DISTRIBUTION PATTERNS OF PRAIRIE PLANT SPECIES IN A CLOSED-CANOPY FOREST SITUATION

J. KENNETH MCCARTY
Missouri Department of Natural Resources

FRED HASSIEN
Lincoln University

Abstract. Prairie plants are part of the woodland understory in lands adjacent to the former Grand Prairie in central Missouri. Though low in vigor, these plants grow from extensive, well-developed root systems. They are grouped in numerous scattered clusters beneath the woodland canopy, and their locations are highly predictable with respect to soil type and aspect. Distributions indicate that they are the result of dynamic interactions between forest and prairie, and that they maintain themselves by preserving root systems rather than by reproduction. Their distributions also provide insights concerning the fine structure of one type of forest/prairie transition.

INTRODUCTION

The tallgrass prairie occurs in a region that supports both forest and prairie. Where the two communities meet, vegetation elements usually intergrade (Bliss and Cox 1964, Bray 1960, Curtis and McIntosh 1951) rather than change abruptly (Dyksterhuis 1957). This creates a transition zone which has been variously described as broad (Anderson and Schwagman 1971, Ehrenreich and Crosby 1960, Vestal 1936), irregular (Weunser and Valiunas 1967), and patchy on both large (Sears 1981) and small (Anderson 1983, Buell and Facey 1960, Forsyth 1981, Sears 1942) scales. Although little is recognizable today, once much of the region supported a vegetation which was not quite forest, and not quite prairie, but somewhere in between.

This was particularly true in Missouri, a prairie transition state (Schroeder 1981). Henry Rowe Schoolcraft (1955) wrote of the Ozark region in 1819: "a tall, thick, and rank growth of wild grass covers the whole country, in which the trees are standing interspersed, like fruit trees in some well-cultivated orchard." More recently, Ray and Lawson (1955) described a forested Missouri Ozark region where "scattered prairie openings, natural clearings, glades, and rocky barrens occupy a considerable acreage," and Martin (1954) discussed the fairly heavy stands of native grasses beneath the "historically open, mature forest canopies."

Unfortunately, most of this landscape type has been lost because of clearing, grazing, and fire suppression. Although literature concerning it is equally scarce, several restoration projects are being undertaken (Iffrig and Nelson 1983, USFS personnel, personal communication). If indeed the transition between forest and prairie is recognized as a restorable landscape type, it is imperative that we better understand the ecological factors involved in the intermixing of these two communities.

This study, which grew from a more comprehensive prairie restoration project still underway, examines some of the local vegetation patterns in a forest/prairie transition zone. In particular, it relates survival of prairie plants in forest communities to successional processes in the Ozark border region.

BACKGROUND

In 1980, the National Forest Service cleared 50 acres of forest from a block of 160 acres of second-growth timber. It was located on the fringe of what once was known as the Grand Prairie, in Callaway County of north-central Missouri. The trees, which were 40 to 60 years old, were removed through the issuance of firewood cutting permits. No herbicide was applied, and approximately ten trees per acre were left standing. The goal of the Forest Service was to burn annually and hopefully produce a "savanna" appearance as the scattered prairie plants increased in number and vigor. Studies to date show that this is occurring (for example, see Fig. 1), but that the response differs according to soil type (Fig. 2). In fact, as is diagrammed in Fig. 3, prairie plants on this research site are distributed in association with certain topographical features. This study began as an attempt to locate prairie plants in the woodlands surrounding the original research site and identify patterns in their distribution.

PROCEDURE

To assist in identifying landscape features in the field, a small-scale shaded relief map of the study area was constructed from the local USGS topographic map. Several transects were marked on this map, each traversing the entire length of a forested ridge and approximating its contour. The transects were spaced about 20 meters apart, and thus the number per ridge varied. Each was traversed in the field and the locations of prairie plants marked, using the transect lines as reference points. Boundary lines were drawn around the clusters of prairie plants when the final copy was prepared. Similarly, areas dominated by species typical of old-field situations, and of shaded mesic forest situations, were located on the map.

After establishing the location of groups of prairie plants, we excavated several and examined their root systems. Included in this survey were six individual lead plants (Amorpha canescens Pursh.), two individual goat’s rue (Tephrosia virginiana (L.) Pers.), three individual sensitive briars (Schränkia uralensis Willd.), and four yarrow colonies (Achillea millefolium L.). The root systems were removed, washed, measured, and photographed.

RESULTS

Prairie plants do exist in the woodlands of the study area, and in discernable patterns. Their locations, together with the locations of old-field and mesic forest species associations, are illustrated in Fig. 4. Understory communities in this latter category are found along the lower portions of the drainages and extend partway up the north- and east-facing slopes. Prairie associations occur on the narrow ridgetops and on high south- and west-facing slopes, just as they do on the nearby deforested area (Figs. 1 and 3). Old-field vegetation occupies positions intermediate between the two.

Preliminary results of the root studies are shown in Fig. 5. Lead plant Amorpha canescens and goat’s rue (Tephrosia virginiana) have long slender taproots which averaged 1.1 m and 0.5 m in length, respectively. Sensitive briar (Schränkia uralensis) has a large vertical taproot which averaged 2.5 cm in diameter at the crown and 0.6 m in length. Numerous secondary roots branched from the taproot. The yarrow (Achillea millefolium) colonies averaged 9.8 live root crowns and 6.5 dead root crowns per colony. Mean total rhizome length was 2.4 m.
FIG. 1. Locations of clumps of big bluestem, little bluestem, and Indiangrass the first three years after tree removal on 50 acres of second growth timber in a prairie-forest transition zone.
DISCUSSION

Our survey located numerous characteristic prairie plants growing in a woodland understory situation. Although they grew from extensive, robust, and presumably old root systems, most were inconspicuous because of limited flowering and production of only one or a very few leaves. They were never isolated but were always grouped with several others to form clusters, which were distributed in relation to local changes in soils, aspect, and topography (Figs. 1-4). Prairie plants were found only on narrow, well-drained ridgetops, and south- and west-facing slopes, high on the watershed. Similar relationships have been noted by several authors throughout the tallgrass prairie region (Ashby and Kelting 1963, Anderson 1983, Buell and Facey 1960, Forsyth 1981, Sears 1942).

The study site lies within a tension zone. This is indicated by soil types which are classified as forest but have certain prairie characteristics (SCS personnel, personal communication), the close proximity to documented pre-settlement prairie systems (Schroeder 1981), and close proximity to prairie soils. Succession is a dynamic process, and the islands of prairie plants found beneath the woodland canopies probably owe their existence to stronger prairie influence in the past. Forest closure displaces prairie species, but rates vary in dissected terrain (Bragg and Hulbert 1976). Though closure is complete on the study site, groups of prairie plants still occupy all of the well-drained or southerly-exposed locations. Vigor in all cases is much reduced from their open-grown counterparts, and site inspections and seedbank studies (Hassien and McCarty unpubl.) show that reproduction is scarce to non-existent. However, all plants examined grew from strong, well-developed root systems and probably have been present for some time. They are the extreme limit of prairie representation in the forest/prairie transition zone, and form a mosaic beyond the more noticeable islands of prairie recorded around the fringe of the prairie peninsula (Oyster-Smith 1983, Sears 1981).

Understanding the structure of forest/prairie transitions, and of the patterns of dynamic interactions between the two
LEAD PLANT
Amorpha canescens
1° Root Length: \( \bar{x} = 111.3 \text{ cm} \)
Crown Diameter: \( \bar{x} = 3.2 \text{ cm} \)
\( n = 6 \)

SENSITIVE BRIAR
Schrankia uncinata
1° Root Length: \( \bar{x} = 57.0 \text{ cm} \)
2° Root Length: \( \bar{x} = 455.6 \text{ cm} \)
Crown Diameter: \( \bar{x} = 2.5 \text{ cm} \)
\( n = 3 \)

GOAT’S RUE
Tephrosia virginiana
1° Root Length: \( \bar{x} = 50.8 \text{ cm} \)
2° Root Length: \( \bar{x} = 455.6 \text{ cm} \)
\( n = 2 \)

YARROW
Achillea Millefolium
Total Rhizome Length: \( \bar{x} = 242.3 \text{ cm} \)
No. Live Root Crowns/Colony: \( \bar{x} = 9.8 \)
No. Dead Root Crowns/Colony: \( \bar{x} = 6.5 \)
\( n = 4 \)

LITERATURE CITED

FIG. 5. Typical root structure and average dimensions for four species of prairie plants.