PRESETTLEMENT BARRENS IN THE GLACIATED PRAIRIE REGION OF ILLINOIS[1]

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"About half a mile from the cabin we passed a small prairie, and soon entered the woods again, and then some barrens. A barren island nearly destitute of timber, but overrun with scrubby underwood. After passing these barrens for more than a mile, we got sight of the prairies" (Woods 1822).

INTRODUCTION

Classification, management and restoration of natural plant communities are difficult objectives for Midwestern conservation agencies, especially when the structure and composition of former vegetation are unclear and management decisions are affected by nomenclature. For example, **prairie**, **savanna**, and **timber** are thought to have comprised the presettlement vegetation mosaic in the forest-prairie transition of Illinois, with savanna occurring in areas of intermediate fire protection (Kilburn 1959, Moran 1976, 1980, Anderson 1991, Bowles *et al.* 1994). Because little specific information is available about presettlement oak savanna and woodland (Apfelbaum & Haney 1991), they have become the focus of community classification (Faber-Langendoen *in press*), conservation and restoration (*e.g.* Burger *et al.* 1991, Stearns *in press*), and research on groundlayer vegetation (Packard 1991, Leach 1994).

This paper treats the related but vaguely classified and poorly understood **barrens** plant community. Although often considered a feature of unglaciated regions, barrens were frequently referred to in the glaciated Illinois landscape at the time of settlement (Vestal 1936, Hutchison 1987). The Illinois Natural Areas Inventory (INAI) classified barrens as a subtype of savanna usually caused by topo-edaphic features such as thin soils over bedrock, and occurring as local inclusions of prairie flora in forested southern and western Illinois (White & Madany 1978, Madany 1981, Anderson & Schwegman 1991). Madany (1981) had 24% floristic similarity between savannas and barrens (exclusive of sand savanna) sampled by the INAI, while Betz (1992) found less than 30% similarity between cemetery savanna floras and the "barrens" flora of Mead (1846). However, Packard (1991) contended that barrens as observed by Mead (1846) were synonymous with savanna.

OBJECTIVES

Do glaciated barrens fall within a savanna concept of non-overlapping canopy tree crowns with a graminoid fuel matrix (*e.g.* Stout 1946, Bray 1958, Curtis 1959, White & Madany 1978, Madany 1981, Packard 1993), or do they represent a different plant community? Is more specific information available about the former structure and ecology of barrens in the prairie region of Illinois? To address these questions, we review historic descriptions and species, classify barrens in glaciated Illinois, and present a model for barrens

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[1]1994. Pages 75-85 *in* Proceedings of the North American Conference on Savannas and Barrens (J.S. Fralish, R.C. Anderson, J.E. Ebinger, & R. Szafoni, eds.), Illinois State University, Normal.

development within a prairie-forest continuum. This paper excludes sand substrates and focuses on silt loam soils, which comprised the substrate for Illinois tallgrass prairie.

HISTORIC DESCRIPTIONS

Terminology

"Barrens" is one of the more ambiguous eastern North American vegetation terms, but usually connotates stressful habitats (*e.g.* White & Madany 1978, Homoya 1994). It has described vegetation differently across regions and over time. For example, the term has been used to classify natural pine and oak sand barrens in Wisconsin (Stout 1946, Curtis 1959), naturally burned heathlands such as the Pine Barrens of New Jersey (Matlack *et al.* 1993), natural or anthropogenic barrens caused by substrate, logging, and fire in Nova Scotia (Hall & Aalders 1968, Strang 1972), and forest openings caused by fire or edaphic factors in the southeastern U.S. (*e.g.* DeSelm 1981, 1986; Homoya 1994). Schroeder (1982) interpreted barrens as an Appalachian term applied to sites perceived as unproductive because of failure to grow trees. Williams (1981) generalized that barrens was applied historically to shrub savannas located chiefly south of the northeasterly axis of the prairie peninsula, while "oak openings," or tree savannas, occurred primarily to the north. Indeed, shrubs and oak grubs occurred in association with grassland and forest openings in sites described as barrens in southern Illinois (*e.g.* Engelman 1863, Hutchison *et al.* 1986), Indiana (Deam 1940, Keith 1980) and in Kentucky (*reviewed in* Baskin & Baskin 1981).

As settlement and the Public Land Survey entered the extensive glaciated prairies of Illinois, barrens terminology was applied to perceived unproductive habitats with vegetation intermediate between grassland and forest, often with "tall grass," but characterized by "underwood" or "brushwood" of fire-resistant shrubs or oak grubs (*e.g.* Birkbeck 1818, Woods 1822, Peck 1834), rather than the open-grown trees of savanna oak openings (*sensu* Gleason 1922, Stout 1946, Curtis 1959, Bray 1960). Barrens in St. Louis (Beck 1826, 1828) were "undulating," with "shrubby oak" and hazel "shrubbery" (*reviewed in* Schroeder 1982). In Illinois, Mitchell (1838) described "bushy" prairies in Illinois covered with hazel and furze, small sassafras, shrubs, and grape vines. Short (1845) referred to sparse oak cover with dense undergrowth of shrubs in barrens, which he used synonymously with hazel "roughs" and "thickets." Farnham (1846) referred to "copse" growth of hazel in barrens, and Brendel (1887) listed vegetation of copses. Bebb (1860) also referred to the hazel undergrowth extending a mile or more into the prairie forming a "hazel ruff."

Ecological factors: fire, topography, and successional change

Although Hutchison (1986) and Homoya (1994) contend that barrens generally have edaphically restricted plant growth, reduced herbaceous diversity, and ecological stability, most historic accounts (reviewed in White 1994) describe barrens as rich and productive, and maintained by fire (*e.g.* Peck 1834, Mitchell 1838). According to Gleason (1922), Illinois barrens represented a late stage of fire-caused forest degeneration characterized by four- to

five- foot high sprouts of scrub oak (apparently *Quercus velutina*[2]), hazel (*Corylus americana*), and wild plum (*Prunus americana*). They were most common in uneven or rolling topography or stream drainages (*e.g.* Peck 1834), which reduced fire effects, or developed on the west sides of forests attacked by eastward-moving prairie fires driven by prevailing winds (Gleason 1913). Thus, north or east sides of prairie groves may have had more stable forest-prairie margins.

With advancing settlement and fire protection, many authors described successional instability of barrens (White 1994). In a remarkably lucid description, Peck (1834) noted that "when the fires are stopped, these barrens produce timber ...", from a "...mass of roots ...," and that when fire protection and grazing reduced prairie grasses, the prairies "begin to assume the character of barrens; first hazel and other shrubs, and finally a thicket of young timber..." By 1873, Ridgway (1873) remarked that "prairies of often ten miles or more .. are now entirely overgrown with a dense scrub of hazel, ..." and that "twenty years from now, they will have ... become transformed into the usual woods of the region." Thus, large areas of barrens were converted into forest "as by magic" when the anthropogenic fires that had maintained them were stopped and the oak sprouts became trees (Gleason 1922).

Species composition: shrub and oak grub dominance

Shrubs and fire-stunted oak grubs appear to have been structurally dominant components of barrens. Historic descriptions (Woods 1822, Peck 1834, Mitchell 1839, Short 1845, Gerhard 1857, Bebb 1860, Hilgard *n.d.*), identify more than 30 shrub species that may have characterized barrens, including hazel, New Jersey tea (*Ceanothus americanus*), the dogwoods *Cornus drummondii, C. obliqua, C. racemosa, & C. stolonifera*, wild crab (*Malus coronaria & M. ioensis*) wild plum (*Prunus americana*), sumac (*Rhus* sp.), rose (*Rosa* sp.), prairie willow (*Salix humilis*), and prickly ash (*Zanthoxylum americanum*). Barrens formed along the western flanks of forests were dominated by hazel, with *Quercus velutina* and *Q. imbricaria* forming the interior forest margin (Gleason 1913).

As with shrubs, historic descriptions list more than 30 forb species occurring in barrens. If these lists focus on showy or distinctive species, they may not represent a typical flora. To obtain a more comprehensive historic list of species that occurred in barrens, we analyzed four historic annotated floras that contained references to either barrens (Mead 1846), "copse" or "thicket" (Higley & Raddin 1871), "copse" (Brendel 1887), or "thicket" (Hus 1908), which appear to be analogous or similar habitats. These floras include counties in which barrens were recorded by the Public Land Survey (Hutchison 1987, M.L. Bowles, pers. obs.). The resulting list (Appendix I) contains 243 taxa that apparently occurred in glaciated barrens. Herbaceous and graminoid species include *Asclepias purpurascens, Baptisia leucantha*, seven *Desmodium* species, *Echinacea purpurea*, four *Eupatorium* species, seven *Helianthus* species, four *Lespedeza* species, two *Elymus* species, five *Panicum* species, seven *Solidago* species, three *Pycnanthemum* species, and the blazing star *Liatris scariosa* var. *nieuwlandii*. The abundance and diversity of grass species is unclear. Although some prairie and woodland grasses are listed, nine of ten grass species that Packard (1991) proposed for addition to the Mead's barrens flora are absent. Even though "tall grass"

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[2] Nomenclature follows: Jones, G.N. & G.D. Fuller. 1955. Vascular plants of Illinois. University of Illinois Press, Urbana & Illinois State Museum, Springfield (Scientific Series, Vol VI).

is described for barrens, Hilgard (*n.d.*) noted that "within these shrubby areas the grass was much suppressed." Gleason (1913) assumed that grasses persisted within hazel zones, but admitted that "there seem to be no authentic data on the matter."

A CLASSIFICATION AND MODEL FOR GLACIATED PRAIRIE BARRENS

Classification

Historic descriptions of barrens on glaciated soils in the prairie region of Illinois are analogous to two related and intergrading community types that were only partially classified by the INAI or Curtis (1959). One type, **shrub prairie**, was defined by the INAI as comprising hazel and plum thickets on silt soils, but no such natural remnants were found (White & Madany 1978). The second type, **oak grub** or **oak brush savanna** (Curtis 1959), had oaks reduced to grub sprouts by repeated fires. On silt soils, the INAI recognized savanna only with mature trees forming a partial canopy cover. We suggest an alternative classification that would combine the two types into a **prairie barrens** category with **shrub barrens** and **oak grub barrens** subtypes that commonly merge into a single community.

Conceptual model

Figure 1 presents a conceptual landscape model for development of barrens and savanna on glaciated silt soils. Although these communities probably co-occurred or integrated at a local scale, this model provides separate pathways for understanding their development. The different factors responsible for shrub barrens, oak grub barrens, and savanna are not clear. References by the Public Land Survey to timber "with" or "without" undergrowth in different landscape positions (Bowles *et al.* 1994) suggest that large scale ecological processes were import. According to Gleason (1922), the parklike conditions known as oak openings (savanana) resulted from destruction of forest undergrowth and susceptible species by fire, and invasion by prairie. This is modeled as a "Savanna Pathway," by which woody understory but not overstory is lost to fire. The fire-resistant bur oak (*Quercus macrocarpa*) would be most adaptable to this process, while other oaks that are less fire resistant but sprout after fire would be reduced to oak grub barrens (Curtis 1959). Development of a "Barrens Pathway," by which woody understory vegetation persists while canopy trees are lost is less clear and the exact cause was unknown to Gleason (1922). Sprouting of fire-adapted hazel and oaks, and absence of fire resistant bur oak may have contributed to this process, while immigration of animal- or wind-dispersed woody species such as plumb, crabs, or willow would have added species to barrens (Gleason 1922). Landscape fire effects probably contributed to these different pathways. As indicated, barrens were usually associated with more rugged topography, which formed partial fire breaks. For example, Bowles *et al.* (1994: Figure 1) found presettlement barrens associated with an area of the West Chicago Moraine in DuPage Co., IL that was not fire protected by the DuPage River. Spatial dynamics in this model are driven by temporal climatic variation. Barrens and savanna encroach toward forest as warm dry conditions promote fire, and toward prairie with cool wet conditions that promote fire protection.

CONCLUSIONS

Presettlement barrens on silt soils in glaciated Illinois were apparently misconstrued as sterile or unproductive, as their vegetation quickly transformed to forest with fire protection. Barrens and savanna differed by presence or absence of woody understory vegetation, and formed through forest degeneration under conceptually different ecological pathways affected by landscape features, fire, and species characteristics. Barrens appear to have been shrub- and oak grub-dominated with limited or patchy distribution of grasses, while a stronger component of prairie vegetation and grasses occurred in savanna. Based on historic descriptions, it appears that barrens were spatially and temporally dynamic. They rapidly succeeded to forest with fire protection, but also manifested in prairie from shrub or grub sprouts that were suppressed by anthropogenic fire. Without fire protection or Indian-set fires, climatic variation would have caused temporal shifts in the spatial pattern of this vegetation. Misapplication of savanna terminology to barrens natural areas could result in management to remove native shrub understories that belong in these communities..

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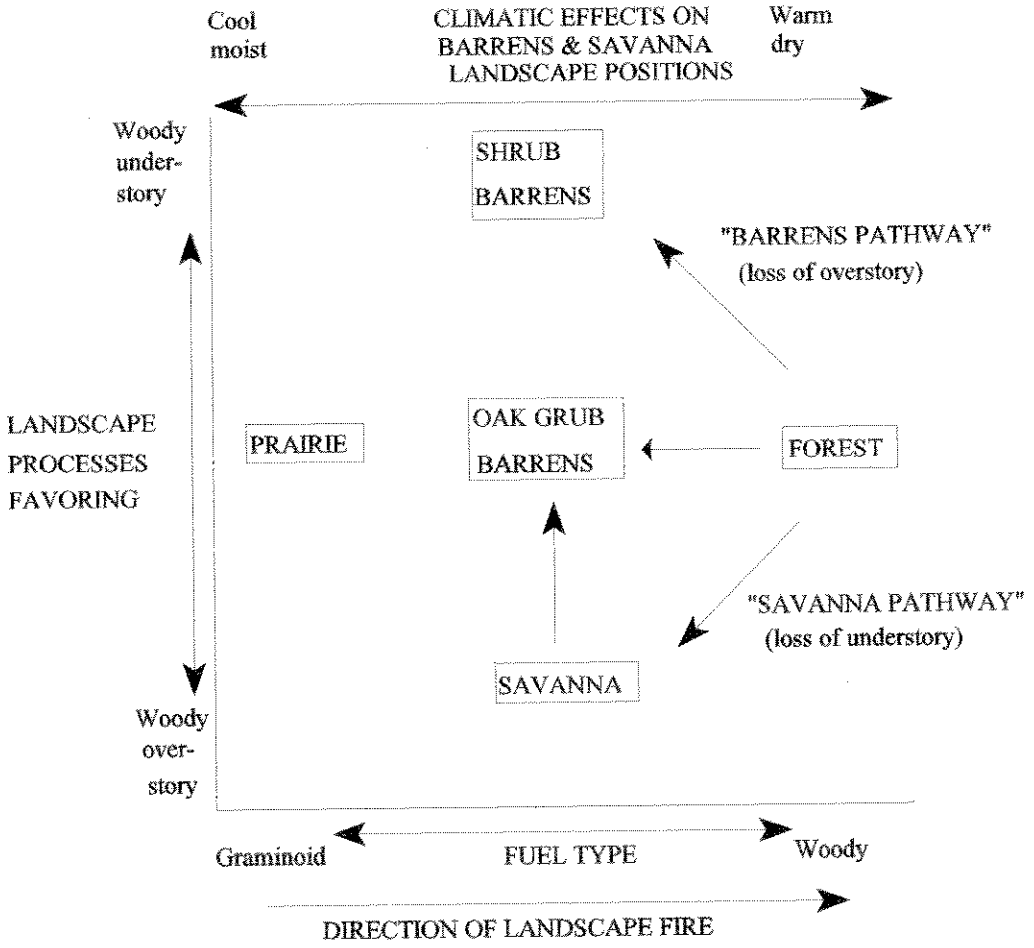

Figure 1. Conceptual landscape model for savanna and barrens development on glaciated silt-loam soils. Horizonal axis: eastward-moving landscape prairie fires cause degeneration of forest (*sensu* Gleason 1922) into barrens or savanna, and are regulated by climate and landscape features. Cool moist conditions reduce fire effects and barrens and savanna encroach on prairie, warm dry conditions increase fire effects and allow barrens and savanna to encroach on forest; firebreaks such as rugged topography or watercourses would affect the landscape pattern of this vegetation. Vertical axis: landscape processes (*e.g.* fire frequency or severity and degree of fire protection) or biological characteristics (*e.g.* fire resistance, dispersal, and colonization rates of different tree and shrub species) favor either woody understory ("Barrens Pathway") or overstory ("Savanna Pathway"). The different pathways may co-occur or integrate. Grub barrens are derived from direct degeneration of forest, or from secondary degeneration of savanna.

APPENDIX I. Historic barrens plant species checklist. Sources: species associated with "barrens" in Mead (1846), "copse" in Brendel (1887), " copse" or "thicket" in Higley & Raddin (1891) and "thicket" in Hus (1908).

Acalypha virginica
Agastache nepetoides
Agastache scrophulariaefolia
Agrimonia parvula
Agrimonia pubescens
Allium tricoccum
Ampelamus albidus
Amphicarpa bracteata
Amphicarpa comosa
Andropogan furcatus
Andropogon scoparius
Anemone cylindracea
Apocynum androsaemifolium
Apocynum cannabinum
Aquilegia canadensis
Arisaema dracontium
Arisaema triphyllum
Asclepias exaltata
Asclepias purpurascens
Asclepias tuberosa
Asclepias verticillata
Aster azureus
Aster drummondii
Aster lateriflorus
Aster novae-angliae
Aster praealtus
Aster turbinellus
Astragalus canadensis
Aureolaria pedicularia
Boehmeria cylindrica
Baptisia leucantha
Baptisia leucophaea
Campanula americana
Carex blanda
Carex cephalophora
Carex jamesii
Carex richardsonii
Carya cordiformis
Carya glabra
Cassia fasciculata
Castilleja coccinea
Ceanothus americanus
Celastrus scandens
Cercis canadensis
Chaerophyllum procumbens
Chamaesyce maculata
Cirsium altissimum
Cirsium discolor
Claytonia virginica
Comandra richardsiana
Commelina erecta
Convolvulus sepium
Convolvulus spithamaeus
Coreopsis palmata
Coreopsis tripteris
Cornus alternifolia
Cornus drummondii
Cornus obliqua
Cornus rugosa
Corylus americana
Cynoglossum virginianaum
Cypripedium calceolus
Cypripedium reginae
Danthonia spicata
Delphinium carolinianum
Delphinium tricorne
Desmodium canadense
Desmodium canescens
Desmodium cuspidatum
Desmodium glutinosum
Desmodium illinoense
Desmodium paniculatum
Desmodium sessilifolium
Dioscorea villosa
Dodecatheon meadii
Echinacea purpurea
Elymus canadensis
Elymus virginicus
Epilobium angustifolium
Erigeron annuus
Erigeron pulchellus
Erythronium albidum
Euonymus atropurpureus
Eupatorium altissimum
Eupatorium purpureum
Eupatorium rugosum
Eupatorium sessilifolium
Galium aparine
Galium circaezans
Galium concinnum
Gentiana flavida
Gentiana quinquefolia
Geranium carolinianum
Geranium maculatum
Gerardia grandiflora
Gerardia tenuifolia
Geum canadense
Geum laciniatum
Hackelia virginiana
Hamamelis virginiana
Helianthus decapetalus
Helianthus divaricatus
Helianthus giganteus
Helianthus grosseserratus
Helianthus hirsutus
Helianthus occidentalis
Helianthus strumosus
Heliopsis helianthoides
Heracleum lanatum
Humulus americanus
Hydrastis canadensis
Hypericum punctatum
Hypericum sphaerocarpum
Ipomoea pandurata
Isanthus brachiatus
Lactuca canadensis
Lactuca ludoviciana
Lathyrus palustris
Lathyrus venosus
Lechea minor
Lespedeza capitata
Lespedeza procumbens
Lespedeza violacea
Lespedeza virginica
Liatris scariosa
Lilium michiganense
Liparis lilifolia
Lonicera prolifera
Lycopus americanus
Lysimachia ciliata
Malus coronaria
Melica nitens
Menispermum canadense
Monarda fistulosa
Napaea dioica
Onoclea sensibilis
Orobanche uniflora
Ostrya virginiana
Oxalis cymosa
Oxalis stricta
Oxalis violacea
Panicum clandestinum
Panicum depauperatum
Panicum dichotomum
Panicum latifolium
Panicum scribnerianum
Paronychia canadensis
Parthenium integrifolium
Passiflora lutea
Petalostemum candidum
Petalostemum purpureum
Phaseoulus polystachyus
Phlox divaricata
Phryma lepstotachya
Physalis subglabrata
Podophyllum peltatum
Polygala ambigua
Polygala incarnata
Polygala polygama
Polygala sanguinea
Polygala senega
Polygala verticillata
Polygonum dumetorium
Polygonum scandens
Polygonum virginianum
Polytaenia nuttallii
Populus tremuloides
Potentilla arguta
Potentilla simplex
Prenanthes alba
Prunella vulgaris
Prunus americana
Prunus serotina
Prunus virginiana
Psoralea onobrychis
Psoralea tenuiflora
Pteridium aquilinum
Pycnanthemum flexuosum
Pycnanthemum pilosum
Pycnanthemum virginianum
Quercus bicolor
Quercus imbricaria
Quercus marilandica
Quercus velutina
Ranunculus abortivus
Ranunculus recurvatus
Rhamnus lanceolata
Rhus aromatica
Rhus copallina
Rhus glabra
Ribes missouriense
Rosa blanda
Rosa carolina
Rosa setigera
Rosa sulfata
Rubus allegheniensis
Rubus flagellaris
Rubus occidentalis
Sabatia angularis
Sambucus canadensis
Sanguinaria canadensis
Sanicula marilandica
Salix discolor
Salix rigida
Scrophularia marilandica
Scutellaria ovata
Scutellaria parvula
Silene stellata
Silphium terebinthinaceum
Silphium integrifolium
Silphium perfoliatum
Smilacina racemosa
Smilax ecirrhata
Smilax herbacea
Smilax hispida
Solidago buckleyi
Solidago caesia
Solidago canadensis
Solidago gigantea
Solidago juncea
Solidago speciosa
Solidago ulmifolia
Staphylea trifolia
Strophostyles helvola
Symphoricarpus orbiculatus
Synthris bullii
Taenidia integerrima
Tephrosia virginiana
Thalictrum dasycarpum
Tradescantia virginica
Trillium recurvatum
Trillium sessile
Triosteum perfoliatum
Veratrum woodii
Verbesina alternifolia
Verbesina helianthoides
Vernonia missurica
Viburnum lentago
Viburnum prunifolium
Vicia americana
Viola cuculata
Viola palmata
Viola pedata
Viola pedatifida
Viola sagittata
Vitis vulpina
Zanthoxylum americanum