



Ecosystem Restoration on the Prairie-Forest Border

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INTRODUCTION

In 1988 my parents purchased an 80 acre farm in south central Minnesota. Since 1993, I have been restoring the land to a more natural state by planting trees and prairie, and eliminating exotic plant species. To date, about 9 acres have been converted from agricultural production to either trees or prairie. With the experience and mistakes of the past plantings, I am planning the restoration of the remaining land still in production. The main motivation behind this project is a personal desire to create an area of prairie and forest reminiscent of the land's original condition.

DESCRIPTION

The farm is located in Wright County in Marysville Township about two miles north of the town of Waverly, and 40 miles west of Minneapolis. Of 80 acres, 47 were in agricultural production at the time of purchase, nine of which are being restored. The remaining area includes an upland forest patch, a floodplain forest with a creek, a wet meadow, and a shallow marsh. The north fork of the Crow River is located just over the border to the north.

SOIL

The area around the farm is a rolling terrain typical of glacial moraine. Much of the soils are glacial till and include Lester series, a prairie border alfisol. The soil on the highest part of the farm is Esterville series, a glacial outwash mollisol. An old gravel pit is located there, resulting in a half-acre crater.

The soil survey, printed in 1968, indicates that the soils of the agricultural fields are moderately to severely eroded. Conventional tillage practices have occurred on the site for decades and are still practiced today. Heavy amounts of sediment are present at the bottom of the slopes at the edge of the woods. While not a main motivation for the restoration, the project will result in greatly reduced soil losses.

SITE HISTORY

The area is considered to be in an area of prairie-forest transition zone at the western end of the Big Woods. The original survey notes describe maple, elm, ash, and oak. In "D. R. Farnham's History of Wright County" (1880), a description of the township mentions scattered prairies on sandy upland soils. Prairie very likely existed on the sand and gravel upland areas of the farm, with forest on the clay and loam soils. It is not known exactly when the original vegetation was cleared. However, the area was settled in the 1870's and clearing probably occurred soon thereafter. An old one room schoolhouse, built before the turn of the century, stands on the southeastern corner of the farm.

Fencing with insulators along the fence lines and the woods indicate that grazing occurred at some point. Young trees are now growing beyond the fenceline, and boxelder trees (*Acer negundo*) felled in the gravel pit in 1995 were about 50 years old. The age of these trees corresponds to the time when farm crop subsidies were made available to farmers, encouraging them to grow crops instead of grazing cattle. Currently the agricultural fields are rented to a local dairy farmer who grows corn, beans, and alfalfa using conventional tillage methods.

INTENDED GOALS AND TARGET COMMUNITY

The goals of the project are twofold; (1) to improve the condition of the remnant patches of woods and expand them, (2) to restore the agricultural fields to either forest or tallgrass prairie and savanna.

Remnant patches of the Big Woods in the area serve as models for the project, including Mary Schmidt Crawford Woods Scientific and Natural Area, ten miles away. Prairie Restorations Inc., the main supplier of prairie seed for the project, has provided much insight into matching appropriate native species to the diverse soil and moisture conditions found on the site. Upland, sandy areas will be planted in mixed height species, while clayey and loamy soils located lower in the landscape will be planted as tallgrass mesic and moist prairie as moisture conditions dictate.

The prairie that did exist on the site was probably an oak savanna possibly containing species such as bur oak (*Quercus macrocarpa*), leadplant (*Amorpha canescens*), prairie rose (*Rosa arkansana*), and little bluestem (*Schizachyrium scoparium*). The ultimate goal for the prairie project is to achieve this community.

THE RESTORATION

Restoration work underway and planned for the future are in the following areas: the agricultural fields where trees and prairie are being planted, the gravel pit, the floodplain woods, and the upland woods, dubbed Painschab Woods.

AGRICULTURAL FIELD: FOREST PLANTING

Restoration began as an idea to plant some trees as a reforestation project. In 1993 about 100 green ash (*Fraxinus pensylvanica*) and bur oak (*Quercus macrocarpa*) purchased from the Department of Natural Resources were planted in a half acre area behind the school house in an abandoned alfalfa field. Weed control consisted of woodchips spread around each seedling. This proved to be insufficient to release the trees from competition. Heavy damage from rodents occurred in the first winter and destroyed approximately half of the trees. In 1996 bur oak (*Quercus macrocarpa*) and red oak (*Quercus rubra*) will be planted to fill in gaps where trees have died. Herbicide will be applied around each tree to release them from competition.

In 1994, about one and a half acres adjacent to Painschab Woods were planted with black walnut (*Juglans nigra*), cottonwood (*Populus deltoides*), silver maple (*Acer saccharinum*), white oak (*Quercus alba*), Norway spruce (*Picea abies*), jack pine (*Pinus banksiana*) and red pine (*Pinus resinosa*). In 1995, two

more acres adjacent to the floodplain woods and forming a connection to Painschab Woods were planted with white pine (*Pinus strobus*), paper birch (*Betula papyrifera*), green ash (*Fraxinus pennsylvanica*), red maple (*Acer rubrum*), sugar maple (*Acer saccharum*), red oak (*Quercus rubra*), bur oak (*Quercus macrocarpa*), black walnut (*Juglans nigra*), wild plum (*Prunus americana*), chokecherry (*Prunus virginiana*), and red-osier dogwood (*Cornus stolonifera*). The objective is to expand the size of the forest patches and connect the two, allowing for easier movement of wildlife between the patches.

Corn was grown the previous year on these sites. The soil was disked prior to tree planting, providing a lumpy, rough soil surface. This micro-topography allows for better infiltration of water than a smooth surface and reduces runoff. Weeds have been a problem, especially the first year when six foot high giant foxtail (*Setaria faberi*) overwhelmed the seedlings. Mowing periodically around the trees helped to prevent losing the trees in the weeds, but in the future herbicide will be applied around each tree to eliminate competition.

In these projects, the seedlings were planted by digging a hole with a shovel and hand planting. The soil is too clayey for the use of planting bars. Beginning in 1996 a power auger will be used to create holes and a dowel will be used to pack the soil in the hole. This will save time and reduce air pockets which are harmful to the roots.

The areas between the school house and Painschab Woods, and along the floodplain woods will likely be planted sometime in the future. Specific plans have not yet been made. The focus, however, will be on planting only Big Woods species, and mimicking the spacing of a natural woods to avoid a contrived appearance.

PRAIRIE

A prairie planting project was planned during the winter of 1994. Due to a lack of experience, equipment, and money, a planting of only one acre was planned for the spring of 1994. A seed mix from Prairie Restoration containing seven species of grasses, including big bluestem (*Andropogon gerardii*), and side-oats grama (*Bouteloua curtipendula*), and 23 species of wildflower such as yellow coneflower (*Ratibida nuttalliana*), butterfly weed (*Asclepias tuberosa*), and purple prairie clover (*Petalostemum candidum*) were hand broadcast on a site adjacent to the 1994 forest restoration site. This site was also a cornfield the year before and was plowed in the fall and disked in the spring prior to planting. After broadcasting the seed, a chainlink fence with a railroad tie attached was dragged over the field by hand to harrow the seed in. Two wildflower species and all seven grasses appeared during the first season along with a variety of weeds, including a particularly heavy concentration of giant foxtail.

In 1995 approximately 4 more acres were planted adjacent to the previous planting. This time a seed drill was used to plant the grasses due to the large size of the planting. Seed from Prairie Restoration Inc., in addition to wildflower seed from two other local seed dealers was used to increase the number of species planted to 47, and a wet forb mix including joe-pye weed (*Eupatorium*

maculatum) and New England aster (*Aster novae-angliae*) was also planted in a seepage area on the site. The first year's results resemble that of the 1994 planting. During the second year of the 1994 planting, not only had prairie plants begun to dominate over the weeds, but seven wildflower species were observed, including an abundance of black-eyed Susan (*Rudbeckia hirta*). According to Prairie Restorations Inc. the progress of the prairie is typical of what should be expected from a first and second year planting.

Oak savanna is the ultimate goal for the prairie areas. As of yet there are no specific plans for how to go about such a project and information is still being gathered. Problems for such a project include preventing oak seedlings from being destroyed during a prescribed burn, placement of the trees to avoid a contrived appearance, and number of oaks to plant. Some possible way to prevent fire damage to the oaks would be to mow around each tree prior to burning and then only burn with a back fire which would not have the intensity of a fire driven by the wind. Another idea is to burn small areas each year as opposed to burning the entire prairie area in a given year. Smaller burn units would have the dual advantages of being easier to control and creating some spatial variation between burn units. Existing oak savanna remnants such as Helen Allison Savanna Scientific and Natural Area could serve as models for not only plant species but also for spacing of individual trees.

GRAVEL PIT.

The gravel pit is an area almost one acre in size which is not in production. Smooth brome (*Bromus inermis*) dominates on all but the north facing slope, where three large cottonwood (*Populus deltoides*), and several smaller boxelder (*Acer negundo*), elm (*Ulmus americana*), and buckthorn (*Rhamnus cathartica*) trees stand.

The prairie restoration of the gravel pit began in 1995. One quarter of the site was sprayed with herbicide and later tilled lightly. A mixed-height grass and wildflower mix for dry, sandy areas from Prairie Restorations was planted and includes blue grama (*Bouteloua gracilis*) and silky aster (*Aster sericeus*). During the winter, buckthorn and boxelder trees were removed from the north slope of the pit. The remainder of the boxelders will be removed later because they are deemed not appropriate for the site. The three large cottonwood trees will remain, adding a beautiful touch to what will be prairie. In 1996 the remainder of the site will be planted in prairie. Seedlings of pasque flower (*Pulsatilla nuttalliana*), prairie smoke (*Geum triflorum*), and a few bur oak (*Quercus macrocarpa*) will be hand planted.

The gravel pit is not a large feature of the overall landscape and is not causing off-site degradation. Therefore, this historic and cultural feature will not be recontoured.

PAINSCHAB WOODS

Painschab woods, named after former neighbors, is about three acres of typical upland hardwood spared agricultural conversion due to its steep slopes. It

consists of basswood (*Tilia americana*), sugar maple (*Acer saccharum*), green ash (*Fraxinus pennsylvanica*), ironwood (*Ostrya virginiana*), aspen (*Populus tremuloides*), bur oak (*Quercus macrocarpa*) and boxelder (*Acer negundo*). Several large basswood and green ash trees tower over the main canopy, while down below the forest floor puts on a spectacle every year with bloodroot (*Sanguinaria canadensis*), Dutchman's breeches (*Dicentra cucullaria*), large-flowered bellwort (*Uvularia grandiflora*), and other spring ephemerals. Elm was found in high concentrations in this portion of the Big Woods, but Dutch elm disease has since killed the mature elms in the patch. The standing dead elms have created a haven for pileated, hairy, downy, and red bellied woodpeckers. Loss of these elms has created holes in the canopy, aiding the invasion of European buckthorn (*Rhamnus cathartica*) which is found in high densities in the woods and along the edges, inhibiting the production of native tree species. This community is indicative of much of the original vegetation on the farm.

Interventions in the Painschab woods have consisted mainly of removing the heavy understory of buckthorn which began in the fall of 1994 by cutting trees at the base and applying 2-4D to the stump. This method resulted in the death of the tree with no observed damage to surrounding vegetation. Due to the large volume of buckthorn trees, several large slash piles were burned. However, two piles were left along the edge of the woods to create habitat for wildlife. Buckthorn was in such thick stands that no new tree regeneration has occurred for some time in much of the woods. In the spring of 1996, 100 sugar maple (*Acer saccharum*) seedlings will be planted with the hope that this shade tolerant species will grow and eventually close the gaps in the canopy, somewhat reducing the stable invasion window for buckthorn. The seedlings will be marked with orange vinyl flagging in order to monitor their progress and determine the success of the project.

The southwest corner of Painschab woods contains several aspens (*Populus tremuloides*). Many more have died and are in various states of decay. The aspen trees are deemed desirable as they were a component of the Big Woods and provide habitat for some species of wildlife. Some regeneration is taking place in this area and it is hoped that more will occur with the release of buckthorn competition. In the winter of 1996 one overmature aspen tree was felled in an attempt to further stimulate aspen regeneration. The regeneration will be observed during the following year, and further decisions to fell the two remaining overmature aspens will be based on the observed results.

FLOODPLAIN WOODS

The other wooded area is a ten acre floodplain forest. Large silver maples (*Acer saccharinum*) and downed trees in various states of decomposition indicate that the forest is relatively undisturbed. Woody debris is abundant throughout with debris in the creek. Twelve Mile Creek meanders through the forest, draining into the north fork of the Crow River just to the northeast of the property. Wildlife is abundant and includes bald eagles, great blue herons, wood ducks, and wild turkeys.

Buckthorn (*Rhamnus cathartica*) is present, but is generally limited to the southern edge of the woods. Some efforts have been made to remove them but much of the work remains to be done. Some short gullies are found just inside the woods where the creek cuts into the southern bank hillside. Piles of garbage consisting of wire, bottles, cans, and other debris were dumped in the gullies some time ago presumably as a crude erosion prevention measure. With the restoration of the upland area to the south, the gully erosion problem was considered to no longer be a threat and most of the garbage was removed. Some small pieces of garbage remain buried in the sediment and are periodically removed as they become visible. At least three other active gullies are present to the west where upland restoration has not yet taken place. These gullies cut from the stream toward the upland areas and are from ten to fifteen feet long. In the spring of 1996 when the farmers pick field stones, the rocks will be deposited near the gullies and used as riprap to control the head cut and prevent further erosion. The creek and floodplain would be best served with the restoration of the upland areas that drain into the creek.

DISCUSSION

When assessing the success of a restoration project, the main criterion is if the site has the structure and function of a natural ecosystem. To this extent, a very small degree of success has been achieved thus far. Grasses cover an area that was previously a corn field. These grasses provide cover for wildlife, prevent soil erosion, and are beginning the process of restoring aggregation to the soil. Still, this site lacks the species composition and soil structure of a remnant prairie. The tree plantings are little more than small shrubs. A successful forest restoration will be one with an overstory, lower canopy, shrub and herb layer. A forest soil is one in which most, if not all rainfall that reaches the mineral soil is infiltrated. A restoration should strive for these conditions as an ultimate goal. Success in the short term can be measured as progress toward these conditions.

The progress of the prairie is assessed by routinely observing the prairie and exotic species present and their relative abundance as well as the general appearance of the prairie. Species that have been planted but have not yet appeared are also noted. This information is relayed to Prairie Restorations Inc. and compared with similar restorations they have performed to determine the progress of the prairie. A more accurate and scientific monitoring system involving survey plots would provide more accurate and detailed information, but at present I lack the expertise for such a monitoring program. It is hoped that in the future this will be possible. The forest restoration is also monitored by observation. Orange flagging has been placed on each seedling to more accurately observe mortality. Trees are also inspected for new growth, herbivory, and disease.

Ideally the seeds for the tree seedlings would be collected locally to ensure plants that are adapted to the area. Due to a lack of time, money, and expertise this has not been possible and all the trees have come from the Minnesota Department of Resources tree seedling program which collects seed from elsewhere. Further, several species typical of the Big Woods, such as basswood

(*Tilia americana*), ironwood (*Ostrya virginiana*), butternut (*Juglans cinerea*), and elm (*Ulmus americana*) are not available from the Department of Natural Resources. While these trees are not currently being planted, some of them are mid to late successional species and it is hoped that they will disperse from the remnant patches into the planted areas. Spacing of the seedlings has focused on random planting allowing for ample space between trees. The model communities need to be mimicked for spacing of trees as well as species composition.

Dispersal hopefully will be the mechanism by which the herbaceous plants are established once the canopy becomes developed. It will be several decades before the ground cover can become established and is not a great concern at this time. Despite enlarging the forests, they will still be mainly edge and largely influenced by the surrounding open areas.

Due to a lack of knowledge, some species of trees not part of the target community were planted in the past. White pine (*Pinus strobus*), red pine (*Pinus resinosa*), jack pine (*Pinus banksiana*), and paper birch (*Betula papyrifera*) were planted along the east border connecting the floodplain woods and Painschab woods. Since these are the only species planted in this area it can more or less be considered to be a cultural landscape. Scattered through the other areas planted in Big Woods species are Norway spruce (*Picea abies*). These will be eliminated over time and replaced with native species.

This 80 acre site is a small area and only a patch in a larger agricultural landscape. Consequently, the farm will be heavily influenced by its surrounding matrix. Climate and biota will be affected.

CONCLUSION

I have paid for most of the materials, opting to avoid the Conservation Reserve Program and other government programs and the terms imposed by them. Due to a lack of money, the restoration is slow and lacks some of the species diversity that the purchase of prairie plants could provide.

The project has been a source of enjoyment as I watch the farm come alive with prairie and trees where corn and alfalfa once stood. In three years of work I have learned a tremendous amount and hope to learn even more in the years to come.