weed free. This will help increase contact with the soil and prevent predation by birds. Good soil contact will help improve germination. A drum roller (heavy metal or water-filled) can be used to press the seed into the soil; however, this may disturb the ground and dredge up weed seed.

Seeding Season

In general, the best time to sow our native prairie species is in the fall (Oct-Nov). This will allow stratification (moisture and cold so seed will imbibe water and germinate) requirements to be met. Many species of native annuals and some perennials do not need long stratification. However, they need varying amounts of cold and wet soil to germinate. They may be sown as late as early March; however, they will produce very small plants and the annuals will flower poorly resulting in little seed.

Forb mixes can have a numerous species which add a lot of diversity but for monitoring purposes, a mix of no more than 10 -12 species will make it easier to later determine how well the natives establish. Depending on the restoration goals, forb mixes can be all perennial, a low ratio of annuals to perennials, or a moderate ratio. Upland and wetland prairies are dominated by perennial forbs and annual species are found on areas of thin, rocky soil. Annual forb species in the Willamette Valley are most common on herbaceous balds and bluffs, and vernal pools (please see the Native Plant Habitats section of our website for detailed descriptions).

As noted in Option 1 above, establishing the perennial forb species while the soil is bare favors their long-term persistence as the grass starts to dominate the site. The annuals will drop out in significant numbers by the third year. But periodic disturbance by burning or mowing will expose bare soil and shift the plant population character toward annuals by allowing them to successfully germinate and compete. Diversity can also be achieved by sowing a variety of mixes on a site by laying out a patchwork of plots. This will give the site a more "natural" look over time. In our restoration project at our Joseph Street farm (**TABLE 7**, 7A and 7B below), the most successful forb species by the third season were *Sidalcea campestris* (meadow checkerbloom), *Sidalcea malviflora* ssp. *virgata* (rose checkermallow), *Prunella vulgaris* var. *lanceolata* (self-heal), *Achillea millefolium* (yarrow), *Eriophyllum lanatum* (Oregon sunshine), and *Lupinus albicaulis* (sickle-keeled lupine). Other perennials such as *Lomatium dissectum* (fern-leaved lomatium) and *Wyethia angustifolia* (mules-ear) can take up to 4-6 years to bloom. Another successful species is *Ranunculus occidentalis* (Western buttercup); it is a ready self-sower and it seems to increase each year.

Many annual species are great nectar and seed sources for birds and butterflies. Since they languish due to perennial dominance by the third season, sowing a border area with a mix of

annual forbs and no grass will maintain populations of these species and add additional color and habitat value. However, make sure to monitor these areas for invasive weeds.

TABLE 7 – Joseph Street farm seeded fall 2004 grasses and forbs together

	
7A 2007 – Western plot with *Sidalcea campestris* and native bunch grasses.	7B 2007- Eastern plot with *Lupinus albicaulis*, *Eriophyllum lanatum*, *Collinsia grandiflora* and low native grass density.

2. If the site is in poor condition or has been disturbed you can sow species that germinate quickly and are good competitors. *Elymus glaucus*, *Elymus trachycaulus* (99% of grass mix) and *Bromus carinatus* (1% of grass mix) germinate quickly and are robust the first year. **Caution**: Bromes are **very aggressive**. The following forbs germinate in the fall and early winter. Perennials - *Achillea millefolium*, *Lomatium utriculatum*, *Lomatium nudicaule*, *Lupinus albicaulis*, *Lupinus rivularis*, *Prunella vulgaris* var. *lanceolata* , *Eriophyllum lanatum,* and *Ranunculus occidentalis* (75% of forb mix). Annuals - *Clarkia amoena, Clarkia purpurea*, *Collinsia grandiflora*, *Collomia grandiflora*, *Gilia capitata*, *Lotus purshianus*, *Madia elegans* and *M. gracilis*, and *Sanguisorba occidentalis* (25% of forb mix).

What to Sow?

For a **comprehensive** list of Willamette Valley prairie plant communities, please visit the Native Seed Network at http://www.appliedeco.org/native-seed-network

Follow the link at the bottom of the page, “Species lists and recommendations”.

OAK HABITAT

DEFINE YOUR STARTING CONDITIONS:

1) Mature oak woodland with conifers over-topping the oaks and young conifer and oak in the understory
2) Young oak - thick stand
3) Invasive shrubs, few trees
4) Disturbed bare-ground after tree and shrub removal
5) Canada thistle, knapweed, and biennial thistle infestation
6) Oak savanna (grassland with large, open-growth oaks spaced 2-10 trees/acre)
7) No or few oak
8) Brush piles and pollinator nesting sites (special notes)

SITE PREPARATION:

1: Remove conifers by hand cutting. Conifers that would harm oaks if felled can be limbed and topped to provide wildlife snags. Also, some conifers can be partially limbed and left as replacement snags. The longest lasting snags are created using conifers more than 10 inches DBH (the larger the better). Young, skinny oaks with no lower branches should be thinned. Retain oaks that are in more open habitat and have developed lower branches. Woodland target density should be no more than 40 – 50 trees/acre.

2: Remove the majority of the oaks so that grasses can be reestablished or enhanced. Retain oaks with lower branches and remove those that are thinly branched. The trees with lower branches will be able to mature with large crowns. These large branches will contain numerous microhabitats for invertebrates, will become draped with desirable lichens, and produce more abundant acorns. Target density should be 2 – 5 trees/acre. Hand-cutting is one option, but there are low-impact (rubber-tracked) skid-steers available that can mechanically remove smaller diameter trees and also apply herbicide to the stump (oaks do re-sprout). Since it is desirable to re-seed immediately after exposing bare soil (see #4 below), tree removal should be done just before fall rains.

3: Mow or hand cut invasive shrubs such as Himalayan and evergreen blackberry, poison-oak (native but can become noxious if not controlled), scotchbroom, English hawthorn, English holly, and sweetbriar rose. Many rubber-tracked skid-steers have brushing mowers that can handle large areas of tall brush. Smaller areas can be mowed with power equipment such as a DR® or Billy Goat® walk-behind brush mower. Hawthorn will re-sprout so application of herbicide to the freshly cut stump is imperative. Poison oak and English ivy that have climbed trees can be cut at the base of the trees using a strong pair of loppers. When working with or near poison oak it is very important to be fully clothed. Wear gloves before removing clothing and wash it immediately. You may not be allergic but others who contact your clothes might be. To protect against poison oak apply Technu® before working near poison oak and immediately after. English ivy growing on the ground can be hand-pulled or cut. However, it roots at the nodes, so must be put onto plastic to dry. For long-term maintenance and control of brush, see **APPENDIX C** for suggestions. Information on the control of invasive species can be found at http://www.invasive.org/gist/handbook.html [also available on our Website **Restoration Resources** page]

4: Bare soil invites weeds (especially thistles) so it must be immediately seeded with natives whenever possible. If the site has a lot of sun, the species in **Table 8** germinate in the fall and early winter and establish well. Sowing prairie species will also reestablish native grass and allow for long-term shrub control using prescribed burns. After seeding the grass and/or forbs, the broadleaf weeds can be spot-sprayed. Allow two years before burning the area to ensure hardiness of the native perennial plant crowns. If burning is not an option, mowing is the best alternative. If the grasses were introduced first and area is mostly free of invasive broadleaf species, sow native forbs after burning or mowing. If the area has a significant canopy, species tolerant of oak and madrone woodland shade are listed in **Table 9**. Many of these species need a full 12 weeks of stratification so it is best to use herbicide on weedy species before sowing.

5: Canada thistle and knapweed are rhizomatous perennials and must not be pulled or tilled. The most effective control is to spot-spray their rosettes with a composite-specific herbicide containing clopyralid in early spring. Note: herbicides with clopyralid are long-lived in soil and compost so the chemical should be applied to the target plants only. Biennial thistles (bull, Italian, milk) can be treated with glyphosate in the rosette stage. If they are in the early flowering stage, it is best to treat them with clopyralid, which will kill the plants more quickly before seed set.

6: Work to improve grassland habitat for ground-nesting species (see *Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington* listed in Suggested References **APPENDIX A** and the **Prairie Habitat** Section above). Retain some smaller oaks as replacement trees.

Retain or plant some native shrubs [see **TABLE 10** below] where appropriate (ravines or around mature trees). Good wildlife shrub species are: *Amelanchier alnifolia*, *Rhamnus purshianus*, and *Holodiscus discolor*. Non-native shrubs such as Himalayan /evergreen blackberry, English hawthorn, and scotchbroom should be removed. Low-impact skid-steers can mow these species down. Re-growth of blackberry can be spot-sprayed with Garlon in September while the foliage is green, and the plants are taking nutrients from stems to roots, but not actively growing. Regular maintenance of the site by burning or mowing should keep the invasive shrubs in control.

7: If you want to plant oak AND want native grassland habitat, establish the prairie first (see the above **Prairie Habitat** section for suggested methods). When the prairie is established (2 – 3 years), mow or burn the site in the fall and plant oaks in clusters of 4 – 5 trees at 2 – 5 clusters/acre (savanna density). Oaks (and other native trees and shrubs) establish best when planted (Oct-Jan). When oaks are 5-10 years old, clusters can be thinned to ensure open-growth oaks are established at a savanna density.

8: Brush Piles and Bare Areas - Special Notes:

1. The species listed in **Table 8** do exceptionally well on ash residue after a brush pile burn. This helps to prevent weeds on bare ground and establishes more natives on the site.
2. During restoration, some bare patches should be retained in order to provide vital pollinator nesting sites because most native bee species nest in bare soil. The best sites to retain are cut banks that face the morning sun. To keep the area free of vegetation, herbicide can be applied very early in the morning or late in the evening before bees are active. For more information on native pollinator conservation, see **Appendix A.**

WHAT TO PLANT:

In addition to the species noted below, a comprehensive list of grasses and forbs in Willamette Valley oak woodland habitat can be found at http://www.appliedeco.org/native-seed-network

Follow the link at the bottom of the page "Species lists and recommendations".

TABLE 8: Selected Grasses and Forbs for Sun on Disturbed Ground and Burn Piles		
Species	**Type (annual/perennial)**	**Common Name**
Elymus glaucus	p	Blue wildrye
Festuca roemeri	p	Roemer's fescues
Achillea millefolium	p	Western yarrow
Clarkia amoena and *C. purpurea*	a	Farewell to spring and Purple godetia
Collinsia grandiflora	a	Large-flowered blue-eyed Mary
Collomia grandiflora	a	Large-flowered collomia
Eriophyllum lanatum	p	Oregon sunshine
Gilia capitata	a	Blue field gilia
Lotus purshianus	a	Spanish clover
Lupinus rivularis	p	Riverbank lupine
Madia elegans and *M. gracilis*	a	Showy and Common tarweed
Prunella vulgaris var. *lanceolata*	p	Self-heal
Ranunculus occidentalis	p	Western buttercup
Sidalcea campestris	p	Meadow checkerbloom
Sidalcea malviflora ssp. *virgata*	p	Rose checkermallow

TABLE 9: Selected Grasses and Forbs for Oak/Madrone Woodland		
Species	**Type (annual/perennial)**	**Common Name**
Bromus Sitchensis	p	Sitka brome
Elymus glaucus	p	Blue wildrye
Festuca californica	p	California fescue
Aquilegia formosa	p	Western columbine
Camassia leichtlinii	p	Tall camas
Collinsia grandiflora	a	Large-flowered blue-eyed Mary
Geum macrophyllum	p	Large-leaved avens
Iris tenax	p	Oregon iris
Ligusticum apiifolium	p	Licorice root
Lomatium dissectum	p	Fern-leaved lomatium
Lupinus latifolius	p	Broadleaf lupine
Plagiobothrys nothofulvus	a	Rusty popcorn flower
Plectritis congesta	a	Rosy plectritis
Thalictrum polycarpum	p	Tall meadowrue

TABLE 10: Small Trees and Shrubs for Oak Woodlands	
Species	**Common Name**
Amelanchier alnifolia	Serviceberry
Corylus cornuta var. *californica*	Western hazelnut
Holodiscus discolor	Ocean spray
Mahonia (*Berberis*) *aquifolium*	Oregon grape
Oemleria cerasiformis	Osoberry or Indian plum
Rhamnus purshianus	Cascara
Ribes sanguineum	Red-flowering current
Rosa gymnocarpa	Baldhip rose
Symphoricarpos albus	White snowberry

APPENDIX A

SUGGESTED ADDITIONAL RESOURCES

- **Literature Cited** for Willamette Valley Proposed Critical Habitat

  http://www.fws.gov/oregonfwo/species/PrairieSpecies/Documents/FR2000Jan25WVCHReferencesCited.pdf

- **Techniques for Restoring Native Plant Communities** in Upland and Wetland Prairies in the Midwest and West Coast Regions of North America by Greg Fitzpatrick (TNC White Paper)

  http://www.cascadiaprairieoak.org/documents/EPA-WhitePaperFinal_001.pdf

- You can download PDF versions of two PowerPoint presentations from a Wet Prairie and Upland Prairie Workshop conducted by the West Eugene Wetlands Partnership, it contains summaries of management costs, a comparison of no-till drill versus broadcast seeding, a brief summary of equipment, and two documents from the Society for Ecological Restoration. [these links will be updated soon]

  ftp://ftp.ris.lane.or.us/cedp/outgoing/Wetlands/ORPA/

  Additional information is also available from the following site (the three most relevant links on this web site are "Native Plants", "Research", and "Reports").
  http://www.eugene-or.gov/wetlands

- **Guidelines for Planting Native Seed** – Pacific Northwest Natives web-site
  http://www.pacificnwnatives.com/

- **Native Seed Network** http:www.nativeseednetwork.org/

- **OSU Professor of Botany, Mark Wilson** http://www.onid.orst.edu/~wilsomar/Index.htm

- **The Institute for Applied Ecology** http://www.appliedeco.org/

- **Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington** – Partners In Fight
  http://community.gorge.net/natres/pif/con_plans/west_low/west_low_plan.html

- **Restoring Rare Native Habitats in the Willamette Valley** *by Bruce Campbell, ODFW*.

  http://heritageseedlings.datahost2.com/habitat-restoration [link updated soon]

- **A Landowner's Guide for Restoring and Managing Oregon White Oak Habitats** Oak ecology, site assessment, restoration planning/methods, controlling invasive species, and wildlife enhancement. *Dave Vesely and Gabe Tucker, Pacific Wildlife Research*.

  http://heritageseedlings.datahost2.com/habitat-restoration. [link updated soon]

- **Landowner Video Guide for Restoring and Managing Oregon White Oak Habitats** *(65 min)* On-the ground coverage of habitat conditions, management opportunities, restoration projects, common landowner goals, and controlling invasive species. *Hugh Snook, BLM, and Barry Schreiber, Flora & Fauna Video Production.* Available free at
  http://www.blm.gov/or/districts/salem/index.php

- **R-J Consulting Services, LLC (contract brush and tree removal with low-impact skid steer and spraying).** Jason Garland, R-J Consulting Services
  (541) 979-7282 rjconsulting@croisan.com (email)

- **USFW Partners for Fish and Wildlife Program** http://partners.fws.gov/**, South Valley contact - Jarod Jebousek ,** 541-757-7236, Jarod_Jebousek@fws.gov (email); North Valley contact - Chris Seal Chris_Seal@fws.gov (email)
- **Natural Resource Conservation Service** (local offices): WRP, WHIP, EQUIP, CREP, CRP Programs, Salem office contact: Les Bachelor 503-399-5741 x122 les.bachelor@or.usda.gov (email)
- **OSU Extension Service**, Private Landowner Workshops for Conservation and Restoration of Native Woodlands. Brad Withrow-Robinson 541-766-3554

  brad.w-r@oregonstate.edu (email)
- **OSU Extension Service.** Using Cover Crops in Oregon

  http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/24506/EMNO8704.pdf?sequence=1
- **Pollinator Conservation Handbook AND Attracting Native Pollinators.** The Xerces Society http://www.xerces.org/
- **Willamette Valley Prairies**; Research from Oregon State University, http://people.oregonstate.edu/~wilsomar/Index.htm
- **Willamette Valley Prairie**; Benton County Prairies Species Conservation Plan

  http://www.co.benton.or.us/parks/hcp/documents/benton_county_prairie_species_hcp.pdf
- **Farmscaping for Beneficials Project**, Gwendolyn Ellen; IPPC/OSU, 2036 Cordley Hall, Corvallis, OR 97331, 541-737-6272
- **Willamette Prairie Wet Prairie Restoration**; The Wetlands Conservancy

  http://oregonwetlands.net/index.php/current-projects/willamette-wet-prarie
- **Institute for Applied Ecology; Prairie research**
  http://www.appliedeco.org/conservation-research/prairie-restoration-research
- **Roadside Revegetation: An Integrated Approach to Establishing Native Plants** Federal Highway Administration US Department of Transportation.

  http://www.nativerevegetation.org/resource_materials/

APPENDIX B

HERBICIDE OPTIONS FOR WEED CONTROL SEED PRODUCTION AND RESTORATION

Note: Always read chemical labels before applying – for restoration, it should be labeled for non-crop land, CRP, or habitat management.

Helpful Sites:

http://www.greensmiths.com/herbicides.htm
http://www.ipaw.org/
http://grounds-mag.com/mag/grounds_maintenance_new_pest_controls/
http://grounds-mag.com/mag/grounds_maintenance_understand_mode_action/
http://www.utextension.utk.edu/publications/pbfiles/PB1728_sec2.pdf
http://www.maltawildplants.com/ASTR/Docs/CNZBO/Weedchart.pdf

Herbicide Effects – are based on my personal experience and conversations with other restoration professionals
Please note: the addition of a non-ionic surfactant or ammonium sulfate increases the efficacy of most herbicides.

- Glyphostate [general purpose]
  - General systemic herbicide that kills most grasses and broadleaf weeds. It is critical to apply before flowering to prevent seed set.
  - Species difficult to kill with glyphosate include fireweed, field bindweed, horsetail, and some strains of annual ryegrass.
  - Fall-applied to blackberry over 3-5 years at 1-2%, results in effective control, but also kills grasses. This will facilitate **weeds.**
- Envoy (clethodim) , Poast (sethoxydim) , and Fusilade (fluzazifop) [grass-specific]
  - Works on all wide-leaf, soft cuticle grasses (annuals and perennials).
  - Clethodim will **control** *Vulpia myuros* (rattail fescue) with repeated application when its applied in early leaf stage.
  - Clethodim kills glyphosate-resistant strains of annual ryegrass.
  - Does not kill red fescue or native Roemer's fescue (narrow leaves and tough cuticle) or wide-leaved tough cuticle grasses such as tall fescue.
  - Hit target grasses while young and actively growing (ineffective in flower, or when going dormant).
  - Safe for broadleaf plants and non-grass monocots (lilies, iris, sedges, rushes)
  - Use without a surfactant if applying over young broadleaf native plants.
- Garlon 3 or 4 (triclopyr) [broadleaf] Note: Garlon 3 is less volatile, but Garlon 4 is more effective for shrubs, since it penetrates better.
  - Spot spray application (1.5% tryclopyr + 0.5% aminopyralid) May-June for: Dock red sorrel, wild carrot, thistles, cat's ears (Hypochaeris), scotch broom, oxeye daisy, knapweed, kickxia, creeping wood sorrel.
  - Backpack or spray gun apply to blackberry in September (back pack 6-8 oz Garlon/4 gallons water; spray tank mix 1-3 gal Garlon per 100 gal water).
- 2,4-D [broadleaf] [short-lived in soil]
  - Young broadleaves are the most susceptible.

- Effective on: young composites, pearlwort, geraniums (including fillaree), and sow thistles.
- Not effective on: fireweed, clover, mustards, speedwell, chickweeds, miner's lettuce, bedstraw, vetch, and St. Johns wort.
- Do not spray over grasses and forb monocots that are sending up flowering stems, or it will diminish seed set. Some graminoid species start developing flower stems very early (fescue's for example) so you should test before spraying. For restoration use, this may not be an issue.
- DO NOT use on *Juncus* spp. – although they are not broadleaf plants, it may severely injure them.

- Mecoprop "MCPP" (broadleaf) – Combin with MCPA and dicamba or MCPA and 2,4-DP [short lived in soil] (Tri-Power®)
  - Effective on many broadleaf weeds.
  - Not effective on St. John's wort, clover, speedwell chickweeds, burdock, bedstraw, or vetch.
  - Best to target prior to pollination otherwise seed-set may occur.
  - Can be sprayed on monocot forbs before flower stems emerge BUT they will bolt and look ugly **(2,4-D is less harsh but they still bolt)**

- Clopyralid [long-lived in soil]
  - Targets are composites (especially Canada thistle, knapweed, milkthistle) and legumes (vetch and clover)
  - **Spot-spray ONLY.**

APPENDIX C

SHRUB TREATMENTS

Information from our experience and Bruce Kelpsas representative of Helena Corp.

- Hardwood stumps
  - Cut & spray with a 25% solution of Garlon 3A + crop oil or diesel within 20 min.
  - Use a 50% concentration of glyphosate.

- Blackberry
  - Mow, survey for natives. Repeat mowing 2x/year for at least 3 years.
  - If herbicides are preferred use Garlon 3A in warm weather & 4A in cooler weather (labeled rates).
  - Glyphosate in October (1-2%) – repeat multiple years (see notes above for warning).
  - If no natives will be over-sprayed, spraying foliage in September to full coverage, but not more, gives best control.
  - Wait one season to spray regrowth.

- Poison oak
  - 2,4-D or Garlon 3A when leaves still green (if less than 50% green foliage, it's not effective).
  - Glyphosate (2-5%) in July.
  - Cut-stem treatment for viney plants growing in trees (25% Garlon 3 + crop oil/diesel).

- English hawthorn - mow &, spray stumps with
  - Garlon 3A (25%), or keep mowing/burning.
  - Shrubby sized trees, treat whole plant with glyphosate (5%) + extra surfactant mid-late summer.

- Scotch broom
  - Mow low, does not resprout, (seed viable for years).
  - In herbicide is preferred, use Garlon 3A (25%) or
  - Glyphosate (5-10%) with surfactant.

- English ivy –
  - Cut from trees with bow saw & apply 100% glyphosate to cut end.
  - Ground- growing plants - shovel/pull and pile onto plastic (do not leave on ground!).
  - Use 2% 2,4-D with surfactant.

Additional information can be found at: http://www.invasive.org/gist/handbook.html [also available on our Website **Restoration Resources** page]

APPENDIX D

RESOURCES FOR WILDLIFE HABITAT CONSERVATION IN OREGON

Prepared by Katie Frerker, Wild Food Alliance, 2006

At-Risk Species: The Oregon Department of Fish and Wildlife compiled a complete list of all vertebrate, invertebrate, and plant species in Oregon that have a federal or state at-risk conservation status. The list includes species that are federal or state endangered, threatened, or candidate species, state sensitive or vulnerable, or natural heritage conservation status. The most recent list can be found at www.dfw.state.or.us/LIP/species_list.pdf with an explanation of the codes at www.dfw.state.or.us/LIP/species_list_explain.pdf.

Incentive Programs and Funding: Incentive programs are offered by a variety of public and private sources, including federal agencies (Natural Resources Conservation Service, the U.S. Fish and Wildlife Service, and the U.S. Forest Service), state agencies, regional or local agencies, and private organizations. For a complete summary of conservation incentive programs available in Oregon, go to www.biodiversitypartners.org/state/or/incentives.shtml.

Land Trusts: Land trusts are nonprofit organizations that as all or part of their mission, actively work to conserve land by undertaking or assisting in land or conservation easement acquisition, or by their stewardship of land or easements. There are land trusts in some, but not all, parts of Oregon. To find a land trust near you, go to www.ltanet.org/findlandtrust and click on “Oregon”, then “local land trusts”.

Natural Resources Conservation Service: The NRCS provides leadership in a partnership effort to help people conserve, maintain, and improve natural resources and the environment. The NRCS also offers several incentive programs specifically for wildlife habitat conservation. Find your local office or technical specialist in Oregon at www.or.nrcs.usda.gov/contact.

Oregon Wildlife Conservation Strategy: This new action plan identifies at-risk native habitats and species in each ecoregion of the state, including: oak woodlands, oak savannas, prairies, wetlands, wet prairies, riparian areas, aquatic habitats, grasslands, ponderosa pine woodlands, and sagebrush steppe / shrublands. For information about where, how, and why to conserve native habitats in Oregon, go to www.dfw.state.or.us/conservationstrategy, or call 503-947-6315 to get a copy on CD.

OSU Extension Service: The OSU extension service offers assistance to agriculture and forestry landowners. The Master Watershed Steward Program provides excellent, in-depth training including: watershed and stream processes, riparian area functions and management, salmonid biology, stream assessment, restoration, water quality monitoring, wetland evaluation and enhancement, and soils and erosion. For more information, go to seagrant.oregonstate.edu/wsep/masterprogram.html.

Restoration of Priority Habitats in the Willamette Valley: This landowner guidebook, produced by Bruce Campbell and Defenders of Wildlife, provides detailed information about restoring priority habitats in the Willamette Valley. It is an excellent guide, but it’s out of print. To print your own copy, go to www.biodiversitypartners.org/pubs/Campbell/Landownerguide.pdf.

Soil and water conservation districts: SWCDs help landowners, land managers, and residents use conservation measures and management practices to protect near-stream areas and reduce the transport of chemicals and nutrients to streams in sedimentation or runoff. These conservation efforts cool water temperatures, stabilize streambanks, and protect water bodies from impacts by farm and ranch animals. Find your SWCD at www.oacd.org.

Watershed councils: Watershed councils are locally organized, voluntary groups established to improve the condition of local watersheds. They include the diverse interests in the watershed and are balanced in their membership. They provide an opportunity to independently evaluate watershed conditions and identify opportunities to restore or enhance the watershed. Partnerships between landowners, local, state, and federal agencies, and other groups integrate local efforts. Find your watershed council at www.oweb.state.or.us/OWEB/WSHEDS/wsheds_councils_list.shtml.

Wildlife Habitat Conservation and Management Program – Rules and Statutes: Statutes for the wildlife habitat special assessment are ORS 308A 400-430 and ORS 308A 700-743, which can be found at www.leg.state.or.us/ors/308a.html. Administrative rules for the habitat program are OAR 635.430, which can be found at arcweb.sos.state.or.us/rules/OARS_600/OAR_635/635_430.html.