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Floristic composition and management of East Texas pitcher plant bogs

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Floristic Composition And Management Of East Texas Pitcher Plant Bogs

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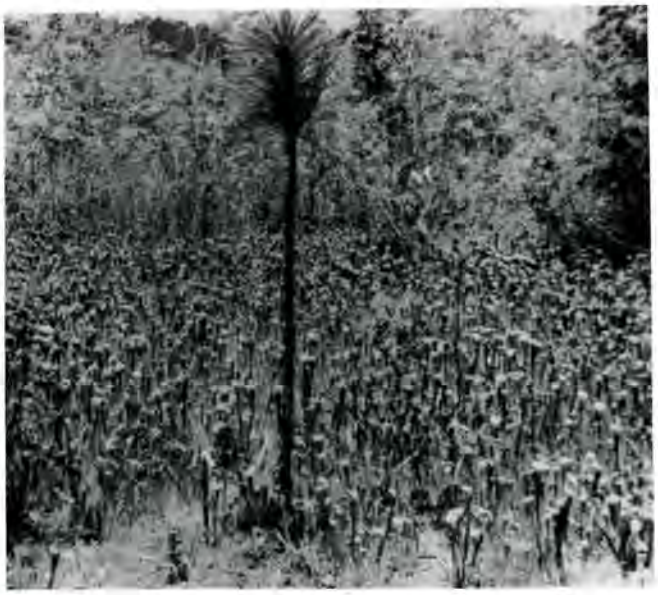
ABSTRACT--Six pitcher plant bog sites in eastern Texas were visited every two weeks from March to November to determine floristic composition. Certain soil characteristics were also determined. The six bogs contained 203 taxa representing 55 families. The mean number of taxa present is 103 with numbers per community ranging from 88 to 116. Plant families with greatest representation are Poaceae (30 taxa), Cyperaceae (26 taxa), and Asteraceae (23 taxa). Indices of similarity indicate that the bogs are quite similar with values ranging from 55 to 78. The management of bogs is discussed in general.

KEYWORDS: *Sarracenia alata*, springs, seepages, fire, soil characteristics.

Pitcher plant bogs, so named because pitcher plants (*Sarracenia* spp.) are a noticeable and interesting component (Folkerts 1982), are fairly common in eastern Texas, especially in the southeastern portion. They are characterized by a variety of plant species, many of which are restricted to this habitat type and many of which produce beautiful flowers and leaves at various times during the growing season. Thus, this assemblage of plants is quite distinct.

Pitcher plant bogs in eastern Texas are usually associated with sandy uplands underlain by impermeable layers of clays developed from tuffaceous and pyroclastic materials. Water percolates downward through the sandy soils to the impermeable clays and then laterally surfacing on the lower slopes of hills. Lateral water movement is usually slow and continuous being little affected by fluctuations in precipitation.

Information is scarce concerning bogs in eastern Texas. Rowell (1949) and Kral (1955) are among the first to describe bogs vegetationally. Rowell (1949) discussed the vegetational composition of a sphagnum bog in Robertson County in southwestern east Texas and Kral (1955) floristically described and compared two hillside bogs in northeastern Texas. Only the Robertson County bog contained *Sarracenia alata*. Although focusing on net aerial primary production, Lodwick (1975) presents some information on the floristics of three west central east Texas peat bogs in Anderson County. More recently, Ajilvsgi (1979) mentions some of the more noticeable species, including *S. alata*, inhabiting wet, acid bogs in the Big Thicket of southeastern Texas. The present study was performed to help characterize east Texas bogs.



METHODS

Study Sites

Soils and Climate--Two geologic formations of greatest importance associated with east Texas pitcher plant bogs are the Willis and Catahoula. The Catahoula is the oldest, originating during the Miocene Epoch of the Tertiary Period. The Willis Formation, which usually overlies the Catahoula, is of Pleistocene origin during the Quaternary Period. The Willis sands essentially provide the water source and the Catahoula clays the impermeable layer

causing lateral movement of water. Soils of the pitcher plant areas are generally considered to be wet alfisols.

The more upland sandy sites associated with pitcher plant bogs are usually savannah-like with pines dominating the overstory. Shrubs and small hardwood trees occur occasionally throughout the sites. Pines present are mostly longleaf (*Pinus palustris*), with shortleaf (*P. echinata*), slash (*P. elliottii*) and loblolly (*P. taeda*) also present. Little bluestem grass (*Schizachyrium scoparium*) is a common herbaceous layer component.

Larkin and Bomar (1983) place the eastern third of Texas within a Subtropical Humid region most noted for its warm summers. Average annual precipitation at the study site areas is about 119 cm. Average monthly precipitation at these sites is fairly evenly distributed, ranging from about 8 to 11 cm with slight highs occurring during April, May and December. Average annual low temperature is 12 degrees C, while average annual high temperature is 26 degrees C.

Location and Description--The six pitcher plant bog sites are generally located along the Angelina-Jasper county line, with three bogs located in Angelina County and three in Jasper County. The two westernmost bogs are within the Upland Island wilderness area just south of Zavalla, Texas. The remaining four extend eastward within the Angelina National Forest to near Sam Rayburn Reservoir. With the exception of communities 2 and 3, the sites are some distance apart. Communities 2 and 3 are actually part of the same bog but a road transects the site causing the upper portion to pond. Thus, the habitats are somewhat different.

The pitcher plant bogs studied by us are generally of two types. Spatulate shaped simibasins with seepages and springs occurring on three sides and drained on the lower side by small streams, and single slopes with springs and seepages drained by small creeks. Three bogs, communities 1, 2 and 3 are designated basin bogs and three (communities 4, 5 and 6) as slope bogs. The basin bogs are generally characterized by having fringe, marshy areas composed primarily of herbaceous heliophytes which grade into central areas consisting of shrubs and small trees. Shrubs are usually more prevalent on the wooded margins. Slope bogs are generally marshy with scattered individuals, patches or rows of shrubs and trees. Shrubs and trees occurring on these six sites are oftentimes broadleaved evergreens; pines occur occasionally. Vines are common and frequently dominate portions of the canopy. All six bogs contain sphagnum moss. Communities 1 and 4 contain outcrops of rock (Catahoula mudstone). Aspect for the bog communities is west, south and southwest with slope ranging from 5 to 30%. None are considered savannah bogs, which are characterized by little relief.

Techniques--To determine floristic content of the six pitcher plant bogs, plants were collected, as they flowered, beginning in March and ending the last of October. Bogs were sampled every two weeks. Soil samples from the upper 15 cm of the soil were also taken. Soils were analyzed by the Stephen F. Austin State University Soil Testing Laboratory. Exchangeable ions were determined by atomic absorption spectrophotometry, organic matter content by loss on ignition and textural class by the hydrometer method.

Species richness, presence and index of similarity were used to determine the extent of floristic similarity among the six communities. Species richness is defined as the number of species present in a community, whereas presence is defined as the percentage of occurrence of species in communities of different size (Daubenmire 1968). It should be noted, however, that the communities were generally of similar size. Sorensen's index of similarity was used to compare communities following the formula IS = (2C/A+B)X100, where C is the number of species in common to the two communities, A is the total number of species in community A, and B is the total number of species in community B.

Scientific nomenclature follows Correll and Johnston (1970) and Gould (1975).

RESULTS

Soils

Soils are generally similar among the six bog sites (Table 1). Community 4, a hillside bog, has the highest pH (5.3) and contains higher concentrations of exchangeable Ca and Mg. The pH ranged from 4.3 to 4.7 at the other five sites. Organic matter content ranged from 2.2% to 5.8%. Texturally, soils are clays or sandy clay loams.

Plants

Plants began flowering in the pitcher plant bogs in March. The number of taxa flowering increased in April and May and then remained fairly constant through July. A peak flowering period occurred during August and September.

A total of 203 taxa, representing 118 genera and 55 families, was recorded for the six bog sites. The mean number of taxa for the six bog communities is 103, ranging from 88 taxa at community 5 to 116 at community 1. Four bogs had over 100 taxa present.

Species that are present in five or more bogs are presented in Table 2. Plant families with the greatest representation are Poaceae (30 taxa), Cyperaceae (26 taxa) and Asteraceae (23 taxa). Other families have less than eight representatives. Insectivorous species of four genera are present--*Sarracenia* (pitcher plants), *Drosera* (sundews), *Pinguicula* (Butterworts), and *Utricularia* (bladderworts).

Indices of similarity indicate that the bogs are vegetationally similar (Fig. 1). Indices averaged 65.5 and ranged from 55 to 78. As might be expected, communities 2 and 3, which are next to each other, are most similar (IS = 78). When averaged within, slope and basin communities displayed the same average index of similarity (IS = 68 for each group). Average similarities between slope and basin communities is slightly lower (IS

Table 1. Soil Characteristics (Upper 15 cm) of Six Pitcher Plant Bog Sites.

Site	pH	Exchangeable Ions (ppm) P	K	Ca	Mg	OM %	Sand %	Silt %	Clay %	Texture Class
Basin communities										
Community 1	4.6	4	30	372	85	2.3	60	16	24	Sandy clay loam
Community 2	4.6	4	32	254	72	5.8	26	24	50	Clay
Community 3	4.7	4	31	200	63	5.3	22	32	46	Clay
Slope communities										
Community 4	5.3	1	76	670	283	4.0	60	15	25	Sandy clay loam
Community 5	4.6	3	8	146	38	2.2	20	16	64	Clay
Community 6	4.3	4	19	150	48	5.5	22	20	58	Clay

Table 2. List of Species in the Six Bogs with Presence[1] Values Greater Than 80 Percent.

Ferns
- *Osmunda cinnamomea*

Angiosperms
- Trees
  - *Acer rubrum*
  - *Magnolia virginiana*
  - *Persea borbonia*
- Shrubs
  - *Ascyrum hypericoides*
  - *Ascyrum stans*
  - *Myrica heterophylla*
  - *Pyrus arbutifolia*
  - *Rhus vernix*
  - *Rubus louisianus*
  - *Vaccinium arkansanum*
  - *Viburnum nudum*
- Woody vines
  - *Gelsemium sempervirens*
  - *Smilax laurifolia*
- Herbs
  - *Agalinis purpurea*
  - *Aletris aurea*
  - *Aster dumosus*
  - *Calopogon pulchellus*
  - *Carex glaucescens*
  - *Centella asiatica*
  - *Coreopsis linifolia*
  - *Drosera capillaris*
  - *Eleocharis tuburculosa*
  - *Eriocaulon decangulare*
  - *Eriocaulon texensis*
  - *Eryngium integrifolium*
  - *Eupatorium leucolepis*
  - *Eupatorium rotundifolium*
  - *Fuirena squarrosa*
  - *Helianthus angustifolius*
  - *Heterotheca graminifolia*
  - *Hypoxis hirsuta*
  - *Liatris pycnostachya*
  - *Lobelia reverchonii*
  - *Marshallia tenuifolia*
  - *Paspalum floridanum*
  - *Pinguicula pumila*
  - *Pogonia ophioglossoides*
  - *Polygala mariana*
  - *Polygala ramosa*
  - *Ptilimnium capillaceum*
  - *Rhexia mariana*
  - *Sarracenia alata*
  - *Scutellaria integrifolia*
  - *Spiranthes vernalis*
  - *Utricularia cornuta*
  - *Viola primulifolia*
  - *Xyris ambigua*

[1] Presence is defined as the percentage of occurrence of species in communities of dissimilar size.

= 64). Basin communities have a slightly higher species richness, averaging 106 taxa. Slope communities averaged 98. Species in common among the six bogs ranged from 54 to 80.

DISCUSSION

Soils

Pitcher plant bog soils of the Gulf Coast Plain are typically sands, loamy sands or sandy loams (Pullen and Plummer 1964, Folkerts 1982). Thus, the high clay content of eastern Texas bog soils is of interest. Hillside bog sites in eastern Texas are usually characterized by having a few inches of sand overlying the more impermeable clay. Because we sampled to a depth of 15 cm, we sampled both the sand and clay layers resulting in a higher clay content.

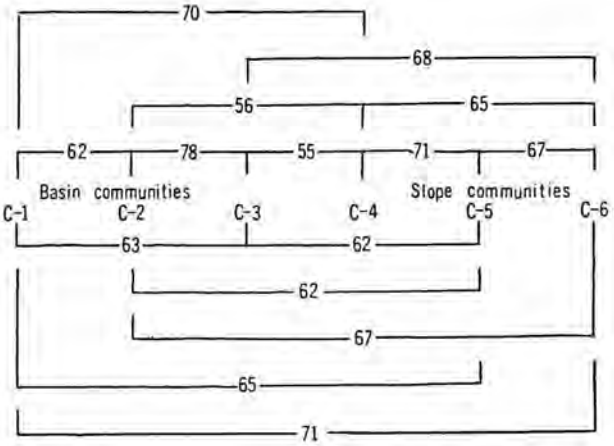


Figure 1. Community coefficients of similarity of six pitcher plant bogs in eastern Texas.

Organic matter content varies among bogs, depending on the type of bog and sample location. In eastern Texas, both Rowell (1949a, 1949b) and Kral (1955) indicated high amounts of organic matter in various portions of the bogs they studied. Organic matter content in bogs we studied was not high (2.2 to 5.8%). Generally, organic matter accumulation is small in Gulf Coast bogs due to frequent fires (Folkerts 1982). The bogs we studied have been subjected to fire and, in addition, are hillside which could result in less accumulation of organic materials.

Pitcher plant bogs are generally acid bogs. Soils usually range in pH from 3.5 to 5.0 (Schnell 1982, Folkerts 1982). The bog soils of our study generally fall within this range. Acidity evidently results from activity of mineral components of the soil as well as from organic acids (Folkerts 1982).

Nutrient content, in regard to those analyzed in our study, is generally low in pitcher plant bog soils (Plummer 1963, Schnell 1982). However, Eleutarius and Jones (1969), upon examining bog soils in Mississippi, did not find deficiencies in N, P or K. East Texas bog soils do not

appear to be deficient, any more than other acid east Texas soils in regard to P, K, Ca and Mg. Soils of a mesic beech forest in east Texas have 50 ppm Ca, 4 ppm P, 28 ppm K, and 10 ppm Mg (Nixon *et al.* 1980b). Wet, creek branch soils have 207 ppm Ca, 45 ppm K and 96 ppm Mg (Nixon *et al.* 1980a). Our bog soils averaged 295 ppm Ca, 3 ppm P, 33 ppm K, and 98 ppm Mg.

Plants

After the initial flowering flush in March and April, the number of plants flowering remains somewhat constant from May through July. A peak flowering period occurs during August and September. Eleuterius and Jones (1969) noted peak flowering periods during June and August in southern Mississippi bogs. Lodwick (1975) indicates that peak production periods occur during spring and fall in west central east Texas bogs.

Although number of taxa inhabiting bogs varies considerably, depending on size, type, degree of disturbance, etc., some comparisons can be made. We recorded 203 taxa, representing 118 genera and 55 families, for the six east Texas bogs. Lodwick (1975), in his work with eastern Texas bogs, presents a partial listing of bog species. Eighty-one percent of the families, 63% of the genera, and 45% of the species that Lodwick (1975) lists, are present in bogs of our study. The two hillside bogs Kral (1955) studied in eastern Texas have 44% of their species in common with bogs we sampled. Eleuterius and Jones (1969) list 271 taxa, representing 134 genera and 63 families, occurring in south Mississippi bogs. Eighty-seven percent of the families, 65% of the genera, and 44% of the species located in our six east Texas bogs occur in the Mississippi bogs. Therefore, floristic composition of east Texas bogs is somewhat similar to those eastward.

There also appears to be some consistency in regard to plant families with greatest representation. The Poaceae (30 taxa), Cyperaceae (26 taxa) and Asteraceae (23 taxa) contained the largest number of bog species in eastern Texas. Most represented plant families in south Mississippi bogs were Asteraceae (54 taxa), Poaceae (27 taxa), and Cyperaceae (27 taxa) (Eleuterius and Jones 1969). The Liliaceae and Orchidaceae families have 11 and 10 taxa, respectively, in Mississippi. In South Carolina pine savannahs, which at times have *Sarracenia* species present, the Asteraceae (29 taxa), Poaceae (12 taxa), Cyperaceae (12 taxa), and Orchidaceae (10 taxa) families are most represented based on number of species (Gaddy 1982).

MANAGEMENT

In general, pitcher plant bog species are heliophytes which are capable of tolerating fire and water saturated soils (Pullen and Plummer 1964). Plant succession on bog sites appears to be towards a sedge-woody species community (Eleuterius and Jones 1969). Therefore, factors which result in the retardation of shrub, tree and woody vine growth, in the maintenance of soil acidity coupled with low nutrient levels (to inhibit the invasion of competing species), in the sustaining of anaerobic soil conditions and in the sustenance of periodic fire, are important in arresting succession (Folkerts 1982). The most important of these factors seems to be fire. Its absence, regardless of other situations, results in the eventual elimination of bog species (Folkerts 1982).

Because natural fires (and fires possibly caused by native peoples) have arrested succession in the past, authors refer to pitcher plant communities as a "fire type" vegetation (Eleuterius and Jones 1969) or as fire subclimax or fire disclimax (Folkerts 1982). They could also be called a fire climax community. The key to a fire climax is fire frequency (Barbour *et al.* 1980). Fires every 5 - 10 years will generally select against woody invaders.

Fire results in a number of favorable conditions for bog maintenance. Not only does fire eliminate woody and other competitors, it also releases some nutrients bound up in organic matter (Pullen and Plummer 1964, Schnell 1982). There is some question, however, as to the overall benefit of fire in regard to nutrient release. Both N and K volatilize and thus may not increase in availability following fires. The addition of N-P-K to bog sites by Eleuterius and Jones (1969) did not increase production. It should also be noted that loss of organic matter by burning may result in a concomitant loss of cation exchange capacity that characterizes organic matter (Barbour *et al.* 1980).

Schnell (1982) feels that the primary value of fire in regard to *Sarracenia* is release from competition and that the most significant competitive factor is shade. Eleuterius and Jones (1969) compared an unburned bog, dominated by sedges, with one which had been recently burned. *Sarracenia* plants growing in the burned bog were more vigorous, having larger leaves and rhizomes than those on the unburned site. Fire increased both productivity and species richness. Schnell (1982) was also able to observe the effects of clearing on *Sarracenia*. Those growing in dense brush grew poorly, except in rare small openings, whereas the effects of clearing resulted in an exuberant growth release of *Sarracenia* and an increase in seedling activity. In summary, to maintain pitcher plant bogs in wilderness areas, it is extremely important that we understand the vital role that fire plays in maintaining this ecosystem.

The maintenance of a high moisture level in bogs is also critical. Ditches as shallow as 2 dm can cause drying of surface soils in savannah type bogs. The plowing of fire lanes to restrict fires to bogs may thus be hazardous to bog species. Other damaging factors include over collecting and destruction of bog plants by grazing and trampling. In addition, heavy livestock usage on some adjacent upland longleaf pine sites could contribute to a decline in percolation and seepage due to soil compaction. Also, clearcutting of uplands associated with bog sites could result in erosional soil movement onto bog sites, eliminating many species and changing habitat conditions. Pitcher plant bogs are extremely fragile systems.

There is concern in regard to conservation and preservation of pitcher plant bogs throughout the eastern United States. Not a whole lot of effort has been put forth. Pullen and Plummer (1964) indicate that many bog sites have been drained, cleared and burned for pasture as well as other uses. Eastern Texas is no exception. On the other hand, many pitcher plant bogs are being preserved and maintained in eastern Texas. They are present in some of our wilderness areas, in the Big Thicket National Preserve, and in Nature Conservancy holdings. Some are fenced or otherwise preserved in our National Forests and on private land. Thus, many are presently preserved as a part of eastern Texas' natural heritage.

LITERATURE CITED

Ajilvsgi, G. 1979. Wild flowers of the Big Thicket, east Texas, and western Louisiana. Tex. A&M Univ. Press, College Station, Tex.

Barbour, M.G., J.H. Burk and W.K. Pitts. 1980. Terrestrial plant ecology. The Benjamin/Cummings Publishing Company, Inc., Menlo Park, Calif.

Correll, D.S. and M.C. Johnston. 1970. Manual of the vascular plants of Texas. Univ. Tex. at Dallas, Richardson, Tex.

Daubenmire, R. 1968. Plant Communities - a textbook of plant synecology. Harper and Row, Publishers, New York, New York.

Eleuterius, L.N. and S.B. Jones, Jr. 1969. A floristic and ecological study of pitcher plant bogs in south Mississippi. Rhodora 71:29-34.

Folkerts, G.W. 1982. The Gulf Coast pitcher plant bogs. Am. Sci. 70:261-267.

Gaddy, L.L. 1982. The floristics of three South Carolina pine savannahs. Castanea 47:393-402.

Gould, F.W. 1975. The grasses of Texas. Tex. A&M Univ. Press, College Station, Tex.

Kral, R. 1955. A floristic comparison of two hillside bog localities in northeastern Texas. Field and Lab. 23:47-69.

Larkin, T.J. and G.W. Bomar. 1983. Climatic atlas of Texas. Tex. Dep. of Water Res., Austin, Tex.

Lodwick, L.N. 1975. Net aerial primary production of three east Texas bogs. Master's Thesis, Baylor University, Waco, Tex.

Nixon, E.S., J.W. Higgins, P.L. Blanchette and F.A. Roth. 1980a. Woody vegetation of a wet creek branch in east Texas. Tex. J. Sci. 32:337-341.

Nixon, E.S., K.L. Marietta, R.O. Littlejohn and H.B. Weyland. 1980b. Woody vegetation of an American beech (*Fagus grandifolia*) community in eastern Texas. Castanea 45:171-180.

Plummer, G.L. 1963. Soils of the pitcher plant habitats in the Georgia Coastal Plain. Ecology 44:727-734.

Pullen, T. Jr., and G.L. Plummer. 1964. Floristic changes within pitcher plant habitats in Georgia. Rhodora 66:375-381.

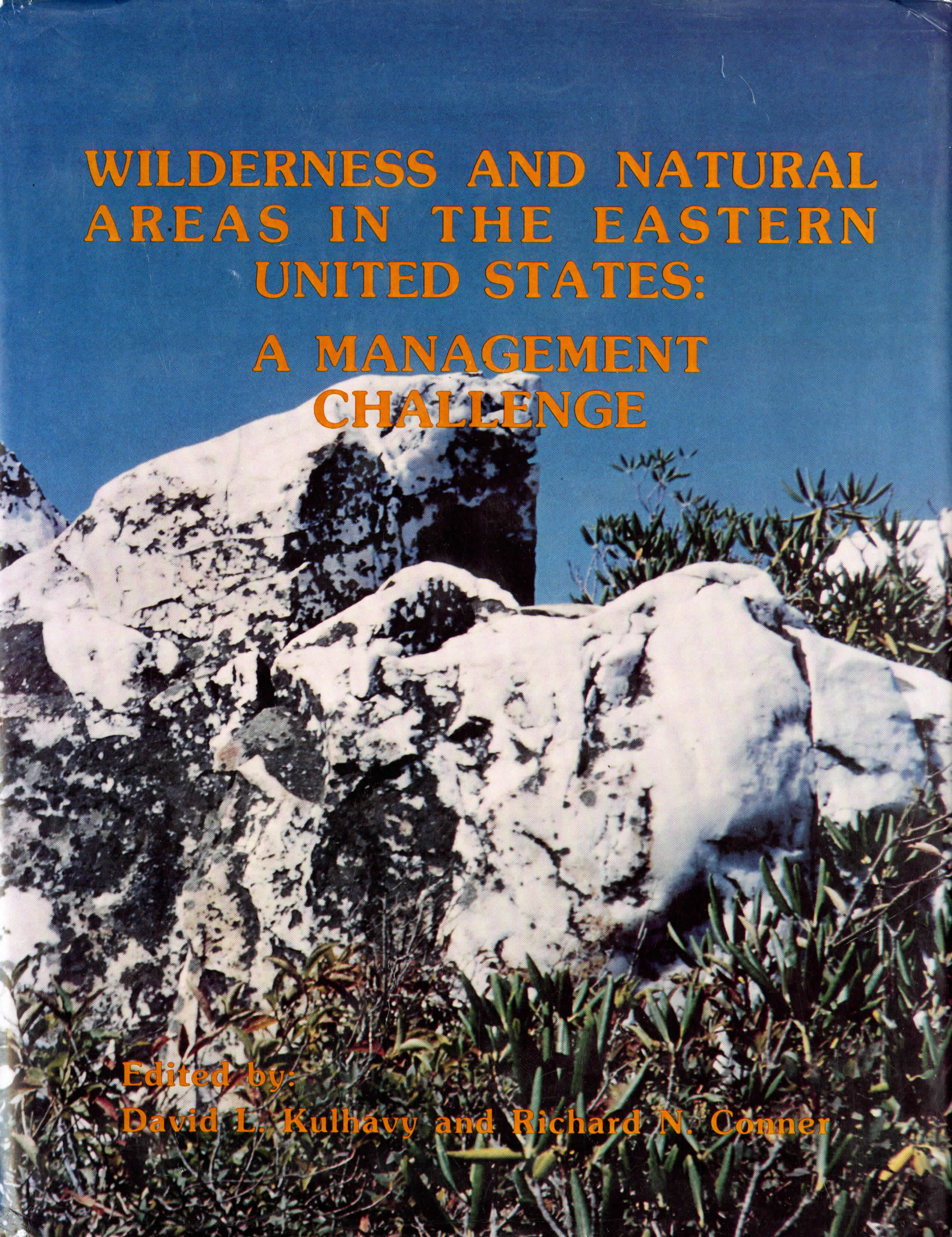
Rowell, C.M., Jr. 1949a. A preliminary report on the floral composition of a *Sphagnum* bog in Robertson County. Tex. J. Sci. 1:50-53.

Rowell, C.M., Jr. 1949b. Floral composition of a *Sphagnum* bog in Robertson County, Texas. Master's Thesis, Tex. A&M Univ., College Station, Tex.

Schnell, D.E. 1982. Effects of simultaneous draining and brush cutting on a Sarracenia L. population in a southeastern North Carolina pocosin. Castanea 47:248-260.

WILDERNESS AND NATURAL AREAS IN THE EASTERN UNITED STATES:

A MANAGEMENT CHALLENGE



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