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Missouriensis is the official publication of the Missouri Native Plant Society. Founded in 1979 as a non-profit corporation, the Society is devoted to the conservation and study of the plants growing wild in Missouri, to the education of the public about the significance of the native flora and its habitat, and to the publication of related information.

BRYOPHYTES OF ROARING RIVER STATE PARK, BARRY COUNTY, MISSOURI

Teresa Hilton [1]

Roaring River State Park consists of 3,459 acres of land located in southern Barry County. It is maintained by the Missouri Department of Natural Resources, Division of Parks, Recreation and Historic Preservation. The spring was originally a mill site, and the area eventually became a resort area. In 1928, Dr. Thomas M. Sayman, a soap manufacturer and philanthropist, bought the spring and surrounding 2800 acres and one week later deeded the land to the State of Missouri for one dollar. The main attractive attraction of the park is Roaring River Spring which produces an average 20,400,000 gallons of water daily.

The park is situated in the White River Hills Section of the Ozark Natural Division (Thom & Wilson. 1980) where the Springfield Plateau drops abruptly 5 miles south of Cassville, Missouri. The area ranges in elevation from the stream valley at 305 meters to several ridge tops whose elevation exceeds 417 meters. The highest point in the park is 438 meters. Six steep-walled hollows contribute to the drainage pattern of the stream. Most of the park is forested, consisting of second growth old-aged timber interdispersed by dolomite glades, cliff ledges, and rock outcropings.

In 1978, two special areas were designated for special consideration. Roaring River Hills Wild Area (2,075 acres) was established to "provide opportunities for solitude or primitive and unconfined recreation," and Roaring River Cove Hardwood Natural Area (120 acres) was set aside to "protect and preserve the native fauna and flora of a biological community found in a nearly undisturbed state," (Missouri Natural Areas Committee, 1978).

The purpose of this study was to 1) collect and identify mosses and liverworts found in the Roaring River Hills Wild Area, the Roaring River Cove Hardwood Natural Area, and the rest of Roaring River State Park and 2) provide

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[1] Based upon a thesis presented to the Faculty of the Graduate School, Southwest Missouri State University in partial fulfillment of the requirements for the degree of Master of Arts. Partial funding and support for this study was provided by the Missouri Department of Natural Resources. 149 Nolker, Lawson, MO 64062.

initial ecological studies.

Field collections began in May, 1978, and continued through September of the same year. An attempt was made to cover all regions of the park and such diverse habitats as ravines, dry creek beds, ridges, slopes and the spring area. At the time of collection, each specimen as labeled as to collection site, general habitat, substrate, pH of the soil if applicable and collection number.

Specimens were identified in the laboratory using primarily Mosses of the Interior Highlands of North America (Redfearn, 1972) and Hepaticae of the Interior Highlands, North America (Thomas, 1974). Nomenclature, with exception of the genera Amblystegium, Ctenidium, Fissidens and Grimmia, follows Crum et al. (1973) for the mosses and Stotler and Crandall-Stotler (1977) for the liverworts.

A complete set of voucher specimens is deposited at the Ozarks Regional Herbarium at Southwest Missouri State University (SMS) and a near complete set has been deposited with the Nature Center at Roaring River State Park.

In addition to the bryophytes collected in this study, an effort was made to catalogue all known previous collections from Barry County. Included in this list are specimens located at the herbaria of Southwest Missouri State University, Missouri Botanical Garden, and the Field Museum of Natural History. Data on these latter collections were provided by Paul L. Redfearn and documentation is located in the Ozarks Regional Herbarium.

The following annotated list contains those specimens collected within the boundaries of Roaring River State Park and Barry County. After each taxon is a short description of the habitat and a subjective evaluation of the abundance of that taxon in the park; either common, uncommon, or rare. Specimens known from Barry County but not yet reported from Roaring River State Park are marked with a plus sign (+). An asterisk (*) denotes a new county record subsequent to Gier (1955). Taxa collected by persons other than the author are indicated by the letters B (B. F. Bush), G (L. J. Gier), I (R. R. Ireland), M (R. L. McGregor), MO (D. M. Moore, R (P. L. Redfearn), T (P. A. Thomas), and TR (Wm. Trelease).

AN ANNOTATED CHECKLIST OF BRYOPHYTES FROM ROARING RIVER STATE PARK AND BARRY COUNTY, MISSOURI

Division HEPATOPHYTA
Class ANTHOCEROTOPSIDA
Family ANTHOCEROTACEAE

*Phaeocerus laevis (L.) Prosk. subsp. laevis. Moist vertical limestone; uncommon; R.

Class HAPLOMITRIOPSIDA
Family LOPHOCOLEACEAE

Lophocolea heterophylla (Schrad.) Dum. Shaded soil & exposed rocks; common.

Family SCAPANIACEAE

* Scapania nemorosa (L.) Dum. Soil on logging road; uncommon.

Family PORELLACEAE

+*Porella pinnata L. On rocks near stream; B.
* P. platyhpylla (L.) Pfeiff. Bark of trees; common.
* P. platyphylloidea (Schwein.) Lindb. Bark of trees; uncommon; B, R, T.

Family JUBULACEAE

* Frullania brittoniae Evans. Bark of trees & shaded rocks; common.
* F. eboracensis Gott. Bard of trees; common.
* F. inflata Gott. On limestone; uncommon; R, T.
* F. plana Sull. Bark of trees; uncommon.
F. riparia Hampe ex Lehm. On limestone & bark of trees; common.
* F. squarrosa (Reinw., et al.) Dum. Bark of trees; common.

Family AYTONIACEAE

* Reboulia hemispherica (L.) Raddi. Limestone bluffs; common.
+*Mannia fragans (Balb.) Frye & Clark. On limestone; R.

Family CONOCEPHALACEAE

* Conocephalum conicum (L.) Lindb. Dry creek beds & limestone; common.

Family RICCIACEAE

* Riccia ozarkiana R. L. McGregor. Soil at edge of lake; rare; M.

Division BRYOPHYTA
Class MUSCI
Family FISSIDENTACEAE

+*Fissidens adiantoides Hedw. Shaded rocks; B.
*F. bryoides Hedw. (sensu lato). O limestone in dry creek beds; common.
+*F. bushii (Card. & Ther.) Card. & Ther. On gravelly ground; B, R.
F. cristatus Wils. ex Mitt. On rocks in or near stream, limestone & dry creek beds; common.
F. fontanus (B. Pyl.) Steud. In water; uncommon; B. R, T.
+ F. grandifrons Brid. Reported by Gier, 1955.
* F. obtusifolius Wils. var. obtusifolius. Limestone rocks along stream; uncommon; R.
+ F. osmundioides Hedw. Reported by Gier, 1955.
F. subbasilaris Hedw. On limestone bluffs & bark of trees; common.
F. taxifolius Hedw. On limestone; common.

Family DITRICHACEAE

Ditrichum pallidum (Hedw.) Hampe. On soil; uncommon.
* Ceratodon purpureus (Hedw.) Brid. On limestone; uncommon; I.

Family SELIGERIACEAE

* Seligeria calcarea (Hedw.) B. S. G. Crevices of limestone; uncommon; R.

Family DICRANACEAE

Dicranella heteromalla (Hedw.) Schimp. var. heteromalla. Soil along ridge tops; common.
+*D. rufescens (With.) Schimp. On ground; B.
* D. varia (Hedw.) Schimp. Rocks in or near streams, dry creek beds; uncommon.
+*Dicranum polysetum Sw. Soil along ridge; R.
D. scoparium Hedw. On soil; uncommon; B, R.

Family LEUCOBRYACEAE

* Leucobryum glaucum (Hedw.) Angstr. in Fr. Soil along ridge tops; common.

Family POTTIACEAE

+*Barbula acuta (Brid.) Brid. var. acuta. Vertical limestone; R.
+*B. cancellata C. Muell. Rocks in creek; R.
B. fallax Hedw. Limestone bluff; uncommon.
* B. unguiculata Hedw. On limestone; common.
* Desmatodon obtusifolius (Schwaegr.) Schimp. Dry creek bed; uncommon.
+*D. plinthobius Sull. & Lesq. ex Sull. Exposed limestone; R.
* D. porteri James ex Aust. Shaded limestone; uncommon.
* Didymodon tophaceus (Brid.) Lisa. Moist limestone; uncommon; R.
* D. rigidulus Hedw. Limestone outcrop; rare; I.
* Eucladium verticillatum (Brid.) B.S.G. Moist limestone bluffs; uncommon.
* Gymnostomum aeruginosum Sm. Spring area & dry creek beds; common.
* G. recurvirostrum Hedw. var. recurvirostrum. Crevices of limestone; uncommon; R.
* Hyophila involuta (Hook.) Jaeg. & Sauerb. On rocks in or near stream, dry creek beds; common.
* Phascum cuspidatum Hedw. Soil on glade; uncommon.
* Pleurochaete squarrosa (Brid.) Lindb. Thin soil on glades; common.
* Trichostomum tenuirostre (Hook. & Tayl.) Lindb. Spring area; rare.
Tortella humilis (Hedw.) Jenn. On limestone, soil & bark of trees; common.
* Tortula pagorum (Milde.) De Not. Bark of trees & vertical limestone; common; R.
* T. papillosa Wild. ex Spruce. Bark of trees; rare; R.
Weissia controversa Hedw. Soil & limestone; common.

Family GRIMMIACEAE

* Grimmia laevigata (Brid.) Brid. Exposed limestone; uncommon; B. R.
+*G. pilifera P.-Beauv. Dolomite & limestone; B, R.
* Schistidium agassizii Sull. & Lesq. in Sull. Limestone rocks; common.
S. apocarpum Hedw. Dry limestone outcrops; common.

Family FUNARIACEAE

* Physcomitrium pyriforme (Hedw.) Hampe. Moist limestone & waste soil; common; B, R.
* Funaria flavicans Michx. Pile of ashes; uncommon; R.
+ F. hygrometrica Hedw. var. hygrometrica. Cleared ground; B.

Family BRYACEAE

+*Bryum argenteum Hedw. var. argenteum Wet ground, limestone & soil along creek; B, R.

* B. argenteum Hedw. var. lanatum (P.-Beauv.) Hampe. Soil on glade; uncommon.
B. bicolor Dicks. Soil on glade; common.
* B. capillare Hedw. Soil; uncommon.
\+ B. creberrimum Tayl. Soil; R.
B. pseudotriquetrum (Hedw.) Gaertn., Meyer & Schreb. Limestone bluffs and benches; common.
+*B. tortifolium Funck ex Brid. Rocks in creek; R.
* Polia nutans (Hedw.) Lindb. On soil; uncommon.
+*P. wahlenbergii (Web. & Mohr) Andr. Soil on bank of creek; R.
* Rhodobryum roseum (Hedw.) Limpr. Limestone bluffs; common.

Family MNIACEAE

Mnium ciliare (C. Muell.) T. Koponen. Rocks in creeks, soil, limestone bluffs; common.
M. cuspidatum Hedw. Soil, dry creek beds, bases of trees; common.
\+ M. punctatum Hedw. Reported by Gier, 1955.
+*M. rugicum Laur. Wet rocks; B.

Family AULCOMNIACEAE

+*Aulacomnium heterostichum (Hedw.) B.S.G. Gravelly ground & soil bank; B, R.

Family BARTRAMIACEAE

* Bartramia pomiformis Hedw. Shaded soil; uncommon; B, R.
+*Philonotis marchica (Hedw.) Brid. Wet ground, rocks & soil; B, R.

Family ORTHOTRICHACEAE

Drummondia prorepens (Hedw.) Britt. Bark of trees; common.
* Orthotrichum ohioense Sull. & Lesq. ex Aust. Bark of trees; common.
* O. pusillum Mitt. Bark of trees; common.
* O. stellatum Brid. Bark of trees; uncommon; R.
O. strangulatum P.-Beauv. On rocks; common.
* Zygodon apiculatus Redf. Bark of trees; rare.

Family FONTINALACEAE

\+ Fontinalis hypnoides C. J. Hartm. Rocks in running water; B, R.

Family CLIMACIACEAE

+*Climacium americanum Brid. On rock; B.

Family HEDWIGIACEAE

Hedwigia ciliata (Hedw.) P.-Beauv. On limestone; common; B, I, R.

Family CRYPHAEACEAE

* Cryphaea glomerata B.S.G. ex Sull. Bark of trees; uncommon; I, R.
* Forsstroemia producta (Hornsch.) Par. Bark of trees; rare; R.
* F. trichomitria (Hedw.) Lindb. Bark of trees; uncommon; R.

Family LEUCONDONTACEAE

Leucodon julaceus (Hedw.) Sull. On limestone & bark of trees; common.

Family THELIACEAE

Thelia asprella Sull. Thin rocky soil & bark of trees; common.
T. hirtella (Hedw.) Sull. Bark of trees; common.
* T. lescurii Sull. Thin soil along ridge top; uncommon.

Family FABRONIACEAE

* Clasmatodon parvulus (Hampe) Hook. & Wils. ex Sull. Vertical limestone & bark of oak; common.
* Fabronia ciliaris (Brid.) Brid. Limestone ledges & bark of trees; common.

Family LESKEACEAE

* Leskea gracilescens Hedw. Bark of trees; common.
L. obscura Hedw. Bark of oak; uncommon; R.
* L. polycarpa Hedw. Bark of sycamore; uncommon.
* Lindbergia brachyptera (Mitt.) Kindb. Bark of trees; uncommon.

Family THUIDIACEAE

Anomodon attenuatus (Hedw.) Heub. Limestone bluffs, dry creek beds, bark of trees; common.
* A. minor (Hedw.) Fuernr. Limestone & bark of trees; common.
A. rostratus (Hedw.) Schimp. Limestone rocks, bases of trees & soil; common.
+* A. viticulosus (Hedw.) Hook. & Tayl. Vertical limestone; R.
* Haplohymenium triste (Ces. ex De Not.) Kindb. Bark of trees; common.
* Haplocladium microphyllum (Hedw.) Broth. Soil on glade; rare.
* H. virginianum (Brid.) Broth. Rocky soil; uncommon; R.
* Thuidium delicatulum (Hedw.) B.S.G. var. delicatulum. Shaded soil; uncommon.

* T. minutulum (Hedw.) B.S.G. Moist rocks; uncommon.
* T. pygmaeum B.S.G. Limestone boulders & dry creek beds; common.
* T. recognitum (Hedw.) Lindb. Shaded limestone & rocky soil; common.

Family AMBLYSTEGIACEAE

* A. fluviatile (Hedw.) B.S.G. var. fluviatile fo. fluviatile. Limestone; common.
* A. fluviatile (Hedw.) B.S.G. var. fluviatile fo. brevifolium Moenk. Edge of trout run; uncommon.
* A. juratzkanum Schimp. Decaying log; uncommon; R.
A. laxirete Card. & Ther. Cold water; uncommon; B, TR.
+ A. noterophilum (Sull. & Lesq.) Holz. Reported by Gier, 1955.
* A. riparium (Hedw.) B.S.G. fo. riparium. Rocks in & along stream; common; collected by B. G, R.
* A. riparium (Hedw.) B.S.G. fo. elongatum (B.S.G.) Moenk. Rocks in creek; uncommon; R.
A. riparium (Hedw.) B.S.G. fo. obtusum (Grout) Grout. Rocks along & in stream, uncommon; R.
* A. serpens (Hedw.) B.S.G. On limestone & bark of Walnut; uncommon.
A. tenax (Hedw.) C. Jens. var. tenax. Moist rocks, thin soil & bark of trees; common.
A. tenax (Hedw.) C. Jens. var. spinifolium (Schimp.) Jenn. Spillway & rearing pool; uncommon; G, R.
A. trichopodium (Schultz) Hartm. Shaded rock; uncommon; R.
* A. varium (Hedw.) Lindb. Moist rocks & decaying wood; common.
Campylium chrysophyllum (Brid.) J. Lange var. chrysophyllum. On limestone & rocky soil; common.
+*C. chrysophyllum (Brid.) J. Lange var. brevifolium (Ren. & Card.) Grout. On moist bank; B.
C. hispidulum (Brid.) Mitt. var. hispidulum. Decaying wood; common.
* Drepanocladus aduncus (Hedw.) Warnst. var.aduncus. Shaded limestone & shaded soil; uncommon; R.
* Platydictya confervoides (Brid.) Crum. Shaded limestone; common.

Family BRACHYTHECIACEAE

* Brachythecium acuminatum (Hedw.) Aust. var. acuminatum. Bark of trees, limestone & soil; common.
* B. acuminatum (Hedw.) Aust. var. cyrtophylla Redf. ex Crum. Thin soil; uncommon.
B. oxycladon (Brid.) Jaeg. & Sauerb. Limestone, bases of trees & soil; common.
B. rivulare B.S.G. Rocks in water; common.
* B. salebrosum (Web. & Mohr) B.S.G. var. Limestone outcrops; uncommon.

+*Bryhnia graminicolor (Brid.) Grout Shaded bank; B. R.
+*B. novae-angliae (Sull. & Lesq. ex Sull.) Grout. On limestone; MO.
Bryoandersonia illecebra (Hedw.) Robins. Limestone bluffs & moist rocks; common.
* Eurhynchium hians (Hedw.) Sande Lac. Limestone & soil; common.
* E. pulchellum (Hedw.) Jenn. Limestone outcrops & soil; common.
E. riparioides (Hedw.) Rich. Rocks in stream & spring pool; uncommon; G.
* Homalothecialla subcapillata (Hedw.) Broth. Bark of trees; common.
* Rhynchostegium serrulatum (Hedw.) Jaeg. & Sauerb. On limestone & bark of trees; uncommon.

Family ENTODONTACEAE

+*Entodon cladorrhizans (Hedw.) C. Muell. Base of cedar; R.
+ E. compressus (Hedw.) C. Muell. Reported by Gier, 1955.
* E. seductrix (Hedw.) C. Muell. var. seductrix. Bark of trees, decaying wood, limestone & soil; common.

Family HYPNACEAE

* Ctenidium malacodes Mitt. (Hedw.) Mitt. Cherty soil along ridge; uncommon; R.
Homomallium adnatum (Hedw.) Broth. Shaded rocks; common.
+*Hypnum lindbergii Mitt. On wet rocks & soil bank; B.
* Isoptergium tenerum (Sw.) Mitt. Decaying wood; uncommon; R.
Platygyrium repens (Brid.) B.S.G. Bark of trees & decaying wood, limestone & soil; common.
* Pylaisiella selwynii (Kindb.) Crum, Steere & Anderson. Bark of trees; common.
* Taxiphyllum deplanatum (Bruch. & Schimp. ex Sull.) Fleisch. Thin soil & dry creek beds; uncommon.
T. taxirameum (Mitt.) Fleisch. Shaded limestone & dry creek beds; uncommon.

Family POLYTRICHACEAE

Atrichum angustatum (Brid.) B.S.G. Limestone outcrops & soil; uncommon.
+*A. tenellum (Rohl.) B.S.G. On soil; R.
+*Polytrichum juniperinum Hedw. Cherty soil; R.
+*P. ohioense Ren. & Card. R.

TAXONOMIC SUMMARY

A total of 427 specimens representing 84 taxa were collected during the study. These specimens, plus those previously collected from the area account for a total of 126 taxa recorded from Roaring River State Park. In all, 38 families are represented with the Pottiaceae having the largest number of

genera (12) and the largest number of species (17). In addition, 97 Barry County County Records have been recorded.

LITERATURE CITED

Crum, H. A., W. C. Steere and L. E. Anderson. 1973. A new list of mosses of North America North of Mexico. Bryologist 76: 85-130.

Gier, L. J. 1955. Missouri Bryophytes. Transactions of the Kansas Academy of Science 58(1): 24-29.

Missouri Department of Natural Resources - Division of Parks and Historic Preservation. 1978. Wild Areas Policy. Unpublished.

Missouri Natural Areas Committee. 1978. A Natural Areas System. Revised Edition of Committee Report.

Stotler, R. and B. Crandall-Stotler. 1977. A checklist of the liverworts and hornworts of North America. Bryologist 80: 405-428.

Thom, R. H. & J. H. Wilson. 1980. The natural divisions of Missouri. Transactions of the Missouri Academy of Sciences 14: 9-23.

Thomas, P. A. 1974. Hepaticae of the Interior Highland, North America. M. A. Thesis. Southwest Missouri State University. 121 pp.

Redfearn, P. L., Jr. 1972. Mossses of the Interior Highlands of North America. Annals of the Missouri Botanical Garden 59 (1): 1-104.

DISTRIBUTION, SYSTEMATICS AND ECOLOGY OF BOTRYCHIUM CAMPESTRE, THE PRAIRIE MOONWORT

D. R. Farrar and C. L. Johnson-Groh [1]

In 1982 a new species of the fern genus Botrychium was discovered in the Loess Hills of western Iowa. This species, recently named Botrychium campestre Wagner and Farrar (Wagner and Wagner, 1986), belongs to the moonwort (or least grapefern) subgenus of Botrychium (Wagner and Wagner, 1983, 1986; Lellinger, 1985) (see Table 1). Like most members of this subgenus, the prairie moonwort is exceedingly small and simple. The above ground portion consists of a single leaf 2 to 10 centimeters tall, divided into a once-pinnate sterile segment and a twice-pinnate fertile segment bearing 20-100 sporangia. Underground, a short, upright rhizome bears fleshy, mycorrhizal roots and a single, leaf-producing bud. The rhizome of Botrychium campestre also bears numerous asexual reproductive bodies, called gemmae, which when detached from the parent rhizome, can grow into new sporophyte plants.

Vegetative reproduction by undergound, sporophytic gemmae has not been previously reported in any fern genus. Since its initial discovery in B. campestre, we have also found gemmae in B. minganense Victor, although in much lower numbers than in B. campestre. W. H. Wagner, Jr., authority on the genus Botrychium, believes that these taxa are very closely related.

Several aspects of Botrychium campestre are highly atypical of moonworts. These include its habitat and phenology as well as its reproduction via gemmae. Most moonworts are found in moist habitats of northern latitudes or high montane elevations, and leaves generally appear between mid July and October. In contrast, B. campestre is found on the driest prairies in western Iowa and Minnesota. Predictably, leaf production occurs in early spring before these habitats become excessively hot and dry. In the vicinity of Sioux City, Iowa, leaf emergence begins in mid to late April with spore release and leaf senescence occurring by mid June.

Following its initial discovery, we have studied the occurrence of B. campestre in Iowa, and have documented its presence at eight localities in five counties bordering the Missouri River from the Missouri state border to about

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50 miles north of Sioux City (Farrar, 1985). All localities are in native Loess Hills prairies. In most localities, less than a dozen plants were found. This may be because the plants are rare, but it is also due to their small size and difficulty of finding them among dense prairie grass. The latter is supported by the finding of more than 200 plants in a pastured prairie (adjacent to an unpastured prairie preserve) where they are not hidden by tall grasses.

Dr. W. H. Wagner, Jr. of the University of Michigan is currently researching the systematics of the moonwort subgenus of Botrychium. In a search of herbarium material he located plants seemingly identical to B. campestre from Brown County, Nebraska, Lincoln County, Minnesota, and from southwestern Saskatchewan and southern Alberta, all from prairie habitats. He also has discovered similar plants growing in sand dunes near Lake Superior in Michigan. Wagner now believes that all these plants are the species, B. campestre, with the Michigan plants constituting a subspecies.

In early June of 1985, in the company of W. H. Wagner, we visited the Lincoln County, Minnesota site. There we found about 20 plants of B. campestre in the Hole-in-the-Mountain Nature Conservancy prairie preserve and adjacent pastured prairies. we then visited sites in Lac Qui Parle and Pipestone Counties where we found two plants at "The Kame" prairie and about a dozen at Aetna Prairie. In each of these sites the habitat was native prairie developed on glacial moraine deposits.

On June 1 & 2, 1986, we visited sites in Brown County, Nebraska where possible B. campestre had been collected. Here, along the Niobrara River in the Niobrara Nature Conservancy Preserve, we found 32 plants growing in juniper-cottonwood-prairie vegetation on floodplain terraces of the Niobrara River and in juniper-ponderosa pine-prairie vegetation on the steep, north-facing south bank of the Niobrara River. Soils of both sites were well drained sand with little humus. These plants are similar to Iowa plants in leaf morphology and in bearing numerous gemmae on the underground rhizomes. We have concluded that they are plants of B. campestre.

In June of 1986, we surveyed 8 native prairies in northwestern Minnesota. In one of these, Frenchman's Bluff in Norman County, we found a large population of plants similar to B. campestre but differing somewhat in leaf morphology and spore size. The plants were equally as gemmiferous as B. campestre. We hypothesized that they are either a new species closely related to B. campestre or a hybrid with B. campestre as one parent. Until

their relationship to B. campestre is determined we will continue to refer to these plants as B. campestre and assume that their biology and ecology is similar to plants of B. campestre in Iowa and southwestern Minnesota.

Table 1. Species of Botrychium subgenus Botrychium and their general distribution in eastern and western North America (Lellinger, 1985: Wagner and Wagner, 1983, 1986).

Species	North American distribution	
	Eastern	Western
Botrychium ascendens		x
Botrychium campestre	x	?
Botrychium crenulatum		x
Botrychium echo		x
Botrychium hesperium	x	x
Botrychium lanceolatum	x	x
Botrychium lunaria	x	x
Botrychium matricariifolium	x	
Botrychium minganense	x	x
Botrychium montanum		x
Botrychium mormo	x	
Botrychium paradoxum		x
Botrychium pinnatum		x
Botrychium pumicola		x
Botrychium pedunculosum		x
Botrychium simplex	x	x

Observations to date suggest that B. campestre is a plant of open, well-drained, undisturbed habitats. It seems to prefer habitats with some open soil such as are found in mid-grass prairie developed on steep or well drained slopes of loess, glacial moraines, and sand deposits. Because this is not a habitat in which ferns have previously been sought, and because of the difficulty of finding these small plants among prairie vegetation, it is possible that our current knowledge underrepresents the occurrence and distribution of B. campestre. It is also not unlikely that additional species of Botrychium may be found in these prairie habitats.

In addition to B. campestre, our prairie searches in the past year have yielded other Botrychium discoveries. In the Cedar Hills Sand Prairie in Blackhawk County, Iowa, we discovered Botrychium simplex. This species had not been seen in Iowa since its two collections in Linn County in 1954. We also found B. simplex in Brown County, Nebraska, and in Norman and Kittson

Counties, Minnesota. All are significant range and habitat extensions for B. simplex. The first Minnesota record for B. minganense was found in Norman County, and a new county record for B. multifidum in Kittson County was discovered.

Biological Problems and Research Needs

The discovery of Botrychium campestre has raised several questions in need of additional research in the areas of ecology, systematics and distribution.

Ecology

Botrychium campestre may be among the rarest ferns in North America. It appears to be endemic to moderately mesic (ie. tallgrass and midgrass) prairies of the northern plains. Little is yet known about its life history..

Most tallgrass and midgrass prairies exist today in moisture and climatic regimes which allow the growth of woody vegetation. Historically, they have been maintained by naturally occurring prairie fires (see for example, Glenn-Lewin and Landers, 1976). Currently these prairies are "managed" to prevent the invasion of woody plants, and the principal management tool is fire. The frequency and season of burning, and the effects of these on woody and native prairie species is important in determining the burning regime for a given prairie. Presumably B. campestre evolved in the prairie habitat and is adapted to periodic fire. However, its response to different burning regimes or other management practices is unknown. This must be determined in order to adapt management programs for optimum protection of this species.

A second problem regards the unknown role of underground propagules, gemmae, in the ecology of Botrychium. These structures may have evolved only in B. campestre. (The presence of gemmae in other taxa examined thus far may result from hybridization with B. campestre.) Excavations of soil surrounding rhizomes has revealed the presence of numerous plants in various stages of development from gemmae to mature plants (Table 2). The method and distance of dispersal of underground gemmae is undetermined, as is their longevity. Presence of thriving rhizome-root systems without emergent leaves suggests that it is not necessary for these plants to produce above-ground leaves on an annual basis (rhizomes and roots of all Botrychium are mycorrhizal).

We are currently attempting to grow gemmae of B. campestre in sterile culture to learn more about their formation, germination and development into mature plants. Additional insight into their role in the species' ecology can be gained by permanent marking and mapping of field populations and by sampling

soil and looking for gemmae and non-emergent plants within the population and in nearby areas.

Systematics

Botrychium campestre promises to hold a key to understanding the systematic relationship of a complex of Botrychium species. Because it occupies a range and habitat bordering on the woodland habitats of eastern, northern and perhaps western species of moonworts, numerous species interactions are possible.

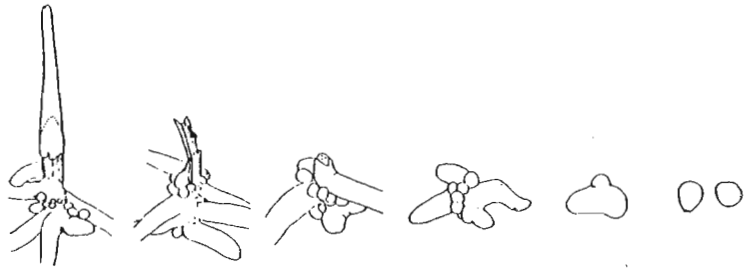
B. campestre, a diploid, is likely one of the ancestors of at least two taxa, B. minganense, and the new taxon from Frenchman's Bluff. B. minganense, a tetraploid, is intermediate in morphology between B. campestre and the diploid species, B. lunaria, and typically has a few gemmae (avg. 2.6 per plant). (B. lunaria has none, and B. campestre averages 18.3 gemmae per plant.) However, the new Minnesota taxon is also intermediate morphologically between B. lunaria and B. campestre, but differs from B. minganense in leaf color, leaf texture, larger spores, and in having many more gemmae (avg. 20.7 per plant) (see Figure 1).

Presence of gemmae may be a useful indicator of systematic relationships, if they are characteristic of only a few species. So far, this seems to be the case. We have examined and not found gemmae in B. simplex, B. lunaria, B. lanceolatum, and B. hesperium. However, we have not sufficiently examined the other species occurring in northeastern U.S. (2) or other exclusively western species (8) of moonworts (see Table 1).

Distribution

Botrychium campestre is now known from 14 sites ranging from western Iowa and northern Nebraska northward through the eastern Dakotas and western Minnesota. From this range it appears to be disjunct to dune systems of Lake Superior in northern Michigan. Herbarium collections from southwestern Saskatchewan and southern Alberta may also be of this species, but have not yet been confirmed through field study. All indications to date are that the species is truly rare (less than 500 plants have been recorded in total), however, the extreme difficulty of finding it among dense prairie vegetation must be considered. Our recent success has resulted from knowledge of what to look for and from many hours of searching specifically for these plants.

Table 2. Development class distributions of submerged plants surrounding emergent leaves of Botrychium campestre from Iowa and Nebraska.



Collection number	Emergent leaf	Non-emergent leaf	Apex without Leaf	No apex	Germinated gemmae	Gemmae
85-6-1-1	2	4	4	1	1	1
85-6-1-2	1	1				30
85-6-1-3	2	2	1	32	50	370
85-6-1-4	2	2	1		2	20
85-6-1-5	1		6	18	14	210
85-6-1-6	1	2	10	6	6	352
85-6-1-7	2			10	10	200
85-6-1-8	3					140
86-6-1-9	3		26	28	71	747
86-5-31-1	6	1		3	42	780
86-5-31-2A	2		1			39
86-6-1-1A	1	7	4	1		210
86-6-1-1B	3					79
86-6-2-1A	4	1				29
86-6-2-3A	1					8
86-6-2-3B	2				1	25
86-6-2-3C	2					64
86-6-2-3D	2					40
Total	40	20	53	99	197	3693
Avg/emergent plant		0.5	1.3	2.5	4.9	92.3

Average number of gemmae (germinated + ungerminated) per rhizome = 18.3

Average number of rhizomes in soil surrounding emergent leaf = 5.3

B. lunaria *B. minganense* *B. campestre*

n = 45 n = 90 n = 45

Figure 1. Leaf outlines of *Botrychium campestre*, *Botrychium lunaria* and their probable allotetraploid hybrid, *Botrychium minganense*. A new taxon from Norman County, Minnesota is similar in leaf outline to *B. minganense* but *B. minganense* differs from the Minnesota taxon in having thicker texture, blue-green color, few gemmae, and a woodland habitat.

Areas of potential habitat remain unsearched. As a next step in determining the species' range, the native blacksoil prairies of northern Iowa, and the hill prairies of northeastern Iowa and southeastern Minnesota should be searched. Also, the Loess hills of northwestern Missouri are good potential habitat. Results of these searches will determine whether further search to the east or south is warranted. Investigating the northern (Canadian) and western range limits is important as well.

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BIBLIOGRAPHY

Farrar, D. R. 1985. Pteridophytes of Iowa's Loess Hills-- Adaptations to dry habitats. Proceedings of the Iowa Academy of Science 92: 196-198.

Glenn-Lewin, D. C., and R. Q. Landers, Eds. 1976. Proceedings of the fifth midwest prairie conference. 230pp. Extension Courses and Conferences, Iowa State University.

Lellinger, D. B. 1985. A field manual of the ferns and fern-allies of the United States and Canada. Simthsonian Institution Press, Washington, D. C.

Wagner, W. H., Jr., and F. S. Wagner. 1986. Three new species of moonworts (Botrychium subg. Botrychium) endemic in western North America. American Fern Journal 76: 33-47.

Wagner, W. H., Jr., and F. S. Wagner. 1983. Genus communities as a systematic tool in the study of new world Botrychium (Ophioglossaceae). Taxon 32: 51-63.

MISSOURI CAREX NOTES 2. A SEARCH FOR CAREX X SUBIMPRESSA CLOKEY IN CLINTON COUNTY 26 YEARS AFTER JULIAN STEYERMARK'S DISCOVERY

David Castaner [1]

Carex x subimpressa Clokey (1916) is known in Missouri from three locations: Clinton county in a "draw" along highway C, T54N, R31W section 6, 2.5 miles southeast of Plattsburg, May 23, 1957, Steyermark 84652 and Lewis County in a "swamp" in alluvial bottoms along the Mississippi River along highway 61, 2 miles north of Canton, May 14, 1939, Steyermark 26489 and Bates County, May 12, 1956, Steyermark 81009. It has been accorded species rank by several authors (Mackenzie, 1935; Fernald, 1950; and Hermann, 1941). Steyermark (1963) in the Flora of Missouri, follows Clokey and treats it a hybrid between C. lanuginosa Michx. (section Hirtae) and C. hyalinolepis Steudel (section Paludosae). Reznicek and Catling (1983, 1986) have provided strong evidence to support the hybrid origin. They also report the species from Indiana (Hermann, 1941), Illinois and Missouuri (Steyermark, 1963), Michigan (Hermann, 1941), Kansas (McGregor and Barkley, 1977) and Ontario (Reznicek and Catling, 1986). In Missouri, Steyermark did not report any of the putative parents at the Bates or Clinton County sites, but found C. lanuginosa and C. vesicaria L. (section Vesicariae) at the Lewis County site. However, the C. x subimpressa only occurs in the range of the two parents, and apparently colonies may be long lived. One colony in Indiana has persisted for over fifty years. When reported beyond the range the report has been based on a misindentification.

As part of a continuing program to revisit and evaluate rare Carex species sites, a special trip was made in the spring of 1983, on June 10th, to find the Clinton County station and determine the present status of the stand. It had been 26 years since Steyermark had first collected there. Since I have on some previous occasions searched for several rare Missouri carices at original collection sites without success, I did not consider the prospects good. In addition, I also hoped to find and collect for our herbarium one or both of the supposed parents nearby.

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When I arrived at the site, it appeared to have been subjected to the deposition of large amounts of soil. Carex vulpinoidea Michx. and C. aggregata Mackenzie were immediately found at the site but no carices from the Paludosae section. With a little more careful collecting, C. lanuginosa was found. Since C. lanuginosa is one of the putative parents of the hybrid, an intensive search of the site followed. The search failed to yield the hybrid. After a short break, in which the site was actually left and other nearby areas visited, the search returned to the Steyermark site to where a fairly large vegetative colony of Carex grew. A culm by culm search of this colony lead finally to finding several fertile spikes with perigynia sill attached and I am happy to report they belong to C. x subimpressa!

Thus after 26 years the colony still persists. It is along a relatively narrow shoulder of County Route C. There is some danger to this colony. It is along the shoulders of County Route C. It is a relatively narrow shoulder. Erosion from surrounding fields have steadily built up the shoulder. Perhaps this has actually benefitted the colony. The real threat will come when the highway department decides to rework the shoulders.

Castaner 7648, 10 June 1983, is deposited in the Herbarium at Central Missouri State University [WARM]. A short field description follows:

> Culms and leaves to 80 cm tall; leaves to 7 mm wide, septate-nodulose at base; dorsal sheath spetatate-nodulose; culm to 12 mm wide just above the crown; ventral sheath top concave, thickened, unpigmented; staminate spikes 3; pistillate spikes 3, about 9 cm long and 12 mm wide, lowest spike loosely flowered at base; perigynia coriaceous, distinctly short pubescent, 5-6 mm long, teeth 1.2-1.8 long to point of convergence, ribs evidence but not coarse; scales elongate-ovate mostly 4-5.5 mm long; awns of perigynial scales to 2.5 mm, antrorsely barbed, divergent.

Literature Cited

Clokey, I. W. 1916. A new hybrid Carex from the middle western States. Torreya 16: 199-201.

Fernald, M. L. 1950. Gray's Manual of Botany. 8th Ed. Am. Book Co., NY.

Hermann, F. J. 1940. Carex. In Flora of Indiana by C. C. Dean. Dept. of Conservation, Indianopolis, Ind.

_____. 1941. The genus Carex in Michigan. American Midland Naturalist 25: 1-72.

Mackenzie, K. K. 1935. Cyperaceae--Cariceae. North American Flora 18: 169-478.

McGregor, R. L. & T. M. Barkley (Editors). 1971. Atlas of the flora of the Great Plains. Iowa State Uiversity, Ames, Iowa.

Reznicek, Anton A., & Paul M. Catling. 1983. The identity of Carex caesariensis and C. subimpressa. (Abstract). Amer. Jour. Botany 70 (5: Part 2): 127.

_____ & _____. 1986. The status and distribution of Carex subimpressa (Cyperaceae). Canadian J. Bot. 64: 227-232.

Steyermark, J. A. 1963. Flora of Missouri. Iowa State University Press, Ames, Iowa. lxxxiii + 1728 pp.

MISSOOURI BOTANICAL RECORD: A Brief History and Update

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Twenty-four years ago, Julian Steyermark (1963) published what has become the standard work for distribution of vascular plant taxa in Missouri. Seventeen years later, Henderson (1980) made the first significant attempt to update these records with publication of a list of 1748 county records.

Soon after organization of the Missouri Native Plant Society in 1979, a society project originated with the intent not only of bringing these records up-to-date, but of setting in motion a permanent record keeping process. The vehicle for making these records official was Missouriensis, the society journal. In the summer of 1982, this section of the journal, the Missouri Botanical Record was initiated with the publication of 54 records. Since then, many records have been published and many others have been submitted for publication.

Another aspect of this project has been the computerization of Steyermark's original distribution records. With the aid of a digitizer, purchased with funds from an SMSU Foundation grant, all of Steyermark's county dot distribution maps were transferred to ten, 5 3/4 inch floppy disks with an Apple IIe personal computer. Recently all of this information has been transferred to an IBM 4341 mainframe computer at Southwest Missouri State University. Currently this data is ready to be used with a computer system called the Statistical Analysis System (SAS), which can be tied to another package called SAS Graph. The IBM 4341 will allow for much greater flexibility and speed in information retrieval, as well as the ability to print out good quality updated dot distribution maps with a plotter.

In the past, the Missouri Botanical Record was prepared by entering new records into a separate data base system, such as Appleworks, and then creating a suitable format for publication in Missouriensis. Since this system was not compatible with the data base containing Steyermark's records,

it means that all previously published records must now be entered, in an additional step, to the Steyermark data base. However, with the move to the mainframe, it is now possible with new records to make one entry into the computer which can then be added as a record to the existing data base, and also be formatted for publication in the Missouri Botanical Record. Thus, no new records are included in this issue of Missouriensis. Rather than waste time on duplicate entries, it seemed judicious to wait until the mainframe system was in operation.

What benefits can be expected from this project in the future? First, immediate information on the distribution of any vascular plant taxon could be obtained, either by writing the Ozarks Regional Herbarium at SMSU for a printout, or by communicating directly with the SMSU computer center. Second, because of the SAS Graph component, quality dot distribution maps of all vascular plant taxa in Missouri can be readily produced for inclusion in an atlas. It is anticipated that such a volume could be produced in the time frame of 1 to 2 years. Furthermore, because of the continuous nature of the project, subsequent revisions could easily be made. Third, various lists can be generated, using the excellent sorting capacity of the SAS system. Such lists might include taxa recorded for specific counties, taxa not recorded for specific counties (want lists), or taxa not in specific counties but in adjacent counties. Many other possibilities exist.

As a final note, it should be mentioned that the project would not have progressed to this point without the dedication of those who have contributed lists, as well as those who have assisted the author in all the steps necessary for establishing the data base. The latter category includes Dr. William Corcoran, Associate Professor of Geography at SMSU, who did all the computer programming associated with the project; Jay Raveill and Doug Ladd who have helped edit the Missouri Botanical Record; and Richard Humphrey who spent many hours helping digitize Steyermark's distribution maps into our data base.

Literature Cited

Henderson, Norlan C. 1980. Additions to the Flora of Missouri. Missouri Department of Conservation, Jefferson City, Mo.

Steyermark, J. A. 1963. Flora of Missouri. Iowa State University Press, Ames, Iowa.