12-1-1985

Lichen Flora of Eastern Nebraska Riparina and Adjacent Bluff Forests.

Teresa Lynn Ingold Cherney

Lichen Flora of Eastern Nebraska Riparian and Adjacent Bluff Forests

A Thesis

Presented to the

Department of Biology

and the

Faculty of the Graduate College

University of Nebraska

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

University of Nebraska at Omaha

by

Teresa Lynn Ingold Cherney

December 1985

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 - 1346

THESIS ACCEPTANCE

Accepted for the faculty of the Graduate College, University of Nebraska, in partial fulfillment of the requirements for the degree Master of Arts, University of Nebraska at Omaha.

Committee

Name	Department
Thomas B. Bragg	Biology
Wayne Peake	Geography - Biology
David M. Sutherland	Biology

Robert S Egan
Chairman

12/4/85
Date

ACKNOWLEDGEMENTS

I wish to express great appreciation to Dr. Robert S. Egan for his understanding and neverending patience. His knowledge and guidance throughout this project have been invaluable, and the use of his personal library and laboratory was extremely helpful.

I express thanks to Dr. Erwin Brodo, National Museums of Canada, Dr. Clifford Wetmore, University of Minnesota, and Dr. Theodore Esslinger, North Dakota State University, for their assistance in identification of difficult lichen species. Many thanks to Dr. David Sutherland for aid with the preparation of the figures as well as being a committee member. To the other committee members, Dr. Thomas Bragg and Dr. Jeffrey Peake, I am also thankful.

Gratitude goes to Jim Fuller of the Nebraska Game and Parks Commission for permission to collect in Nebraska State Parks and Recreation Areas. I also wish to thank Dr. Sandra Marlatt for permission to collect in Fontenelle Forest and Neale Woods. Partial funding from the Biology department has assisted with travel expenses.

I wish to thank Molly Doyle for her assistance with some of the field work. Special thanks go to my parents, Harry and Joyce Ingold, for their continued encouragement and love during my graduate career. Lastly to my husband, Michael, I express heartfelt appreciation for his support and companionship throughout this project.

ABSTRACT

Seventy-one species in 31 genera were collected in 14 riparian and adjacent bluff forest sites in eastern Nebraska. Data were gathered on aspect, vertical zonation, substrate preference, and latitudinal differences with respect to species diversity. A majority of species were collected above one meter on wood substrates of northern aspect. Greatest number of lichen species were found in the central and southern counties in eastern Nebraska. Three genera are reported for the first time from Nebraska (Anisomeridium, Lepraria, and Thyrea), and 26 species collected were state records. Keys to the collected genera and species are provided with a brief discussion of each taxon.

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

In comparison to other states, relatively little work has been done on the lichen flora of Nebraska. The earliest known lichen reports for Nebraska were by Tuckerman (1872) in which 15 species were listed for the Nebraska Territory. A portion of this area has since become Wyoming; therefore, these records may not represent accurate reports for Nebraska. Another early report lists 41 species (Aughey, 1875), but these records are questionable because Aughey has been shown to extrapolate data from other published material not necessarily about Nebraska (Pound & Clements, 1900). More recent and reliable contributors include Fink (1935), Thomson (1963, 1967), and Esslinger (1973, 1977, 1978). The most recent records include map localities (Hale, 1979), but only the common foliose and fruticose species are treated. In addition, a literature survey found that few actual lichen collections have been made in Nebraska. Williams (1889) collected 108 species, and Webber (1890) reported 111 species for Nebraska. Walter Kiener who collected lichens between 1939 and 1967, never published on any of his Nebraska collections.

The purposes of this investigation were four-fold: 1) to document the lichen flora of eastern Nebraska riparian and adjacent bluff forests, 2) to gather data on the habitat preference of these taxa, 3) to assess any the latitudinal influence on species diversity, and 4) to prepare keys for the identification of species collected in this study.

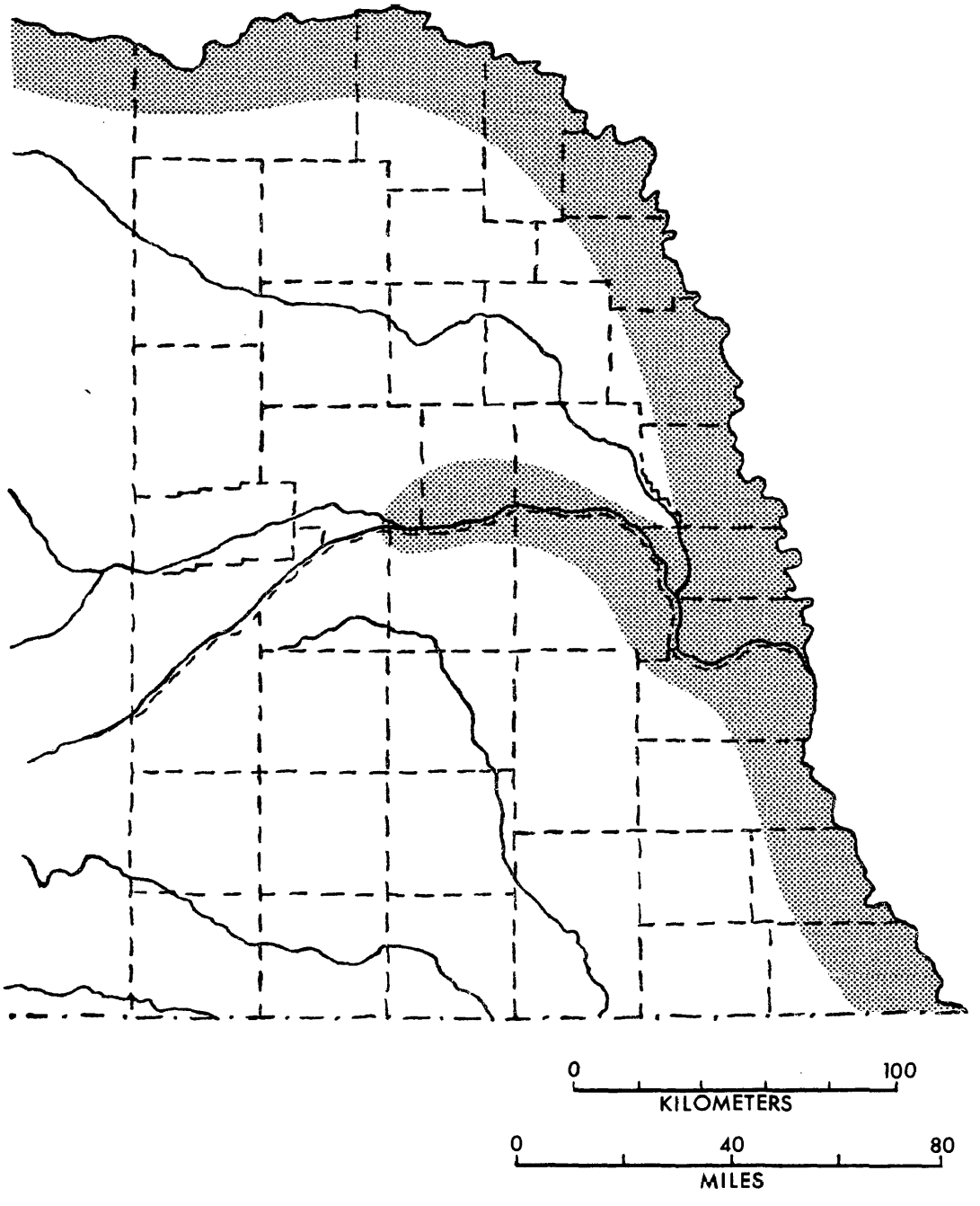
DESCRIPTION OF THE EASTERN NEBRASKA STUDY AREA

The Missouri River bluffs, rising up to 300 feet above the river level, form the eastern border of Nebraska. They are partially wooded and have numerous ravines and tributaries leading into the Missouri River. One of the tributaries, the Platte River, is a broad, shallow river with occasional sandbars.

Soils of the bluffs have developed in loess where glacial materials occasionally outcrop. The loess is grayish or pale buff in color and is a calcareous material that is 50-60% silt. The middle and lower slopes are composed of reddish brown silt, clay, till, and sandstone or limestone. The bottomland soils are are subjected to overflow and deposition of sand, silt or clay sediments (Elder, 1969). Both areas experience slow surface drainage and are retentive of moisture (Carter, 1963; Elder, 1969).

The Eastern Deciduous Forest Province (Figure 1) includes the eastern region of Nebraska along the Missouri and Platte Rivers (Stephens, 1973). The dominant trees of the bluff forests include bur oak (Quercus macrocarpa Michx.) and bitternut hickory (Carya cordiformes (Wang.) K. Koch) on the hilltops and upper slopes. In addition, red oak (Quercus borealis Michx. f. var. maxima (Marsh.) Ashe) and American linden (Tilia americana L.) frequently occur in protected slopes and ravines. Other trees include: American elm (Ulmus americana L.), green ash (Fraxinus pennsylvanica Marsh. var. subintegerrima (Vahl.) Fern.), white ash (Fraxinus americana L.), black oak (Quercus velutina Lam.), and white

Figure 1. Eastern Deciduous Forest Province in Nebraska. This vegetative region occurs along the Missouri and Platte Rivers in eastern Nebraska (Stephens, 1973).


0
100
KILOMETERS
0
40
80
MILES

oak (Quercus alba L.). A common shrub found in tallgrass prairie areas is smooth sumac (Rhus glabra L.) (Heineman, 1982). In lowlands close to the Missouri and Platte Rivers the eastern cottonwood (Populus deltoides Marsh.) is common.

A north-south transition in woody plants has been reported by Stephens (1973). Forty-five woody plant species occur in these eastern Nebraska forests. Thirty-eight species, however, are found exclusively in the southeastern corner of the state with only 17 of the 38 extending into the central Nebraska counties. One example of the north-south transition is found among the oaks. Bur oak occurs throughout eastern Nebraska forests whereas red oak extends northward only into Dakota County south of Ponca State Park. Black oak extends northward as far as southern Sarpy County, whereas white oak is found only rarely in the southeastern corner of the state. Such transitions are common in other flowering plants and thus may also be reflected in lichen species.

The hilly nature of the eastern Nebraska bluffs makes the land of little use as farmland. Clearing the land, therefore, has been done on a small scale leaving large treed areas with old individuals. Many floodplain areas are also not suitable for farming and have been left relatively untouched. Most of these remnant bluff and floodplain forests have become state parks or private forest preserves which provide the best sites for lichens to become established. Collecting efforts, therefore, were concentrated in such protected areas.

COLLECTION SITES

Collections were made in the state parks and recreation areas in bluffs and bottomland forests of eastern Nebraska during the summer and fall months of 1984 and 1985. The following is a brief description of each collection site. Numbers in the left-hand column are my collection numbers. Dates are collection dates. The letters (A-N) refer to the collection areas in Figure 2.

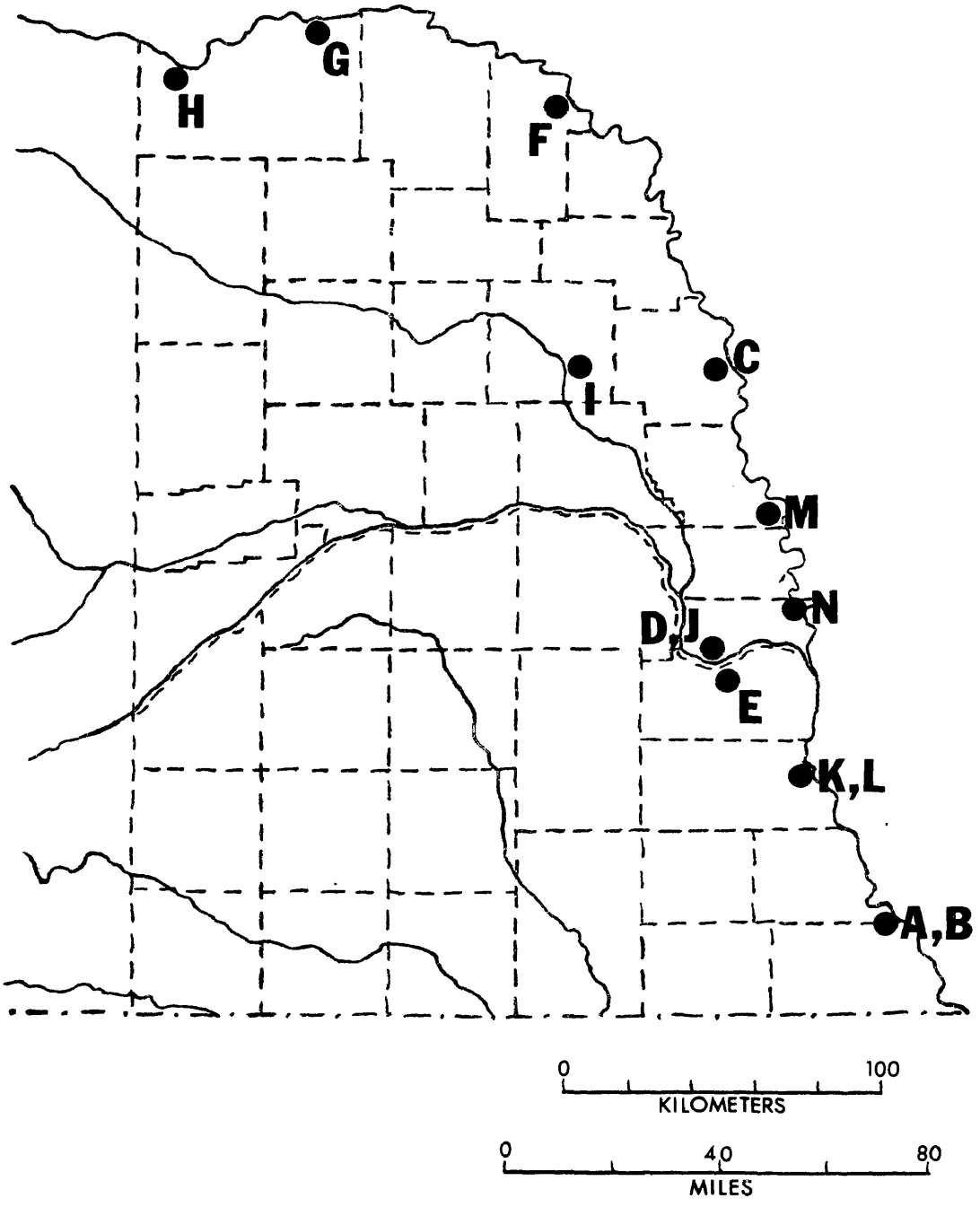
255 - 295 (A) **Nemaha County. Indian Cave State Park.** North Ridge Trail. 7 miles (11.2 km) south of Nemaha. T3N, R16E. Mixed oak forest. 19 July 1984.

296 - 324 (B) **Richardson County. Indian Cave State Park.** Cave area. 8 miles (12.8 km) northeast of Shubert. T3N, R16E. Sandstone, soil, and oak substrates. 19 July 1984.

325 - 337 (C) **Burt County. Pelican Point State Recreation Area.** 6 miles (9.6 km) northeast of Tekamah. T21N, R12E. Cottonwood stand with mostly young trees void of lichen growth. Sandy marina area. 28 July 84.

338 - 343 (D) **Sarpy County. Schramm Park State Recreation**
367 - 387 **Area.** 7 miles (11.2 km) southwest of
461 - 497 Springfield. T12N, R10E. Mainly oak forest. Junipers present void of lichen growth. Infrequent rock outcrops in both open and wooded areas. 19 August 1984, 12 April 1985, 22 May 1985.

Figure 2. Location of study areas in eastern Nebraska. Letters refer to the 14 collection sites discussed in the text.


H
G
F
I
C
M
N
D,J
E
K,L
A,B
0
100
KILOMETERS
0
40
80
MILES

344 - 366 (E) **Cass County. Platte River State Park.** Sjogren tract area. 3 miles (4.8 km) west of Louisville. T11N, R10E. Mixed oak forest and hill-prairie openings. 26 October 1984.

388-395 (1) (F) **Dixon County. Ponca State Park.** 3 miles
396-409 (2) (4.8 km) north of Ponca. T30N, R5E. Mixed
410-419 (3) hardwood forest. 15 May 1985. Numbers (1-6)
420-423 (4) refer to various collection sites within the
424-429 (5) park.
430-433 (6)

434 - 443 (G) **Knox County. Lewis and Clark Recreation Area.** South Shore State Recreation Area. 7 miles (11.2 km) north of Crofton. T33N, R1W. Bluff area has a great deal of juniper. Sandy soil near lake. Rock outcrops frequent. 15 May 1985.

444 -455 (H) **Knox County. Niobrara State Park.** 1 mile (1.6 km) west of Niobrara. T32N, R6W. Tree flora sparse. Cottonwood predominates. River bottom area with sandy soil. 16 May 1985.

456 - 460 (I) **Cuming County.** Junction of U.S. 275 and Nebraska Route 9. 1 mile (1.6 km) north of West Point. T21N, R6E. Oak stand in "wayside area". 16 May 1985.

498 - 499 (J) **Sarpy County.** 204th and Fishery Road overlooking the Platte River. 7 miles (11.2 km) southwest of Springfield. T12N, R10E. Road leading to Schramm Park from the east. Rocky bluffs with junipers and deciduous trees. Very dusty due to dirt road travel. 22 May 1985.

500 - 517 (K) **Otoe County. Arbor Lodge State Historical Park.** Northwest part of Nebraska City. T8N, R13E. Collections made in arboretum along tree trail and planted tree stands. Horticulturally maintained park with a wide diversity of tree species. 30 May 1985.

518 - 527 (L) **Otoe County. Riverview Marina State Recreation Area.** Northeast part of Nebraska City. T8N, R13E. Lichens found above flood line (4-5 feet above ground level). River bottom with sandy soil. 30 May 1985.

528 - 538 (M) **Washington County. Neale Woods.** 3 miles (4.8 km) north of Omaha. T16N, R12E. Mixed oak forest. Abundance of open prairie area occurs with much immature forest. 13 Oct 1985.

539 - 560 (N) **Sarpy County. Fontenelle Forest.** Eastern part of Bellevue. T14N, R14E. Mixed oak forest. Pollution from Iowa Power & Light plant directly across the river may contribute to low lichen diversity in the area. 14 Oct 1985.

METHODS

Field Methods

Field collections were handled using standard lichenological methods (Hale, 1979). Specimens were placed in paper bags with labels containing their collection numbers. Ecological information for each collection was also recorded including substrate type (tree, rock or soil), vertical zone (below or above one meter), aspect (north, south, east, west), and the circumference class of the corticolous substrate (small, medium, large). Efforts were made to collect every lichen species present at every site and to examine as many different substrates as possible. Since rock outcrops were infrequent, special efforts were made to find and sample these substrates in order to fully document the lichen flora. No quadrat or transect methods were employed.

Laboratory Methods

Specimens were returned to the laboratory and processed for placement into the herbarium (Hale, 1979). Identification of species was accomplished by examining morphological characteristics using both compound and dissecting microscopes. Hand sections of ascocarps were prepared allowing measurements and drawings of spores for crustose lichens. Slides were stained with lactophenol-cotton blue, or sections were mounted in 10% aqueous potassium hydroxide.

Since chemical differences among some lichen species are important for species recognition, standard chemical spot tests were performed with the following solutions: a 10% aqueous solution of potassium hydroxide (K), liquid CLOROX (C), and p-phenylenediamine crystals dissolved in 95% ethyl alcohol (PD). For identification of some lichens, actual determination of specific lichen substances was required. Characteristic depsides and depsidones were identified using thin-layer chromatography with silica gel plates and a solvent of toluene: dioxane: acetic acid (180:45:5). This technique for more precise identification was performed following the methods of Culberson and Kristinsson (1970), Culberson (1972), and Walker and James (1980).

Identified lichens were placed in packets and attached to herbarium sheets. Voucher specimens are deposited at the University of Nebraska at Omaha. Duplicate specimens have been sent to the Smithsonian Institution and other university herbaria.

Identifications were based on Culberson and Culberson (1980), Esslinger (1978, 1985), Hale (1979), Harris (1977), Rudolph (1955), and Wetmore (1967).

Key to Lichen Genera of the Eastern Nebraska Riparian and Bluff Forests

In this key and throughout this thesis, standard lichenolgical terminology is used (Hale, 1979, 1983; Hawksworth, 1984). For those genera with more than one taxon in eastern Nebraska, an additional key to the collected species will be found in the annotated alphabetical treatment which follows the generic key.

1. Thallus crustose 3
1. Thallus fruticose, foliose, or squamulose 2
    2. Thallus fruticose 17
    2. Thallus foliose or squamulose 19
3. Reproductive structures lacking; thallus a sorediate mass with no differentiation into cortices; yellowish-green to blue-green ..... Lepraria
3. Ascocarps with mature spores present 4
    4. Ascocarp lirelliform, elongated, sometimes branched 5
    4. Ascocarp a perithecium or apothecium, not elongated or branched 6
5. Ascocarp immersed in thallus, black with carbonized walls and pruinose; spores 3-10 septate, 25-54 µm .... Graphis scripta (L.) Ach.
5. Ascocarp not immersed in thallus, black but not pruinose; spores 6-8 septate, 19-21 µm ..... Opegrapha sp. 1
    6. Ascocarp a perithecium or disc opening as a single pore 7

6. Ascocarp an apothecium with disc expanded when mature 10

7. Spores simple and hyaline 8

7. Spores 2-celled and hyaline 9

8. Ascocarp wart-like, light brownish-gray like thallus; spores 95-110 µm ..... Pertusaria

8. Ascocarp a perithecium, not wart-like, black; spores 15-22 µm ..... Verrucaria

9. Spore cell sizes unequal ..... Anisomeridium biforme (Borr. in Hook. & Sowerb) R. Harris in Vezda

9. Spore cell sizes equal ..... Arthopyrenia sp. 1

10. Spores brown 11

10. Spores hyaline 14

11. Spores muriform ..... Diploschistes scruposus (Schreb.) Norm.

11. Spores 2-celled 12

12. Spores 16-23 µm; apothecia lecanorine ..... Rinodina c.f. confragrosa (Ach.) Körb.

12. Spores under 16 µm 13

13. Thallus effigurate, pale yellow-green; on rock; spores 7-11 µm; apothecia lecanorine ..... Dimelaena oreina (Ach.) Norm.

13. Thallus not effigurate, greenish-gray to ashy; on wood; spores 10-13 µm; apothecia lecideine ..... Buellia punctata (Hoffm.) Mass.

14. Spores polaribilocular; apothecia and/or thallus K+ purple (parietin) ..... Caloplaca

14. Spores not polaribilocular; apothecia and thallus K- 15

15. Spores simple, 9-14 µm; apothecia lecanorine; if spores are over 90 µm with sheath, see Pertusaria ..... Lecanora

15. Spores 3-8 septate, greater than 14 µm; apothecia lecideine 16

16. Spores 3-septate, 15-20 µm; interthecial threads branching and anastomosing ..... Arthonia radiata (Pers.) Ach.

16. Spores 5-8 septate, 16-39 µm; paraphyses simple ..... Bacidia

17. Thallus umbilicate; phycobiont Xanthocapsa with a K+ yellow sheath..... Thyrea pulvinata (Schaer.) Mass.

17. Thallus not umbilicate; phycobiont a green alga 18

18. Thallus tufted; apothecia and thallus K+ purple (parietin); in trees ..... Teloschistes chrysophthalmus (L.) Th. Fr.

18. Thallus with many basal squamules and erect, hollow podetia; apothecia and thallus K- or K+ yellow to red (norstictic acid); on soil ..... Cladonia

19. Thallus squamulose, green to greenish-gray; on soil; podetia may be present ..... Cladonia

19. Thallus foliose, not squamulose 20

20. Thallus umbilicate; phycobiont Xanthocapsa .... Thyrea pulvinata (Schaer.) Mass.

20. Thallus not umbilicate; phycobiont not Xanthocapsa 21

21. Thallus dull black; cortices absent; gelatinous .... Collema limosum (Ach.) Ach.

21. Thallus gray, brown, yellow-orange, orange, or yellow-green; cortices present; not gelatinous 22

22. Lower surface of thallus with distinct veins .... Peltigera rufescens (Weis) Humb.

22. Lower surface lacking veins 23

23. Upper surface of thallus with pseudocyphellae ..... Punctelia

23. Upper surface lacking pseudocyphellae 24

24. Thallus orange, yellow-orange or yellow-green 25

24. Thallus gray or brown 27

25. Thallus orange, K+ purple ..... Xanthoria

25. Thallus yellow-orange or yellow-green, K- 26

26. Thallus linear-lobed, 2-5 mm; yellow-green; on rocks .....
..... Xanthoparmelia

26. Thallus lobes very narrow, 0.3-1.5 mm; yellow-orange or yellow-green; on wood ..... Candelaria

27. Thallus K+ yellow (atranorin present) 28

27. Thallus K- 30

28. Thallus broad-lobed; upper cortex often reticulately cracked to margin ..... Parmotrema reticulatum (Tayl.) Choisy

28. Thallus narrow-lobed; upper cortex not cracked 29

29. Lower surface black, lobe margins sometimes short-ciliate .....
..... Parmelina aurulenta (Tuck.) Hale

29. Lower surface white to tan; eciliate ..... Physcia

30. Lower cortex paraplectenchymatous ..... Phaeophyscia

30. Lower cortex prosoplectenchymatous 31

31. Rhizines lacking; thallus closely appressed on substrate .....
..... Hyperphyscia

31. Rhizines present; thallus not tightly attached to substrate 32

32. Thallus strongly pruinose ..... Physconia

32. Thallus not pruinose ..... Physciella

ANISOMERIDIUM (Müll. Arg.) Choisy

The spores in this crustose genus are 1-septate, hyaline and 10-14 µm long. One cell of the spore is larger than the other. The thallus is light gray to lacking with black perithecia.

ANISOMERDIUM BIFORME (Borr. in Hook. & Sowerb.) R. Harris in Vězda

A. biforme was rarely found on oak. The genus is very similar to Arthopyrenia in all aspects except for the spore morphology. This is the first report of this genus for Nebraska. Specimen collected. Cass County: 349.

ARTHONIA Ach.

The brown to black apothecia of Arthonia are characterized by branching and anastomosing paraphyses and the lack of excipular tissue. The spores are 3-septate, hyaline, and 15-20 µm in length. The crustose thallus is gray and lacks cortices.

ARTHONIA RADIATA (Pers.) Ach.

This lichen was only found in the southeast counties of Nebraska. It was collected from an exposed root and is a new report from the state. Specimen collected. Richardson County: 301.

ARTHOPYRENIA Mass.

The spores of this crustose genus are 1-septate, hyaline, 29-35 µm, and have equal size cells. Each spore is surrounded by a sheath. The light gray thallus is usually scattered with black perithecia.

ARTHOPYRENIA sp. 1

This species was found on elm. It is similar to A. finkii Zahlbr. morphologically. However, the spores are larger (29-35 µm) and the spore wall is not punctate. The genus Arthopyrenia has been reported from Nebraska by Reynolds (1942). Specimen collected. Sarpy County: 477.

BACIDIA De Not.

This crustose genus has been reported from Nebraska by Fink (1935) and Wetmore (1967). The lecideine apothecia are black and species have simple, unbranched paraphyses. Spores are acicular to subfusiform, hyaline, 5-8 septate, and 16-39 µm in length. The thallus is often light green, tan to gray or lacking.

1. Acicular spores 5-8 septate, 37-39 µm ..... Bacidia sp. 1
1. Subfusiform spores 3 septate, 16-22 µm 2
    2. On rock ..... Bacidia sp. 2
    2. On soil over rock ..... Bacidia sp. 3

BACIDIA sp. 1

The only specimen of this species was collected from soil with moss. It is very similar to B. bagliettoana (Mass. & De Not. in Mass.) Jatta, except the spores are larger. Specimen collected. Dixon County: 432.

BACIDIA sp. 2

The second unnamed species of Bacidia was found on rock. Its spores are hyaline, septate, and 18-22 µm long. Specimen collected. Richardson County: 305.

BACIDIA sp. 3

This species is very similar to Bacidia sp. 2 except that it is found on soil over rock. Its spores are morphologically the same and are 16-20 μm in length. Specimen collected. Richardson County: 304.

BUELLIA De Not.

Buellia spores are 2-celled, brown, and 10-13 μm long. The lecideine apothecia are black and found on a crustose thallus that is greenish-gray to ashy in color.

BUELLIA PUNCTATA (Hoffm.) Mass.

Imshaug (1951) reports this lichen from Nebraska. In addition, Aughey (1875) and Webber (1890) report it as B. myriocarpa (DC.) De Not. This specimen was found on roof shingles. Specimen collected. Knox County: 442.

CALOPLACA Th. Fr.

This crustose lichen genus has several sorediate species, a characteristic rare in the crustose lichens. Thalli are closely adnate on the substrates and yellow-orange to dark gray. Both the thallus and the apothecia are K+ purple due to the anthroquinone pigment parietin. The spores are characteristically polaribilocular, hyaline, and 9-18 μm in length.

1. Thallus squamulose and sorediate; on wood; spores 9-10 μm, isthmus 2-3 μm ..... C. microphyllina (Tuck.) Hasse
1. Thallus crustose 2

2. Thallus sorediate 3

2. Thallus not sorediate 4

3. On wood ..... C. discolor (Will.) Fink

3. On rock ..... C. citrina (Hoffm.) Wade

4. On wood 5

4. On rock 9

5. Apothecial margin same color as disc 6

5. Apothecial margin cream or gray 7

6. Apothecia orange ..... C. holocarpa (Hoffm.) Wade

6. Apothecia disc dark reddish-brown .....
..... C. ferruginea (Huds.) Th. Fr.

7. Apothecial rim and thallus cream-colored .....
..... C. flavorubescens (Huds.) Laund.

7. Apothecial rim gray; thallus gray or lacking 8

8. Apothecial disc yellow, margin gray and pruinose; thallus gray
..... C. ulmorum (Fink) Fink

8. Apothecial disc pale to dark yellow-orange, margin gray;
thallus lacking ..... C. cerina (Ehrh. in Hedw.) Th. Fr.

9. Spore isthmus 1-3 μm 10

9. Spore isthmus 4-6 μm 12

10. Thallus yellow ..... C. feracissima Magn.

10. Thallus gray or lacking 11

11. Apothecial disc bright orange ..... C. holocarpa (Hoffm.) Wade

11. Apothecial disc dull yellow-orange ..... Caloplaca sp. 1

12. Thallus and apothecial rim yellow; apothecial disc dingy
orange ..... C. flavovirescens (Huds.) Laund.

12. Thallus or apothecial rim gray to black 13

13. Thallus and apothecial rim gray to black; apothecia dark orange ... . C. sideritis (Tuck.) Zahlbr.

13. Thallus lacking; apothecial rim gray; apothecial disc pale ..... yellow-orange ..... C. cerina (Ehrh. in Hedw.) Th. Fr.

CALOPLACA CERINA (Ehrh. in Hedw.) Th. Fr.

This Caloplaca species was found on both mulberry and rock. Its spores measure 10-14 μm (isthmus 2-4 μm) in length. Specimen #474 is not a typical representative. It is a very small thallus overgrown with algae, making the color difficult to determine. Specimens collected. Otoe County: 524; Sarpy County: 474.

CALOPLACA CITRINA (Hoffm.) Wade

This sorediate lichen was collected from rocks. Its spores are 12-14 μm long and has an isthmus 1-2 μm wide. It has been reported by Reynolds (1942) from Richardson County and by Webber (1890) as Placodium citrinum (Hoffm.) Leight. Specimen collected. Dixon County: 388.

CALOPLACA DISCOLOR (Will.) Fink

This is one of the sorediate, crustose Caloplaca species collected. It was found on cottonwood, oak, and tulip trees. According to Wetmore (1967), the distribution of this species is uncertain and is found rarely on oak in the Black Hills. This is a new report for Nebraska. Specimens collected. Knox County: 448; Nemaha County: 290; Otoe County: 516.

CALOPLACA FERACISSIMA Magn.

Found on HCl+ cement block or rock, this is a new species record for the state. The spores have a small isthmus (1-3 µm) and are 10-14 µm long. Rudolph (1955) reports this species from Wisconsin and New York. Wetmore (1967) cites it from the Black Hills, and states that it is probably more widely distributed than the range mentioned by Rudolph. Specimens collected. Dixon County: 391a; Knox County: 440; Sarpy County: 551.

CALOPLACA FERRUGINEA (Huds.) Th. Fr.

This is a rare species of Caloplaca. It was found on elm in the middle part of the state, and is also a first report for Nebraska. This lichen has been collected in Iowa and Illinois (Rudolph, 1955) and from the northern Black Hills area (Wetmore, 1967). Specimen collected. Washington County: 534.

CALOPLACA FLAVORUBESCENS (Huds.) Laund.

This widespread species was collected from cottonwood and oak. Its spores measure 13-14 µm in length, and the isthmus measures 4-5 µm. A majority of the reports for this species are from eastern states; however, it has been found in Illinois and Kansas (Rudolph, 1955). Specimens collected. Knox County: 451; Nemaha County: 295.

CALOPLACA FLAVOVIRESCENS (Wulf.) Dalla Torre & Sarnth.

This rare species was found only on rock. Its spores are 12-13 µm long (isthmus 4-5 µm). Caloplaca flavovirescens is a pan-boreal species that has been collected throughout the midwest (Fink, 1935; Rudolph, 1955; Wetmore, 1967). This is the first report for the state of Nebraska. Specimens collected. Richardson County: 298, 307.

CALOPLACA HOLOCARPA (Hoffm.) Wade

Caloplaca holocarpa was collected from rock, from boards in an old wood pile, and from a dead tree. Its spores measure 11-15 µm long with an isthmus of 1-3 µm. This taxon has been reported from Nebraska as Placodium cerinum (Hedw.) Naeg. & Hepp. by Webber (1890) and is a widespread species in North America and Europe. Specimens collected. Cass County: 356a; Sarpy County: 494; Washington County: 553.

CALOPLACA MICROPHYLLINA (Tuck.) Hasse

This species is the only non-crustose Caloplaca collected. It was found on elm, fence posts, and roof shingles, and was previously reported from Richardson County by Reynolds (1942) and from Lincoln and Lancaster counties by Rudolph (1955) as Gasparrinia microphyllina (Tuck.) E. Rud. ined. Specimens collected. Cass County: 364; Cuming County: 458; Dixon County: 409; Knox County: 441a.

CALOPLACA SIDERITIS (Tuck.) Zahlbr.

Caloplaca sideritis is a new record for Nebraska. It was found on rock at only one study site in Sarpy County. The spores are 10-11 µm long, and the isthmus is 5-6 µm. Rudolph (1955) reported C. sideritis from Iowa. Specimen collected. Sarpy County: 490.

CALOPLACA ULMORUM (Fink) Fink

Caloplaca ulmorum was collected on ash and cottonwood. Spores in this species are 12-15 µm in length with an isthmus 4-6 µm long. The holotype for this species is from Iowa, and it has also been found in Kansas (Rudolph, 1955). It is rare farther north in the Black Hills (Wetmore, 1967). This is a new report for Nebraska. Specimens collected. Knox County: 453; Otoe County: 505.

CALOPLACA sp. 1

The apothecia of this species are dull yellow-orange to dark orange with spores 9-12 μm long and an isthmus of 2-3 μm. The thallus is scant or lacking and located only on rocks. Specimens collected. Sarpy County: 498, 499.

CANDELARIA Mass.

The corticolous thallus of Candelaria species are very narrow-lobed, foliose, and greenish-yellow or orange. Soredia are present in one species and apothecia are rare. Thalli and apothecia may be confused with species of Xanthoria or Caloplaca, but those react K+ purple with KOH while Candelaria species react K-.

1. Thallus sorediate; soredia scattered on the surface .... C. concolor (Dicks.) B. Stein.
1. Thallus not sorediate ..... C. fibrosa (Fr.) Müll. Arg.

CANDELARIA CONCOLOR (Dicks.) B. Stein.

This widespread lichen was collected from shagbark hickory, cottonwood, elm, and oak. All specimens were collected above one meter. Webber (1890) reported this species from Nebraska as Teloschistes concolor (Dicks.) Tuck. Specimens collected. Knox County: 446; Nemaha County: 262; Otoe County: 522; Sarpy County: 377, 481, 541, 545, 548, 554, 558; Washington County: 531.

CANDELARIA FIBROSA (Fr.) Müll. Arg.

C. fibrosa is the non-sorediate counterpart of C. concolor and is typically found with apothecia. It was rarely collected from branches at Indian Cave State Park. This is the first report from the state of Nebraska. Specimen collected. Nemaha County: 277.

CLADONIA Hill ex Wigg.

The fruticose thalli in the eastern Nebraska collections are yellowish-green to mineral gray, composed of an erect podetium and basal squamules (primary thallus), and react K- or K+ yellow to red (salazinic acid). The apothecia are brown or the same color as the thallus. More than 100 species occur in North America.

1. Podetia smooth; squamules 4-10 mm, K+ yellow to red, PD+ red (norstictic acid and atranorin)..... C. polycarpoides Nyl.
1. Surface of podetia with longitudinal strands of cortex visible; squamules smaller 1 mm, K-, PD+ red (fumarprotocetraric acid) ..... C. peziziformis (With.) Laund.

CLADONIA PEZIZIFORMIS (With.) Laund.

This lichen was found in southern collection sites on soil over rock. Cladonia peziziformis was previously reported as C. mitrula Tuck. by Webber (1890) and by Reynolds (1942) from Richardson County. More recent reports from Nebraska are found under C. capitata (Michx.) Spreng. (Thomson, 1967; Hale, 1979). Specimens collected. Richardson County: 297; Sarpy County: 467.

CLADONIA POLYCARPOIDES Nyl.

Like C. peziziformis, this species was found in Richardson County only at Indian Cave State Park. All collections were made directly from soil with a northern exposure. This species has been reported from Nebraska by Culberson (1969) and Hale (1979). It reported by Thomson (1967) as C. subcariosa Nyl. Specimens collected. Richardson County: 313, 314.

COLLEMA Wigg.

The thallus of Collema species are gelatinous and lack cortical layers. The phycobiont (Nostoc) is found scattered throughout the thallus. The apothecial disc and thallus are both black with muriform spores occurring four per ascus in the Nebraska species reported below.

COLLEMA LIMOSUM (Ach.) Ach.

This lichen was found at Ponca State Park on soil. It is the first report for this species in Nebraska. This species is very similar to the more common C. tenax (Sw.) Ach., but that species has greater thallus development and eight spores per ascus. Specimen collected. Dixon County: 430.

DIMELAENA Norm.

The light yellow-green, effigurate thallus is a distinguishing characteristic of this crustose genus. It has black, lecanorine apothecia that contain 2-celled, brown spores.

DIMELAENA OREINA (Ach.) Norm.

This crustose lichen was collected from rock. It was found in one of the northern most study areas. This collection represents the gyrophoric acid chemical strain, one of more than five chemical variants found worldwide. Its spores are 7-11 μm in length, brown, and 2-celled. Webber (1890) reported this lichen from Nebraska as Rinodina oreina (Ach.) Mass. It was cited from Nebraska by Hale (1979) in distribution maps. Specimen collected. Knox County: 435.

DIPLOSCHISTES Norm.

Spores of this genus are typically brown and muriform. The lecanorine apothecia are tan to gray, very small, and are immersed in the crustose thallus. The thallus is the same color as the apothecial rim.

DIPLOSCHISTES SCRUPOSUS (Schreb.) Norm.

This species was found only once on rock. It has spores that are 19-23 μm long, brownish, and muriform. Previous reports from Nebraska were published as Urceolaria scruposa (Schreb.) Ach. by Tuckerman (1872, 1882) and Aughey (1875). Specimen collected. Sarpy County: 495.

GRAPHIS Adans.

The thallus in Graphis is a light tan to gray crust with elongate or branching apothecia. The apothecia have carbonized walls and may also be pruinose. Spores in Nebraska material are septate, hyaline, and range from 25 to 54 μm in length. This species represents our sole

representative of a large and diverse lichen genus widely distributed in the southern United States and in tropical regions of the world.

GRAPHIS SCRIPTA (L.) Ach.

This is one of the few corticolous species that was consistently collected below one meter. It occurs on elm, oak, and hickory. There was wide variation in spore morphology ranging from 3-10 septate and anywhere from 25 μm to 54 μm in length. The lirelliform apothecia varied in branching pattern and degree of carbonization. Webber (1890) reported G. scripta from Lincoln and Weeping Water. The most recent citation for Nebraska was published in Reynolds (1942). Specimens collected. Burt County: 300; Richardson County: 319, 321; Sarpy County: 476.

HYPERPHYSCIA Müll. Arg.

The brownish-gray foliose thalli of Hyperphyscia species lack atranorin (K-) and rhizines. The lower cortex is prosoplectenchymatous, and the lower surface is pale. Thalli are usually very tightly appressed to the substrate. Soredia occur in one species of this genus in North America. Species of Hyperphyscia were previously included in the collective genus Physcia and more recently in the segregate genus Physciopsis.

1. Marginal soredia, thallus brown ..... H. adglutinata (Flörke) Mayrh. & Poelt
1. Not sorediate, thallus whitish-gray ..... H. syncolla (Tuck. ex Nyl.) K. Kalb

HYPERPHYSCIA ADGLUTINATA (Flörke) Mayrh. & Poelt

This widespread lichen was found on oak, ash, juniper, dead logs, and roof shingles. It has been reported from Nebraska as Physcia adglutinata (Flörke) Nyl. by Webber (1890) and Reynolds (1942) from Richardson County. Specimens collected. Cuming County: 460; Knox County: 438, 455; Nemaha County: 274, 278; Sarpy County: 480, 543.

HYPERPHYSCIA SYNCOLLA (Tuck. ex Nyl.) K. Kalb

Not as common as H. adglutinata, this species was collected from oak and cottonwood. It was recently listed from Nebraska by Hale (1979) as Physciopsis syncolla (Tuck. in Nyl.) Poelt. Specimens collected. Knox County: 452; Otoe County: 504; Sarpy County: 384a.

LECANORA Ach. in Luyken

This genus has simple, hyaline spores found in lecanorine apothecia. The thallus in Nebraska species is yellow-green or tan to gray, crustose and can be sorediate. The apothecia discs are tan or orange to brownish-orange.

1. Thallus sorediate ..... L. conizaea (Ach.) Nyl.
1. Thallus not sorediate 2
   2. Thallus on rock 3
   2. Thallus on wood 4
3. Apothecia tan; thallus buff to tan, effigurate; spores 10-12 µm ... . L. muralis (Schreb.) Rabenh.
3. Apothecia tan to dark brown, pruinose; thallus lacking; spores 9-10 µm ..... Lecanora sp. 1

4. Apothecia orange to brownish orange with gray rim; thallus scant, gray ..... L. hybocarpa (Tuck.) Brodo

4. Apothecia rust-brown with tan rim; thallus scant, buff to tan ..... Lecanora sp. 2

LECANORA CONIZAEA (Ach.) Nyl.

This lichen was only collected on locust at Arbor Lodge in Nebraska City. The spores measure 10-14 µm in length. It is a new record for the state of Nebraska. Specimen collected. Otoe County: 512.

LECANORA HYBOCARPA (Tuck.) Brodo

Like L. conizaea, this species was also collected from locust in Nebraska City. It has spores 10-13 µm long, and also represents the first report from the state. Specimen collected. Otoe County: 513.

LECANORA MURALIS (Schreb.) Rabenh.

The spores of this species are typical for the genus and measure 10-12 µm. It was found on rock. Lecanora muralis is a widespread saxicolous lichen in North America and Europe and was reported from Nebraska by Aughey (1875) and Pound and Clements (1900). Specimens collected. Sarpy County: 491, 497.

LECANORA sp. 1

This species resembles L. dispersa (Pers.) Somm., except the apothecial discs are dark brown not tan. It could also be L. crenulata Hook. but the young apothecia are not semi-immersed in the thallus, and the apothecial rim is not crenulate (Harris, 1977). Pruina are present. The specimens were found on rock, and the spores were 9-10 µm long. Specimens collected. Dixon County: 389, 399.

LECANORA sp. 2

The only specimen of this unidentified Lecanora was collected from old, wooden roof shingles. Apothecia are rust-brown in color with tan to brown rims and have hyaline hypothecia. The spores are 9-11 μm long. Specimen collected. Cass County: 355.

LEPRARIA Ach.

A prominent characteristic of this genus from Nebraska is a thallus which consists solely of soredia-like granules. There is no differentiation of the thallus into tissue layers. The color of the thallus ranges from white to blue-green to yellow-green in the Nebraska material. Reproductive structures are absent, and therefore Lepraria species are usually placed in the artificial group the Lichenes Imperfecti. The individual taxa are inadequately studied for North America. This represents the first report of this genus from Nebraska.

1. On rock..... L. finkii (B. de Lesd. in Hue) R. Harris ined.
1. On wood 2
    2. Thallus a fine soredioid mass, pale blue-green .....
    ..... Lepraria sp. 1
    2. Thallus a coarse soredioid mass, whitish-blue .....
    ..... Lepraria sp. 2

LEPRARIA FINKII (B. de Lesd. in Hue) R. Harris ined.

This species was found in the southern and middle counties of the collection area. It has a yellow-green leprose thallus and is the only Lepraria found on rock. Atranorin and two unknown lichen compounds were

determined by thin-layer chromatography. Specimens collected. Richardson County: 299, 306; Sarpy County: 470.

LEPRARIA sp. 1

This corticolous species was found on European larch and oak trees. Usnic acid and an unknown are present as determined by thin-layer chromatography. Specimens collected. Cass County: 350; Otoe County: 508; Sarpy County: 542.

LEPRARIA sp. 2

This species was found on oak in southeastern Nebraska. In addition to atranorin, it produces the same unknowns as Lepraria sp. 1. Morphologically, however, it is similar to Lepraria finkii. Specimens collected. Nemaha County: 257, 265.

OPEGRAPHA Ach.

This is one of the two crustose genera collected during this study producing lirelliform ascocarps (hysterothecia). The black hysterothecia are not immersed in the thallus and are not pruinose; spores are hyaline and 6-8 septate. The thallus is light tan-gray and closely appressed on the substrate. As with Lepraria and many other crustose genera, the taxonomy of North American Opegrapha species is outdated and in need of revision.

OPEGRAPHA sp. 1

This taxon was collected only once. It was found on a cottonwood in Sarpy County and appears to belong in the O. pulicaris group. The

spores are 19-21 µm long. The genus Opegrapha was first reported from Nebraska by Aughey (1875). Specimen collected. Sarpy County: 559.

PARMELINA Hale

This narrow-lobed, foliose genus has a black lower surface, short marginal cilia, and a gray thallus. The thallus and cortex are K+ yellow, indicating the presence of atranorin. The only species of Parmelina collected in Nebraska has a pale yellow medulla below the diffuse laminal soredia. Members of this genus were previously included in the collective genus Parmelia.

PARMELINA AURULENTA (Tuck.) Hale

The only specimen collected of this species was found below one meter on an oak tree at Indian Cave State Park, the southern most collection area in the study. Formerly known as Parmelia aurulenta Tuck., this lichen has not been previously reported from Nebraska and is a lichen common in the Appalachian Mountains and in New England. Specimen collected. Richardson County: 323.

PARMOTREMA Mass.

The thallus of this foliose genus is broad-lobed, mineral gray, and many species produce marginal soredia. The upper cortex can have reticulate cracking to the margin and in Nebraska material is K+ yellow (atranorin). The medulla is K+ yellow to red (salazinic acid). The lower surface is black. Sparse cilia are frequently present on the lobe

tips. Species of Parmotrema were formerly placed in Parmelia subgenus Amphigymnia.

PARMOTREMA RETICULATUM (Tayl.) Choisy

The substrates for this species included oak and locust; it was not collected in the northern part of the state. Specimen #556 is depauperate and identification is questionable. The chemistry of #556 is correct for the species as determined by thin-layer chromatography (atranorin and salazinic acid); however, the thallus is weakly reticulate, rather narrow lobed, and not ciliate. P. reticulatum (formerly known as Parmelia reticulata Tayl.) is a new record for Nebraska. Specimens collected. Cass County: 365; Otoe County: 511; Sarpy County: 556.

PELTIGERA Willd.

This is the only genus collected in the study producing veins on the lower surface. The foliose thallus is brown with broad, curled lobes. Unlike most other lichens collected in eastern Nebraska, the phycobiont is a cyanobacterium rather than a member of the green algae.

PELTIGERA RUFESCENS (Weis) Humb.

This species was common on soil near sandstone entrance to the sandstone "cave" at Indian Cave State Park. It was only collected on that north-facing slope. Reynolds (1942) mentions this species from Richardson County, and Thomson (1950) cites this lichen from Weeping Water as P. canina (L.) Willd. var. rufescens (Weis) Mudd. Specimens collected. Richardson County: 311, 312, 315, 317.

PERTUSARIA DC.

This genus has wart-like apothecia (easily confused with perithecia) that are light brownish-gray like the thallus. Spores are simple, hyaline and larger than any other crustose genus in Nebraska (95-110 µm). The genus has been reported from the state by Aughey (1875), Webber (1890), and Reynolds (1942). Although Pertusaria was recently monographed by Dibben (1980), identification of many species remains difficult without ample comparison material.

1. Apothecia 0.5 cm and larger; spores 8/ascus, 95-110 µm .... Pertusaria sp. 1
1. Apothecia under 0.5 cm; spores 2-3/ascus, 100-110 µm .... Pertusaria sp. 2

PERTUSARIA sp. 1

This species was found on red oak. The medulla is K+ yellow to dark yellow. The spores occur 8/ascus and are very large, 95-110 µm. Specimen collected. Richardson County: 320.

PERTUSARIA sp. 2

This species was found in the same location as Pertusaria sp. 1; however, it was collected from hickory. The spores are 100-110 µm and are found 2-3/ascus. Thin layer chromatography revealed the presence of several unknown compounds. The cortex is UV+ orange, and this taxon is similar to P. leioplaca DC. in Lam. & DC. due to the UV+ reaction. However, the stictic acid characteristic of P. leioplaca was absent. Specimen collected. Richardson County: 318.

PHAEOPHYSCIA Moberg

This common foliose genus is narrow-lobed, grayish-brown to brown, and has a K- cortex (lacks atranorin). The lower surface is dark brown to black, and the lower cortex is paraplectenchymatous. The thallus can be sorediate. The North American taxa including Physciella species were treated by Esslinger (1978).

1. Thallus sorediate 2
1. Thallus not sorediate 5
    2. Colorless cortical hairs present 3
    2. Colorless cortical hairs absent 4
3. Soralia marginal, not labriform ..... P. cernohorskyi (Nadv.) Essl.
3. Soralia labriform, mostly terminal, occasionally marginal .... P. hirsuta (Meresch.) Essl.
    4. Pale lower surface; laminal soredia in orbicular patches, sometimes capitate ..... P. insignis (Meresch.) Moberg
    4. Lower surface dark brown to black; soredia distinctly capitate, terminal on lobes ... P. pusilloides (Zahlbr.) Essl.
5. Colorless cortical hairs present ..... P. hirtella Essl.
5. Colorless cortical hairs absent ..... P. ciliata (Hoffm.) Moberg

PHAEOPHYSCIA CERNOHORSKYI (Nadv.) Essl.

This species was found throughout eastern Nebraska on ash, elm, and cottonwood. It is very similar to P. hirsuta except that the soralia are marginal. It has been reported from the state by Hale (1979).

Specimens collected. Dixon County: 400, 413, 433; Knox County: 454; Otoe County: 506, 519, 521; Sarpy County: 369, 375, 378, 462, 546, 557.

PHAEOPHYSCIA CILIATA (Hoffm.) Moberg

All specimens were collected above one meter on cottonwood, ash, ironwood, poplar, elm, and mulberry. This species was one of the most frequently collected lichens in the entire study. Phaeophyscia ciliata has been reported from Nebraska as Physcia ciliata (Hoffm.) DuRietz by Thomson (1963) and as Physcia obscura (Ehrh.) Hampe by Webber (1890). Specimens collected. Burt County: 329, 335; Knox County: 434, 447; Otoe County: 520, 523, 526; Richardson County: 303; Sarpy County: 484, 486, 552; Washington County: 529, 532, 536.

PHAEOPHYSCIA HIRTELLA Essl.

This report represents a new species record for Nebraska. Phaeophyscia hirtella was found on both cottonwood and ash. It is morphologically similar to P. ciliata except for the presence of cortical hairs. Many older records of P. ciliata probably refer to this species. Specimens collected. Burt County: 336; Cass County: 348; Dixon County: 402, 407; Knox County: 445; Nemaha County: 272, 276.

PHAEOPHYSCIA HIRSUTA (Meresch.) Essl.

This widespread lichen was found on oak, cottonwood, catalpa, and rock. Unlike P. cernohorskyi, the soredia are labriform in position on the thallus. These are the first reported collections from Nebraska. Specimens collected. Dixon County: 394, 422, 428, 429; Knox County: 449; Otoe County: 503, 525; Sarpy County: 376, 466, 483, 492.

PHAEOPHYSCIA INSIGNIS (Meresch.) Moberg

This is a new species record for the state. It was rarely found on corticolous substrates in counties located in the middle of the study area. This species was only recently reported from North America (Esslinger, 1985) and one of these collections was identified by Dr. Esslinger. Specimens collected. Sarpy County: 382; Washington County: 537.

PHAEOPHYSCIA PUSILLOIDES (Zahlbr.) Essl.

All of the specimens were found at Indian Cave State Park on oak. This species was reported as a map record for Nebraska by Hale (1979). Specimens collected. Nemaha County: 256, 268, 269.

PHYSCIA (Schreb.) Michx.

The lower cortex in Physcia species is prosoplectenchymatous, and this represents one major difference between this genus and the previous genus Phaeophyscia in which the lower cortex is paraplectenchymatous. Thalli are narrow lobed, pale gray to dark gray with a lower surface colored tan to white. The depside atranorin is always present in the upper cortex (K+ yellow); species of Phaeophyscia lack atranorin. Soredia occur in some species.

1. Thallus sorediate 2
1. Thallus not sorediate 4
    2. On rocks ..... P. subtilis Degel.
    2. On trees 3

3. Lobes narrow 0.1-0.3 mm, finely branched; medulla K-; soredia marginal, granular ..... P. millegrana Degel.

3. Lobes wider 0.5-3 mm, not finely branched; medulla K+ yellow; soredia laminal, orbicular ..... P. americana Merr.

4. Medulla K+ yellow; upper cortex white-spotted; apothecia white pruinose ..... P. aipolia (Ehrh. ex Humb.) Fürnrohr

4. Medulla K-; upper cortex not white-spotted; apothecia black to slightly white pruinose ..... P. stellaris (L.) Nyl.

PHYSCIA AIPOLIA (Ehrh. ex Humb.) Fürnrohr

This species of Physcia is widespread on ash, oak, and shagbark hickory. It is similar to P. stellaris except for white spotting, abundance of pruinosity on the apothecia and thallus, and K+ medullary reaction. This species has been reported by Hale (1979) and by Thomson (1963) from Sarpy and Lancaster Counties. Specimens collected. Burt County: 325, 326, 330, 332; Cass County: 345, 347, 352; Dixon County: 397, 399, 412, 427; Knox County: 436; Nemaha County: 255, 263, 271, 279; Otoe County: 514; Sarpy County: 340, 342, 343, 367, 372, 374, 379, 463, 485.

PHYSCIA AMERICANA Merr.

Physcia americana was found on red oak at Indian Cave State Park. This is a new report for the state of Nebraska. Specimens collected. Richardson County: 322, 324.

PHYSCIA MILLEGRANA Degel.

Arbor Lodge State Historical Park was the only collection site for this lichen. It is one of the few species found on pine and is a new

record for Nebraska. This species is widespread in the eastern United States and rarely collected in the midwest. Specimen collected. Otoe County: 507.

PHYSCIA STELLARIS (L.) Nyl.

Physcia stellaris was frequently collected, but not as often as P. aipolia. It was found on a variety of substrates including sumac, cottonwood, pine, and wooden roof shingles. For distinctions between P. stellaris and P. aipolia, see under that taxon. Several authors have reported P. stellaris from Nebraska (Webber, 1890; Pound & Clements, 1900; Hale, 1979). Specimens collected. Cass County: 359; Cuming County: 459; Knox County: 441, 450; Otoe County: 500, 501; Sarpy County: 339, 371, 384, 540, 549, 555.

PHYSCIA SUBTILIS Degel.

The only specimen of this species was collected from metamorphic rock with a southern exposure at Schramm Park State Recreation Area. The extremely finely branched lobes and saxicolous habit are distinctive for this species. It is a new record for Nebraska. Specimen collected. Sarpy County: 473.

PHYSCIELLA Essl. ined.

This new genus will be described early in 1986 by Esslinger in Mycologia (Esslinger, personal communication). The thallus is grayish-brown, foliose, narrow-lobed, and the cortex reacts K- like the very closely related genus Phaeophyscia. Like species of Physcia, however, Physciella taxa produce a prosoplectenchymatous lower cortex while the lower cortex in Phaeophyscia is paraplectenchymatous.

Sorediate and non-sorediate species are known. Physciella and Phaeophyscia species were previously included in the collective genus Physcia.

1. Soralia terminal, distinctly labriform .. P. chloantha (Ach.) Essl.
1. Soralia laminal to submarginal, rounded to irregular in shape .... P. melanchra (Hue) Essl.

PHYSCIELLA CHLOANTHA (Ach.) Essl. ined.

This species was more frequently collected than P. melanchra and occurred on ash, cottonwood, oak, and rock from just north of Omaha to Nebraska City. Hale (1979) cited this species from Nebraska as Physcia chloantha Ach. and Esslinger (1973) reported it from Knox County as Physcia luganensis Meresch. Specimens collected. Cass County: 354; Otoe County: 527; Sarpy County: 468, 547; Washington County: 529a.

PHYSCIELLA MELANCHRA (Hue) Essl. ined.

The location of the soredia on the thallus distinguishes this species from P. chloantha although some specimens appear to intergrade. This collection from a dead tree in Fontenelle Forest is a new report for the state. Specimen collected. Sarpy County: 539.

PHYSCONIA Poelt

Species of Physconia are all strongly pruinose, gray-brown to dark brown, K- (no atranorin). The lower surface of these foliose, narrow lobed species is black and rhizinate, and the lower cortex is prosoplectenchymatous. Soredia are present in both Nebraska taxa.

1. Medulla C+ red (gyrophoric acid) ..... P. kurokawae Kashiwadani

1. Medulla C- ..... P. detersa (Nyl.) Poelt

PHYSCONIA DETERSA (Nyl.) Poelt

This lichen species was collected on all directional aspects and vertical zones of oak, ash, elm, and catalpa trees. It was first reported from Nebraska by Thomson (1963) as Physcia grisea (Lam.) Zahlbr. and later by Hale (1979) as Physconia detersa. Specimens collected. Cass County: 344, 363; Dixon County: 398, 416, 418, 420, 424; Nemaha County: 258, 268a, 291, 294; Otoe County: 510, 517; Richardson County: 316; Sarpy County: 461.

PHYSCONIA KUROKAWAE Kashiwadani

Morphologically similar to P. detersa, this species is most easily identified by chemical testing for the presence of gyrophoric acid, either by medullary spot tests or by thin-layer chromatography. It occurred on oak, ash, and elm but was not as common as P. detersa. This is the first report of this species from Nebraska. Esslinger (1985) only recently reported P. kurokawae as new to North America. Specimens collected. Dixon County: 418a, 420a; Nemaha County: 291a; Otoe County: 515; Richardson County: 316a.

PUNCTELIA Krog

This genus is characterized by the presence of white pores (psedocyphellae) on the upper surface of the thallus. Lobes of the mineral gray thallus are narrow to medium in width. Isidia are

sometimes present on the foliose thallus. These species were previously included in the collective genus Parmelia.

1. Isidia present; medulla C+ red (lecanoric acid) .... P. rudecta (Ach.) Krog
1. Isidia absent 2
    2. Medulla C- ..... P. bolliana (Müll. Arg.) Krog
    2. Medulla C+ (lecanoric acid)..... ..... P. semansiana (W. Culb. & C. Culb.) Krog

PUNCTELIA BOLLIANA (Müll. Arg.) Krog

This is the most common Punctelia species collected. It is widespread on oak, ash, and northern catalpa, and was reported from Richardson County as Parmelia bolliana Müll. Arg. by Reynolds (1942) and Hale (1979). Specimens collected. Cass County: 353, 361, 366a; Cuming County: 456; Dixon County: 406, 410, 414, 415, 416a, 417, 425; Knox County: 443; Nemaha County: 261, 266, 292; Otoe County: 509; Sarpy County: 338, 381, 465, 489.

PUNCTELIA RUDECTA (Ach.) Krog

This species was found on oak, elm, and soil over rock. Like P. bolliana, this was reported from Richardson County by Reynolds (1942) and by Hale (1979) as Parmelia rudecta Ach. All specimens contain the depside lecanoric acid which gives a vivid C+ red medullary reaction. This is one of the most commonly collected lichens in the eastern United States. Specimens collected. Nemaha County: 264, 267, 293; Richardson County: 302, 309; Sarpy County: 373, 482.

PUNCTELIA SEMANSIANA (W. Culb. & C. Culb.) Krog

Punctelia semansiana was collected from oak. This species, first separated from P. hypoleucites (Nyl.) Krog by Culberson & Culberson (1980), produces microconidia 4-8 um in length, while the microconidia in P. hypoleucites are 8-14 um long. Until now, neither P. hypoleucites nor P. semansiana had been reported from Nebraska. Specimens collected. Cass County: 361a, 366; Dixon County: 423; Nemaha County: 273, 280.

RINODINA (Ach.) S. Gray

The lecanorine apothecia of Rinodina species are black and found on the gray, non-lobate, crustose thalli. The spores are 2-celled and brown. Dimelaena, which has similar spores and apothecia, produces flattened marginal lobes. The lecanorine apothecia of Rinodina separate this genus from similarly spored Buellia which has lecideine apothecia. The North American species of Rinodina are presently being revised by Dr. John Sheard at the University of Saskatchewan.

RINODINA c.f.CONFRAGOSA (Ach.) Körb.

This saxicolous species of Rinodina is very similar to R. confragrosa as discussed in Wetmore (1967) from the Black Hills. However, the Nebraska material lacks the "coarse" thallus described by Wetmore. Specimens collected. Sarpy County: 471, 496.

TELOSCHISTES Norm.

The tufted thalli and apothecia of this fruticose lichen genus are orange, reacting K+ purple indicating the presence of the anthroquinone

pigment parietin. This is the only fruticose genus is the family Teloschistaceae and is the only corticolous fruticose lichen found in this study.

TELOSCHISTES CHRYSOPHTHALMUS (L.) Th. Fr.

A majority of the specimens of T. chrysophthalmus were found on sumac branches above one meter. Numerous reports have been made for Nebraska (Webber, 1890; Pound & Clements, 1900; Reynolds, 1942; Hale, 1979). Specimens collected. Cass County: 358; Dixon County: 431; Sarpy County: 487.

THYREA Mass.

Thyrea is the only umbilicate lichen genus found in this study. The thalli are small, black, and dark brownish-gray below. The phycobiont, Xanthocapsa, is a rare symbiont in lichens and produces a K+ yellow sheath.

THYREA PULVINATA (Schaer.) Mass.

This is the only fruticose lichen collected in eastern Nebraska that is attached to its rock substrate by a central holdfast (an umbilicus). This is the first report of this genus from Nebraska. Specimen collected. Sarpy County: 387.

VERRUCARIA Schrad.

This crustose genus produces black perithecia on a white to brownish-gray thallus. The spores are simple and hyaline. The North

American species of this genus are inadequately known. Verrucaria species are most common on calcareous substrates.

1. Thallus brown ..... Verrucaria sp. 1
1. Thallus white ..... Verrucaria rupestris (Scop.) Schrad.

VERRUCARIA RUPESTRIS (Scop.) Schrad.

Verrucaria rupestris was rarely collected during this study and spores in my collections measured 15-22 µm. This species has been reported from Nebraska by Webber (1890). Specimens collected. Sarpy County: 478, 550.

VERRUCARIA sp. 1

This species was found on rock at Ponca State Park. It is similar to V. glaucovirens Grumm. except the hypothecium is hyaline, not light brown. The spores are 14-21 µm. Specimen collected. Dixon County: 391, 392, 393.

XANTHOPARMELIA (Vain.) Hale

This genus is foliose, linear-lobed, yellow-green, and is found exclusively on rocks in Nebraska. Many species are distinguished by production of characteristic depsidones. Nebraska species reported here have pale lower surfaces and lack isidia. The taxa were previously included in the collective genus Parmelia.

1. Thallus easily removed from rock; K+ yellow turning red (salazinic acid) ..... X. taractica (Kremp.) Hale

1. Thallus tightly appressed to the rock; K+ orange-red (stictic and norstictic acids) ..... X. cumberlandia (Gyeln.) Hale

XANTHOPARMELIA CUMBERLANDIA (Gyeln.) Hale

Specimens were tightly adnate to the metamorphic rocks at Schramm Park State Recreation Area. This species was reported from Nebraska in distribution maps by Hale (1979), and its range includes much of North America. Specimens collected. Sarpy County: 469, 472.

XANTHOPARMELIA TARACTICA (Kremp.) Hale

Morphologically similar to X. cumberlandia, X. taractica was more easily removed from its metamorphic rock substrate and produces a different medullary depsidone, salazinic acid. Hale (1979) reported this species in distribution maps for Nebraska. Specimen collected. Sarpy County: 475.

XANTHORIA (Fr.) Th. Fr.

The thallus of this foliose genus in the family Teloschistaceae is orange and narrow-lobed. Thalli react K+ purple (parietin) and can be sorediate. Xanthoria species can be distinguished most easily from morphologically similar Candelaria species by this K reaction.

1. Thallus not sorediate ..... X. polycarpa (Hoffm.) Rieber
1. Thallus sorediate 2
    2. Lobes broad, 2-4 mm, seldom branching .... X. fallax (Hepp in Arn.) Arn.
    2. Lobes narrow, 0.2-0.5 mm, frequently branching .... X. candelaria (L.) Th. Fr.

XANTHORIA CANDELARIA (L.) Th. Fr.

Smaller lobed than X. fallax, this lichen was collected from all regions of the study area and is probably the most common lichen in eastern Nebraska. In addition to elm, ash, and rock, it was found on cottonwood and oak. This lichen species was reported by Rudolph (1955) from Lancaster County and for most areas of Nebraska by Hale (1979) in a distribution map. Earlier state reports include Aughey (1875) as Teloschistes candelaris (L.) Fink, and Webber (1890) as Teloschistes parietinus (L.) Norm. var. lychneus (Nyl.) Tuck. Specimens collected. Burt County: 327, 328, 331, 333; Cass County: 346, 351; Cuming County: 457; Dixon County: 395, 396, 401, 404, 405, 411, 421, 426; Knox County: 437; Nemaha County: 270, 275; Otoe County: 502; Sarpy County: 368, 479, 493.

XANTHORIA FALLAX (Hepp in Arn.) Arn.

A majority of specimens of X. fallax were collected above one meter from oak. It was rarely found on cottonwood and elm; one collection came from soil over rock. Like X. candelaria, it was found throughout the region. Only Hale (1979) has reported this taxon from Nebraska. Specimens collected. Burt County: 334; Dixon County: 408; Knox County: 439, 444; Nemaha County: 259; Richardson County: 308; Sarpy County: 380, 384b, 464, 544; Washington County: 528, 538.

XANTHORIA POLYCARPA (Hoffm.) Rieber

Unlike the other common Xanthoria species, X. polycarpa was only found on small sumac shrubs at Platte River State Park and at Schramm Park State Recreation Area. Reynolds (1942) reported it from Richardson County under Teloschistes polycarpus (Ehrh.) Tuck. and Webber (1890)

listed a Nebraska record as Teloschistes parietinus (L.) Norm. var. polycarpus (Ehrh.) Tuck. Specimens collected. Cass County: 360; Sarpy County: 488.

DISCUSSION

Substrate Preference

Lichens were collected from these substrates: soil (terricolous lichens), rock (saxicolous lichens), and bark (corticolous lichens). Few specimens were collected from soil (Figure 3), because either the soil substrates explored were overly shady for successful lichen growth or, in the case of terricolous habitats, the soil was heavily vegetated with grasses.

Eastern Nebraska has few exposed rock substrates suitable for lichen growth. When these substrates are encountered, the lichen species found often represent unusual distributional species records or genera seldom reported for the midwest. The saxicolous lichens collected were arranged into two groups--those that were found on the hard metamorphic type rocks and those growing on softer sandstones or limestones. For example, at Schramm Park State Recreation Area, Xanthoparmelia species occurred only on the metamorphic rocks, while Verrucaria species were collected off non-metamorphic rocks.

Most lichens were found on wood substrates, including trees, fence posts, and roof shingles. The most common tree species from which lichens were collected were oak, cottonwood, ash, and elm. While it could be a bias on my part, it appears that more lichen growth is found on older and larger trees (Figure 4).

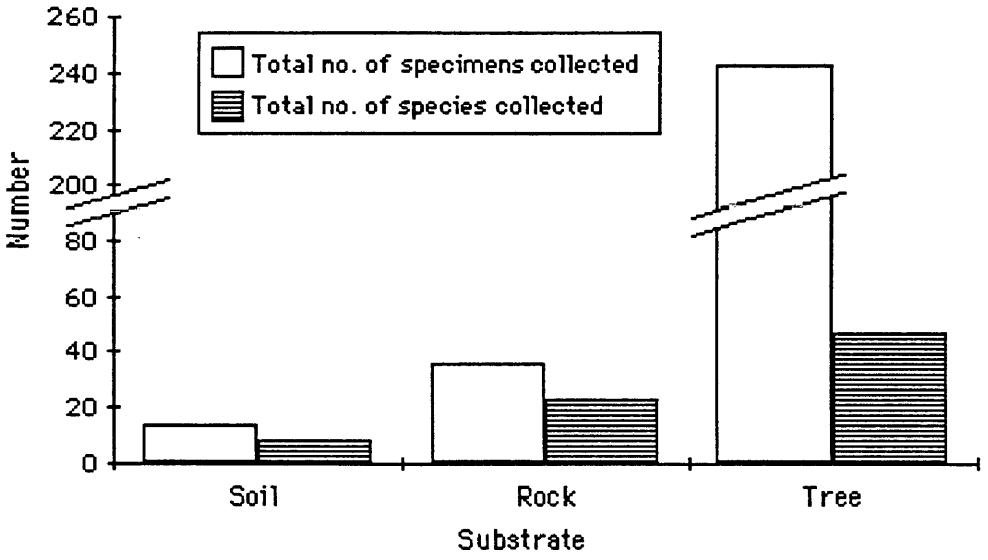


Figure 3. Comparison of the numbers of lichens collected from soil, rocks and trees.

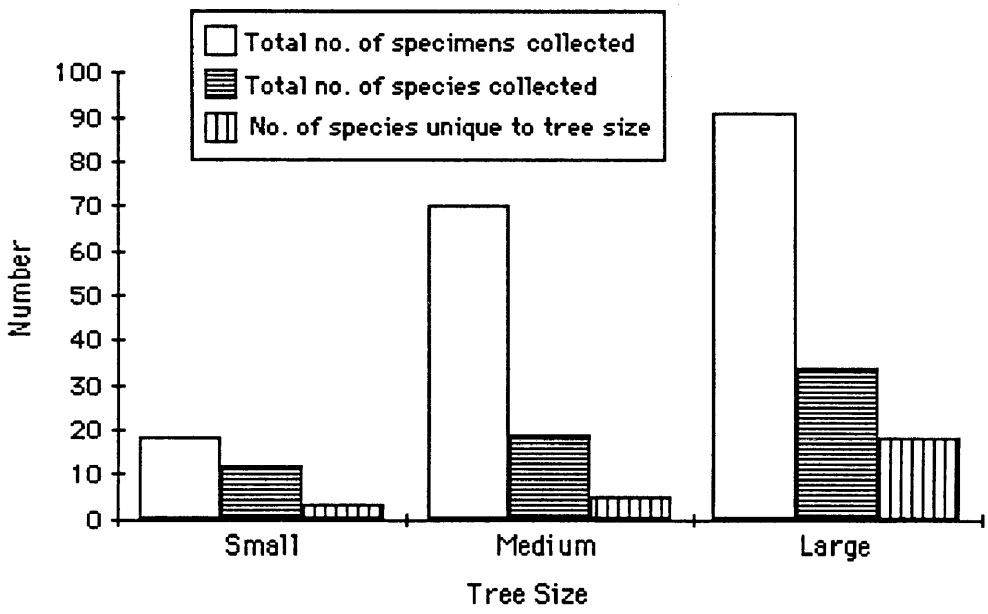


Figure 4. Comparison of lichen growth on small, medium and large trees.

Aspect

Lichen presence differed according to aspect. Fewer lichen species were found on southern exposures than on other aspects (Figure 5). This southern aspect experiences greater insolation; therefore, the temperature is often higher and the humidity is generally lower. Conditions on the north side are frequently more favorable for lichen growth. The western and eastern aspects have intermediate conditions.

Vertical Zonation

Microclimatic conditions not only vary with aspect, but differ with respect to height above the ground level. Several authors have shown that these differences effect lichen distribution patterns (Hale, 1983; Hawksworth, 1984). In this study the zone of growth on trees was arbitrarily recorded as either above or below one meter. Both more lichen collections and more lichen species were found above one meter (Figure 6). Moreover, 21 lichen species were collected only above one meter and seven were found exclusively below one meter. For example, in the open areas of Neale Woods tall grasses grow and shade much of the bottom meter of the tree trunks. As a result, this part of the tree has conditions that are unsuitable for lichen growth and no lichens were found. Apparently, microclimatic conditions such as this, and others, are of sufficient magnitude to segregate some lichen species, at least those inhabiting corticolous substrates.

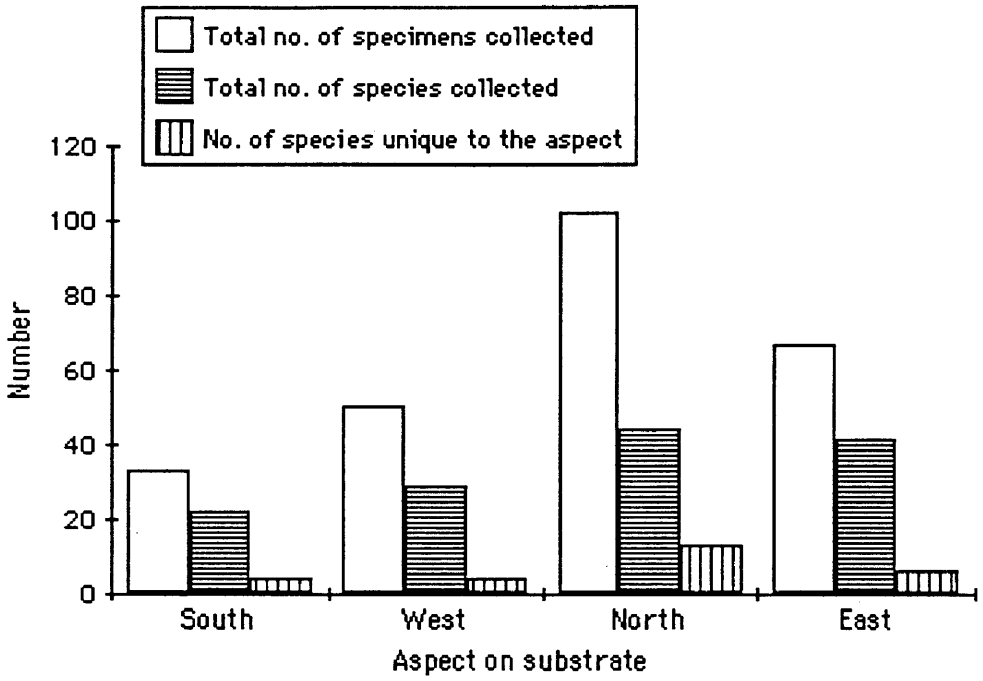


Figure 5. Number of lichens collected with respect to aspect on all substrates.

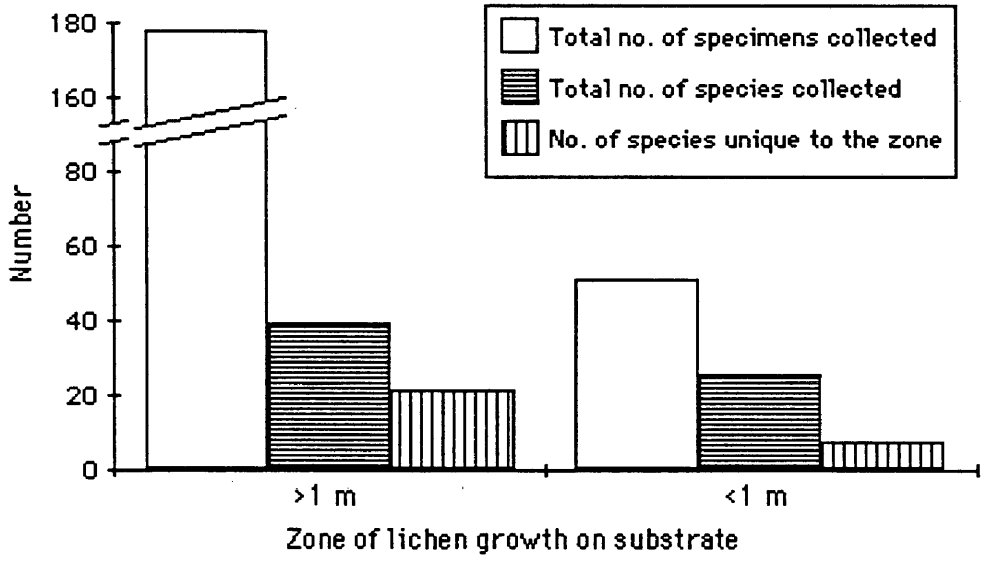


Figure 6. Number of lichens collected with respect to vertical zonation on the substrate.

Latitude

The number of lichen collections and lichen species from the northern, middle, or southern counties along the Missouri and Platte Rivers of eastern Nebraska are compared in Figure 7. The northern section includes collection records from Knox, Dixon, and Burt counties. The middle counties are Cuming, Washington, Sarpy, and Cass, while the southern list includes collection sites in Otoe, Nemaha, and Richardson counties.

Although great differences were not found, the number of lichen species found in the middle and southern counties was greater than that found in the northern counties (Figure 7). The overall climate of the northern area is cooler and less humid than those areas to the south, and these factors may explain, in part, the lower lichen diversity found in these northern counties. It is possible that the differences among the northern, middle and southern counties resulted from fortuitous collecting at the study sites. Further, although every effort was made to collect all species at all localities, the "spotty" distribution patterns of many of the "rarer" species reported in this study may be due to the infrequent occurrence of appropriate substrates and microclimatic conditions within this region.

Geographical Affinities of the Lichen Flora

Of all the lichen species collected in the eastern Nebraska study sites, none is considered a "western" species. Most of the taxa reported are species which are generally widespread across the United

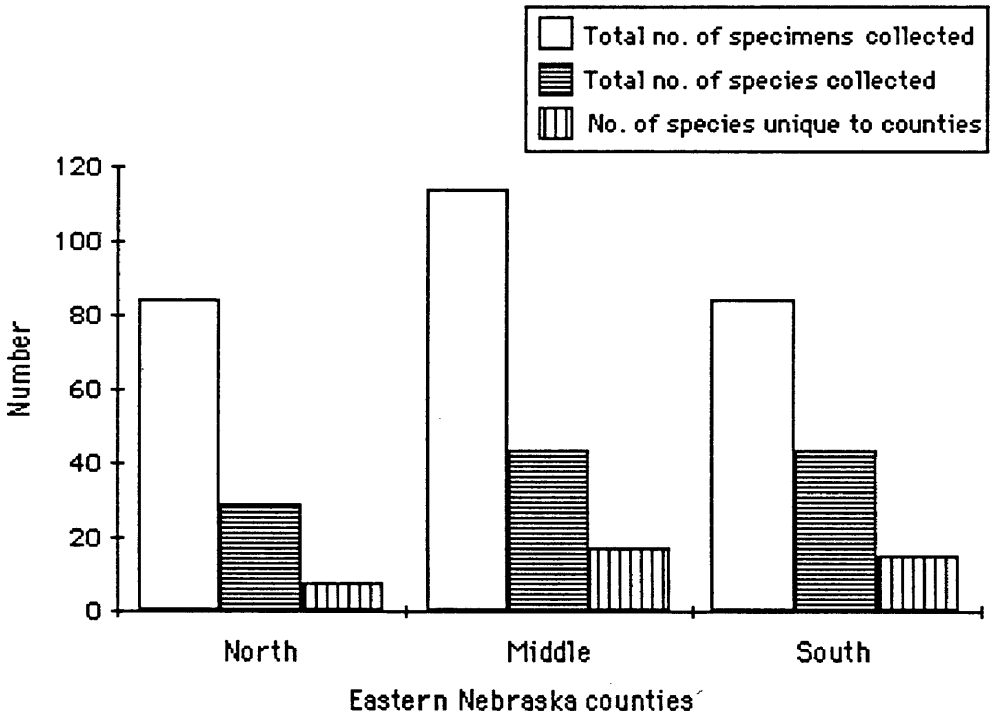


Figure 7. Latitudinal comparison of lichens collected in eastern Nebraska

States (Hale, 1979). However, Punctelia rudecta (Ach.) Krog, Parmelina aurulenta (Tuck.) Hale, Cladonia polycarpoides Nyl., Physcia millegrana Degel., and Physcia americana Merr. show distinct eastern distribution patterns, while Parmotrema reticulatum (Tayl.) Choisy is primarily a southeastern taxon with many records from the New World tropics as well. Two of the collected species could be considered known from the "midwest" in their primary distribution pattern, Physconia kurokawae Kashiwadani and Teloschistes chrysophthalmus (L.) Th. Fr. The "eastern" or "widespread" character of the lichen flora closely parallels the affinities of the better documented vascular plants.

New State Records

Three genera (Anisomeridium, Lepraria, and Thyrea) are reported as new to Nebraska and the following 26 species represent new state records: Anisomeridium biforme (Borr. in Hook. & Sowerb.) R. Harris in Vězda, Arthonia radiata (Pers.) Ach., Caloplaca discolor (Will.) Fink, Caloplaca feracissima Magn., Caloplaca ferruginea (Huds.) Th. Fr., Caloplaca flavorubescens (Huds.) Laund., Caloplaca flavovirescens (Wulf.) Dalla Torre & Sarnth., Caloplaca sideritis (Tuck.) Zahlbr., Caloplaca ulmorum (Fink) Fink, Candelaria fibrosa (Fr.) Müll. Arg., Collema limosum (Ach.) Ach., Lecanora conizaea (Ach.) Nyl., Lecanora hybocarpa (Ehrh.) Hampe, Lepraria finkii (B. de Lesd. in Hue) R. Harris ined., Parmelina aurulenta (Tuck.) Hale, Parmotrema reticulatum (Tayl.) Choisy, Phaeophyscia hirsuta (Meresch.) Essl., Phaeophyscia hirtella Essl., Phaeophyscia insignis (Meresch.) Moberg, Physcia americana Merr.,

Physcia millegrana Degel., Physcia subtilis Degel., Physciella melanchra (Hue) Essl. ined., Physconia kurokawae Kashiwadani, Punctelia semansiana (Culb. & Culb.) Krog, and Thyrea pulvinata (Schaer.) Mass. Most of the collections cited in this thesis also represent new county records.

Literature Cited

Aughey, S. 1875. Catalogue of the Flora of Nebraska. University of Nebraska, Lincoln.

Carter, J. L. 1963. Plant communities of the loess bluffs of northwestern Iowa. Journal of the Iowa Academy of Science 70: 45-50.

Culberson, C. F. 1972. Improved conditions and new data for the identification of lichen products by a standardized thin-layer chromatographic method. Journal of Chromatography 72: 113-125.

Culberson, C. F. & H. Kristinsson. 1970. A standardized method for the identification of lichen products. Journal of Chromatography 46: 85-93.

Culberson, W. L. 1969. The chemistry and systematics of some species of the Cladonia cariosa group in North America. The Bryologist 72: 377-386.

Culberson, W. L. & C.F. Culberson. 1980. Microconidial dimorphism in the lichen genus Parmelia. Mycologia 72: 127-135.

Dibben, M. J. 1980. The Chemosystematics of the Lichen Genus Pertusaria in North America. Publications in Biology and Geology No. 5. Milwaukee Public Museum, Milwaukee.

Elder, J. A. 1969. Soils of Nebraska. University of Nebraska Conservation and Survey Division, Lincoln.

Esslinger, T. L. 1973. Physcia luganensis new to North America. The Bryologist 76: 421-423.

Esslinger, T. L. 1977. A chemosystematic revision of the brown Parmeliae. Journal of the Hattori Botanical Laboratory 42: 1-211.

Esslinger, T. L. 1978. Studies in the lichen family Physciaceae. II. The genus Phaeophyscia in the North America. Mycotaxon. 7: 283-320.

Esslinger, T. L. 1985. Studies in the lichen family Physciaceae. VI. Two species new to North America. Mycotaxon 23: 219-222.

Fink, B. 1935. The Lichen Flora of the United States. University of Michigan Press, Ann Arbor.

Hale, M. E., Jr. 1979. How to Know the Lichens. 2nd edition. Wm. C. Brown Co., Dubuque.

Hale, M. E., Jr. 1983. The Biology of Lichens. Third Edition. Edward Arnold, London, Melbourne, Baltimore.

Harris, R. C. 1977. Lichens of the Straits Counties, Michigan. Published by the author, University of Michigan Herbarium, Ann Arbor.

Hawksworth, D. L. 1984. The Lichen-Forming Fungi. Chapman & Hall, New York.

Heineman, P. L. 1982. Woody Plant Invasion of Iowa Loess Bluff Prairies. M. A. Thesis, University of Nebraska at Omaha, Omaha.

Imshaug, H. A. 1951. The Lichen-Forming Species of the Genus Buellia Occurring in the United States and Canada. Ph. D. Dissertation, University of Michigan, Ann Arbor.

Pound, R. & F. E. Clements. 1900. The Phytogeography of Nebraska. 2nd edition. Jacob North & Co., Lincoln.

Reynolds, H. C. 1942. Flora of Richardson County, Nebraska. M.S. Thesis, University of Nebraska-Lincoln, Lincoln.

Rudolph, E. 1955. Revisionary Studies in the Lichen Family Blasteniaceae in North America North of Mexico. Ph.D. Dissertation, Washington University, St. Louis.

Stephens, H. A. 1973. Woody Plants of the North Central Plains. The University Press of Kansas, Lawrence.

Thomson, J. W. 1950. The species of Peltigera of North America north of Mexico. American Midland Naturalist 44: 1-44.

Thomson, J. W. 1963. The Lichen Genus Physcia in North America. Beihefte zur Nova Hedwigia No. 7. J. Cramer, Weinheim.

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

Tuckerman, E. 1872. Genera Lichenum: An Arrangement of the North American Lichens. Edwin Nelson, Amherst.

Tuckerman, E. 1882. A Synopsis of the North American Lichens: Part 1., Comprising the Parmeliacei, Cladoniei, and Coenogoniei. S. E. Cassino, Boston.

Walker, F. J. & P. W. James. 1980. A revised guide to microchemical techniques for the identification of lichen products. British Lichen Society Bulletin 46: 13-29.

Webber, H. J. 1890. Catalogue of the flora of Nebrakska. Protophyta - Anthophyta, pp. 35-162. In C. E. Bessey & H. J. Webber, Report of the Botanist on the Grasses and Forage Plants, and the Catalogue of Plants. Board of Agriculture, Lincoln.

Wetmore, C. M. 1967. Lichens of the Black Hills of South Dakota and Wyoming. Publications of the Museum, Michigan State University 3: 209-464.

Williams, T. A. 1889. A Preliminary Descriptive List of the Lichens of Nebraska. M. A. Thesis, University of Nebraska, Lincoln.