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A Study of the Lichens at Rocky Branch Nature Preserve

Clark County, Illinois

(TITLE)

BY

Eric B. Grunder

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

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IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY
CHARLESTON, ILLINOIS

1997

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ABSTRACT

In 1971, a graduate student at Eastern Illinois University, James E. Wiedman, studied the lichen flora of Rocky Branch Nature Preserve, Clark County, Illinois. During his study he collected, identified, and recorded a total of 64 lichen species. Since 1971, Rocky Branch Nature Preserve has experienced a dramatic increase in use by people and a concomittant decline in the quality of lichen habitats. In order to assess the decline of suitable lichen habitats and the reduction of lichen species a second study of the lichens at Rocky Branch Nature Preserve was undertaken. As part of this study, ten habitat sites were selected from which lichens were collected, identified, and recorded. Ten collecting trips were made and a total of 46 lichen species were collected. A comparison of lichens collected in 1971 and 1993 is included as are all possible explanations for the decline in lichen diversity over this twenty-two year period.

ACKNOWLEDGMENTS

I would like to express my most sincere appreciation and gratitude to Dr. Andrew Methven for being so very patient and offering advise and encouragement throughout the years of our association. I would also like to thank Dr. John Ebinger for his assistance with the distribution maps and help when I needed it and Dr. Charles Arzeni for all his wisdom and encouragement. Also to my loving wife Rachel, for her patience, assistance, encouragement, for being the driving force for me always, and for all the love and support. To my mother and father who made it possible for me to attain my collegiate goals by always being there for me and being great role models, and of course for their love and support. And a special thanks to Larry Nelson for his most gracious assistance.

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I. INTRODUCTION

A. HISTORICAL PERSPECTIVE

Illinois lichens have not been researched to the extent that other plant groups have. In fact, very few studies have been completed since Willey's in 1877 report (Wiedman,1971) on 111 species collected by J. Wolf in Fulton County. Wolf and Hall (1878) later reported on 220 specimens from Menard, Fulton, Johnson, Union, and Jackson counties. Brendel (1887) subsequently collected and studied 35 lichen species found within a ten to twelve mile radius of Peoria. Calkins (1896) researched the lichens ofCook, DuPage, and Will counties in Illinois, and a portion of Lake County in Indiana, collecting and recording 125 species from 12 families. He concluded that a lack of habitat diversity in these counties resulted in the relatively small number of lichen species collected and suggested that lichen species diversity was adversely affected by the environmental quality of the Chicago area. Fink (1899) reported 228 lichen species throughout Illinois and later included 12 additional species from Bald Mound and Johnson Mound, Johnson County, Illinois(Fink,1906). Hartline (1938) collected and recorded 31 species from Hicks Dome, Sparks Hill, and Union School in Hardin County. Skorepa and Snider (1967) recorded 16 species from Lusk Creek Canyon in Pope County. Skorepa (1970) later reported 51 species from central and northern Illinois. Wiedman (1971) collected and identified 70 species of lichens from Clark and Marshall counties. Since 1971 lichen research has been limited to a few lichenologists including Gerould Wilhelm, Bill McKnight, Floyd Swink, Andrew Methven, and their students. Wilhelm and McKnight continue to compile information about, and construct keys to, the lichens of the Chicago region.

B. STUDY SITE

Rocky Branch Nature Preserve is located in Clark County (Sec. 29 and 30, T 12N, R 12W), six miles northwest of Marshall, Illinois. Rocky Branch features xeric uplands supported by sandstone cliffs and outcrops, floodplain forests, and two permanent streams (Rocky Branch Creek and Big Creek) . While the upland forests are dominated by oaks, hickories, sugar maples, black

walnut, white ash, and American beech, the floodplain is dominated by blue beech, sycamore, cottonwood, and tulip poplar. Finally,the sandstone cliffs and outcrops provide unique habitats for many species of mosses (Arzeni, 1947) and liverworts(Arzeni, 1947) such as Grimmia laevigata. (Brid.) Brid., Plagiothecium roeseanum (Hampe) Bry. and Frullania squarrosa (R. Bl. & N.) Dummort. which all were considered rare finds at the preserve, and lichens.

The 138 acre preserve was purchased by the Illinois Chapter of the Nature Conservancy and placed in the trusteeship of Eastern Illinois University for research and instructional purposes. Since the university became steward of the preserve, Rocky Branch has become a popular place for students, faculty, and people living in the surrounding area. With its vast array of paths, cliffs, and creeks the number of people that visit the preserve continues to increase. People and animals, especially horses, which venture through the preserve have a major impact on the vegetation and plant communities. These disturbances have had detrimental effects on lichen habitats as well. As more people walk or ride through the preserve, existing paths are widened and new paths created leaving less area for natural vegetation. In addition, horse trails have caused a significant increase in soil erosion throughout the preserve. Crustose lichens are also threatened by individuals who scale or climb the sandstone cliffs and outcrops, destroying lichen colonies that took many years to form.

A number of organismal and ecological studies have been completed at Rocky Branch Nature Preserve, including analyses of vascular plants and bryophytes. Stover (1930) compiled the first checklist of vascular plants and plant associates in the preserve. While Vaughn (1941) was the first to study bryophytes in specific areas of Rocky Branch, Arzeni (1947) expanded the scope of Vaughn's study to include new reports of bryophytes from the preserve and corrected the names of several misidentified taxa.

Ebinger and Parker (1969) reported on the woody vegetation of the western part of Rocky Branch. They found a total of 35 woody species, with white oak comprising half of the basal area

and almost one-third of the total individuals present. Additional woody species of importance were black oak, red oak, shagbark hickory, sugar maple, mockernut hickory, bitternut hickory, tulip poplar, black gum, and American beech. Ebinger and Hellinga (1970) completed a checklist of the vascular species in the preserve which included a total of 445 species of plants in 97 different families. Ebinger and Hughes (1971) later surveyed the woody vegetation of the eastern portion of the preserve. They reported 62 woody species of which 40 were canopy trees, 5 were understory trees, and 17 were shrubs or woody vines. White oak was again the dominant hardwood species.

In 1988, Clapp and Ebinger found that the dominant tree was still the white oak, although sugar maple had become the second most dominant tree. In addition, shagbark hickory and mockernut hickories had overtaken red and black oaks which are slowly declining in number. Other trees of importance included slippery elm, pignut hickory, black walnut, white ash, bitternut hickory, and American beech.

In 1971, a graduate student at Eastern Illinois University, James E. Wiedman, studied the lichen flora of Rocky Branch Nature Preserve, Clark County, Illinois. Since 1971, Rocky Branch has experienced a dramatic increase in use by people and a concomittant decline in the quality of lichen habitats through their activities. In order to assess the decline of suitable lichen habitats and the reduction of lichen species a second study of the lichens at Rocky Branch Nature Preserve was undertaken.

C. LICHENS

i. MORPHOLOGY

A lichen is a symbiotic association between a fungus and a green alga (Chlorophyceae) or a blue-green alga (Cyanophyceae) which results in a growth form that resembles neither individual component. The fungal component, or mycobiont, which comprises most of the thallus is usually a member of the Ascomycota, although in some lichens the mycobiont is a member of Basidiomycota or Deuteromycota. The morphology or growth form of the thallus or body of the lichen is an

important taxonomic characteristic. Three distinct growth forms are recognized: foliose (leaf-like), fruticose (shrub-like), and crustose (crust-like). Some lichens exhibit a fourth growth form in which the thallus appears to be intermediate between foliose and crustose and is referred to as squamulose.

Foliose lichens appear flat or prostrate on the substrate and feature an upper surface that is different than the lower surface in color or physical features. The upper surface of the thallus may be smooth, wrinkled, cracked, or pitted. The lower surface of foliose lichens usually differs in color, ranging from white to brown or black, and may be also pitted. Pits on the upper surface which extend through the cortex into the medulla are referred to as pseudocyphellae. Pits which occur on the lower surface and extend through the cortex into the medulla are termed cyphellae. Foliose lichens are often attached to the substrate by means of root-like processes called rhizines which extend from the lower cortex (Hale, 1979). Rhizines are composed of masses of hyphae, colored white to black, and may be simple or exhibit dichotomous branching (Taylor, 1967). The thallus of foliose lichens is usually divided into numerous branches called lobes. Although lobes tend to elongate and fork as the lichen grows, they usually maintain a relatively constant width. Lobe width can be an important diagnostic character and is used to separate broad-lobed thalli (3-20 mm) from narrow-lobed thalli (0.1-3.0 mm) (Hale, 1979). Broad-lobed lichens are often more irregular in width with rounded tips while narrow-lobed lichens are linear or strap-shaped in appearance. The margins of the lobes may be entire or dissected and may or may not produce small hair-like appendages called cilia. In some species, small, distinct lobes called lobules are produced along the margins. In heteromerous, foliose lichens, the internal anatomy reflects a distinctive layered structure. The upper cortex is composed of tightly interwoven hyphae beneath which is found the medulla that is composed of fungal hyphae intermixed with a well-defined layer of algal cells or cyanobacteria. The lower cortex, which is not present in all lichen thalli, is composed solely of fungal hyphae. In homeomerous, foliose lichens, the thallus tissues are not organized into distinct layers, there is no

differentiation into layers internally, and the algal cells or cyanobacteria are scattered throughout the medulla.

Fruticose lichens differ from foliose lichens in their morphology and anatomy. Fruticose lichens are shrub-like and exhibit simple or branched, round or flattened branches. While fruticose lichens are generally attached to the base of trees or rocks they can be free growing on the soil as well. Fruticose lichens lack rhizines and generally do not produce cilia. Unlike foliose lichens, fruticose lichens grow from the apices and may reach up to two meters in length. A fruticose lichen is composed of an outer cortex or pseudocortex and a medulla with a distinctive algal or cyanobacterial layer. The center of the thallus may be hollow or solid. In some lichens a distinctive medullary cord or central strand of different color and structure from the remainder of the medulla is found.

Although crustose lichens lack a lower cortex and rhizines, they feature an upper cortex and a medulla with a well-defined algal or cyanobacterial layer. Since the medulla is closely attached to the substrate it is often difficult to collect specimens without the accompanying substrate. The thallus of crustose lichens can be smooth, reticulate or cracked in various ways (Hale, 1979).

The thallus of squamulose lichens consists of small, independent, lobe-like units that contain an upper cortex and medulla but lack a lower cortex and rhizines. Squamulose lichens most often form the primary thallus of the genus Cladonia which forms two thallus types. The primary squamule may lie close to the ground, be more or less erect and generally exhibits three layers; an upper cortex, an algal or cyanobacterial layer, and a medullary layer. Soredia may form on the underside, margins, or upper surface of the squamules. A hollow, erect structure, a podetium, arises form the margins of primary squamules or their upper surface. Podetia contain an outer cortex, an algal or cyanobacterial layer, a medullary layer, and a cartilaginous layer. Podetia are simple or branched, produce apothecia at the tips or on the margins of cups, and ensure effective spore dispersal. The

apothecia may be large and solitary or small and clustered. Apothecia range in color from cream to yellow, yellow-brown, orange to red, red-brown, brown, or almost black (Thompson, 1967).

ii. VEGETATIVE PROPAGULES

In addition to morphological form, vegetative propagules such as isidia and soredia are important diagnostic features. Isidia are small, flattened or cylindrical, thalloid outgrowths located on the upper surfaces of the thallus or margins of the lobes. They may appear as simple projections or be branched, papillate or globular with a coarse to granular appearance. Anatomically, isidia are outgrowths of cortical, and medullary tissues. Isidia break away form the thallus and may generate a new lichen thallus if they come to rest on a suitable substrate. Soredia originate in the medulla and erupt through the cortex to the upper surface of the thallus or lobes. A soredium is composed of algal cells or cyanobacteria surrounded by fungal hyphae. Groups of soredia are referred to as soralia and appear as large powdery masses easily seen by the naked eye. Soralia may form irregular masses, linear shapes along the lobe margins or orbicular patterns on the surface of the lobes. Lichen reproduction in nature seems to be the result of vegetative reproduction by means of isidia, soredia, or fragmentation.

iii. SEXUAL REPRODUCTION

The mycobiont is the only component of a lichen thallus which undergoes sexual reproduction. When the mycobiont reproduces sexually it may produce apothecia, perithecia, or pseudothecia. Apothecia are cup-shaped or disc-shaped structures ranging from 1-20mm in diameter. Apothecia are located on the upper surface of the thallus, along the margins or, in the case of Cladonia species, at the tips of club-shaped podetia. The hymenium is often some shade of brown, but can be orange, red or yellow as well. The hymenium is composed of asci which contain one to eight (or more) ascospores, and paraphyses. In some lichens the paraphyses extend past the asci to form an epithecium. The layer of hyphae which gives rise to the asci and paraphyses is

referred to as the hypothecium. Some lichens produce perithecia rather than apothecia. Perithecia are flask-shaped structures embedded in the thallus that open to the environment through a small apical pore or ostiole. Perithecia also contain paraphyses and asci with one to eight ascospores. Perithecia appear as small black dots or mounds on the surface of the thallus. Pseudothecia, also known as ascostromata, apothecioid or perithecioid ascomata are produced by ascolocular lichens. Although pseudothecia resemble perithecia in being flask-shaped structures immersed in a thallus, they differ in ontogeny. It is not easy to distinguish the pseudothecia produced by ascolocular lichens from perithecia formed by ascohymenial lichens (Hale, 1983).

Ascospore morphology can be an extremely important taxonomic character. The number of cross walls or septations, color, shape, size, and arrangement in the ascus are all important. The shape of the asocspores can be thread-like to globular and range in size from a few microns to 350 um in length. Ascospore arrangement in the ascus may be seriate, parallel or irregular (Wiedman, 1971).

Hale (1979) concluded that although sexual reproduction is possible in nature, no one had been able to document this phenomenon, as such, it appears that sexual reproduction is not the primary manner in which lichens reproduce and are dispersed.

II. MATERIALS AND METHODS

Initial collections were made in a wooded area west of the entrance road in February 1993. Additional trips were made in March, April, May, and June 1993. A total of ten trips were made to Rocky Branch to facilitate collections in the eastern portion of the preserve (Map 4): Site I was located to the west of the entrance road. Site II was located east of the entrance road and north of Rocky Branch Creek along a fenced area. Site III was also north of the creek but in an upland area. Site IV was located south of Rocky Branch Creek in a rocky cliff area and included the upland area along the southern border of the preserve. Site V was located north and west of the bend in Rocky Branch Creek. Site VI was located in the creek floodplain with collections made on both sides of the Big Creek. Site VII was located south of the creek , from the edge of the floodplain to the eastern uplands. Site VIII was located in the uplands south of the Big Creek extending to the eastern boundary of the preserve. Site IX was located north of site VIII along Big Creek and also extended to the eastern boundary. Site X was the uppermost eastern panhandle of the preserve, bordered on the north by Big Creek and the east by the preserve boundary.

Specimens collected were placed in brown paper lunch bags and labeled with the date of collection, collection site, substrate, and any other pertinent information. Lignicolous lichens were removed with a knife, as it was sometimes required to collect bark surrounding the lichen. Lichens which grew on rocks were harder to collect. A rock hammer and chisel were used to break off portions of the substrate. Lichens growing on soil or amongst mosses were collected using a knife by digging under and around the specimen to prevent damage to the thallus or denude the area collected.

Lichens were identified using Hale (1979), Wiedman (1971), and Wilhelm(1994) following standard protocol. A Bausch and Lomb stereobinocular microscope was used to study morphological features such as isidia, soredia, apothecia, rhizoids, cyphellae, pseudocyphellae, and cilia. Microscopic features such as ascospore shape, size, color, septation, and number of

ascospores per ascus were examined using apothecia rehydrated in water and a Nikon compound microscope. Once the lichens were identified, they were compared to the specimens in the E.L. Stover Herbarium at Eastern Illinois University (EIU), and the Morton Arboretum in Lisle, Illinois. Lichens were then placed in packets labeled with the collection information and deposited in the Stover herbarium (EIU). Chemical tests were required to confirm the identification of individual taxa. Potassium hydroxide (K), calcium hypochlorite (C) and paraphenylenediamine (P) with ethyl alcohol were also used to test for distinctive chemical compounds.

III. RESULTS

A. LIST OF LICHENS COLLECTED IN 1993

The lichens listed below werecollected in Rocky Branch Nature Preserve, Clark County, Illinois and are arranged according to Wilhelm (1994) following the nomenclature of Esslinger and Egan (1995). The site within the preserve (I-X), substrate, date of collection, and collection number of the author follows the name. (*) Also collected by Wiedman (1971).

Order Sphaeriales

Family Verrucariaceae

(*) 1. Dermatocarpon miniatum (L.) Mann., site V, sandstone, April 30, 1993, coll. no. 32

2. Verrucaria calciseda DC., site II, rock, April 28, 1993, coll. no. 31

3. Verrucaria sordida Servit, site II, rock, April 6, 1993, coll. no. 25

Order Pleosporales

Family Pyrenulaceae

4. Kirschsteinothelia aethiops (B & C) D. Hawks, site VII, bark, June 18, 1993, coll. no.35

Family Trypetheliaceae

5. Trypthelium virens Tuck.ex. Michener, site IV, bark, June 17, 1993, coll. no. 34

Order Myrangiales

Family Arthoniaceae

(*) 6. Arthonia caesia (Flotow), site I, bark, March 10, 1993, coll. no. 18

[reported by Wiedman (1971) as A. prunata]

Order Lecanorales

Family Graphidiaceae

(*) 7. Graphis scripta (L.) Ach., site I, bark, Feb. 10, 1993, coll. no. 17

Family Peltigeraceae

(*) 8. Peltigera rufescens (Weiss.) Humb., site IV, soil, April 6 1993, coll. no. 22

[reported by Wiedman (1971) as P. canina]

Family Porpidiaceae

(*) 9. Porpidia albocaerulescens (Wulfen.) Hertel & Knoph, site IV, rock, April 6, 1993, coll. no. 20

Family Cladoniaceae

(*) 10. Baeomyces absolutus Tuck., site IV, rock, April 24, 1993, coll. no. 29

11. Cladina arbuscula (Wallr.) Hale & Culb., site IV, soil, April 30, 1993, coll. no. 33

12. Cladina mitis (Sandst.) Hustich, site IV, soil, June 18, 1993, coll. no. 44

13. Cladina subtenius (Abb.) Hale & Culb., site IV, soil, Feb. 10, 1993, coll. no. 09

(*) 14. Cladonia macilenta var. bacillaris (Genth) Schaerer, site IV, soil, Feb. 10, 1993, coll. no. 11

(*) 15. Cladonia chlorophaea (Flk.) Spreng., site I, wood, April 24, 1993, coll. no. 10

(*) 16. Cladonia conioceaea (Flk.) Spreng., site IV, wood, April 24, 1993, coll. no. 27

(*) 17. Cladonia cristatella Tuck., site III, soil, Feb. 10, 1993, coll. no. 08

(*) 18. Cladonia furcata (Huds.) Schrad., site X, bark, June 18, 1993, coll. no. 40

19. Cladonia grayi G. K. Merr ex Sanst., site X, bark, June 18, 1993, coll. no. 37

20. Cladonia ramulosa (With.) Laundon, site IV, bark, April 6, 1993, coll. no. 23

Family Pertusariaceae

(*) 21. Pertusaria pustulata (Ach.) Duby, site VIII, bark, April 6, 1993, coll. no. 19

Family Lecanoraceae

22. Candelariella efflorescens Harris & Buck, site I, bark, Feb. 10, 1993, coll. no.15

23. Lecanora sp. # 2 sensu Wilhelm (1994), site X, bark, June 18, 1993, coll. no. 39

Family Pyxinaceae

24. Buellia polyspora (Willey) Vainio, site IV, bark, April 6, 1993, coll. no. 13 [reported by Wiedman (1971) as B. vernicoma]

(*) 25. Heterodermia speciosa (Wulf.) Trev., site VIII, bark, April 28, 1993, coll. no. 04

(*) 26. Phaeophyscia rubropulchra (Degel.) Essl., site I, bark, Feb. 3, 1993, coll. no. 05

27. Physcia adscendens (Fr.) Oliv., site X, bark, June 18, 1993, coll. no. 41

(*) 28. Physcia aipolia (Ehrh.ex Hampe.) Furnr., site I, bark, Feb. 3, 1993, coll. no. 02

(*) 29. Physcia americana Merr., site I, bark, Feb. 10, 1993, coll. no. 14

(*) 30. Physcia millegrana Degel., site IX, bark, April 30, 1993, coll. no. 01

31. Physcia pumilior R. C. Harris, site X, bark, June 18, 1993, coll. no. 26

32. Physciella chloantha (Ach.) Essl., site I, bark, Feb. 10, 1993, coll. no. 12

(*) 33. Pyxine sorediata (Ach.) Mont., site X, bark, June 18, 1993, coll. no. 43

34. Pyxine subcinera Stirton, site X, bark, June 18, 1993, coll. no. 45

Family Parmeliaceae

(*) 35. Candelaria concolor var. concolor (Dicks.) Stein., site I, bark, Feb. 3, 1993, coll. no. 07

36. Flavoparmelia baltimorensis (Gyelnik & Foriss) Hale, site X, rock, June 18, 1993, coll. no. 36

(*) 37. Flavoparmelia caperata (L.) Hale, site IX, bark, April 28, 1993, coll. no. 24

38. Flavopunctelia flaventior (Stirt.) Hale, site IX, bark, April 30, 1993, coll. no. 30

39. Myelochroa aurulenta (Tuck.) Elix. & Hale, site I, bark, Feb. 10, 1993, coll. no. 16

(*) 40. Parmotrema hypotropum (Nyl.) Hale, site VII, bark, April 6, 1993, coll. no. 21

(*) 41. Punctelia bolliana (Mull) Krog, site X, bark, June 18, 1993, coll. no. 38

(*) 42. Punctelia rudecta (Ach.) Krog, site I, bark, Feb. 3, 1993, coll. no. 06

43. Xanthoparmelia hypomelaena (Hale) Hale, site X, rock, June 18, 1993, coll. no. 46

Class Fungi Imperfecti

44. Lepraria lobificans Nyl., site I, bark, Feb. 3, 1993, coll. no. 03

45. Lepraria sp. #1 sensu Wilhelm (1994), site VII, bark, April 24, 1993, coll. no. 28

(*) 46. Racodium rupestre Pers., site X, bark, June 18, 1993, coll. no. 42

(*) Also collected by Wilhelm (1971).

B. LIST OF LICHENS COLLECTED 1971

The following is a list of lichens collected at Rocky Branch Nature Preserve by James Wiedman in 1971, but not found in collections made in 1993. Nomenclature has been updated according to Esslinger and Egan (1995).

Bacidina inundata (Fr.) Vezda

Caloplaca cervina (Hedwig) Th. Fr.

Candelaria concolor var. effusa (Tuck.) Merr & Burnham

Catillaria chalybeia (Borrer) Massal.

Cladonia caespiticia (Pers.) Florke

Cladonia peziziformis Sprengel

Cladonia consista Evans

Cladonia cylindrica (Evans) Evans

Cladonia humilis (With.) Laundon

Cladonia piedmontensis Merr.

Cladonia pleurota (Florke) Schaerer

Cladonia polycarpoides Nyl.

Cladonia cervicornis s. verticillata (Hoffm.) Schaerer

Collema subflaccidum (Ach.) Ach.

Cyphelium tigillare (Ach.) Ach.

Endocarpon pusillum Hedwig

Heterodermia obscurata (Nyl.) Trevisan

Lecanora allophana Nyl.

Lecanora hageni (Ach.) Ach.

Lecanora varia (Hoffm.) Ach.

Micarea sulvicola (Flowtow) Vezda & Wirth

Mycocalicium albonigrum (Nyl.) Fink

Pertusaria multipuncta misidentified for the U.S.

Pertusaria pertusa misidentified for the U.S.

Pertusaria velata (Turner) Nyl.

Phaeophycia orbicularis (Necker) Moberg

Physcia stellaris (L.) Nyl.

Porpidia macrocarpa (DC.) Hertel & Schwab

Pyxine caesiopruinosa (Tuck.) Imshaug

Rimeliella subtinctoria (Zahlbr.) Hale

Rinodina lecanorina (Hoffm.) Arnold & Wirth

Rinodina milliaria Tuck.

Sarcogyne clavus (DC.) Kremp.

Trapelia coarctata (Sm.) Choisy

Verrucaria viridula (Schrader) Ach.

Xanthoparmelia conspersa (Ehrh. ex. Ach.) Hale

IV. DISCUSSION

A. RELATIVE ABUNDANCE

Of the 46 lichen species collected from Rocky Branch Nature Preserve during this study, the following are considered to be common:

Candelaria concolor var. concolor	Graphis scripta
Cladonia chlorophaea	Heterodermia speciosa
Cladonia coniocraea	Lepraria lobificans
Cladonia cristatella	Peltigera rufescens
Cladonia furcata	Physcia millegrana
Flavoparmelia caperata	Punctelia rudecta

Lepraria lobificans is a crustose lichen that is very abundant and conspicuous due to its unique morphology. It has a bluish-grey, powdery apperarance which is unlike any other lichen species. Flavoparmelia caperata, Punctelia rudecta, Candelaria concolor, Physcia millegrana, and Heterodermia speciosa are foliose lichens which exhibit rosette-like growth forms that are readily observed on the bark of trees. The Cladonia species listed were generally found on soil, rock, old rotten wood, and tree bark. The west-facing hillside near the parking area (Site IV) is a common habitat for most of the Cladonia species collected. In addition to the site at the entrance, Cladonia cristatella was also found in sites lacking vegetation. Peltigera rufescens is a soil-inhabiting, foliose lichen which has protruding veins on the underside of the thallus. It was found along the path at the entrance of the preserve (Site II).

Other species of interest found in the preserve include Dermatocarpon miniatum, Trypthelium virens, Porpidia albocaerulescens, Baeomyces absolutus, and Racodium rupestre. Baeomyces

absolutus and Dermatocarpon miniatum thrive on wet, sandstone outcrops. Dermatocarpon miniatum was noted by Wiedman (1971) as rare, but was found in great abundance in moist, shaded, sandstone outcrops in the preserve. Baeomyces absolutus was also considered to be rare by Wiedman (1971) and its distribution in the preserve is limited to shaded, wet, sandstone outcrops. Porpidia albocaerulescens is less structured in its habitat preference and occupies moist or dry, sunny or shaded, sandstone outcrops. Trypthelium virens, a crustose lichen, occurs in considerable abundance in the preserve but only on the bark of Carpinus caroliniana. It usually grows in association with Graphis scripta.

B. LICHEN HABITATS

Light intensity plays an important role in lichen growth and distribution. Flavoparmelia caperata and Cladonia cristatella require abundant sunlight while Cladonia chlorophaea, Porpidia albocaerulescens, Racodium rupestre, and Dermatocarpon miniatum favor shaded habitats. Lichens such as Lepraria lobificans exhibit little preference to light intensity and grow in many areas of the preserve on a variety of substrates. In addition to light intensity, moisture content of the substrate may contribute to lichen distribution. Dermatocarpon miniatum and Baeomyces absolutus favor moist habitats while Racodium rupestre and Cladonia chlorophaea prefer drier substrates. Substrate availability also affects lichen distribution in the preserve. Phaeophyscia rubropulchra, Verrucaria caliseda, and V. sordida all grow on concrete. Xanthoparmelia hypomelaena, Porpidia albocaerulescens, Cladonia chlorophaea, and C. coniocraea grow on sandstone. Although foliose and fruticose lichens are found on rock or concrete, crustose lichens are generally predominate on these substrates. Old, rotting, partially decayed wood, trees, and bark are also excellent substrates for lichens. Foliose lichens seem to be more abundant on rough barked trees such as oak and hickory. Examples include Flavoparmelia caperata, Punctelia rudecta, Heterodermia speciosa, Phaeophyscia rubropulchra, Physcia aipolia, P. millegrana, Candelaria concolor var. concolor, Pyxine subcinera, and P. sorediata. Crustose lichens, such as Graphis scripta, Trypthelium virens,

Pertusaria pustulata, and Buellia polyspora inhabit smooth barked trees. Fruticose species such as Cladonia chloropaea, C. coniocraea, and occasionally C. cristatella, may inhabit the basal areas of trees.

C. SITE DISCUSSION

When entering the preserve Site I is located to the west of the parking area. This is a small, somewhat open area in which Arthonia caesia, Graphis scripta, Myelochroa aurulenta, and Lepraria lobificans were collected.

Site II was located as you entered the preserve along the narrow path to the east of the parking area. Not much was found here since it was a small area. Verrucaria calciseda and Verrucaria sordida were the only species collected here.

In the area of Rocky Branch Nature Preserve east of the entrance road is an old, abandoned house (Site III). Just west of the old house is a pile of crushed rock and cement, on which Phaeophyscia rubropulchra and Porpidia albocaerulescens were found. This area is exposed to high light intensities and is quite xeric.

Along the path that follows Rocky Branch Creek (Sites IV & V), Carpinus caroliniana Walt. is a dominant species. On the bark of these trees were found colonies of Trypthelium virens and Graphis scripta. Physcia millegrana, Candelaria concolor var. concolor, and Heterdermia speciosa were less commonly encountered. Each of these lichens were most abundant in areas of greatest sunlight.

West of the Porpidia habitat, on the northern side of the Rocky Branch Creek (Site V), was found Dermatocarpon miniatum. The pale brown-grey thallus blends in with the sandstone but stands out against the dark green mosses associated with it. This habitat is well-shaded and very moist with the moisture provided by natural springs in the vicinity.

A sandstone outcrop west of the Dermatocarpon habitat where the preserve reaches its narrowest point on the northern side of Rocky Branch Creek (Site V),supports Lepraria lobificans,

Baeomyces absolutus, Cladonia chlorophaea, and Porpidia albocaerulescens. The cliff has been grooved by streams and erosion. Cladonia chlorophaea, which typically grows on soil, grows on rock in this area. The amount of shading around the outcrop varies with the distribution of Acer rubrum L., Acer saccharum, Carpinus caroliniana, and Ostrya virginiana (Mill.) K. Koch.

The hilltop prairie on the western end (Site V) supports a Cladonia cristatella habitat. This lichen produces large, dark red apothecia on club-shaped podetia and grows on wood, rock, or soil. Cladonia cristatella thrives under a wide range of environmental conditions and grows in greater abundance where there is little or no vegetation. Other plants associates include Ditrichum pallidum (Hedw.) Hampe., Solidago nemoralis Ait., Potentilla simplex Michx., and Andropogon scoparius Michx.

On the south side of Rocky Branch Creek (Site VI) is a sandstone outcrop where an unusual lichen, Baeomyces absolutus ,is found growing on the vertical faces along with Sphagnum palustre L. This lichen is characterized by a dark green thallus and large, pink apothecia that resemble mushrooms. Although some of the colonies were small, a number of them were 45 cm long and 8-10 cm wide. The colonies face north and are associated with well-shaded, moist areas. According to Fink (1935), Rocky Branch is near the western end of the range of Baeomyces absolutus.

The hilltops on the south side of Rocky Branch Creek (Sites VI & VIII) were dominated by Cladina subtenuis and Cladonia furcata. The size of the aggregation is upwards of 25 yards long and 15 yards wide. These lichens grow on the slopes more than they do on level areas of the preserve where trees and grasses dominate. They are well-adapted for xeric conditions and do better where there is less competition from vascular plants. These species are found elsewhere in the preserve but not in as great a profusion. Vascular plant species in the area include Quercus alba L., Carya glabra (Mill.) Sweet, Solidago nemoralis Ait., Liatris aspera Michx., Agrostis hyemalis Walt., and Panicum huachucae Ashe.

On north-facing sandstone cliffs (Site VII) Lepraria incana and Racodium rupestre predominate. These lichens cover large areas of the cliff face and are easily recognized by their whitish-grey powdery thallus and black, filamentous thallus, respectively. Although these lichens are generally found in areas with little sunlight and consistent moisture, the genus Lepraria is found throughout the preserve on hardwoods, soil, and rock.

Further to the east on the hilltop above Big Creek (Sites VII & IX) is a habitat containing a large number of foliose lichens. Flavoparmelia caperata was found on the bark of oaks and hickories along with Punctelia rudecta. Both species were found from the base of the trees to above breast height. Additional foliose species found in abundance included Physcia millegrana, Candelaria concolor var concolor, Physcia aipolia, Phaeophyscia rubropulchra, Pyxine sorediata, and Pyxine subcinera. Crustose species encountered included Graphis scripta, Pertusaria pustulata, and Lepraria lobificans. The dominant tree species in this area were Quercus alba L., Quercus rubra L., and Quercus velutina Lam., Carya ovata (Mill.) K. Koch., Carya tomentosa Mill., and Carya glabra (Mill.) Sweet., but the emergence of Fagus grandifolia Ehrh., saplings were also noted.

Following the creek eastward, a sandstone outcrop arises on the southern side of the creek (Site IX). On this outcrop was found Porpidia albocaerulescens, a crustose lichen which is found in many areas of Rocky Branch in moist, shaded areas. The thallus is a pale grey with frosted black apothecia. Its unique appearance, Porpidia albocaerulescens, is easily recognized. This genus and species is very common in New England and the eastern United States, but is known to inhabit only a few counties in Illinois and only on the eastern side (Wilhelm, 1994).

The last site (Site X) is located in the northeast corner of the preserve. Once again only a few species of lichens were found here since it was a relatively small area. Some species of note were Pyxine sorediata, P. subcinera, Punctelia bolliana, and Racodium rupestre.

IV. CONCLUSION

In Wiedman's study (1971), a total of 64 lichens from Rocky Branch were collected and identified. In 1993 a total of 46 lichen species were collected, identified, and recorded from the same area of Rocky Branch. This is a 28 % reduction in the number of species of lichens in the preserve during the past 22 years. Reasons vary for the dramatic decrease. One reason could be that in Wiedman's study (1971) he only surveyed the inner portion of the preserve (Map 3). This could account for the differences in species not found by Wiedman, and the species not found by the 1993 study. Other factors could explain the differences in species collected such as the increased number of sugar maples that now inhabit the area of study as opposed to the number of trees that were present in 1971. More extensive stands of maples increase the amount of shade, creating cooler soil temperatures, increased the soil moisture content, and decrease the amount of sunlight which reaches the forest floor. These conditions could have eliminated suitable habitats for light requiring, xeric species of lichens. Additional reasons for a decline in species diversity could be attributed to increased air, soil, and water pollution. Lichens are able to absorb and accumulate toxic compounds such as metals (copper, lead, and zinc), as well as nitrogen dioxide, PAN's, ozone, and especially damaging is sulfur dioxide. Some of these originate from industrial combustion of fossil fuels, but more commonly from automobile exhaust. Lichens absorb and retain these substances because they do not have a protective cuticle and readily absorb airborne substances.

The uptake of sulfur dioxide depends on the pH of the surface in which the sulfur dioxide is deposited. If on an alkaline substrate, some to most of the pollutant is counteracted and is then less of a threat. If deposited on an acidic surface the pollutant can become lethal. Sometimes the pollutant comes into direct contact with the thallus. Only in solution, made by water from dew, rain, or a film of water on the thallus, are the toxic effects seen (Richardson & Puckett, 1973) Turk and Wirth, 1975.

At acid pH levels, sulfur dioxide is converted into bisulfite and sulfurous acid which are toxic (Ahmadjian, 1993). Enzyme activity along with cell structure and permeability are altered (Sundstrom & Hallgren, 1973). When serious damage occurs, chlorophyll is converted into the brown pigment phaeophytin which reduces net effects of photosynthesis. Also, nitrogen fixation rates of some species is reduced when exposed to sulfur dioxide (Ahmadjian, 1993). Some morphological responses of sulfur dioxide exposure are thalli that are smaller and more compact and reduced or absent fruiting bodies. Polluted thalli also may turn brown at the lobe ends or become white and detach from the substrate (Saunders, 1970).

Acid rain is another possible danger to lichen communities. Nitrogen fixation is decreased in some species by 50 % when exposed to acid rain at pH 5, 80 % at pH 4, and completely inhibited at pH 2 (Amhadjian, 1993).

Thalli of lichens are also sensitive to toxic metals. Lead is one of the most commonly found within the thallus. Lead is produced in the atmosphere as a result of automobile exhaust. Lead inhibits the growth rate of small thalli more than larger thalli. (Lawery & Hale, 1979).

Lichens also had effects from combinations of herbicides and lead at low doses and low temperatures. Combined, they have a synergistic effect on net photosynthesis. Inhibition occurs at high doses and high temperatures. (Amhadjian, 1993).

Ozone damage to lichens has also been studied. These studies have shown that gross photosynthesis has significantly declined and has been responsible for a 50 % decline in the lichen species diversity on conifers in Southern California since the early 1900's (Sigal & Nash, 1983).

Human intervention is another concern. When Rocky Branch Nature Preserve was established, it was used for the sole purpose of education and research. Today, many people use the preserve for recreation, walking its paths, riding bicycles, riding horses, and driving motorized vehicles such as motorcycles and all-terrain vehicles. While the use of such equipment within the preserve is illegal, proper enforcement has not been a priority and many new trails have been

formed which increase the amount of soil erosion and result in a further loss of suitable habitats. A more recent problem is people who scale and repel on the sandstone cliffs. Such activities can destroy hundreds of years of growth or completely wipe out an entire genus. All of these problems, coupled with dramatic changes in our climate, such as drought and severe floods, have wreaked havoc on the vegetation within the preserve and subsequently reduced lichen species and their natural habitats . Continued progression of detrimental human activities and unpredictable climate changes may further diminish the number of lichen species over the next decade. Agriculture can also be a cause for lichen species decline. The entire preserve is surrounded by farmland. Increased use of pesticides, herbicides, and fertilizers in the surrounding farmland has made its way into the preserve either through airborne broadcasting, erosion, or in the water directly. Most of the preserve is below the grade of the surrounding farms and the run-off accumulates in several areas of the preserve.

We need to find ways to maintain and possibly increase the number of lichen species in Rocky Branch Nature Preserve. Enforcing the rules of banning motorized vehicles, not allowing people to scale and repel the sandstone cliffs, find ways to combat erosion in and around the preserve, and using the preserve as an educational and research tool would be the first steps in preserving lichen diversity. It will be difficult to engineer and enforce a plan of action that will be fair and equitable to all involved, but once a plan is initiated nothing but good can come out of it.

VI. LITERATURE CITED

Ahmadjian, V. 1993. The Lichen Symbiosis. Wiley and Sons Inc. Toronto, Canada. pp. 142-154.

Arzeni, Charles, 1947. Some bryophytes of Coles and Clark Counties. **Transaction of the Illinois Academy of Science**. 40: 44-49.

Brendel, F. 1887. Flora Peoriana. Peoria, Illinois. 89 pp.

Calkins, W. W. 1896. The lichen flora of Chicago and vicinity. Bulletin No. 1. **Chicago Academy of Science**. 62: 379-387.

Clapp, L. A. , and J. E. Ebinger. 1988. Vegetation survey of Rocky Branch Nature Preserve, Clark County, Illinois. **Transaction of the Illinois Academy of Science**. 81(1-2): 19-24.

Ebinger, J. E., and H.M. Parker. 1969. Vegetation survey of an oak-hickory-maple forest in Clark County, llinois. **Transactions of the Illinois Academy of Science.** 62: 379-387.

Ebinger, J.E., and G.A. Hellinga. 1970. Additions to the flora of Clark County, Illinois, from Rocky Branch Nature Preserve. **Transactions of Illinois Academy of Science**. 63: 392-396.

Ebinger, J.E., and Hughes. 1971. Woody vegetation survey of the Rocky Branch Nature Preserve (Unpublished manuscript)

Esslinger, T.L. andEgan, R.S. 1987. A sixth checklist of the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada. **The Bryologist**. 98(4): 467-549.

Fink, B. 1899. Notes on lichen distribution in the Upper Mississippi Valley. Mem. Torrey. Botany Club. 6: 285-307.

Fink, B. 1906. Floristic notes from an Illinois esker. **Proceedings of the Iowa Academy of Science**. 13: 59-63.

Fink, B. 1935. The Lichen Flora of the U.S. Completed by J. Hedrick. University of Michigan Press, Ann Arbor. 426 pp.

Hale, Jr., M.E. 1979. How to Know the Lichens . 2nd ed. Wm. C. Brown Co. Dubuque, Iowa. 246 pp.

Hale, Jr., M.E. 1983. The Biology of Lichens. 3rd Ed. Edward Arnold Press, London. 190 pp.

Hartline, D.C. 1938. A list of teh lichens of Hardin County. **Transactions of Illinois Academy of Science**. 31: 110.

Jones, G.N. 1950. Flora of Illinois. University of Notre Dame Press, West Lafeyette, Indiana.

Lawrey, J. and M. Hale. 1979. Lichen growth and responses to stress induced by automobile exhaust pollution. **Science**. 204: 423-424.

Richardson, D. and K. Puckett. 1973. Sulfur dioxide and photosynthesis in lichens. In air pollution and lichens. B.W. Ferry, M.S. Baddeley, and D. L. Hawksworth, eds., Buffalo, University of Toronto Press. 283-298.

Saunders, P. 1970. Air pollution in relation to lichens and fungi. **Lichenologist**. 4: 337-349.

Sigal, L. and T. Nash. 1983. Lichen communities on conifers in southern California mountains: An ecological survey related to oxidant air pollution. **Ecology**. 64: 1343-1354.

Skorepa, A.C., and J.A. Snider. 1967. Some unusual lower plants from Lust Creek, Pope County, Illinois. **Transactions of Illinois Academy of Science.** 60:105-106.

Skorepa, A.C. 1970. Lichenological records from central and northern Illinois. **Transactions of Illinois Academy of Science**. 63: 78-82.

Stover, E.L. 1930. A mesophytic ravine Rocky Branch -- a floristic account. **Eastern Illinois State Teachers College Bulletin110**.

Sundstrom, K. and J. Hallgren. 1973. Using lichens as physiological indicators of sulfurous pollutants. **Ambio**. 2: 13-21.

Taylor, J. 1967. Lichens of Ohio. Part 1. Foliose Lichens. The Ohio State University, Columbus, Ohio.

Thomson, J.W. 1967. The Lichen Genus **Cladonia** in North America. University of Toronto Press, Toronto, Canada. 172 pp.

Turk, R. and V. Wirth. 1975. The pH dependence of SO_2 damage to lichens. **Oecology**. 19: 285-291.

Vaughn, H.R. 1941. Bryophytes of Rocky Branch Region of Clark County, Illinois. **Transactions of Illinois Academy of Science**. 34: 96-97.

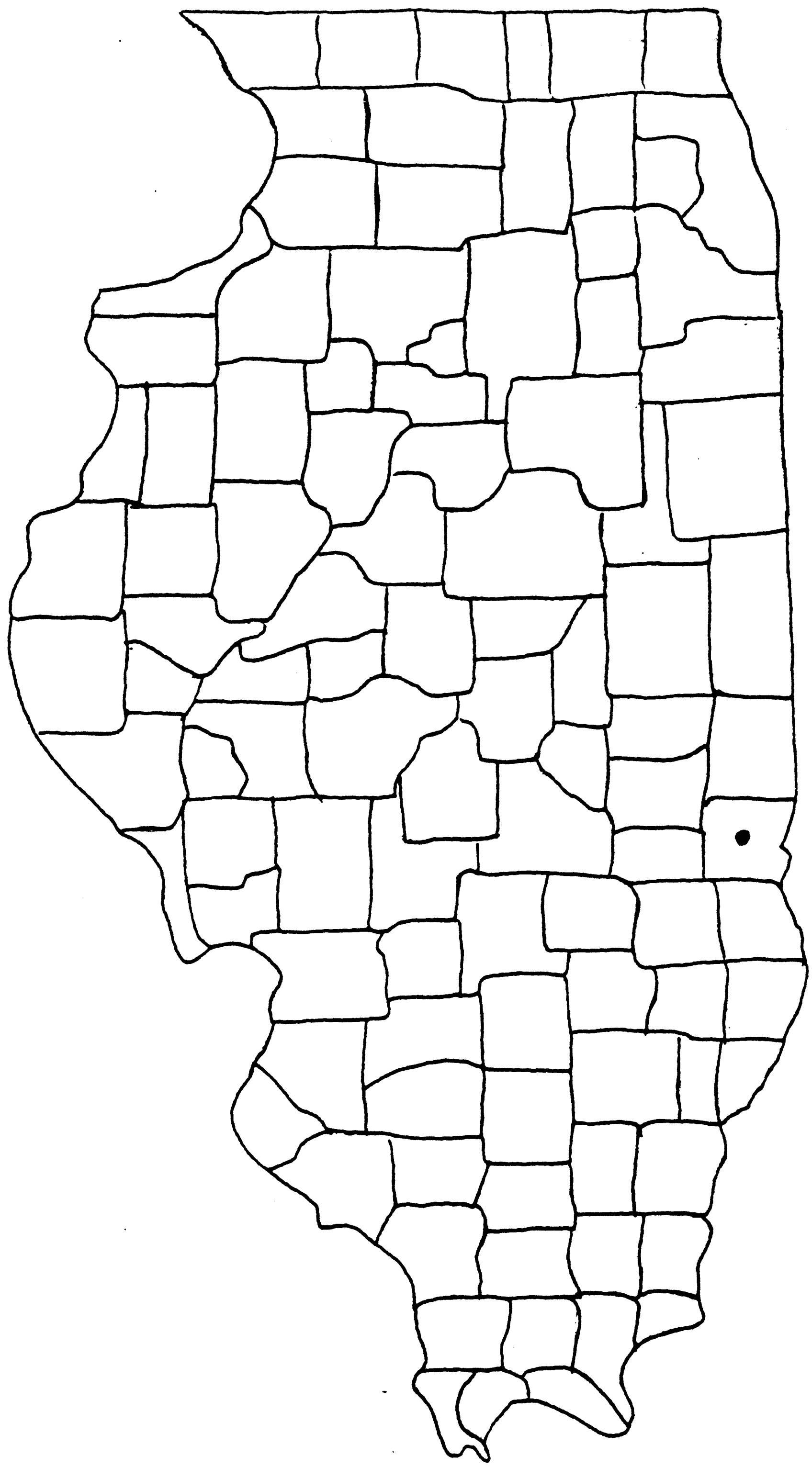
Wiedman, J.E. 1971. The Lichen Flora of Rocky Branch Nature Preserve, Clark County, Illinois. Master's Thesis Eastern Illinios University, Charleston, Illinois. 109 pp.

Wilhelm, G. 1994. Lichens of the Chicago Region. The Morton Arboretum, Lisle, Illinois.

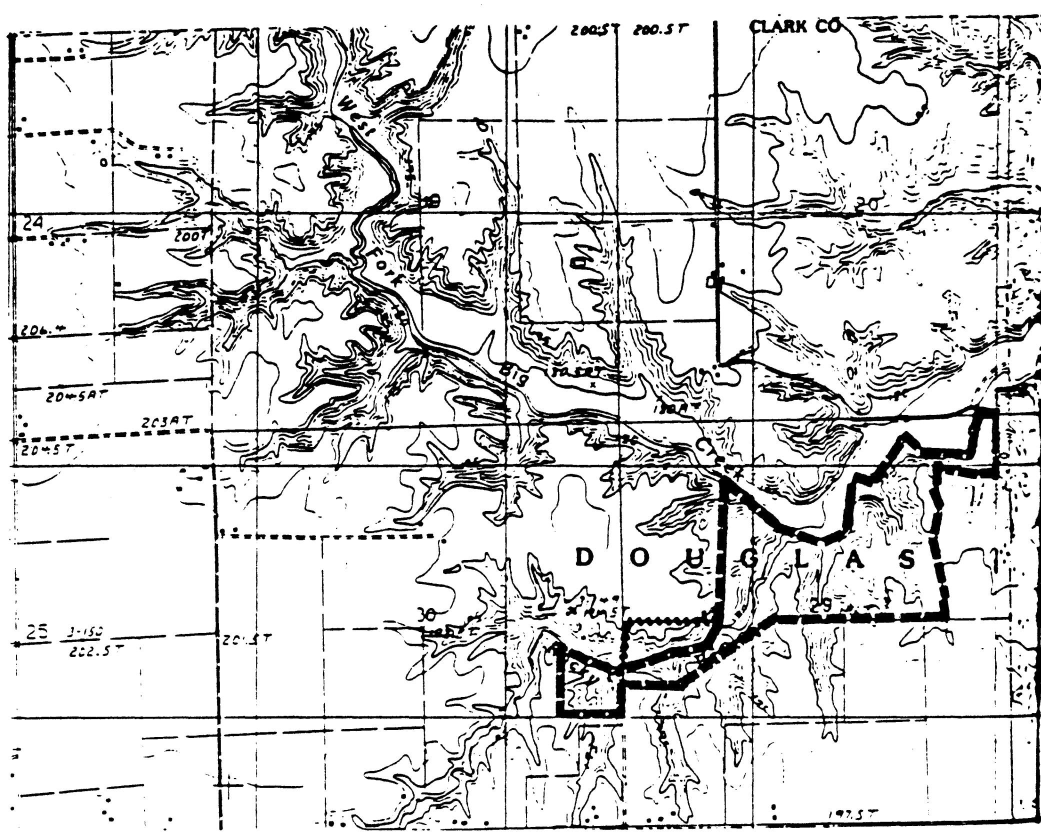
Willey, H. 1877. Illiniois lichens. **Botany Gazette**. 2: 77-79.

Willey, H. 1878. Lichens of southern Illinois. **Botany Gazette**. 3: 21-22.

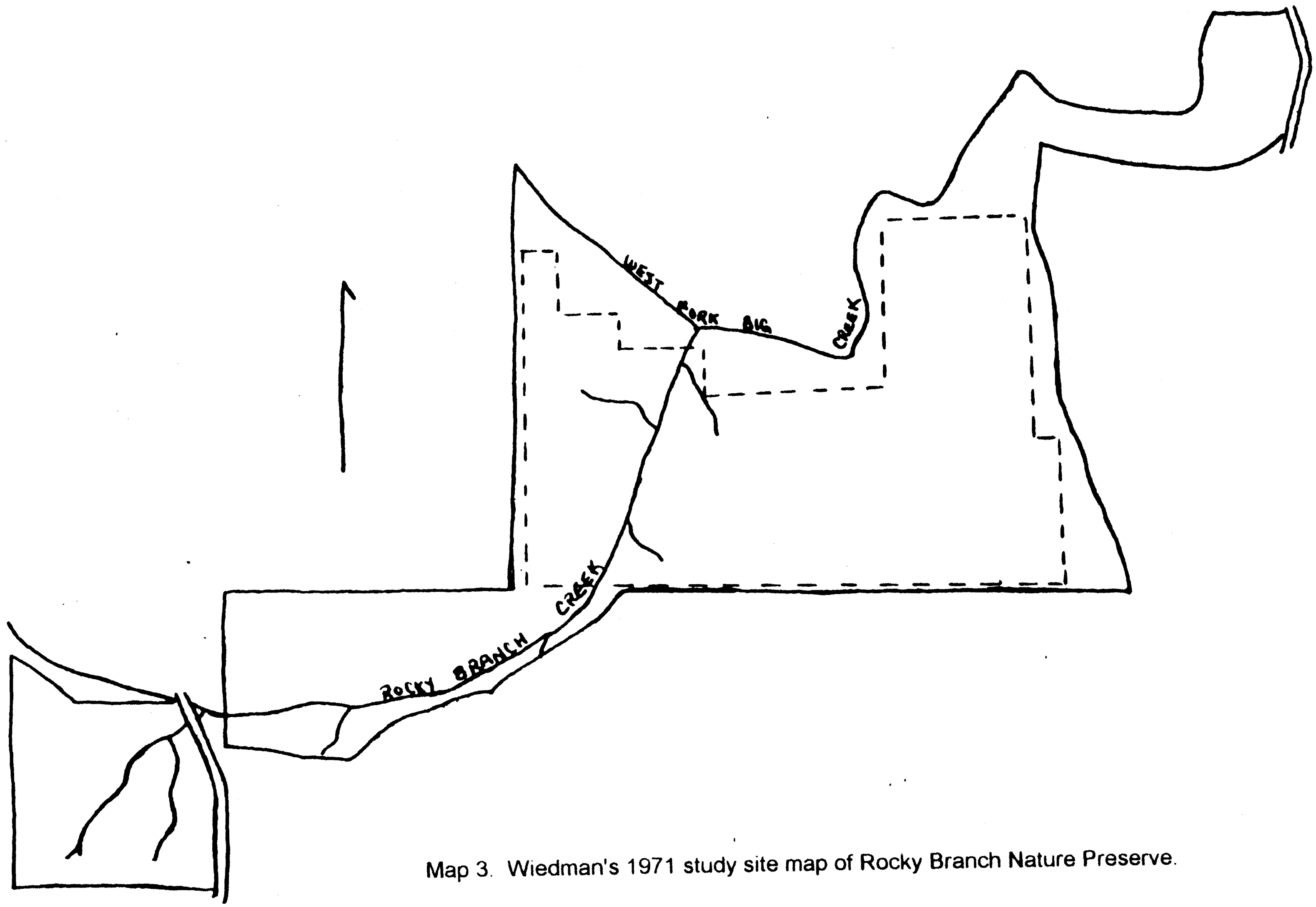
Wolf , J. and E.Hall. 1878. A list of the mosses, liverworts. and lichens of Illinois. **Bulletin of the Illinois State Laboratory of Natural History**. 1: 18-37.



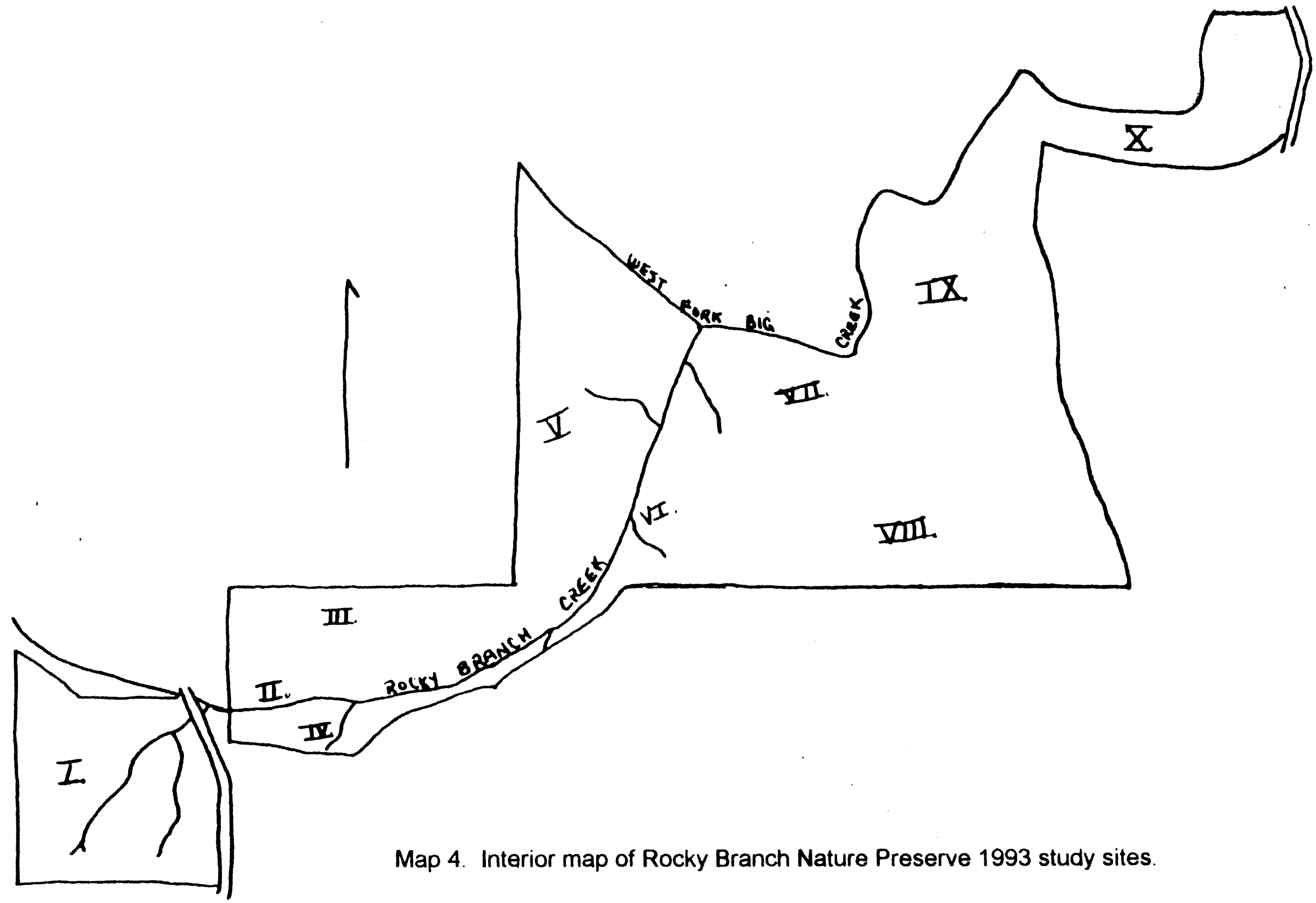
Map 1. Map of Illinois highlighting Clark County.



Map 2. Plat map of Rocky Branch Nature Preserve, Clark County, Illinois.



Map 3. Wiedman's 1971 study site map of Rocky Branch Nature Preserve.



Map 4. Interior map of Rocky Branch Nature Preserve 1993 study sites.

VI. VITA

Eric Benjamin Grunder was born on November 5, 1966, and raised in Lincoln, a farming community in central Illinois. His high school education was received at Lincoln Community High School where he graduated in the top quarter of his class in 1985.

In August, 1986, Eric enrolled at Lincoln College where he received an Associates in Arts degree in May, 1988, graduating on the President's List and as a member of Phi Theta Kappa. In August 1988, Eric enrolled at Eastern Illinois University to pursue a bachelor's degree in Botany, which he completed in December of 1990. He continued his education in the graduate program in Botany under the instruction of Dr. Andrew Methven. In August, 1993, Eric accepted a teaching position in the Biology Department at Lincoln College, where he currently teaches biology, environmental biology, and physical geography. Eric Grunder received his Master of Science degree in Botany in August, 1997.