

Limestone Glades of Harrison County, Indiana

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Introduction

Limestone glades are relatively small natural openings in the forest caused by bedrock at or near the surface, usually on steep south or west-facing slopes of seven to twenty degrees. They are dominated by prairie grasses and forbs. This xeric community has not been previously described in studies of Indiana's plant communities (13). In this paper, we will discuss limestone glades recently located in Harrison County, including the methods used to locate, evaluate and describe them. A preliminary species list is presented, including information concerning some very rare floristic elements.

Methods

A systematic search for glades was made in Harrison County during March, 1980 (12). The initial step was an examination of the Agriculture Stabilization and Conservation Service aerial photographs, in conjunction with the 7.5' United States Geological Survey topographic quadrangle maps, section by section, to select potential glades. Fifty possible glade sites were selected during the map and photo examinations. These were chosen as grassy or brushy openings in the forest on south and west-facing slopes (Figure 1). The county was then flown in a small plane at an altitude of 1000 feet, and the potential sites were examined to determine if they were unnatural, disturbed, or were potentially a natural glade of significance for preservation. Of these fifty, twenty-seven were eliminated.

During the ground survey that followed, four significant glades were identified, and a number of disturbed glades with potential for restoration were also located. The significant glades were determined to be of high natural quality based on a number of factors including: lack of obvious signs of disturbance, relative absence of weedy and alien species, a diversity of native species, and a lack of woody encroachment.

Results

Three of the significant glades were selected for more intensive surveys. During 1981, from April to September, each glade was visited approximately every six weeks to compile a species list. Seventy-two native taxa were identified on these three glades (Table 1). Of particular note is the high number of plants considered rare, endangered or threatened (1,2) in Indiana (Table 2). The axe-shaped St. John's-wort (*Hypericum dolabriforme*) was considered to be extirpated before its discovery in all three glades. It had not been reported for Indiana since Blatchley collected it in 1899 near Wyandotte Cave. The glade heliotrope (*Heliotropium tenellum*), a new state record, was reported by Medley (17) during a visit to one of the glades in August, 1981. This summer annual was subsequently discovered to occur in one other glade. Four other species, slender-stalked gaura (*Gaura filipes*), downy milk pea (*Galactia volunbilis*), flax (*Linum sulcatum*), and heart-leaved



FIGURE 1. Oblique aerial photo of a Harrison County limestone glade taken in March, 1980. the darker, conical shaped trees in and around the light colored forest opening are eastern red cedar (*Juniperus virginiana*).

meadow parsnip (*Zizia aptera*), that are currently listed as state endangered were found to occur in the glades. Two state threatened species, narrowleaf houstonia (*Houstonia nigricans*) and angle-pod (*Gonolobus obliquus*) were also found in the glades.

TABLE 1. *Species occurring in Harrison County, Indiana limestone glades.*¹

<i>Agave virginica</i>	<i>Gaura filipes</i>
<i>Allium cernuum</i>	<i>Gentiana quinquefolia</i>
<i>Andropogon gerardii</i>	<i>Gerardia tenuifolia</i>
<i>A. scoparius</i>	<i>Gonolobus obliquus</i>
<i>Anemone virginiana</i>	<i>Heliotropium tenellum</i>
<i>Anemone thalictroides</i>	<i>Hexalectris spicata</i>
<i>Asclepias syriaca</i>	<i>Houstonia angustifolia</i> (nigricans)
<i>A. verticillata</i>	<i>Houstonia purpurea</i>
<i>A. variegatum</i>	<i>Hypoxis hirsuta</i>
<i>Aster patens</i>	<i>Juniperus virginiana</i> var. <i>crebra</i>
<i>A. sp.</i>	<i>Kuhnia eupatorioides</i>
<i>Carex blanda</i>	<i>Lespedeza capitata</i>
<i>C. oligocarpa</i>	<i>Liatris aspera</i>
<i>C. swanii</i>	<i>Liatris spicata</i>
<i>Cercis canadensis</i>	<i>Liatris squarrosa</i>
<i>Comandra umbellata</i>	<i>Linum sulcatum</i>
<i>Coreopsis tripteris</i>	<i>Lithospermum canescens</i>
<i>Danthonia spicata</i>	<i>Lobelia spicata</i>
<i>Dodecatheon meadia</i>	<i>Lysimachia lanceolata</i>
<i>Echinacea purpurea</i>	<i>Melica mutica</i>
<i>Eryngium yuccaeifolium</i>	<i>Menispermum canadense</i>
<i>Euphorbia corollata</i>	<i>Monarda fistulosa</i>
<i>Pelea atropurpurea</i>	<i>Salvia lyrata</i>
<i>Phytostegia virginiana</i>	<i>Silphium trifoliatum</i>
<i>Polygonatum biflorum</i>	<i>Sisyrinchium albidum</i>
<i>Quercus muhlenbergii</i>	<i>Smilax bona-nox</i>
<i>Ratibida pinnata</i>	<i>Solidago</i> sp.
<i>Rhamnus carolinensis</i>	<i>Sorghastrum nutans</i>
<i>Rhus aromatica</i>	<i>Sporobolus vaginiflorus</i>
<i>Rosa carolina</i>	<i>Swertia carolinensis</i>
<i>Rudbeckia fulgida</i>	<i>Thalictrum revolutum</i>
<i>Ruellia carolinensis</i> (humilis)	<i>Viburnum rufidulum</i>
<i>Sabatia angularis</i>	<i>Viola triloba</i>
	<i>Zizia aptera</i>

¹ Nomenclature follows Gleason and Cronquist, 1963.TABLE 2. *Rare, threatened and endangered species in the Harrison County Limestone glades and their relative status, including protectedness, in Indiana.*

Species	Status	Number of Occurrences in Glades	Total Extant Sites	Protected ¹ Sites
<i>Galactia volubilis</i>	Endangered	3	4	0
<i>Gaura filipes</i>	Endangered	3	5	1
<i>Gonolobus obliquus</i>	Threatened	2	4	0
<i>Heliotropium tenellum</i>	Endangered ²	2	2	0
<i>Houstonia nigricans</i>	Threatened	3	7	0
<i>Hypericum dolabriforme</i>	Endangered	3	4	1
<i>Liatris squarrosa</i>	Rare	1	4	1
<i>Linum sulcatum</i>	Endangered	2	4	0
<i>Melica mutica</i>	Rare	3	12	0
<i>Zizia aptera</i>	Endangered	3	5	1

¹ Occurrences of viable populations on State Nature Preserves.² Proposed status.

Discussion

The glades of Harrison County are a relic component of the barrens or prairies of southern Indiana that in presettlement times covered 33,250 hectares in Washington and Harrison Counties (15). These prairies were *primarily restricted* to the Mitchell Plain Physiographic Province (18). This province extends into Kentucky, where limestone glades also occur (4,5).

Five limestone glades have previously been reported from this physiographically similar area in Kentucky. The Baskins listed 148 taxa, 25 of which were alien, from five glades within the barrens region of Kentucky. This high number of taxa reflects quite a bit of disturbance from grazing and subsequent invasion of many weedy species (5). The number of taxa from the Harrison County glades that were surveyed, which were relatively undisturbed natural areas, contained 72 taxa. Of particular importance is the lack of weedy and alien species, attesting to the relative absence of past disturbance.

No accounts have been written about the plant ecology or other unique elements of the southern Indiana glades (13), but published accounts of limestone glades in the adjoining states of Ohio (14,21), Kentucky (4,5) and Illinois (16) have been written. Little, besides historical accounts, has been written about the once more extensive "barrens" that may no longer exist in Indiana. Although these noteworthy communities are an outlying component of the mid-western prairies within the eastern deciduous forest region, it was not recognized by E. N. Transeau (20). This may be because he relied on Gordon's vegetation map of Indiana (11). Gordon may have overlooked these areas because the English-speaking settlers to the area used the term "Barrens" to describe these prairie areas since they associated the absence of trees with non-productive soils or barren lands. However, it should be known that Deam (8) was aware that presettlement barrens had existed in Indiana through communications with Gleason (9), and from the collections and notes of Dr. A. Clapp at DePauw University and C. W. Short's collections of *Aconitum uncinatum* in 1840 and 1842 from the "Barrens near Corydon".

The prairie element in the Harrison County limestone glades appears to be well represented. Thirty-eight species that occurred in the limestone glades have major distributions in the Great Plains (3). Similarly, thirty-three species are found in prairie or savanna habitats in northwest Indiana (19). Only a few of the Harrison County glade species are frequently found on cedar glades in the southeastern United States. These include *Andropogon scoparius*, *Hypericum dolabriforme* and *Oxalis violacea* (6). Many of the remaining glade species are also frequently encountered in dry, open woodlands and on exposed cliffs in the central Ohio River Counties of Indiana. These appear to have originated as elements of the eastern deciduous forest. This may be related to the prairie grass formation of the Midwest described by Gleason (9) to have occurred near the close of the xerothermic period. At this time, many western prairie species were unable to withstand large increases in moisture and were replaced by grasses and forbs, a more mesic, eastern derivation. Three of the most important Illinois prairie grasses, *Andropogon gerardi*, *A. scoparius*, and *Sorghastrum nutans*, which also occur in the Harrison County glades, were of eastern origin (9).

The remnant glades of Harrison County have resisted the encroachment of woody vegetation. their persistence involves a complex interplay of factors including thin soils, a southerly aspect, seven to twenty degree slopes, xeric conditions, and fire. Undoubtedly it has been Western man's post-settlement control and suppression of fire (21), as well as agricultural activities (7), that has been one of the

primary factors influencing the elimination or replacement of both glades and barrens by woody vegetation.

Although the glades are saturated with water during late fall, winter and spring, due to their southerly exposure and associated climatic conditions, they are very xeric during the summer months. This annual prolonged xeric period in combination with very thin or nearly lacking soil probably puts a severe physiological stress on woody invaders and correspondingly results in a very high mortality rate among wood species. Even so, the lack of fire has taken its toll on the glades' integrity and they are in danger of being squeezed out of existence if fire does not once again become an integral part of the maintenance of these unique areas. Aerial photographs document the continuing shrinkage of these glades, as they were nearly double their present size in the 1940s.

None of the glades are presently protected and managed as state natural areas. They and their rare floristic elements face an uncertain future. Fortunately, efforts towards their protection and management are being taken. Owners of two of the glades have agreed to protect their glades voluntarily through the Indiana Natural Areas Registry, a cooperative program between the Department of Natural Resources and The Nature Conservancy, supported by a grant from the Lilly Endowment. Another glade will be leased for preservation purposes. Future inventory efforts to locate, evaluate and study other similar and different types of glades in Indiana are also much needed.

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