

## Bryophytes of Graham Cave State Park, Montgomery County, Missouri

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**ABSTRACT.** — An inventory of the bryophytes at Graham Cave State Park in east-central Missouri resulted in 131 taxa (105 mosses, 24 liverworts, and 2 hornworts). Sixty-two of these species are new records for Montgomery County. Four mosses (*Atrichum crispulum*, *Calliergonella lindbergii* var. *lindbergii*, *Mnium thomsonii*, and *Orthotrichum lescurii*) and two liverworts (*Riccia macallisteri* and *R. hirta*) are of conservation concern in Missouri. Based on a review of previously published checklists as well as unpublished survey data, the number of bryophyte taxa per acre at Graham Cave State Park is remarkably diverse compared to other Missouri State Parks.

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### INTRODUCTION

Graham Cave State Park comprises 386 acres within the Montgomery-Warren Oak Woodland/Forest Rugged Hills Land Type Association of the Outer Ozark Border Subsection of the Ozarks Highlands Section (Nigh & Schroeder 2002). Roughly 329 of those acres are in a well-preserved state, with 82 acres designated as a Missouri Natural Area. In 2007, Graham Cave State Park was included in the Missouri Department of Conservation's Missouri River Hills Conservation Opportunity Area; the designation identifies those areas deemed of high importance in preserving the state's biodiversity.

The park boasts 13 terrestrial natural communities (Nelson 2005), and a detailed 2007 soil survey yielded 28 soil types (Missouri State Parks n.d.). It is noteworthy that 188 of the 386 total acres of the park are sandstone-based natural communities with State Ranks of S2 (Imperiled) and S3 (Vulnerable). Graham Cave State Park is one of two Missouri State Parks with St. Peter Sandstone glades. This ecologically diverse park is designated a priority in The Nature Conservancy's Ozarks Ecoregional Conservation Assessment (The Nature Conservancy 2003), under the Central Missouri River Hills subsection.

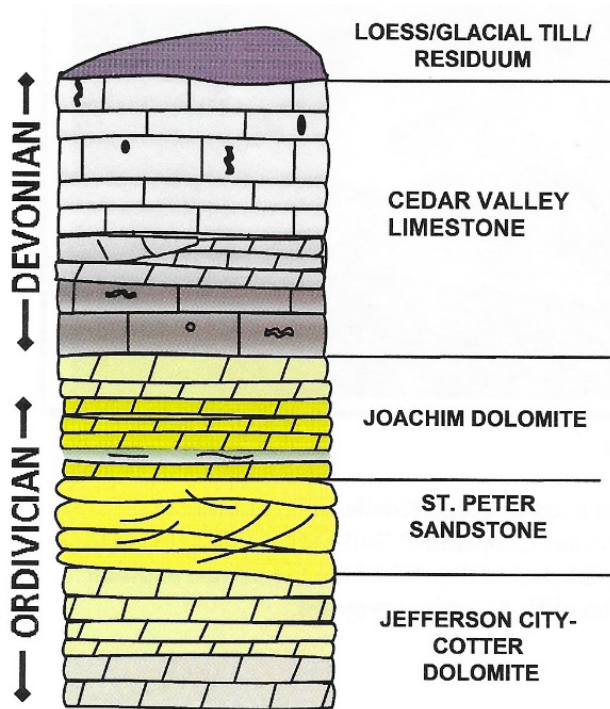
The park's land is flanked by glaciated plains to the north and the Missouri River alluvial plain to the south. At higher elevations (~780 ft), oak/hickory woodlands dominate the loess-covered ridges, which give way through four major forested ravines and valleys, to the mesic forested bottomlands of the Loutre River floodplain (~560 ft). This change in elevation cuts through Ordovician and Devonian aged rock. One can see Ordovician Jefferson City-Cotter Dolomite outcrops and a small glade, St. Peter Sandstone glades, ridges and cliffs, and Cedar Valley Limestone glades and rock outcrops (**Figure 1**).

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**Figure 1.** Rock strata layer of Graham Cave State Park. From Graham Cave State Park Natural Resource Management Plan (Missouri State Parks, n.d.).

Daniel Morgan Boone was the first European owner of the land just south of the park's boundaries, which he acquired via a Spanish Land Grant (Missouri State Parks n.d.). He sold the land in its original condition to Robert Graham in 1816. In 1847, Graham bought the adjacent land containing the cave from the U.S. government. Archaeological excavations in the cave from 1949-1955 were led by Dr. Charles Chapman, Director of American Archaeology at the University of Missouri. The excavations yielded important pre-historical data via the new technology of radiocarbon dating and established a time frame for the Archaic period in North America. The significance of this information led to the cave's designation as a National Historic Landmark in 1961 — the first archaeological site in the United States to be given this title. The Graham family understood the importance of this site and wished to see it preserved by donating the original 237 acres including the cave to the Missouri State Park Board in 1961. In 1966–67, Robert Klippel, a post-doctoral student under Chapman, completed research in the cave and surrounding lands (Klippel 1971) that aided in understanding environmental changes that took place since archaic times, stating "It is suggested that the oak-hickory forest discussed in chapter II was always present in the Loutre River Valley."

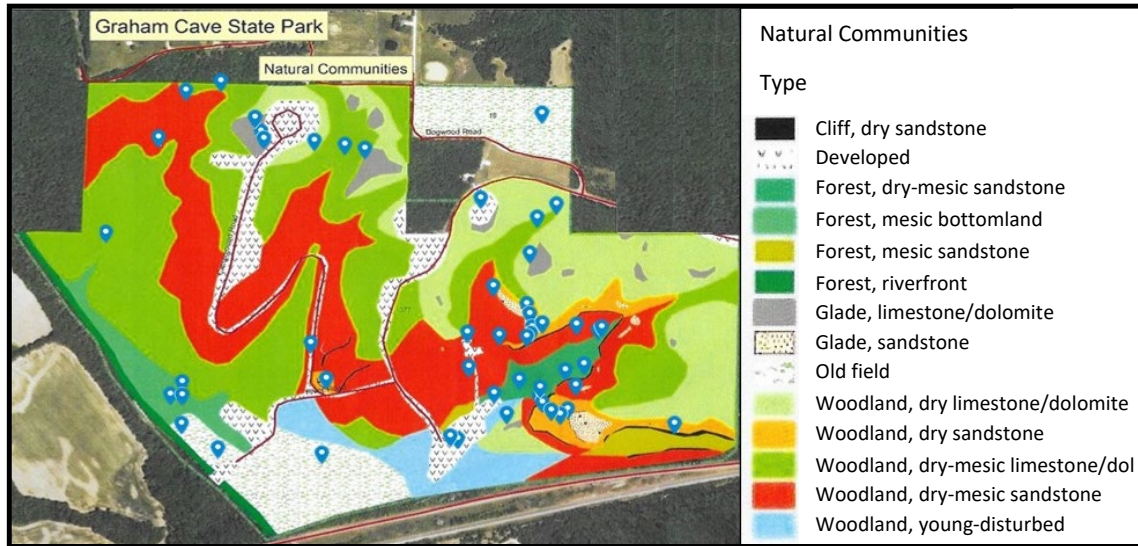
The earliest historical data giving an account of the vegetative environment are from the Federal Land Survey done in June and July of 1816 by William Rector. The survey reported an oak/hickory-dominated upper woodland, with the number of tree species increasing towards the bottomland. The survey also noted an open prairie roughly one mile east of the current park boundaries. Klippel noted that "...it can be safely assumed that very little of the natural vegetation could have been altered prior to the original land survey in this six-mile square study area."

(Klippel 1971). While the Loutre River bottomland was cleared for farming (and is currently in different stages of old-field succession), and a moderate level of timbering and grazing has occurred, human alterations to the landscape have been minimal during European occupation. Fire suppression has likely played a role in both the appearance and increase of certain species. The land surveys make no mention of eastern red cedar which is now prevalent throughout the park and has invaded many of the glades. Additionally, sugar maples have significantly increased in areas such as ridgetops that were once more open and dominated by oak and hickory. In 2007, the park acquired a 16+ acre tract just east of its entrance that was historically used as pasture and hay land and is currently in the beginning stages of a prairie restoration project.

Graham Cave State Park is rich in vascular plant biodiversity, but less is known about the non-vascular flora. Missouri State Park's maintains organismal records for each state park and historic site within its Natural Resource Inventory Database System. Graham Cave is documented as having more than 480 vascular plants, but little documentation of the bryophytes, lichens, and fungi of the park exist as no formal surveys have been conducted for these taxonomic groups (C. Crabtree, Natural Resource Steward, Missouri State Parks, personal communication, 2021). Over the last 50 years, 69 moss species and 15 liverwort species have been documented from Graham Cave State Park based on specimen records in the herbarium of the Missouri Botanical Garden. The purpose of this survey was to document the bryophyte diversity within Graham Cave State Park to establish a reference list of taxa and denote any species of conservation concern that occur within the park's boundaries.

## METHODS

A bryophyte survey of Graham Cave State Park (**Figure 2**) was conducted from May 2020 to June 2021. Voucher specimens are deposited in the herbaria of the Missouri Botanical Garden and the Division of State Parks, Missouri Department of Natural Resources (MODNR). Complete locality and habitat data for the vouchered specimens can be accessed through Tropicos, the Garden's online database (<http://www.tropicos.org>). Specimens previously collected at Graham Cave State Park and deposited at MO were reviewed and are cited here only when the species was not recollected during this survey. Taxa are associated with the natural communities in which they were collected, with separate lists for hepatics and mosses, and are arranged alphabetically by genus, followed by species and infra-specific ranks. Classification of the mosses follows Flora of North America (2007, 2014), except for some deviations based on recent publications. Classification of liverworts follows Stotler and Crandall-Stotler (2017), and that of hornworts follows Stotler and Crandall-Stotler (2005), except for some deviations based on recent publications.



**Figure 2.** Graham Cave State Park Natural Communities map. GPS coordinates for each collection site were entered into Google maps, and then overlaid on top of the Natural Communities map. Blue flags indicate collection sites. The natural community assigned to each sample was based on site characteristics at each collection site. Adapted from Graham Cave State Park Natural Resource Management Plan (Missouri State Parks, n.d.).

## RESULTS & DISCUSSION

As a result of fieldwork, 116 taxa were identified during this inventory (93 mosses, 21 liverworts, and 2 hornworts). These taxa were sampled from 10 terrestrial natural communities and 2 anthropogenically disturbed communities within the park. An additional 15 species (12 mosses and 3 liverworts) previously collected in the park, but not found during this survey, were verified and added to the list based on collections at MO. In total, 131 species of bryophytes (105 mosses, 24 liverworts, and 2 hornworts) are documented from Graham Cave State Park (**Table 1**). Sixty-two of these species are new records for Montgomery County (**Appendix 1**). These new records are particularly rich in liverwort taxa, as only two species (*Aneura pinguis* and *Frullania eboracensis*) had been reported previously from the county (Atwood 2014). Other noteworthy records include *Atrichum crispulum*, *Forsstroemia trichomitria* and *Ditrichum lineare*, all three of which are the first documented occurrences of these species in the state, north of the Missouri River (Darigo 2015). *Brachythecium rotaeanum*, a species not collected during the survey, is reported based on a specimen from the park (Redfearn & Key 27764 [MO]) that had been previously misdetermined as *B. rivulare* Schimp. (Darigo 2015). Additionally, four mosses (*A. crispulum* [S2], *Calliergonella lindbergii* var. *lindbergii* [SU], *Mnium thomsonii* [S?], and *Orthotrichum lescurii* [S1]), and two liverworts (*Riccia macallisteri* [S1] and *R. hirta* [S2]) were found that are of conservation concern in Missouri (Missouri Department of Conservation 2021).

Extensive soils and natural community mapping in Graham Cave State Park allowed the opportunity to compare species within communities. Although collecting was not equivalently thorough within every community, a modest comparison between sandstone and limestone/dolomite communities can be made. The Dry Mesic Sandstone Woodland community had the most recorded bryophyte diversity with 36 taxa. The Sandstone Glade and Sandstone Dry Cliff communities had the second highest diversity with 33 taxa each. There are several

intermittent waterfall and seepage areas found within the Sandstone Dry Cliff communities that do not meet the criteria to be designated as Sandstone Moist Cliff communities (Missouri Natural Resources n.d.). Because these areas maintain a level of moisture greater than the typical Dry Cliff community and can host species of bryophytes not typically found in a Sandstone Dry Cliff community, it was important to identify the species found in these wet (w) areas of the Sandstone Dry Cliff community. They are given the designation x(w) in **Table 1**. Among the Limestone/Dolomite communities in the park, the Limestone/Dolomite Dry Woodland had the highest diversity with 23 recorded taxa. The total number of taxa collected within each community is given at the bottom of **Table 1**. All species except for three were able to be assigned to specific communities. Two un-assigned species (*Thuidium recognitum* and *Calliergonella curvifolia*) were from herbarium specimens previously collected at Graham Cave State Park (*Redfearn & Key 27732b* and *Feigley s.n.*, respectively [both MO]) and do not contain enough detail to assign a community. One species -*Brachythecium rotaeantum* (*Redfearn & Key 27764* [MO]) - could be assigned only to a general community of sandstone. These three specimens were collected over 35 years ago.

Overall, sandstone communities showed the highest diversity with 98 species represented, followed by limestone/dolomite communities with 41 species; 24 of these species were found in both communities. Sandstone communities comprise roughly 187 acres (48.63%) of the park's total acreage, while limestone/dolomite communities cover roughly 125 acres (32.5%). The number of bryophyte species per acre would be 0.52 and 0.33, respectively.

An interesting finding is the presence of *Campyllum chrysophyllum* on thin soil over sandstone in the sandstone glade within the designated Natural Area. This glade receives calcium deposits in the runoff from the exposed limestone/dolomite bedrock above. *Campyllum chrysophyllum* usually inhabits calcium-rich substrates, as shown by nine collections of this species during this inventory, with six occurrences in limestone/dolomite settings and one in the prairie restoration area.

As stressed in the Missouri Department of Natural Resources' strategic planning documents, a critical information gap exists in the documentation of the flora and fauna occurring within state parks. As a result of this survey, the bryophyte diversity at Graham Cave State Park was found to be comparable to the bryophyte diversity documented from other Missouri State Parks such as Taum Sauk (Holmberg & Atwood 2014), Roaring River (Hilton 1986) and Meramec (Nels Holmberg, personal communication, 2021). Graham Cave State Park has a notably smaller acreage than those parks, demonstrating the contribution bryophytes make to the overall floristic richness within the park. At the county level, the number of mosses recorded from Montgomery County increased from 91 to 127 taxa, while the number of liverworts and hornworts increase from 2 to 28 taxa. Montgomery County now has the greatest number of reported bryophytes for any county in the state north of the Missouri River. Only 19 Missouri counties have more than 125 mosses reported (Darigo 2015), while only 9 counties have more than 25 liverworts and hornworts reported (Atwood 2014). As demonstrated by this study, the importance of having protected natural resources such as those found within Missouri State Parks, and the need for their continued preservation, cannot be overstated.

## ACKNOWLEDGMENTS

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**Table 1.** Complete checklist of bryophytes in Graham Cave State Park, Montgomery County, Missouri, and their related communities. **Communities** – **1:** Bottomland Mesic Forest; **2:** Limestone/Dolomite Dry-Mesic Woodland; **3:** Limestone/Dolomite Dry Woodland; **4:** Limestone/Dolomite Glade; **5:** Sandstone Glade; **6:** Sandstone Dry Cliff [(w): wet]; **7:** Sandstone Dry Woodland; **8:** Sandstone Dry-Mesic Woodland; **9:** Sandstone Dry-Mesic Forest; **10:** Sandstone Mesic Forest; **11:** Developed; **12:** Prairie Restoration.

Species	Communities (see key above)											
	1	2	3	4	5	6	7	8	9	10	11	12
<i>Anthoceros punctatus</i> L.						x(w)						
<i>Asterella tenella</i> (L.) P. Beauv.					x			x				
<i>Calypogeia neogaea</i> (R.M. Schust.) Bakalin						x						
<i>Cephaloziella divaricata</i> (Sm.) Schiffn.					x	x						
<i>Chiloscyphus pallescens</i> (Ehrh. ex Hoffm.) Dumort.						x(w)		x				
<i>Cololejeunea biddlecomiae</i> (Austin ex Pearson) A. Evans									x			
<i>Conocephalum salebrosum</i> Szweyk., Buczk. & Odrzyk.						x(w)						
<i>Frullania asagrayana</i> Mont.						x						
<i>Frullania ericoides</i> (Nees) Mont.								x				
<i>Frullania inflata</i> Gottsche					x			x				
<i>Frullania riparia</i> Hampe ex Lehm.		x	x	x								
<i>Geocalyx graveolens</i> (Schrad.) Nees					x							
<i>Lophocolea coadunata</i> (Sw.) Mont.								x				
<i>Lophocolea heterophylla</i> (Schrad.) Dumort.								x				
<i>Mannia fragrans</i> (Balb.) Frye & L. Clark					x							
<i>Odontoschisma sphagni</i> (Dicks.) Dumort.					x							
<i>Phaeoceros carolinianus</i> (Michx.) Prosk.						x(w)		x				
<i>Porella platyphylla</i> (L.) Pfeiff.		x										
<i>Porella platyphylloidea</i> (Schwein.) Lindb.	x		x	x				x	x			
<i>Radula obconica</i> Sull.							x					
<i>Reboulia hemisphaerica</i> subsp. <i>hemisphaerica</i> (L.) Raddi				x		x(w)						
<i>Riccia beyrichiana</i> Hampe ex Lehm.					x							
<i>Riccia hirta</i> (Austin) Underw.					x							
<i>Riccia macallisteri</i> M. Howe				x								
<i>Scapania nemorea</i> (L.) Grolle					x		x					
<i>Syzygiella autumnalis</i> (DC.) K. Feldberg, Váňa, Hentschel & Heinrichs							x					

Species	Communities (see key above)											
	1	2	3	4	5	6	7	8	9	10	11	12
<b>Mosses</b>												
<i>Anomodon minor</i> (Hedw.) Lindb.	x		x						x			
<i>Anomodon tristis</i> (Ces.) Sull.	x							x				
<i>Arrhenopterum heterostichum</i> Hedw.						x		x				
<i>Atrichum angustatum</i> (Brid.) Bruch & Schimp.	x				x	x				x		
<i>Atrichum crispulum</i> Schimp. ex Besch.								x				
<i>Aulacomnium palustre</i> (Hedw.) Schwägr.					x			x				
<i>Barbula unguiculata</i> Hedw.											x	
<i>Bartramia pomiformis</i> Hedw.						x						
<i>Brachythecium acuminatum</i> (Hedw.) Austin								x		x		
<i>Brachythecium laetum</i> (Brid.) Schimp.	x		x					x	x		x	x
<i>Brachythecium rotaeantum</i> De Not.												
<i>Brothera leana</i> (Sull.) Müll. Hal.					x							
<i>Bryoandersonia illecebra</i> (Hedw.) H. Rob.						x			x			
<i>Bryum argenteum</i> Hedw.											x	
<i>Callicladium haldaneanum</i> (Grev.) H.A. Crum						x(w)						
<i>Callicladium imponens</i> (Hedw.) Hedenäs, Schlesak & D. Quandt								x				
<i>Calliergonella curvifolia</i> (Hedw.) B.H. Allen												
<i>Calliergonella lindbergii</i> var. <i>lindbergii</i> (Mitt.) Hedenäs		x						x	x			
<i>Campylium chrysophyllum</i> (Brid.) Lange			x	x	x			x				x
<i>Ceratodon purpureus</i> (Hedw.) Brid.					x							
<i>Claopodium rostratum</i> (Hedw.) Ignatov	x		x		x			x	x			
<i>Clasmatodon parvulus</i> (Hampe) Sull.									x			
<i>Climacium americanum</i> Brid.						x						
<i>Dicranella heteromalla</i> (Hedw.) Schimp.		x			x							
<i>Dicranum condensatum</i> Hedw.								x				
<i>Dicranum scoparium</i> Hedw.					x			x	x			
<i>Didymodon rigidulus</i> var. <i>gracilis</i> (Hook. & Grev.) R.H. Zander				x								
<i>Ditrichum lineare</i> (Sw.) Lindb.				x								
<i>Ditrichum pallidum</i> (Hedw.) Hampe					x	x(w)						
<i>Drummondia prorepens</i> (Hedw.) E. Britton											x	
<i>Entodon seductrix</i> (Hedw.) Müll. Hal.			x		x				x			
<i>Eurhynchiastrum pulchellum</i> (Hedw.) Ignatov & Huttunen									x			
<i>Fissidens adianthoides</i> Hedw.						x(w)		x				
<i>Fissidens bryoides</i> Hedw.	x											
<i>Fissidens bushii</i> (Cardot & Thér.) Cardot & Thér.								x				
<i>Fissidens dubius</i> P. Beauv.		x	x					x				



Species	Communities (see key above)											
	1	2	3	4	5	6	7	8	9	10	11	12
<b>Mosses (cont.)</b>												
<i>Fissidens fontanus</i> (Bach. Pyl.) Steud.			x						x			
<i>Fissidens minutulus</i> Sull.						x(w)						
<i>Fissidens subbasilaris</i> Hedw.			x									
<i>Fissidens taxifolius</i> Hedw.						x(w)			x	x		
<i>Forsstroemia trichomitria</i> (Hedw.) Lindb.	x											
<i>Funaria hygrometrica</i> Hedw.				x								
<i>Geheebia tophacea</i> (Brid.) R.H. Zander						x(w)						
<i>Gemmabryum caespiticium</i> (Hedw.) J.R. Spence					x						x	
<i>Gemmabryum dichotomum</i> (Hedw.) J.R. Spence & H.P. Ramsay								x				
<i>Grimmia laevigata</i> (Brid.) Brid.					x		x					
<i>Grimmia pilifera</i> P. Beauv.					x		x					
<i>Gymnostomum aeruginosum</i> Sm.								x				
<i>Haplocladium microphyllum</i> (Sw. ex Hedw.) Broth.	x											
<i>Haplocladium virginianum</i> (Brid.) Broth.					x		x					
<i>Hedwigia ciliata</i> (Hedw.) P. Beauv.							x				x	
<i>Homalotheciella subcapillata</i> (Hedw.) Broth.												
<i>Homomallium adnatum</i> (Hedw.) Broth.			x	x								
<i>Hygroamblystegium varium</i> (Hedw.) Mönk. var. <i>humile</i> (P. Beauv.) Vanderp. & Hedenäs									x	x		x
<i>Hygroamblystegium varium</i> var. <i>varium</i> (Hedw.) Mönk.		x	x			x(w)		x	x	x	x	
<i>Hymenostylium recurvirostrum</i> (Hedw.) Dixon						x(w)						
<i>Hyophila involuta</i> (Hook.) A. Jaeger									x			
<i>Koponeniella graminicolor</i> (Brid.) Huttunen, Ignatov, Min Li & Y.F. Wang						x(w)			x			
<i>Leptodictyum riparium</i> (Hedw.) Warnst.		x						x				
<i>Leskea gracilescens</i> Hedw.	x		x						x		x	
<i>Leucobryum glaucum</i> (Hedw.) Ångstr.					x		x	x				
<i>Leucodon julaceus</i> (Hedw.) Sull.	x											
<i>Mnium marginatum</i> (Dicks.) P. Beauv.						x(w)						
<i>Mnium stellare</i> Hedw.						x(w)						
<i>Mnium thomsonii</i> Schimp.						x(w)						
<i>Orthodicranum montanum</i> (Hedw.) Loeske						x						
<i>Orthotrichum lescurii</i> Austin			x									
<i>Orthotrichum ohioense</i> Sull. & Lesq.	x		x									
<i>Orthotrichum parvulum</i> Mitt.				x							x	
<i>Orthotrichum pumilum</i> Sw.											x	
<i>Orthotrichum stellatum</i> Brid.	x			x								
<i>Pelekium minutulum</i> (Hedw.) Touw	x											

Species	Communities (see key above)											
	1	2	3	4	5	6	7	8	9	10	11	12
<b>Mosses (cont.)</b>												
<i>Philonotis fontana</i> (Hedw.) Brid.					x			x				
<i>Philonotis marchica</i> (Hedw.) Brid.						x(w)						
<i>Physcomitrium pyriforme</i> (Hedw.) Brid.											x	
<i>Plagiomnium ciliare</i> (Müll. Hal.) T.J. Kop.		x	x			x		x				
<i>Plagiomnium cuspidatum</i> (Hedw.) T.J. Kop.			x		x			x	x	x		
<i>Platygyrium repens</i> (Brid.) Schimp.	x				x				x			
<i>Pleuridium subulatum</i> (Hedw.) Rabenh.					x							
<i>Pohlia annotina</i> (Hedw.) Lindb.												
<i>Pohlia nutans</i> (Hedw.) Lindb.					x							
<i>Polytrichum commune</i> Hedw.							x					
<i>Polytrichum juniperinum</i> Hedw.					x		x					
<i>Pseudanomodon attenuatus</i> (Hedw.) Ignatov & Fedosov	x		x					x	x			
<i>Ptychomitrium incurvum</i> (Schwägr.) Spruce							x					
<i>Ptychostomum creberrimum</i> (Taylor) J.R. Spence & H.P. Ramsay			x			x	x					
<i>Ptychostomum pseudotriquetrum</i> (Hedw.) J.R. Spence & H.P. Ramsay ex Holyoak & N. Pedersen				x	x	x			x			
<i>Pylaisia condensata</i> (Mitt.) A. Jaeger	x			x								
<i>Rhodobryum ontariense</i> (Kindb.) Paris			x					x				
<i>Rhynchostegium serrulatum</i> (Hedw.) A. Jaeger								x		x		x
<i>Rosulabryum capillare</i> (Hedw.) J.R. Spence						x						
<i>Schistidium crassithecium</i> H.H. Blom ex B.H. Allen									x			
<i>Schistidium viride</i> H.H. Blom & Darigo			x	x							x	
<i>Sematophyllum adnatum</i> (Michx.) E. Britton				x								
<i>Sematophyllum demissum</i> (Wilson) Mitt.							x					
<i>Syntrichia ruralis</i> (Hedw.) F. Weber & D. Mohr				x								
<i>Taxiphyllum deplanatum</i> (Bruch & Schimp. ex Sull.) M. Fleisch.				x				x		x		
<i>Taxiphyllum taxirameum</i> (Mitt.) M. Fleisch.	x											
<i>Tetraphis pellucida</i> Hedw.						x						
<i>Thelia asprella</i> (Schimp.) Sull.			x					x				
<i>Thuidium delicatulum</i> (Hedw.) Schimp.		x				x		x				
<i>Thuidium recognitum</i> (Hedw.) Lindb.												
<i>Tortella humilis</i> (Hedw.) Jenn.			x								x	
<i>Tortula obtusifolia</i> (Schwägr.) Mathieu					x				x		x	
<i>Weissia controversa</i> Hedw.				x	x		x					
<b>Total Species in each Community</b>	<b>18</b>	<b>9</b>	<b>23</b>	<b>18</b>	<b>33</b>	<b>33</b>	<b>16</b>	<b>36</b>	<b>23</b>	<b>8</b>	<b>14</b>	<b>4</b>

**Appendix 1.** Taxa representing new Montgomery County records. All collection numbers are those of the first author unless otherwise noted. Voucher specimens for each taxon are deposited at MO; repositories for duplicate specimens are indicated below.

### **Hepatics**

*Anthoceros punctatus*, 129; *Asterella tenella*, 40; *Calypogeia neogaea*, 62; *Cephaloziella divaricata*, 12A; *Chiloscyphus pallescens*, 52; *Cololejeunea biddlecomiae*, 198; *Frullania asagrayana*, 22; *F. ericoides*, 177; *F. inflata*, 161; *F. riparia*, 245; *Geocalyx graveolens*, 164; *Lophocolea coadunata*, 178; *L. heterophylla*, 207; *Mannia fragrans*, 155; *Odontoschisma sphagni*, 164A; *Phaeoceros carolinianus*, 74; *Porella platyphylla*, 82; *P. platyphylloidea*, 116; *Radula obconica*, Holmberg 3382; *Reboulia hemisphaerica* subsp. *hemisphaerica*, 31 (MODNR); *Riccia beyrichiana*, Atwood 3185; *R. hirta*, Atwood 3184; *R. macallisteri*, 249; *Scapania nemorea*, 76; *Syzygiella autumnalis*, 5A.

### **Mosses**

*Atrichum crispulum*, 42 (MODNR); *Aulacomnium palustre*, 41 (MODNR); *Brachythecium rotaeanum*, Redfearn & Key 27764; *Didymodon rigidulus* var. *gracilis*, 83; *Ditrichum lineare*, 221; *Eurhynchiastrum pulchellum*, 199; *Fissidens adianthoides*, 61; *F. bryoides*, 145; *F. bushii*, 47; *F. dubius*, 218; *F. fontanus*, 193; *F. subbasilaris*, 110; *Forsstroemia trichomitria*, 143; *Geheebia tophacea*, 57; *Gemmabryum caespiticium*, 68; *Grimmia laevigata*, 156; *G. pilifera*, 182; *Haplocladium microphyllum*, 135; *H. virginianum*, 20; *Homalotheciella subcapillata*, 229; *Hygroamblystegium varium* var. *humile*, 236; *H. varium* var. *varium*, 46A; *Hyophila involuta*, 197A; *Koponeniella graminicolor*, 201; *Mnium thomsonii*, 64; *Orthotrichum ohioense*, 149; *O. stellatum*, 87; *Pelekium minutulum*, 142; *Philonotis marchica*, 56; *Pleuridium subulatum*, 18; *Ptychomitrium incurvum*, 183; *Ptychostomum creberrimum*, 75 (MODNR); *P. pseudotriquetrum*, 65; *Pylaisia condensata*, 89; *Schistidium crassithecium*, 197; *Taxiphyllum deplanatum*, 210; *Tortula obtusifolia*, 98.