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SNAIL SHELL CAVE SINKHOLE: A MICROHABITAT[1]

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ABSTRACT

The sinkhole of Snail Shell Cave, Rutherford County, Tennessee was studied with attention being given to a comparison of the physical factors and vegetation of the sinkhole and the surrounding area. The lower elevations were found to be more humid and have lower soil and air temperatures in the summer as well as a greatly reduced light intensity. Thirty out of 69 species of vascular plants of the immediate area occurred at the lower elevations only.

INTRODUCTION

The sinkhole area surrounding the entrance to Snail Shell Cave represents a local environment which contrasts greatly with the surrounding flat terrain. The purpose of this study is to analyze certain aspects of these environments and to correlate with these the vegetation.

No papers dealing with the ecology of angiosperms of the sinkhole or immediately surrounding area have been found. Sharp (1939) and Shaver (1954) each mention the occurrence of one or more species of bryophytes and ferns respectively. The sinkhole has been used as a study area for biology classes from colleges of Middle Tennessee. It is hoped that these findings will enhance the value of the area for such ecological study.

DESCRIPTION OF THE AREA

Snail Shell Cave is located in Rutherford County, Tennessee, 15 miles southwest of Murfreesboro and 1.7 miles north of Rockvale at an elevation of 700 feet, latitude 35° 46′ 56″ N. and longitude 86° 31′ 12″ W. Barr (1961) described the physical aspects of the cave and noted that it is one of the most extensive cave systems known in Tennessee. The sinkhole accompanying the cave is nearly one hundred feet deep and approximately one hundred-fifty feet wide at its widest point. The walls are nearly vertical at many places, especially on the southwest side. On this side at the bottom of the sinkhole is located a stream which, after leaving one mouth of the cave, flows into a larger mouth of the cave some 25 feet away. The flow of water is continuous throughout the year but is greatest during the winter and spring months when it reaches a depth of approximately one foot and a width of 5-6 feet. Contributing to the stream is a small waterfall which originates from a spring 40 feet above the mouth.

The sinkhole has been subject to regular human visitation for many years. Reports of local residents mention the existence of a dance floor near the bottom several decades ago.

METHODS

Observation of the sinkhole began in the fall of 1965 and extended through the fall of 1966. Recordings of soil and air temperatures and relative humidity readings were made at four microclimatic stations located approximately equidistant vertically. Station 1 was at the margin of the depression and therefore reflects the conditions of the area surrounding the sinkhole. Station 2 was about one-third of the way to the bottom; Station 3, about two-thirds down; and Station 4 at the bottom of the depression at stream level.

Measurements were taken within thirty minutes of noon, one to three times per month (always at least a week apart) beginning November 1965 and extending through October 1966.

Soil temperatures were taken by a soil thermometer extending two inches into the ground. Air temperatures and relative humidity readings were determined by a sling psychrometer six feet above the ground.

TABLE I

MONTHLY VARIATIONS IN AVERAGE NOON SOIL TEMPERATURES (°F) AT FOUR MICROCLIMATIC STATIONS

Month	Sta. #1 (Entrance)	Sta. #2 (⅓ Down)	Sta. #3 (⅔ Down)	Sta. #4 (Bottom)
November ('65)	60	56	58	50
December	48	45	43	40
January ('66)	43	44	38	37
February	39	37	35	37
March	53	55	53	53
April	58	52	54	54
May	63	65	63	55
June	81	74	68	60
July	82	75	70	62
August	72	71	69	60
September	74	69	66	60
October	69	64	58	50

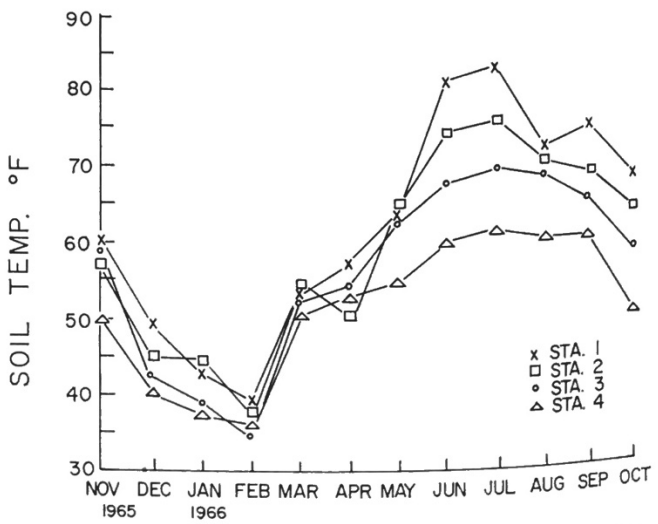

Figure 1. Monthly variations in average noon soil temperatures (°F) at four microclimatic stations.

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TABLE II

MONTHLY VARIATIONS IN AVERAGE NOON AIR TEMPERATURES (°F) AT FOUR MICROCLIMATIC STATIONS

Month	Sta. #1 (Entrance)	Sta. #2 (⅓ Down)	Sta. #3 (⅔ Down)	Sta. #4 (Bottom)
November ('65)	65	64	61	53
December	42	44	37	37
January ('66)	41	44	32	32
February	38	40	33	33
March	72	65	58	58
April	65	68	65	60
May	80	77	72	65
June	93	88	81	69
July	88	86	82	68
August	78	79	77	64
September	79	77	71	63
October	72	74	67	60

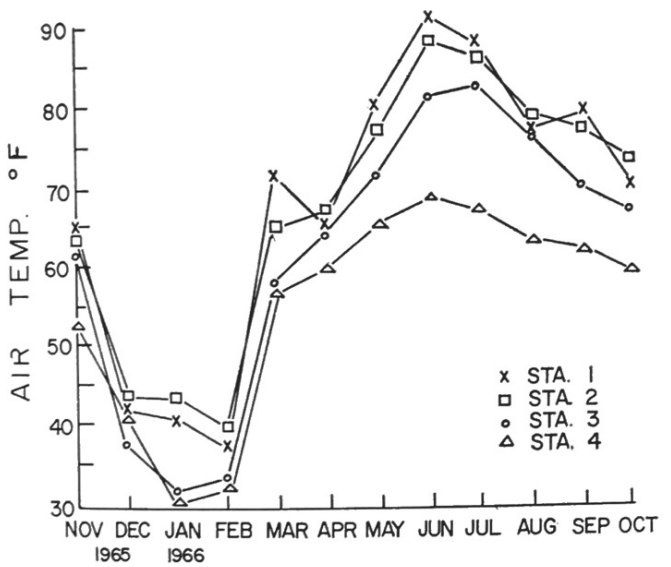

Figure 2. Monthly variations in average noon air temperature (°F) at four microclimatic stations.

TABLE III

MONTHLY VARIATIONS IN AVERAGE NOON RELATIVE HUMIDITY (%) AT FOUR MICROCLIMATIC STATIONS

Month	Sta. #1 (Entrance)	Sta. #2 (⅓ Down)	Sta. #3 (⅔ Down)	Sta. #4 (Bottom)
November ('65)	45	48	56	68
December	69	63	71	68
January ('66)	39	36	43	43
February	83	69	59	83
March	51	66	66	69
April	35	38	37	54
May	45	52	65	85
June	38	43	64	90
July	52	57	61	85
August	71	64	74	95
September	42	50	65	90
October	49	48	62	81

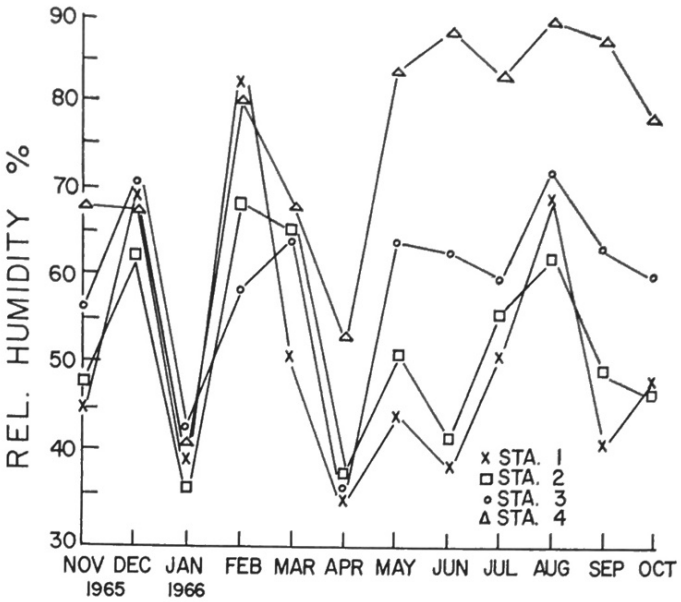

Figure 3. Monthly variations in average noon relative humidity (%) at four microclimatic stations.

No measurements of light intensity were made. However, it was noted that Stations 3 and 4 are shaded except for two or three hours at mid-day.

Herbaceous angiosperms were collected and identified as they flowered during the spring and summer of 1966. Ferns were also taken during this time. These plants were deposited in the herbarium of Middle Tennessee State University. The incidence of trees and shrubs were recorded. Names of plants follow the nomenclature of Gray's Manual of Botany, 8th edition (Fernald, 1950).

RESULTS

Physical factors. Average noon soil temperatures at each of the four microclimatic stations for each of twelve months were calculated (Fig. 1 and Table I). Notable is the fact that the highest average monthly reading (July) for the lowest station (4) is only 62 F as compared to 82 F for the highest (1). This difference continues into the fall. Little or no significant differences, however, occur in winter and spring temperatures.

The air temperature data (Fig. 2 and Table II) indicate that cool summer temperatures occur at the lower stations which contrast with warmer temperatures of the upper stations. Winter temperatures were also cooler at the lower stations.

Relative humidity data (Fig. 3 and Table III) indicate that during the summer and fall lower elevations are distinctly more humid. During the winter, readings at the four levels were rather close.

Vegetation. The vascular plants of the sinkhole area were identified and grouped on the basis of their location relative to microclimatic Station 2. Plants occurring below this station were assumed to be influenced by the more humid and cooler conditions prevalent during the summer. Those found above this station

must endure a climate little different from that of the surrounding area. In this study, peripheral plants occurring within ten feet of the edge of the depression were included as a part of the upper group.

TABLE IV

LIST OF FERNS ACCORDING TO ELEVATION

	Below Sta. #2	Above Sta. #2
1. *Woodsia obtusa* (Spreng.) Torr.	X	X
2. *Athyrium pycnocarpon* (Spreng.) Tidest.	X	
3. *Camptosorus rhizophyllus* (L.) Link	X	
4. *Asplenium platyneuron* (L.) Oakes	X	X
5. *Pellaea atropurpurea* (L.) Link	X	X
6. *Cheilanthes lanosa* (Mitchx.) D.C. Eaton		X
7. *Adiantum Capillus-Veneris* L.	X	
8. *Polypodium polypodioides* (L.) Watt	X	

A total of eight species of fern was recorded; of these, seven occur below Station 2 with only four above this level (Table IV). Four species at the lower elevations did not occur at the higher. This later group of four fern species is the most significant group—it includes those for which the sink serves as an oasis. These are *Athyrium pycnocarpon, Camptosorus rhizophyllus, Adiantum Capillus-Veneris,* and *Polypodium polypodioides.*

TABLE V

LIST OF HERBACEOUS ANGIOSPERMS ACCORDING TO ELEVATION

	Below Sta. #2	Above Sta. #2
1. *Uniola latifolia* Michx.		X
2. *Arisaema atrorubens* (ait) Blume var. *zebrium* (Sims) Fern.	X	
3. *Erythronium americanum* Ker.	X	
4. *Sisyrinchum* sp. L.	X	
5. *Pilea pumila* (L.) Gray	X	
6. *Asarum canadense* L.	X	
7. *Arenaria stricta* Michx.		X
8. *Silene virginica* L.		X
9. *Ranunculus recurvatus* Poir	X	
10. *Ranunculus sardous* Crantz		X
11. *Hepatica acutiloba* DC.	X	
12. *Clematis Viorna* L.		X
13. *Dicentra Cucullaria* (L) Bernh.	X	
14. *Dentaria laciniata* Muhl.	X	X
15. *Arabis laevigata* Muhl.	X	
16. *Sedum pulchellum* Michx.		X
17. *Saxifraga virginiensis* Michx .		X
18. *Geum camporum* Jacq.		X
19. *Geum triflorum* Michx.	X	
20. *Trifolium repens* L.	X	
21. *Desmodium Dillenii* Dail.		X
22. *Viola papilionaceae* Pursh.	X	X
23. *Salvia lyrata* L.		X
24. *Monarda Russelina* Nutt.		X
25. *Penstemon canescens* Britt.		X
26. *Veronica serpyllifolia* L.	X	
27. *Houstonia longifolia* Gaertn		X
28. *Eupatorium coelestinum* L.	X	X
29. *Aster* sp. L.		X
30. *Erigeron pulchellus* Michx.	X	
31. *Polymnia canadensis* L.	X	X
32. *Rudbekia triloba* L.	X	
33. *Bidens frondosa* L.	X	X
34. *Senecio Smallii* Britt.	X	
35. *Senecio obovatus* Muhl.	X	X
36. *Taraxacum officinale* Weber	X	

A total of 36 species of flowering herbs (Table V) was identified. Of these, twenty-two species occur below Station 2 with twenty species occurring above this level. Sixteen species were limited to the lower elevations. These are: *Arisaema atrorubens, Erythronum americanum, Sisyrinchum* sp., *Pilea pumila, Asarum canadense, Ranunculus recurvatus, Hepatica acutiloba, Dicentra Cucullaria, Arabis laevigata, Geum camporum, Trifolinm repens, Veronica serpyllifolia, Erigeron pulchellus, Rudbekia triloba, Senecio Smallii,* and *Taraxacum officinale.*

TABLE VI

LIST OF TREES, SHRUBS AND WOODY VINES ACCORDING TO ELEVATION

	Below Sta. #2	Above Sta. #2
1. *Juniperus virginiana* L.		X
2. *Juglans nigra* L.	X	
3. *Carya ovata* (Mill) K. Koch		X
4. *Ostrya virginiana* (Mill) K. Koch	X	X
5. *Quercus Prinus* L.	X	X
6. *Quercus Shumardii* Buckl.	X	X
7. *Ulmus americana* L.	X	
8. *Ulmus atala* Michx.	X	X
9. *Celtis laevigata* Willd.		X
10. *Asimina triloba* (L.) Dunal	X	
11. *Lindera Benzoi* (L.) Blume	X	
12. *Hydrangea arborescens* L.	X	
13. *Cercis canadensis* L.	X	X
14. *Rhus aromatica* Ait.	X	X
15. *Rhus radicans* L.	X	
16. *Acer saccharum* Marsh	X	X
17. *Parthenocissus quininquefolia* (L.) Planch.	X	X
18. *Vitis* L. sp.	X	
19. *Hypericum spathulatus* (Spach) Steud.		X
20. *Cornus florida* L.	X	
21. *Vaccinium* L. sp.		X
22. *Fraxinus americana* L.	X	X
23. *Symphoricarpos orbiculatus* Moench		X
24. *Viburnum prunifolium* L.	X	
25. *Sambucus canadensis* L.	X	

SUMMARY AND DISCUSSION

The lower elevations of Snail Shell Sinkhole possess a summer microclimate which is distinctly cooler and