

BRYOPHYTES OF CEDAR GLADES

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Abstract. Calcareous cedar glades are common in southwest Missouri. Seventy-four taxa are reported and listed as to their occurrence on soil, exposed rock surfaces, cedar trees, hardwood trees, or logs. A comparison is made of the bryofloras of calcareous glades of southwest Missouri with similar cedar glade habitats in Tennessee and the Edward's Plateau of Texas. The cedar glades of southwest Missouri and Tennessee are similar in floristic composition but dissimilar to the cedar glades of the Edward's Plateau. It is suggested that this difference is due to drier conditions in the latter.

Introduction

Cedar glades are common throughout much of southwest Missouri. They develop from open areas where the bedrock is close to the surface and has extensive horizontal outcroppings. Consequently, soils are usually thin and have little water retaining capacity. Though cedar glades may develop from sandstone, granitic, and rhyolitic rocks, this paper deals only with calcareous glades occurring on limestones or dolomitic limestones. Such glades may be characterized as alkaline habitats with irregular outcroppings of rock that produce horizontal and vertical bare exposures. Small rock fragments are also common. By any measure, vegetation of the cedar glades must be considered xerophytic. Yet, a remarkable diversity of bryophytes occur on the exposed rocks, thin soils, trees, and logs and it is the purpose of this paper to report on this diversity in the bryoflora and to compare the bryofloras of calcareous glades of southwest Missouri with similar cedar glade habitats in Tennessee and the Edward's Plateau of Texas.

In the discussion that follows it is important to recognize that the description of the bryoflora is based upon non-quantitative collection data and observations over a 20-yr period. Based on this experience, estimates of presence of a taxon in a particular cedar glade habitat have been made and range from rare (probably present in a particular habitat in less than 25% of the glades), to uncommon (probably present in a particular habitat in 25-60% of the glades), to common (probably present in a particular habitat in 60-100% of the glades). the nomenclature of the taxa follows Conard and Redfearn (1979).

The distribution of a bryophyte in an areas is

largely governed by microhabitats such as the degree of shading and the type of substrate upon which it is growing. For the purpose of this survey the habitats of bryophytes in cedar glades have been divided into the following categories:

- 1) Epilithic habitats. - rock surfaces with negligible accumulation of soil beneath the bryophyte colony.
- 2) Soil habitats. - soil may be relatively thin, only about 2-5 cm deep, or deeper soils often with numerous fragments.
- 3) Corticolous and epixylic habitats. - at the base of or on the trunk or limbs of cedars and hardwoods, or on logs.

Epilithic Habitats

On rocks that are essentially unshaded and horizontal, the common species are *Grimmia alpicola*, *G. apocarpa*, *Orthotrichum strangulatum*, *Ptychomitrium incurvum*, *Hedwigia ciliata*, and *Desmatodon plinthobius*. All of these species may be locally frequent and have extensive coverage. This is particularly true for *Hedwigia ciliata*, the species of *Grimmia*, and *Orthotrichum strangulatum*. Species that are uncommon on unshaded rocks include *Entodon seductrix*, *Grimmia pilifera*, *G. laevigata*, and *Bryum pseudotriquetrum*. The latter species may form extensive mats on open rock surfaces where there is sufficient seasonal seepage. Species that may be considered rare in open rocky habitats are *Brachythecium acuminatum*, *Ptychomitrium leibergii*, *Tortula ruralis*, *Mannia gragrans*, and *Reboulia hemisphaerica*. *Tortula ruralis* may be locally abundant. *Ptychomitrium leibergii* is the rarest of the species occurring in cedar glades, being known from a single glade in Ozark County. On open vertical

surfaces of large rocks *Anomodon rostratus* and *Bryum pseudotriquetrum* are uncommon.

On shaded horizontal rocks the common species are *Homomallium adnatum*, *Weissia controversa*, and *Anomodon rostratus*. Uncommon species are *Brachythecium oxycladon*, *Rhynchostegium serrulatum*, *Bryoandersonia illecebra*, and *Campylium chrysophyllum*. Along small drainage pathways *Amblystegium varium* is rare.

On vertical rocks surfaces that are shaded the common species are *Anomodon rostratus* and *Clasmatodon parvulus*. The latter species is particularly characteristic of vertical exposures of fissures. Uncommon species are *Anomodon attenuatus*, *Fissidens viridulus*, *Weissia controversa*, and *Frullania riparia*. *Drummondia prorepens*, *Fissidens subbasilaris*, and *Porella platyphylla* are rare.

Soil Habitats

Pleurochaete squarrosa may be considered a characteristic species of cedar glades. It grows on thin and deep soils in both the open and beneath cedar trees. It is certainly common, probably found in over 90% of the cedar glades in southwest Missouri. Its coverage is frequently extensive, forming large mats growing loosely on the soil. Other species that are common on soils in both the open and shade are *Bryum argenteum*, *Weissia controversa*, and *Bryum pseudotriquetrum*. Another common species is *Tortella humilis* though it is usually restricted to shaded soils at the bases of trees and rocks. Other species common on shaded soil are *Campylium chrysophyllum*, *Leucodon julaceus*, *Mnium cuspidatum*, *Fissidens cristatus*, *Brachythecium oxycladon*, *Thuidium recognitum*, *Fabronia ciliaris*, and *Taxiphyllum taxirameum*. The latter 2 species characteristically grow on soil beneath rock overhangs.

A number of species occur sporadically on soil in both the open and shade and may be considered uncommon. These are:

Anomodon attenuatus
Astomum muhlenbergianum
Atrichum angustatum
Barbula unguiculata
Bryoandersonia illecebra
Bryum bicolor
Bryum capillare
Dicranella heteromalla
Dicranum Scoparium
Eurhynchium hians
Eurhynchium pulchellum
Haplocladium virginianum

Leucobryum glaucum
Mnium affine var. *cilaire*
Rhynchostegium serrulatum
Thelia asprella
Lophocolea heterophylla
Mannia fragrans
Reboulia hemisphaerica

Many of these species such as *Dicranum scoparium*, *Leucobryum glaucum*, *Bryoandersonia illecebra* and *Lophocolea heterophylla* become common in adjacent hardwood forests.

Two species, *Physcomitrium pyriforme* and *Funaria flavicans*, characteristically appear on open soils during the spring. They are common.

Corticolous and Epixylic Habitats

The corticolous and epixylic flora of cedar glades is diverse. Species such as *Pylaisiella selwynii*, *Drummondia prorepens*, and *Leucodon julaceus* often cover extensive areas at the base or on the trunk and limbs of trees. Other species such as *Tortula pagorum*, *T. papillosa*, *Orthotrichum* spp. and *Homalotheciella subcapillata* tend to be scattered and relatively small in coverage. Some species are abundant on the bases of trees or on logs. This is particularly true for *Thelia asprella* on bases of trees and *Leucodon julaceus* on logs. The most typical species growing on both cedars and hardwoods are *Tortula pagorum*, *Drummondia prorepens*, *Leucodon julaceus*, *Orthotrichum* spp. and *Pylaisiella selwynii*. The characteristic species growing on logs are *Entodon seductrix* and *Platygyrium repens*. The distribution of corticolous and epixylic species is shown in Table 1.

Comparison of the Bryofloras of Southwest Missouri with Tennessee and the Edward's Plateau of Texas

Geographers and ecologists are always interested in the floristic composition of areas with similar physiognomy. This is no less true for bryologists though comparisons may be more difficult. This is because bryophytes present in an area are easily overlooked or misidentified by even experienced collectors. Thus a comparison of floras may be spurious. This is certainly the case when the species lists being compared are compiled from reports prepared by different collectors. Some authors, particularly Grieg-Smith (1964) consider such comparisons naive when made between areas of different sizes. With these disclaimers in mind, it is still possible, using presence or absence data, to make an approximation of similarity between 2 floras using a Coefficient of Community (Whittaker 1975, Peilou 1979) calculated by the

Table 1. Corticolous and epixylic bryophytes of calcareous cedar glades of Southwest Missouri. c = common; u = uncommon; r = rare

Taxa	Cedars		Hardwoods		Logs
	Base	Trunk	Base	Trunk	
A. Mosses					
<i>Amblystegium varium</i>					r
<i>Anomodon minor</i>			c	c	
<i>Brachythecium acuminatum</i>			r		
<i>Bryum pseudotriquetrum</i>			r		
<i>Campylium chrysophyllum</i>					r
<i>Campylium hispidulum</i>	r		r		
<i>Clasmatodon parvulus</i>	r				
<i>Drummondia prorepens</i>		c	c	c	r
<i>Entodon seductrix</i>	r		c		c
<i>Fabronia ciliaris</i>		c		u	
<i>Fissidens cristatus</i>					r
<i>Fissidens subbasilaris</i>			c		
<i>Haplophymenium triste</i>		c		c	
<i>Homalotheciella subcapillata</i>		r		r	
<i>Leskea gracilescens</i>	u	u	c	c	
<i>Leucodon julaceus</i>		c		c	c
<i>Lindbergia brachyptera</i>		u		c	
<i>Orthotrichum ohioense</i>				u	
<i>Orthotrichum pussillum</i>		c		c	
<i>Orthotrichum stellatum</i>				r	
<i>Platygyrium repens</i>					c
<i>Pylaisiella selwynii</i>		c		c	u
<i>Rhynchostegium serrulatum</i>			u		
<i>Sematophyllum adnatum</i>					r
<i>Thelia asprella</i>	c		c		r
<i>Thelia hirtella</i>		c		c	
<i>Tortella humilis</i>	c		c		u
<i>Tortula pagorum</i>		c		c	
<i>Tortula papillosa</i>		r			
B. Liverworts					
<i>Frullania brittoniae</i>		r			
<i>Frullania eboracensis</i>		c		c	
<i>Frullania riparia</i>	u	u			
<i>Frullania squarrosa</i>				u	
<i>Porella platyphylla</i>		r			
<i>Porella platyphylloidea</i>		u		u	

following equation:

$$\text{Coefficient of Community (CC)} = \frac{2c}{a + b}$$

Where a is the total taxa in 1 community,

b is the total taxa in the comparison community, and

c is the taxa common to both communities.

Two communities that have all taxa in common

will have a CC = 1. If 2 communities share no taxa in common, CC = 0).

A comparison of the bryofloras of calcareous cedar glades of Tennessee, southwest Missouri, and the Edward's Plateau of Texas is shown in Table 2. The taxa listed for southwest Missouri and the Edward's Plateau are based upon my own collections. The taxa listed for Tennessee are based on reports by Quarterman (1947, 1949). From Table 2 the following comparisons are possible:

Table 2. Bryophytes present in the calcareous cedar glades of southwest Missouri, Tennessee, and the Edward's Plateau of Texas

Taxa	Southwest Missouri	Tennessee	Edward's Plateau
Mosses			
<i>Amblystegium serpens</i> (Hedw.) B.S.G.		x	
<i>Amblystegium varium</i> (Hedw.) Lindb.	x	x	
<i>Anomodon attenuatus</i> (Hedw.) Hueb.	x	x	
<i>Anomodon minor</i> (Hedw.) Fuernr.	x	x	
<i>Anomodon rostratus</i> (Hedw.) Schimp.	x	x	
<i>Astomum muhlenbergianum</i> (Sw.) Grout	x		
<i>Atrichum angustatum</i> (Brid.) B.S.G.	x		
<i>Barbula acuta</i> (Brid.) Brid. var. <i>bescherellii</i> (Sauerb. ex Jaeg. & Sauerb) Crum			x
<i>Barbula unguiculata</i> Hedw.	x		
<i>Brachythecium acuminatum</i> (Hedw.) Aust.	x		
<i>Brachythecium oxycladon</i> (Brid.) Jaeg. & Sauerb.	x		
<i>Brachythecium salebrosum</i> (Web. & Mohr.) B.S.G.		x	
<i>Bryoandersonia illecebra</i> (Hedw.) Robins.	x	x	
<i>Bryum argenteum</i> Hedw.	x		
<i>Bryum bicolor</i> Dicks.	x		
<i>Bryum calillare</i> Hedw.	x	x	
<i>Bryum pseudotriquetrum</i> (Hedw.) Gaertn., Meyer & Schreb.	x		x
<i>Bryum billardieri</i> Schwaegr			x
<i>Bryum caespitium</i> Hedw.			x
<i>Campylium chrysophyllum</i> (Brid.) J. Lange	x	x	
<i>Campylium hispidulum</i> (Brid.) Mitt.	x	x	
<i>Ceratodon purpureus</i> (Hedw.) Brid.			x
<i>Clasmatodon parvulus</i> (Hampe) Hook. & Wils.	x	x	
<i>Climacium americanum</i> Brid.		x	
<i>Cryphaea glomerata</i> B.S.G. ex Sull.		x	
<i>Desmatodon plinthobius</i> Sull. & Lesq. ex Sull.	x		
<i>Discranella heteromalla</i> (Hedw.) Schimp.	x		
<i>Dicranum scoparium</i> Hedw.	x	x	
<i>Drummonida prorepens</i> (Hedw.) Britt.	x		
<i>Entodon seductrix</i> (Hedw.) C. Muell.	x	x	
<i>Eurhynchium hians</i> (Hedw.) Sande Lac.	x	x	
<i>Eurhynchium pulchellum</i> (Hedw.) Jenn.	x		
<i>Fabronia ciliaris</i> (Brid.) Brid.	x		x
<i>Fissidens cristatus</i> Wils. ex Mitt.	x	x	
<i>Fissidens osmundoides</i> Hedw.		x	
<i>Fissidens subbasilaris</i> Hedw.	x		
<i>Fissidens taxifolius</i> Hedw.	x	x	
<i>Fissidens viridulus</i> (Sw.) Wahlenb.	x	x	x
<i>Funaria flavicans</i> Michx.	x		
<i>Grimmia alpicola-apocarpa</i> complex	x	x	x
<i>Grimmia laevigata</i> (Brid.) Brid.	x		
<i>Grimmia pilifera</i> P. - Beauv.	x		
<i>Grimmia rauii</i>			x
<i>Grimmia wrightii</i> (Sull.) Aust.			x
<i>Haplocladium virginianum</i> (Brid.) Broth.	x		
<i>Haplohymenium triste</i> (Ces. ex De Not.) Kindb.	x	x	
<i>Hedwigia ciliata</i> (Hedw.) P. - Beauv.	x		
<i>Homalotheciella subcapillata</i> (Hedw.) Broth.	x	x	
<i>Leskea gracilescens</i> Hedw.	x	x	
<i>Leskea obscura</i> Hedw.		x	
<i>Leskeela nervosa</i> (Brid.) Loeske		x	

Table 2. continued

Taxa	Southwest Missouri	Tennessee	Edward's Plateau
<i>Leucobryum glaucum</i> (Hedw.) Angstr. ex Fr.	x	x	
<i>Leucodon brachypus</i> Brid.		x	
<i>Leucodon julaceus</i> (Hedw.) Sull.	x	x	x
<i>Lindbergia brachyptera</i> (Mitt.) Kindb.	x	x	
<i>Mnium affine</i> Bland. ex Funck, var. <i>ciliare</i> C. M.	x		
<i>Mnium cuspidatum</i> Hedw.	x	x	
<i>Orthotrichum diaphanum</i> Brid.			x
<i>Orthotrichum ohioense</i> Sull. & Lesq. ex Aust.	x	x	
<i>Orthotrichum pusillum</i> Mitt.	x	x	
<i>Orthotrichum stellatum</i> Brid.	x	x	
<i>Orthotrichum strangulatum</i> P. -Beauv.	x	x	
<i>Physcomitrium pyriforme</i> (Hedw.) Hampe	x	x	
<i>Platygyrium repens</i> (Brid.) B.S.G.	x	x	
<i>Pleurochaete squarrosa</i> (Brid.) Lindb.	x	x	x
<i>Pylaisiella selwynii</i> (Kindb.) Crum, Steere & Anderson	x	x	
<i>Ptychomitrium incurvum</i> (Schwaegr.) Spruce	x		
<i>Ptychomitrium leibergii</i> Best	x		x
<i>Rhynchosetegium serrulatum</i> (Hedw.) Jaeg. & Sauerb.	x	x	
<i>Sematophyllum adnatum</i> (Michx.) Britt.	x	x	
<i>Sterophyllum radiculosum</i> (Hook.) Mitt.			x
<i>Taxiphyllum deplanatum</i> (Bruch & Schimp. ex Sull.) Fleisch.		x	
<i>Taxiphyllum taxirameum</i> (Mitt.) Fleisch.	x	x	
<i>Thelia asprella</i> Sull.	x		x
<i>Thelia hirtella</i> (Hedw.) Sull.	x	x	
<i>Thuidium recognitum</i> (Hedw.) Lindb.	x	x	
<i>Tortella humilis</i> (Hedw.) Jenn.	x	x	x
<i>Tortula pagorum</i> (Milde) De Not.	x	x	x
<i>Tortula papillosa</i> Wils. ex Spruce	x		
<i>Tortula ruralis</i> (Hedw.) Gaertn. Meyer & Scherb. var. <i>ruralis</i>	x		
<i>Trichostomum jamaicense</i> (Mitt.) Jaegr. & Sauerb.			x
<i>Weissia controversa</i> Hedw.	x	x	x
<i>Weissia ligulifolia</i> (Bartr.) Grout			x
Liverworts			
<i>Asterella tenella</i> (L.) P. Beauv.		x	
<i>Cephaloziella</i> sp.		x	
<i>Fossombronina brasiliensis</i> Steph.		x	
<i>Frullania brittoniae</i> Evans	x	x	
<i>Frullania ebolacensis</i> Gott.	x	x	x
<i>Frullania inflata</i> Gott.		x	
<i>Frullania riparia</i> Hampe ex Lehm	x	x	
<i>Frullania squarrosa</i> (Reinw. et al.) Dum.	x	x	x
<i>Lophocolea heterophylla</i> (Schrad.) Dum.	x		
<i>Mannia fragrans</i> (Balbis) Frye & Clark	x	x	
<i>Porella platyphylla</i> (L.) Pfeiff.	x		
<i>Porella platyphylloidea</i> (Schwein.) Lindb.	x	x	

Table 2. continued

Taxa	Southwest Missouri	Tennessee	Edward's Plateau
<i>Radula complanta</i> (L.) Dum.		x	
<i>Reboulia hemisphaerica</i> (L.) Raddi	x		x
<i>Riccia macallisteri</i> M. A. Howe		x	
Total taxa in cedar glades of Tennessee	61		
Total taxa in cedar glades of southwest Missouri	74		
Total taxa in cedar glades of the Edward's Plateau	25		
Taxa common to cedar glades of Tennessee and southwest Missouri	46		
Taxa common to cedar glades of Tennessee and the Edward's Plateau of Texas	9		
Coefficients of Community (CC)			
Southwest Missouri - Tennessee	0.68		
Southwest Missouri - Edward's Plateau	0.30		
Tennessee - Edward's Plateau	0.21		

between the cedar glade floras is proportional to their dissimilarity (1 - CC), the width between the connecting lines is proportional to the CC, and the diameter of the circles is proportional to the total number taxa present. It is obvious that the bryofloras of the calcareous cedar glades of southwest Missouri and Tennessee are much more similar to each other than they are to the bryoflora of the Edward's Plateau of Texas.

The cause for the difference between the bryofloras of Tennessee and southwest Missouri with the bryoflora of the Edward's Plateau appears to be in the difference in the moisture relations of these areas (Table 3). The Edward's Plateau has significantly less precipitation, a much higher mean lake evaporation and over twice as many days when the temperature exceeds 32°C than does southwest Missouri and Tennessee. However, the moisture conditions between Tennessee and southwest Missouri are not that different and probably will not explain the difference between their bryofloras. Furthermore, nearly all the taxa reported in the cedar glades of Tennessee but not from the cedar glades of southwest Missouri do occur in other habitats in southwest Missouri. The same may be said for the taxa reported from the cedar glades of southwest Missouri but not in the cedar glades of Tennessee. In fact, only 1 species, *Ptychomitrium leibergii*, a

These relationships can be visualized in the form of a plexus (Fig. 1.) where the distance

Table 3. Climatic data for southwest Missouri, middle Tennessee, and the Edward's Plateau of Texas. Estimates based on the Climatic Atlas of the United States

Study Location	Mean Lake Evaporation -cm/year	Mean No. Days Temp above 32°C	Avg Ppt - cm		Avg Temp °C	
			May-Sept	Total	Jan	July
Middle Tennessee	96.5	40	45.7	122.0	4.5	25.6
Southwest Missouri	101.2-106.7	40	53.3	101.6	1.1-2.2	24.4-25.6
Edward's Plateau of Texas	172.7-188.0	90-110	33.0	63.5	4.5-10.0	27.8-28.9

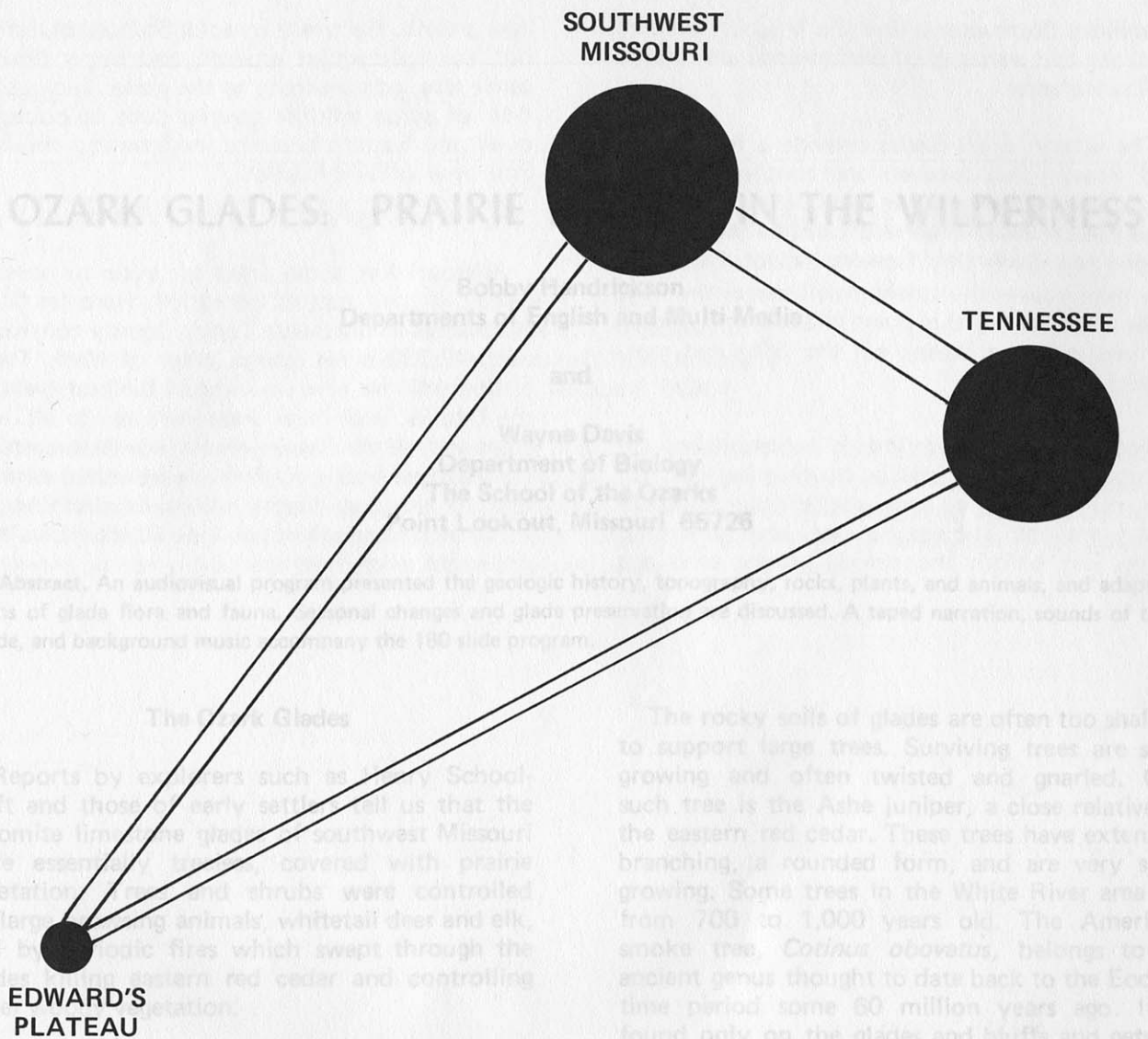


Fig. 1. Plexus diagram of bryophytic floras of calcareous glades of southwest Missouri, Tennessee, and the Edward's Plateau of Texas.

species with a decidedly western distribution, is missing from the bryoflora of Tennessee. It may be that the difference between southwest Missouri and Tennessee cedar glade floras are not significant and are due to the random dispersion of taxa or to insufficient collections. On the other hand, the differences may be significant and due to subtle, yet undetected ecological or geographical factors.

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