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Oak Savanna Restoration Techniques

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The oak savanna ecosystem lies along a continuum between the tallgrass prairie and the true woodland ecosystem. An oak savanna is comprised primarily of widely spaced oak trees including Quercus macrocarpa (bur oak), Quercus alba (white oak), Quercus rubra (red oak), with more than one mature tree per acre but less than 50 percent tree canopy cover, and a ground layer of herbaceous prairie grasses and forbs. The spacing of these trees ranges from widely scattered to clumps and groups of trees with mottled sunlight available to the understory only a portion of the day (Wovcha et al. 1993). This ecosystem developed with periodic burning. Fires, started from both lightning, and more frequently, native people, raced over the land in varied intensities to create the oak savanna. The survivors were deep-rooted grasses and forbs like Agastache necpetoides (yellow giant hyssop), Besseya bullii (kitten tails), Bromus kalmii (prairie brome), Lupinus perennis orcidentalis (Wild lupine), Phlox pilosa fulgida (prairie phlox), and Silene stetlata (starry campion) and larger oak trees with bark thick enough to withstand the heat. Corylus americana, hazel and small populations of other native shrubs occupied portions of the original savannas where fires were of low intensity or infrequent (Packard 1997). This mosaic of vegetation changed with events like fires and shifts in weather patterns. Other species of trees, smaller oaks, and brushy species perished in these fires allowing the prairie like understory to flourish beneath the great gnarled oaks. The herbaceous plants that grew in this understory beneath the oaks are commonly associated with more open prairie regimes, but there are many species in an oak savanna ecosystem that are considered good indicators of this type of ecosystem (See Addendum # 1). These ecosystems began to decline or disappear as European settlement spread over the midwest region that was composed of savanna. As European settlement occurred in the oak savanna region fire suppression was widely practiced. It was the lack of fire that was the primary stressor to the oak savanna ecosystem. Without periodic fire disturbance to these systems, brushy understory would secure a stronghold and begin crowding out the herbaceous groundcovers originally there. Tree species such as *Ulmus americana* (american elm) not able to tolerate fires were now able to invade and take hold in the savanna ecosystem. Further degradation of the Savanna ecosystem has occurred with the invasion of exotic species such as *Rhamnus cathartica* (Common buckthorn), and *Lonicera tatarica* (Tartarian honeysuckle). This paper describes some of the techniques being employed to restore and reclaim existing oak savanna landscapes that have regressed into a low quality woodland ecosystem with little biological diversity. Most of the original species found in the understory have now been replaced by more aggressive species that are often exotic as well. The first consideration in this type of oak savanna restoration is the reintroduction of a fire regimen along with the mechanical removal of smaller trees and brush. An assessment of a given site must be made to determine the feasibility of a successful burn. A successful burn is determined by the amount of fuel available for the prescribed burn. A successful prescribed burn is a fire that kills off the brushy understory leaving the ground mostly bare with the larger oak trees alive and intact. The right kind of fuel for this type of fire is usually made up of dry grassy herbaceous material found throughout the ground layer. But in a degraded oak savanna the brushy understory is often dense to the point that little if any grassy vegetation exists. If not enough fuel exists, mechanically removing the underbrush becomes necessary. Removal of underbrush, both

native and exotic species is usually performed with chain saws, brush cutters, or hand saws. The brush material can be piled up and burned on site. Once this is complete enough sunlight will now be able to reach the floor and trigger the growth of more herbaceous vegetation. Measures for controlling invasive plants of brushy species in an oak savanna include; repeated fires, additional mechanical and hand removal, and the use of herbicides. As fuel from leaf litter and establishing grasses builds up, annual repeated burning can assist in keeping resprouting brush and tree species under control (Packard). If a particular tree or brush species such as Acer saccharum (sugar maple) and Rhus glabra (smooth sumac) is susceptible to fire then a prescribed burn regimen will eventually remove that species from the oak savanna landscape. Mechanical and hand removal of invasive plants and regrowth can be accomplished in a number of ways. If the regrowth is from existing roots then cutting the sprouts off with a loppers or brush cutter at the ground level will continue to deplete the food reserves in the plant's root system. However, this approach may take many years and the use of a herbicide may be more practical. Seedlings can be pulled by hand if adequate soil moisture allows for the removal of the root structure as well (Packard 1997). Hand pulling is labor intensive and is most practical when the restoration site is small and the target species like Rhamnus cathartica (common buckthorn) is easily identified. Invasive plant and regrowth of brushy species can be controlled with the use of non-selective herbicides such as Round-Up or a broadleaf selective herbicide such as Garlon 4. Round-Up herbicide can effectively control brushy species and undesirable tree species that resprout by applying the herbicide directly to the cut stump or by foliar application using either a low pressure sprayer or a wick applicator. The Round-Up label recommends a 50 to 100 percent concentration for these types of application. Garlon 4 can be used effectively for cut stump application of the undesirable species. 50 to 100 percent concentration of Garlon 4 should be applied within a few hours of cutting the stump or it should be applied to the bark below the cut stump (Packard 1997). Care should be taken that only the target species come in contact with the herbicide. Trimec, an herbicide for broadleaf plants, effectively controls Rhamnus cathartica (common buckthorn) but because it readily moves in soil careful consideration should be given before using it in an oak savanna remnant. Establishment of herbaceous species indigenous to the oak savanna ecosystem can begin after the initial brushy understory has been removed. Once a prescribed burn has been completed on the site an assessment should be made to determine if any remnant species exist. If a viable seed bank of some of the original savanna species exists than opening up the canopy to the ground layer could trigger this seed to germinate. Also, remnant populations of herbaceous savanna species may have existed along the edges of the savanna site where enough sunlight filters down to maintain a viable environment for these species (Wade, personal communication). Seed from these herbaceous species can provide a seed source to the site. Even if species re-establish as a result of the brush clearing and fire disturbance there may need to be some additional seeding and or planting to introduce original oak savanna species to the site (Wade, personal communication). Developing a seed mix that is site specific for an oak savanna ecosystem can be accomplished by referring to species lists found in the reference list at the end of this paper. A list titled "Understory Plant Species Indicative of Recoverable Oak Savanna and Open Oak Woodland in Southern Wisconsin" may be useful in selecting species indigenous to the savanna ecosystem. This list consists of four categories, with category 1 containing species considered the best indicators of former savanna/open woodland (See Addendum 1). Indicator species of former savanna woodland decline from category (2) to category (4) and category (4) contains species that are tentatively proposed as indicators of former savanna/woodland. Often the species of oak present on the restoration site are indicators

of soil types and soil moisture. Quercus macrocorpa was the dominant oak on moist, fertile soils where fire was most severe. Quercus alba was more likely to occupy drier soils of lower fertility. This correlation may assist in developing the appropriate seed mix for the oak savanna regime being restored (Packard 1997). Once a proposed species list is developed seed can be acquired either by hand harvesting from remnant nearby populations or seed can be bought from a commercial grower of native seed. One advantage to harvesting from a nearby population is it will be seed of a local genotype. If remnant populations of herbaceous plants can be found try to gather seed where the oak species are similar to the oak species found at the site being restored (Packard 1997). However, it is likely many species hoping to be re-established will not be found and using a native seed supplier can greatly expand the possible species used. Also, native suppliers save the time of locating and harvesting the seed. When restoring a degraded oak savanna the optimum time of year for planting the herbaceous species is spring or fall or as soon as seed becomes ripe (Packard 1997). Dormant fall seeding can also be considered over bare soil of the brushed out site. Frost and rain will work the ground up sufficiently, especially during freeze thaw cycles late in the year. In a degraded oak savanna, once the site is cleared of the heavy brush, the bare soil is an acceptable seed bed and requires little if any preparation (Packard 1997). Seed can be applied by simply broadcasting throughout the site or using a native seed drill. However, a native seed drill is only practical where the savanna is very open and beginning to resemble a prairie ecosystem. An area seeded with a native seed drill will have to accommodate larger farm type equipment. Areas beneath the drip line of the oaks are best seeded by broadcast methods. If each species of seed being sown can be kept separate, they can readily be placed in the microsite where they are best. The restortationist placing the seed should have an understanding of varying light conditions throughout the savanna ground layer and be able to place seed in the right location in terms of light requirements (Packard 1997). In the more open areas of the savanna the plants will be mostly prairie plants. But as tree canopy gets denser species requiring varying amounts of shade will begin to dominate. By keeping seed mixes specific or altogether separate the restorationist has the advantage of being able to place species in the microhabitats that they require throughout the oak savanna landscape. A separate mix should be prepared for each distinct microhabitat. Another option for re-introducing herbaceous species back into the oak savanna landscape is to plant seedlings. Seedlings can also be planted to supplement the seeding process. Seedlings may also be available from growers that specialize in native herbaceous plants. To propagate native seedlings the additional time needed and growing facility requirements will have to be addressed. The advantage to using seedlings in the savanna restoration is the shortened amount of time required for plant establishment. Because of the scarcity of some savanna seed it may be appropriate to introduce herbaceous species back into the oak savanna landscape with seedlings. Some species of plants such as Besseya bullii (kitten-tails) may be so rare that seed collected, if at all, is too valuable to plant in an environment without controls. This seed can be propagated and the seedlings then placed in the habitat they require (Stevens 1995). Upon completion of the initial planting of oak savanna species the site will need to be monitored and aggressive weed and shrub species will need to be removed for the first few years (Packard 1997). In addition, interseeding will continue to play a role in the restoration of the oak savanna. Herbaceous species are continually harvested and collected and dispersed in appropriate locations throughout the site as they become available (Packard 1997). After several years the site may only require regular controlled burning, and will begin to resemble the original oak savanna with many of the original species thriving and intact.

Reference

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Sources: Individuals

Alan Wade, Prairie Moon Nursery, Winona, MN 55987 (507) 452-1362

Charles Umbanhower, MN Native Plant Society 213 Plum St. N. Northfield, MN 55057 (507) 645-4386

Addendum #1: Understory Plant Species Indicative of Recoverable Oak Savanna and Open Oak Woodland in Southern Wisconsin

The following list was developed to help conservationists identify savanna and open oak woodland remnants that have recently become closed-canopied forests due to lack of fire or other disturbances that control woody growth. The list consists of understory plants that require at least some direct sunlight each day in order to persist in a native plant community over a long time period. Thus the presence of these species in a closed-canopied forest indicates that the canopy has only recently closed in. Wooded sites containing these sufficient populations of these species have the highest potential for being recovered as savannas (10%-50% canopy) and/or open oak woodlands (50%-80% canopy), given appropriate management (i.e. prescribed fire, mechanical canopy thinning, etc.).

This list is for use in southern Wisconsin and in neighboring regions of southeastern Minnesota, northeastern Iowa and northern Illinois. It is a working list that will be updated as researchers gain more insight into each species usefulness as an indicator of a recoverable savanna or open woodland.

Category 1 species are considered the best indicators of former savannas/woodlands. These species tend to be strongly limited to partial canopy conditions. In more densely-wooded sites, these species are usually in a state of declining vigor due to the ever-increasing canopy closure above them. Their ability to persist in densely-wooded sites depends upon being near a canopy opening such as a woodlot edge, roadside, brushed utility corridor, etc.

list developed by Brian Bader, Ted Cochrane, Eric Epstein

Rich Henderson, Randy Hoffman, Mark Leach and Brian Pruka

Understory plant species indicative of recoverable oak savanna and open oak woodland in southern Wisconsin

Category 1 species - best indicators

Agastache nepetoides	Yellow giant hyssop	Heiracium canadense	Canada hawkweed
Agastache scrophularienefolia	Purple giant hyssop	Hypoxis hirsuta	Yellow star-grass
Anemone virginiana	Tall anemone	Krigia biflora	False dandelion
Asclepias purpurascens	Purple milkweed	Lilium philadelphicum	Prairie lily
Aster linariifolius	Flax-leaved aster	Lupinus perennis	Wild lupine
Astraglus canadensis	Canadian milkvetch	Lysimachia lanceolata	Lance-leaved loosestrife
Aureolaria grandiflora	Yellow false foxglove	Lysinachia quadrifolia	Whorled loosestrife
Aureolaria pedicularia	Clammy false foxglove	Oenothera perennis	Small sundrops
Baptisia leucantha	White wild indigo	Oxalis violacea	Violet wood-sorrel
Baptisia leucophaea	Cream wild indigo	Pedicularis canadensis	Wood betony
Besseya bullii	Kitten tails	Penstemon gracilis	Slender beard-tongue

Blephilia ciliata	Ohio horse-mint	Phlox pilosa	Prairie phlox
Bromus kalmii	Prairie brome	Polemomium reptans	Jacob’s ladder
Cacalia artiplicifolia	Pale Indian plantain	Plygala senega	Seneca snakeroot
Cacalia muhlenbergii	Great Indian plantain	Ploytaenia imtallii	Prairie parsley
Camassia scilloides	Wild hyacinth	Prenanthes alba	Lion’s foot
Castilleja coccinea	Indian paintbrush	Ramunculus fascicularis	Early buttercup
Ceanotinus americana	New Jersey tea	Ramunculus rhomboidens	Prairie buttercup
Ceanothus ovatus	Prairie redroot	Silene stellata	Starry campion
Cirsium altissimum	Woodland thistle	Solidago Irrspida	Hairy goldenrod
Convolvulus spithamaeus	Low bindweed	Taenidia integerrima	Yellow pimpernel
Cypripediun pubescens	Large yellow lady-slipper	Tephrosia virginiana	Goat’s rue
Demodium canadense	Showy tick-trefoil	Thaspium trifoliatum	Meadow parsnip
Dodecatheon meadia	Shooting star	Tomanthera auriculata	Eared false foxglove
Elymus villosus	Silky wild rye	Triosteum aurantiacum	Late horse gentian
Elymus virginicus	Virginia wild rye	Triosteum peroliatum	Early horse gentian
Erigeron pulchellus	Robin’s plantain	Veronicastrum virginicum	Culver’s root
Eupatorium sessilifolium	Woodland	Zigadenus	White camas

	boneset	elegans	
Gentiana alba	Cream gentian	Zizia Aurea	Golden Alexander
Heuchera americana	Prairie alum-root		