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THE SEEDBANK OF WOODLOTS IN AN AGRICULTURAL MATRIX

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ABSTRACT

Soil samples from four woodlots representing different land-use history and canopy vegetation were sampled to determine the composition of the seedbank. Seeds of 73 taxa distributed among 35 families were represented. Comparisons among the seedbank of the four woodlots were made using Sorensen's Index of Similarity. Grazing affected the similarity between seedbanks more than did canopy composition. Twenty-seven percent of the aggregate seedbank was composed of weeds or widespread annuals suggesting an important contribution from the surrounding matrix. The impact of the current disturbance regime on the future composition of vegetation is discussed.

INTRODUCTION

The presettlement landscape of southern Wisconsin was dominated by fire. Fire frequency was an important determinant of the presence of prairie, savanna, oak openings, oak forests, and more mesic vegetation types. European settlement eliminated fire as a major agent of disturbance and replaced it with one dominated by man's activities.

The modern midwestern landscape is primarily agricultural. Natural vegetation persists as remnant patches or forested woodlots embedded in the agricultural matrix. These habitat islands are frequently small and increasingly isolated from each other (Guntenspergen 1984). These sites have suffered from: grazing by cattle, selective cutting, and other disturbances associated with management by man. In such a landscape it is quite justified to ask: what will become of the natural vegetation of the region under present management conditions?

Myers and Henry (1976) have documented the loss of 16% of the 820 native plant species present at settlement in two west-central Illinois counties. Throughout the midwest, efforts by private conservation organizations and by state and federal agencies are concerned with the preservation of the rare and threatened biota and examples of intact ecosystems. Often times, loss of habitat does threaten a species with extinction. In Wisconsin, the loss of upland forest habitat has been documented through examinations of Cadiz Township in Green County along the Illinois border (Shriner and Copeland 1904, Curtis 1956, Sharpe et al. 1981). Fragmentation, isolation, restriction of forest to extreme sites, an altered disturbance regime, and the presence of exotics and early successional

species may well influence the composition of the remaining forested areas and result in the extirpation of certain plant species in this landscape.

For the past several years, we have been concerned with the distribution and abundance of plant species in an agricultural landscape in southern Wisconsin. These studies in Cadiz Township have recently been summarized (Stearns et al. 1986). In this paper, we address a series of questions about the potential vegetation in forest islands and the possible shift in species composition by examining the seedbanks of a number of woodlots.

The seedbank represents a store of seeds buried in the soil which can contribute to the vegetation on a site following disturbance. The importance of the seedbank in recovery following disturbance in forests was recognized early on (Brenchley 1918, Peter 1893). However, most studies have attempted to analyze changes in the seedbank throughout the sequence of old field succession (Olmsted and Curtis 1947, Livingstone and Allessio 1968, Oosting and Humphreys 1940). Few studies have attempted to use the seedbank as an indicator of the potential change in vegetation in the landscape and the interactions between landscape elements (sensu Forman and Gordon 1986).

Specifically, we ask three questions: 1) What species are present in the seedbank of isolated woodlots? 2) How does disturbance affect the composition of the seedbank? 3) What does the composition of the seedbank tell us about potential dispersal of species within the landscape?

METHODS

We sampled the seedbanks of eight woodlots from Cadiz Township, Green County, Wisconsin in the late fall of 1984. In each woodlot, soil was removed from the forest floor from eight randomly selected 0.125 m^2 quadrats to a depth of six centimeters. Each sample was placed in a plastic bag and returned to the laboratory. These samples were cold stratified in an environmental chamber at eight degrees centigrade. After several months, the samples were spread in flats over a perlite greenhouse mixture and placed randomly in a glasshouse. The soil was kept moist by regular watering. Seedlings were removed as individuals matured to an identifiable stage. After each flush of germination, soil in the flats was stirred. In the fall, after germination stopped, the flats were again put in a cold environmental chamber. After several months, samples were placed in the glasshouse, stirred, and additional germinants identified and removed. The flats were kept active until several weeks after the last recorded germination.

In this paper, we report on data from only four of the eight woodlots: Meyer, Leck, Klemm, and Browntown (a state scientific area). These sites differ in the composition of the overstory vegetation. Meyer and Leck have a primary maple overstory, Browntown is dominated by oaks, and Klemm by a canopy of elm, ash, and basswood. These sites have also had different land use histories: Meyer

is actively grazed by cattle, Klemm was grazed twenty years ago, and Leck and Browntown show no signs of ever having been significantly disturbed.

For each stand we compiled a species list from the seedbank. Comparisons among stands were made pair-wise using Sorensen's Index of Similarity (Muller-Dombois and Ellenberg 1974):

$$S=(2C/A+B)100$$

where: C=number of species common to two stands
A=total number of species in stand A
B=total number of species in stand B

RESULTS AND DISCUSSION

A total of 73 species in 35 families were identified in the seedbanks of the four woodlots. The most common families represented were in order of importance: Asteraceae, Poaceae, Ulmaceae, Onagraceae, Liliaceae, and the Urticaceae. Table 1 identifies those species which were common to three or four of the woodlots. They are, for the most part, native species common to woods. However, there are several weedy species present among this group. In the aggregate seedbank pool of these four woodlots, twenty-seven percent of the 73 species found can be classified as either weedy or widespread annuals.

Table 1. Species common to at least 3 of 4 sampled woodlots of Cadiz Township, Green County, Wisconsin.

Cirsium spp.	weedy
Taraxacum officinale	weedy
Campanula americana	native moist woods
Viola spp.	native
Ulmus rubra	native
Claytonia virginica	native
Solanum nigrum	native
Xanthoxylum americanum	native
Galium aparine	widespread
Ranunculus abortivus	native woods
Eupatorium rugosum	moist woods
Parthenocissus quinquefolia	moist soils
Schizachne purpurascens	dry woods

Table 2 suggests a similarity among stand seedpools although the stands differ in canopy vegetation and disturbance history. The two ungrazed stands (Leck and Browntown) are similar to each other and to Klemm, which has not had any recent grazing. Meyer, which is currently grazed, is somewhat different than the other three stands. Meyer also has the highest percentage (37%) of species unique to it from among the four stands. Those species were primarily annuals reflecting the more disturbed and open nature of Meyer.

Table 2. A matrix of Sorensen's Similarity Indices comparing the seedbanks of four woodlots from Cadiz Township, Green County, Wisconsin. An index of 100 would indicate identical species composition.

	Leck	Browntown	Klemm
Meyer	47	41	42
Leck		50	54
Browntown			54

The four woodlots sampled represent different land-use history and vegetation types. Despite these differences, they appear to have sufficiently similar seedbanks to indicate either past disturbance common to all these woods or a similar seed rain favoring species with relatively high dispersal ability. Exotics, annuals, and agricultural weeds are important components of the aggregate seed pool and share good dispersal characteristics suggesting an important influx from the surrounding matrix.

The present day forest stands are increasingly isolated from each other and would appear to be more closely influenced by the species present in the surrounding matrix. If the crown cover is opened and the soil is disturbed, or if grazing is prevalent, it is likely that the germinating species may resemble the annual and exotic weeds present in the matrix. This may influence the normal sequence of succession found in forest gaps and result in the native understory species being replaced by exotics and others tolerant of disturbance and more characteristic of early successional communities. Consequently, only those species best suited for dispersal and establishment may remain in these woodlots leading to a homogenization of the vegetation and the extirpation of species. Selection for the conditions present in increasingly disturbed, isolated, and marginal habitats may eventually lead to a wholesale reassortment of the flora of the region.

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