FINAL REPORT

SECTION 6

ENDANGERED SPECIES ACT

FEDERAL AID PROJECT E-4

STATUS SURVEY AND HABITAT ANALYSIS OF Stenotrema pilsbryi
RICH MOUNTAIN SLITMOUTH (PULMONATA: GASTROPODA)

MAY 1, 1989 thru APRIL 30, 1990

FINAL REPORT

State: Oklahoma **Project Number: E-4**

Project Title: Status Survey and Habitat Analysis of *Stenotrema pilsbryi*, Rich Mountain Slitmouth (Pulmonata: Gastropoda)

ABSTRACT

Rich, Black Fork, Winding Stair, and Kiamichi Mountains of Oklahoma and Arkansas were surveyed for *Stenotrema pilsbryi* between 16 May - 30 May 1989. Vegetation analysis was conducted at both positive and negative sites. Various soil parameters (e.g., soil moisture and calcium concentration) were analyzed from each locality. Populations were not found on Kiamichi Mountain. The eastern and western limits of the species were determined. Populations are known from the north and south face of Rich Mountain. Populations are present on the north face of Black Fork Mountain and the south face is believed to harbor *S. pilsbryi* populations, but this could not be documented. Vegetation and soil characteristics do not seem to be the limiting factors determining the range of this species. The zoogeographic reasons determining the present range is hypothesized.

Program Narrative Objective: Determine the status of *Stenotrema pilsbryi* in areas west of Rich Mountain. Habitat analysis will be carried out at selected sites where *S. pilsbryi* occurs.

INTRODUCTION

Stenotrema pilsbryi (Ferriss) has been surveyed in Arkansas (Caldwell 1988) and Oklahoma (Caldwell 1989). Subsequently, the U.S. Fish and Wildlife listed this species as category 1 (Federal Register 1989). In a cooperative agreement between the Oklahoma Department of Wildlife Conservation, Ouachita National Forest, and U.S. Fish and Wildlife, further survey work was conducted to delineate the boundary of this species' range. Also habitat analysis was conducted which included vegetation and soil parameters.

METHODS AND MATERIALS

Dates of survey were 16 May - 30 May 1989. Sites in both Arkansas and Oklahoma were surveyed. Previous studies (Caldwell *op cit.*) have shown *S. pilsbryi* to be confined to rock glaciers. Rock glaciers or "stone rivers" are a type of talus slope that can develop in areas of severe cold and this type of talus can move slowly downward (Cleland 1929). A point quarter method was utilized in vegetation analysis. In addition a 16 square meter and a 1 square meter quadrant were placed at each point to sample shrub and herb layers, respectively. Trees were defined as woody-stemmed plants equal to or greater than 10 cm dbh. Woody plants less than 10 cm dbh but at least 30 cm tall were considered shrubs. Woody-stemmed plants less than 30 cm tall were considered part of the herb layer. Vernier calipers were used to determine shrub diameter at 10 cm above the ground. In the herb layer, cover was estimated as the percentage a species occupied in the one square meter quadrant. Standard derived measurements of vegetation were density, relative density, frequency, relative frequency, coverage, relative coverage and importance values. These measurements were determined using calculations provided by Brower and Zar (1984). Vegetation was sampled at the boundaries and within ***vegetational islands*** of rock glaciers. Fifty-nine points were sampled at positive sites (*S. pilsbryi* present) and fourteen at negative sites (*S. pilsbryi* not found). Additional sampling at negative sites was desired but because of time constraints was impossible. A composite soil sample made up of ten soil samples was randomly collected from each area. In the laboratory, the composite soil sample, three replicates each were used to calculate soil moisture, loss on ignition, pH, and soil calcium. A 1:1 soil/water soil slurry was used for pH. Calcium levels were determined using a Hach DREL/5 spectrophotometer.

RESULTS AND DISCUSSION

RANGE

Figure 1 shows the known range of *Stenotrema pilsbryi*. It is now known from both north and south faces of Rich Mountain and north face of Black Fork Mountain. Populations

could not be verified on the south face of Black Fork Mountain, although it is believed populations exist there since adequate habitat is available. Figures 2 and 3 show the western-most population in Oklahoma on Winding Stair Mountain (OK-09) and the eastern-most population in Arkansas on Rich Mountain (AR-5). Rock glaciers or talus areas west and east of these localities were searched and no populations were found. Populations were confined to the glacier edges or ***vegetational islands***. Searches were carried out in adjacent woods and no *S. pilsbryi* were found.

SPECIES ASSOCIATES

Nine species of macro-snails were found associated with *S. pilsbryi*. These were *S. labrosum*, *S. leai aliciae*, *S. unciferum*, *Mesodon binneyanus*, *M. zaletus ozarkensis*, *M. inflectus*, *Mesomphix friabilis*, *Ventridens brittsi*, and *Anguispira strongylodes*. Laborious soil separation will have to be completed to determine micro-snail associates.

ZOOGEOGRAPHY

Habitat identical to positive *Stenotrema pilsbryi* sites occur further west on Winding Stair Mountain and Kiamichi Mountain to the south. Less than 5 overland miles separate the latter two mountains at the 1200 foot contour. Then the question becomes why *S. pilsbryi* has not been able to invade these areas.

The answer appears to lie in the faulting and consequent streams of the *S. pilsbryi* area. For a detailed discussion of the geology of the area see Hart (1963) and Seely (1963). Two major thrust faults define this species' range (figure 4). ***Briery Fault*** is at the north base of Black Fork Mountain and runs diagonally southwest to the north base of Rich Mountain below Page, Oklahoma. ***Honess Fault*** is at the north base of Rich Mountain, and merges with Briery Fault at the base of the western end of Rich Mountain. The consequent streams of Briery Creek at the north base of Black Fork Mountain and Big Creek at the north base of Rich Mountain probably connected the two watersheds of these mountains and has acted as corridors of dispersal for *S. pilsbryi*. Present day Briery Creek has been captured by Black Fork. The OK-9

(western-most) locality is at the headwaters of Shawnee Creek which drains into Black Fork in the valley. These streams are in the Poteau River drainage. The ridge above OK-9 is the drainage divide between the Poteau and Kiamichi River drainages (***Shawnee Divide*** of Winding Stair Mountain). *Stenotrema pilsbryi* has not invaded Kiamichi Mountain. To do this populations would have had to spread down the south slope of Rich Mountain, traverse the lowland valley floor and up the headwater streams of Kiamichi. To invade western Winding Stair mountain, they would have had to move down to the valley floor of Black Fork and Rich Mountains, traverse the lowland streams and migrate up the headwater streams draining into the Poteau. So the valleys and river drainage divides have provided the barriers to dispersal for *Stenotrema pilsbryi*.

It is hypothesized that the center of dispersal for *Stenotrema pilsbryi* is the north slope of Rich Mountain. From here, *S. pilsbryi* invaded Black Fork Mountain using the Big Creek corridor. Further, eastern Winding Stair Mountain was invaded via the Big Creek, Black Fork, Shawnee Creek corridor. Populations AR-5 and AR-6 (eastern most localities, figure 2) are the only populations found in the Ouachita River drainage. In the narrow valley between Black Fork Mountain and Rich Mountain the headwaters of the Ouachita River and Big Creek are no more than 0.5 miles apart. It is very possible that *Stenotrema pilsbryi* is in the Ouachita River drainage due to headwater piracy.

VEGETATION ANALYSIS

Results of the vegetational analysis are presented in Tables 1-6. Composition of plant communities at positive and negative sites was similar. A coefficient of similarity was derived by the formula $C = (2W + A+B) \times 100$, where C= coefficient of similarity, A= number of species of one community, B= number of species of the other community, and W= number of species common to both communities (Phillips 1959). Unknowns were not included in this computation. The coefficient of similarity was found to be 61.76%, which indicates that the vegetation at negative and positive sites is relatively similar. Only six of the twenty-seven species found at negative sites were not found at positive sites (Table 7). All eight of the tree species found at

negative sites were found at the positive sites. Of these, *Quercus alba, Quercus rubra, Carya tomentosa, Nyssa sylvatica, Tilia americana* and *Robinia pseudoacacia* are included in the nine most important tree species of positive sites (Table 8). In the shrub layer *Asimina triloba, Toxicodendron radicans, Hamamelis virginiana, Nyssa sylvatica, Acer rubrum* and *Quercus rubra* were common taxa at positive and negative sites having importance values approximating or greater than 0.10. In the herb layer *Polymnia canadensis, Toxicodendron radicans* and *Parthenocissus quinquefolia* were the three most important taxa at positive and negative sites. While additional sampling of negative sites would provide more insight, no plant or plant community was found to be associated with the presence or absence of *S. pilsbryi*. It appears that the vegetation of Black Fork, Rich, and Winding Stair Mountains has no influence on the distribution of *S. pilsbryi*.

SOILS

There were no significant differences between positive and negative sites in milliequivalents/100 grams soil for calcium, soil pH and moisture, and loss on ignition at p=0.05. Table 9 gives the means of these parameters for positive and negative sites. This condition would seem to argue in favor of zoogeographic events shaping the present distribution of *Stenotrema pilsbryi*. Where ***opportunity corridors*** existed, *S. pilsbryi* invaded. Water courses have played a major role in land snail dispersal (Adams 1903, Brooks 1931).

RECOMMENDATIONS

Zoogeography suggests that there are four isolated populations of *Stenotrema pilsbryi*. For purpose of discussion, these are named and grouped by river drainage.

Poteau River Drainage	Ouachita River Drainage
Black Fork Mountain	Ouachita Headwaters
Rich Mountain	
Shawnee Creek	

Major threats to *S. pilsbryi* would be linked to loss of habitat. Forest removal around the rock glaciers or above them in their watershed could cause drying conditions that would reduce or eliminate populations. Any forest removal projects (e.g., harvesting, power lines, road construction, etc.) should take this species into account. Forest buffer zones should be left above and around rock glaciers of the area.

Figures 2 and 3 coupled with Appendix 1 show all known populations studied. Other rock glaciers are found between these sites. Much of Black Fork Mountain in Arkansas has wilderness protection. In Oklahoma most of the available habitat is Forest Service inholding except east of OK-7 and OK-8 in the Stony Creek watershed. Western populations in Oklahoma occur on Forest Service inholding except portions of the Shawnee Creek watershed. Arkansas populations east of AR-1 are on private land. These determinations were made using a map of Ouachita National Forest (western half) inholdings map. These inholdings were current to August 1984.

1. The taxon *Stenotrema pilsbryi* as currently applied should be continued as Category 1 by the USFW.

2. *Stenotrema pilsbryi* should receive an appropriate state category based upon existing habitat in each state. For example, only four localities are known from Arkansas. Two are in the Poteau River drainage and two in the Ouachita River drainage. One locality of the Poteau drainage is the probable type locality (Caldwell 1988). These populations should be protected by the appropriate state and federal agencies. A threatened category would be appropriate at the state level due to the relatively small amount of habitat available.

3. Electrophoretic variation should be assessed within and between all four populations identified. There appears to have been adequate time and geographical barriers to promote speciation.

4. On two rock glaciers of the north face of the Shawnee Divide, a large form *Strenotrema cf. aliciae* was found. This form may be an undescribed species. In light of this, rock glaciers west of the Shawnee Divide should be surveyed for this potential ecological equivalent to *Stenotrema pilsbryi*.

5. USFS Ouachita National Forest. The Ouachita Trail runs through the western-most population (OK-9). The glacier should be reestablished at this point (dimensions are very small) and a small railed foot bridge constructed over the glacier. Interpretive signs would be appropriate.

6. Black Fork Mountain is still in need of survey to define positive and negative sites for middle and eastern sections of the north face, and the south face generally. This could be accomplished with USFS personnel or in conjunction with taxonomic work.

7. Areas within *S. pilsbryi* range with adequate habitat and not currently Forest Service inholding should be given priority in future Forest Service purchase agreements.

8. All federal and state agencies involved should devise an overall monitoring/management plan for the four populations. This would preclude any necessity to federally list *S. pilsbryi* dependent upon taxonomic outcomes.

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Figure 1. Range of *Stenotrema pilsbryi* (black) shown in relation to other mountain ranges in immediate vicinity. The map was drawn using the 1220 foot contour interval as the minimum elevation.

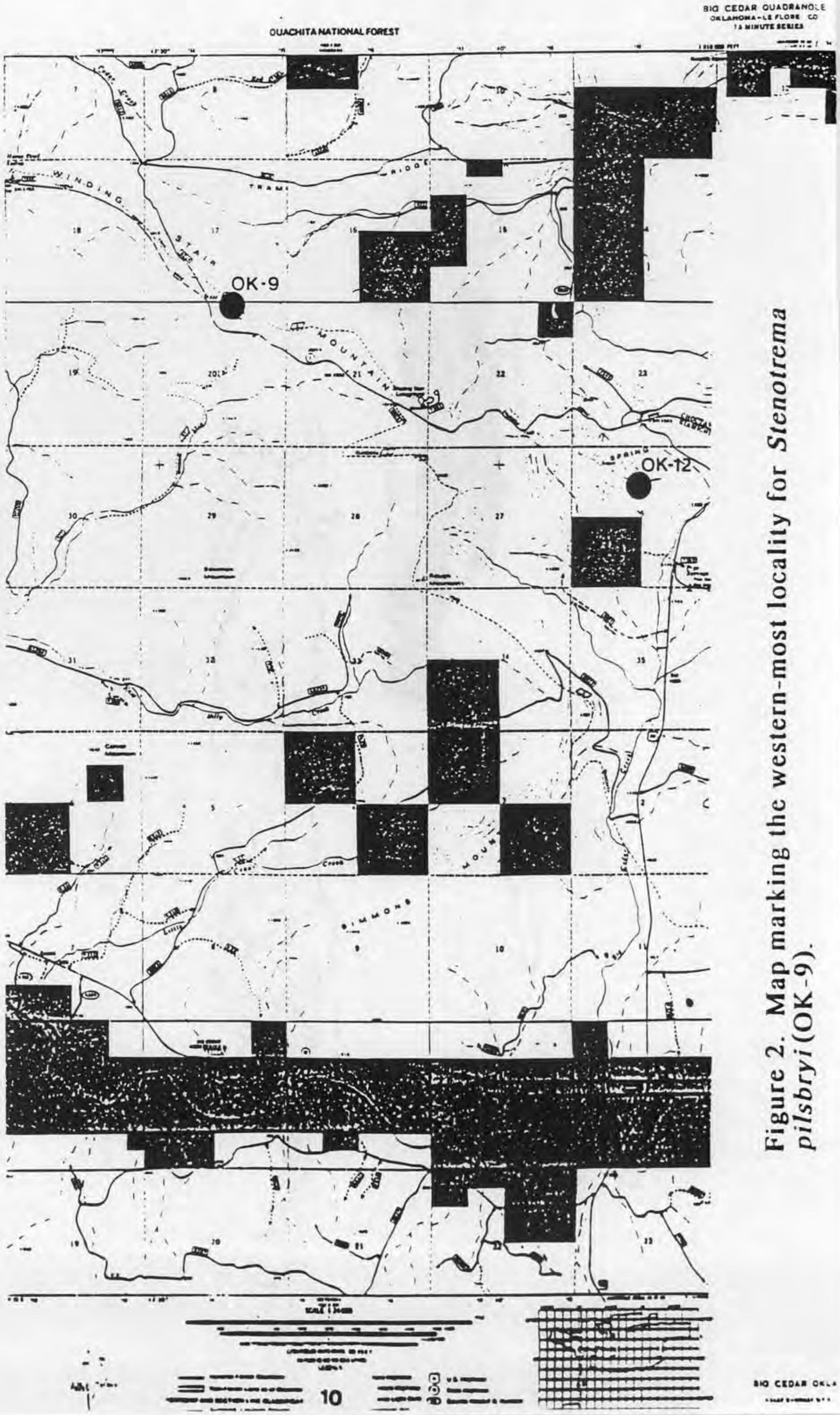


Figure 2. Map marking the western-most locality for *Stenotrema pilsbryi* (OK-9).

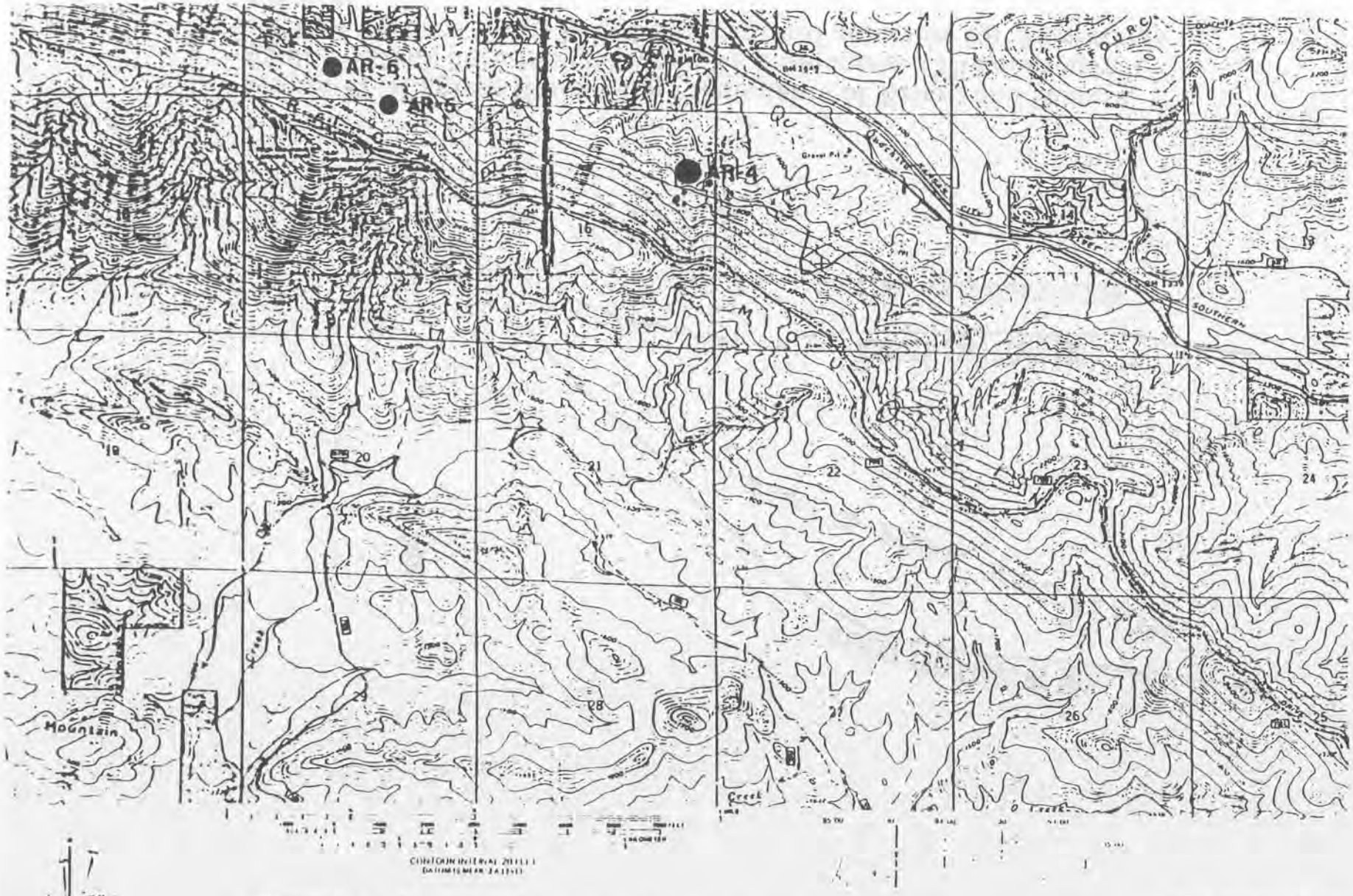


Figure 3. Map marking the eastern-most locality for *Stenotrema pilsbryi* (AR-5)

RICH MOUNTAIN, ARK

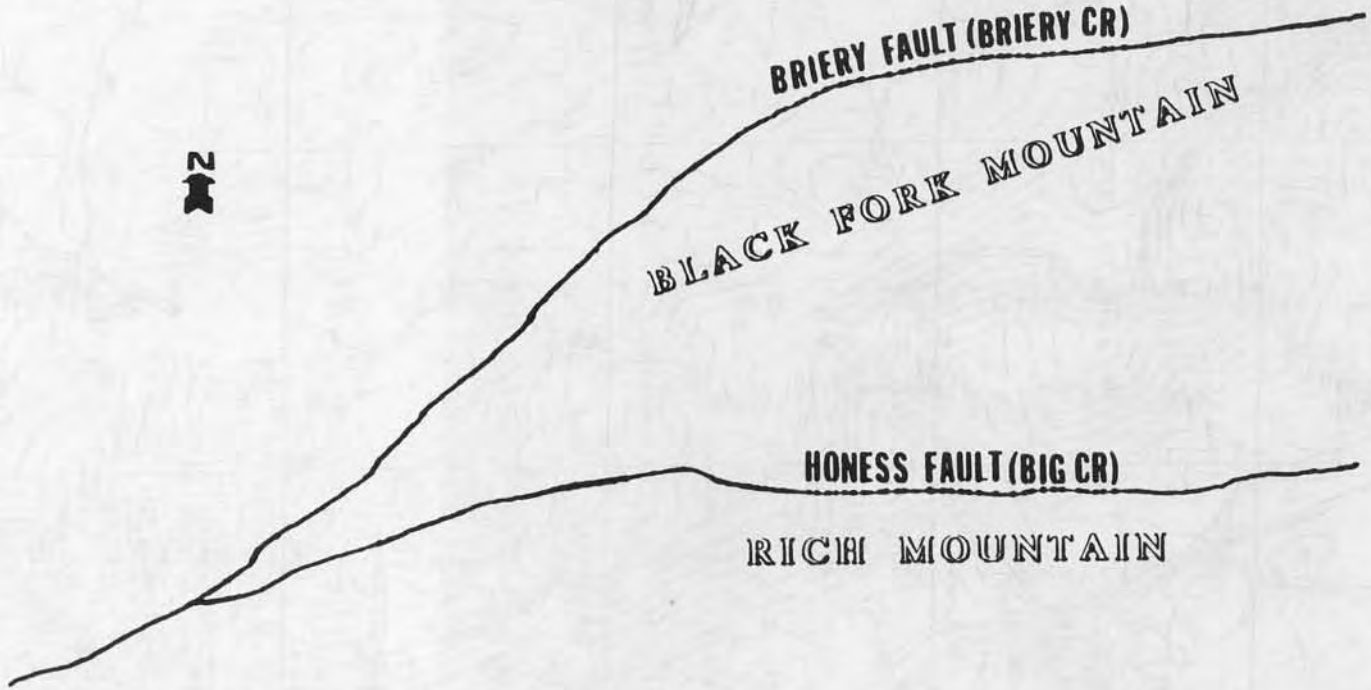


Figure 4. Diagram illustrating relationship of Briery and Honess Fault to Black Fork Mountain and Rich Mountain. The consequent streams of these faults have been dispersal corridors for *Stenotrema pilsbryi*.

Table 1: Point-Quarter VEGETATION ANALYSIS - ALL POSITIVE SITE TREES

Species	Number of Individuals	Relative Density	Density	Frequency	Relative Frequency	Coverage	Relative Coverage	Importance value
Quercus rubra	36	0.153	48.991	0.458	0.156	89019.125	0.256	0.565
Nyssa sylvatica	42	0.178	57.155	0.373	0.127	30499.040	0.088	0.393
Acer rubrum	18	0.076	24.495	0.254	0.087	47245.277	0.136	0.299
Quercus alba	17	0.072	23.134	0.169	0.058	58066.267	0.167	0.297
Carya tomentosa	21	0.089	28.577	0.271	0.092	36303.074	0.104	0.285
Sassafras albidum	27	0.114	36.742	0.288	0.098	17744.328	0.051	0.263
Ostrya virginiana	21	0.089	28.577	0.305	0.104	8166.430	0.023	0.216
Robinia pseudoacacia	10	0.042	13.608	0.169	0.058	8362.268	0.024	0.124
Tilia americana	8	0.034	10.884	0.119	0.040	11871.477	0.034	0.108
Cornus florida	8	0.034	10.884	0.119	0.040	2760.917	0.008	0.082
Prunus serotina	5	0.021	6.802	0.068	0.023	11322.712	0.033	0.077
Magnolia acuminata	4	0.017	5.441	0.068	0.023	8862.252	0.025	0.065
Carya texana	5	0.021	6.802	0.068	0.023	5569.085	0.016	0.060
Acer saccharum	3	0.013	4.082	0.034	0.012	2049.437	0.006	0.031
Quercus velutina	2	0.008	2.720	0.034	0.012	3535.282	0.010	0.030
Tilia caroliniana	2	0.008	2.720	0.034	0.012	2845.651	0.008	0.028
Asimina triloba	3	0.013	4.082	0.034	0.012	669.139	0.002	0.027
Fraxinus americana	1	0.004	1.359	0.017	0.006	1864.282	0.005	0.015
Bumelia lanuginosa	1	0.004	1.359	0.017	0.006	1085.777	0.003	0.013
Liquidambar styraciflua	1	0.004	1.359	0.017	0.006	273.149	0.001	0.011
Cotinus obovatus	1	0.004	1.359	0.017	0.006	249.771	0.001	0.011
TOTAL	236	0.998			0.993		0.998	3.000

Table 2: Point-Quarter VEGETATION ANALYSIS - ALL POSITIVE SITES SHRUBS

Species	Density #/944m²	Relative Density	Frequency	Relative Frequency	Coverage	Relative Coverage	Importance Value
Asimina triloba	180	0.200	0.339	0.110	590.085	0.228	0.538
Ostrya virginiana	35	0.039	0.271	0.088	507.336	0.196	0.323
Toxicodendron radicans	180	0.200	0.271	0.088	80.166	0.031	0.319
Hamamelis virginiana	101	0.112	0.288	0.094	135.340	0.052	0.258
Nyssa sylvatica	39	0.043	0.220	0.072	225.079	0.088	0.203
Ribes cynobati	110	0.122	0.186	0.061	40.228	0.016	0.199
Cornus florida	17	0.019	0.153	0.050	140.893	0.054	0.123
Smilax sp.	59	0.065	0.153	0.050	10.163	0.004	0.119
Acer rubrum	39	0.043	0.203	0.066	15.323	0.006	0.115
Cotinus obovatus	4	0.004	0.017	0.006	253.424	0.098	0.108
Quercus rubra	11	0.012	0.085	0.028	152.414	0.059	0.099
Carya tomentosa	8	0.009	0.119	0.039	116.459	0.045	0.093
Vitus sp.	17	0.019	0.169	0.055	47.132	0.018	0.092
Sassafras albidum	13	0.014	0.136	0.044	83.134	0.032	0.090
Cercis canadensis	4	0.004	0.068	0.022	32.657	0.013	0.039
Rubus sp.	16	0.018	0.051	0.017	5.144	0.002	0.037
Tilia americana	9	0.010	0.017	0.006	48.027	0.019	0.035
Viburnum sp.	11	0.012	0.017	0.006	43.220	0.017	0.035
Prunus serotina	4	0.004	0.051	0.017	18.433	0.007	0.028
Carya texana	6	0.007	0.051	0.017	4.186	0.002	0.026
Vaccinium arborea	10	0.011	0.034	0.011	1.791	0.001	0.023
Amelanchier arborea	7	0.008	0.017	0.006	16.022	0.006	0.020
Castanea ozarkensis	5	0.006	0.017	0.006	21.583	0.008	0.020
Robinia pseudoacacia	5	0.006	0.034	0.011	1.406	0.001	0.018
Unknown	3	0.003	0.034	0.011	0.966	0.0004	0.014
Quercus alba	3	0.003	0.017	0.006	1.704	0.001	0.010
Bumelia lanuginosa	3	0.003	0.017	0.006	0.463	0.0002	0.009
Rhus aromatica	1	0.001	0.017	0.006	0.071	0.00003	0.007
Magnolia acuminata	1	0.001	0.017	0.006	0.283	0.00001	0.007
TOTAL							

Table 3: Point-Quarter VEGETATION ANALYSIS - ALL POSITIVE SITES HERBS

Species	Density #/59m²	Relative Density	Frequency	Relative Frequency	Coverage	Relative Coverage	Importance Value
Polymnia canadensis	467	0.497	0.542	0.283	5.949	0.328	1.108
Toxicodendron radicans	197	0.210	0.424	0.221	6.153	0.340	0.771
Parthenocissus quinquefolia	172	0.183	0.254	0.123	2.949	0.163	0.478
Unknown grass	29	0.031	0.068	0.035	0.508	0.028	0.094
Acer rubrum	10	0.011	0.119	0.062	0.356	0.020	0.093
Dryopteris sp.	19	0.020	0.051	0.027	0.424	0.023	0.070
Hamamelis virginiana	10	0.011	0.068	0.035	0.339	0.019	0.065
Quercus rubra	6	0.006	0.068	0.035	0.220	0.012	0.053
Vitus sp.	1	0.001	0.017	0.009	0.508	0.028	0.038
Carya tomentosa	3	0.003	0.051	0.027	0.051	0.003	0.033
Nyssa sylvatica	4	0.004	0.034	0.018	0.119	0.007	0.029
Ribes cynobati	4	0.004	0.034	0.018	0.102	0.006	0.028
Ostrya virginiana	4	0.004	0.034	0.009	0.102	0.003	0.028
Asplenium platyneuron	3	0.003	0.034	0.018	0.034	0.002	0.023
Smilax sp.	2	0.002	0.017	0.018	0.085	0.005	0.016
Rubus sp.	2	0.002	0.017	0.009	0.068	0.004	0.010
Polystichum acrostichoides	3	0.003	0.017	0.062	0.034	0.002	0.014
Vaccinium sp.	1	0.001	0.017	0.027	0.051	0.003	0.013
Castanea ozarkensis	1	0.001	0.017	0.009	0.034	0.002	0.012
Prunus serotina	1	0.001	0.017	0.009	0.017	0.001	0.011
Botrychium sp.	1	0.001	0.017	0.009	0.017	0.001	0.011
TOTAL	940	0.999		1.063		1.000	2.998

Table 4: Point-Quarter VEGETATION ANALYSIS - ALL NEGATIVE SITE TREES

Species	Number of Individuals	Relative Density	Density	Frequency	Relative Frequency	Coverage	Relative Coverage	Importance value
Quercus alba	9	0.164	90.924	0.500	0.200	137399.690	0.386	0.750
Quercus rubra	15	0.273	151.356	0.500	0.200	98635.677	0.277	0.750
Carya tomentosa	14	0.255	141.099	0.643	0.257	39518.731	0.111	0.623
Nyssa sylvatica	8	0.145	80.390	0.214	0.086	41883.961	0.118	0.349
Tilia americana	2	0.036	19.959	0.143	0.057	27079.095	0.076	0.169
Asimina triloba	3	0.055	30.216	0.214	0.086	3375.977	0.009	0.150
Robinia pseudoacacia	2	0.036	19.959	0.143	0.057	4346.027	0.012	0.105
Quercus velutina	2	0.036	19.959	0.143	0.057	3499.144	0.010	0.103
TOTAL	55	1.000			1.000		0.999	2.999

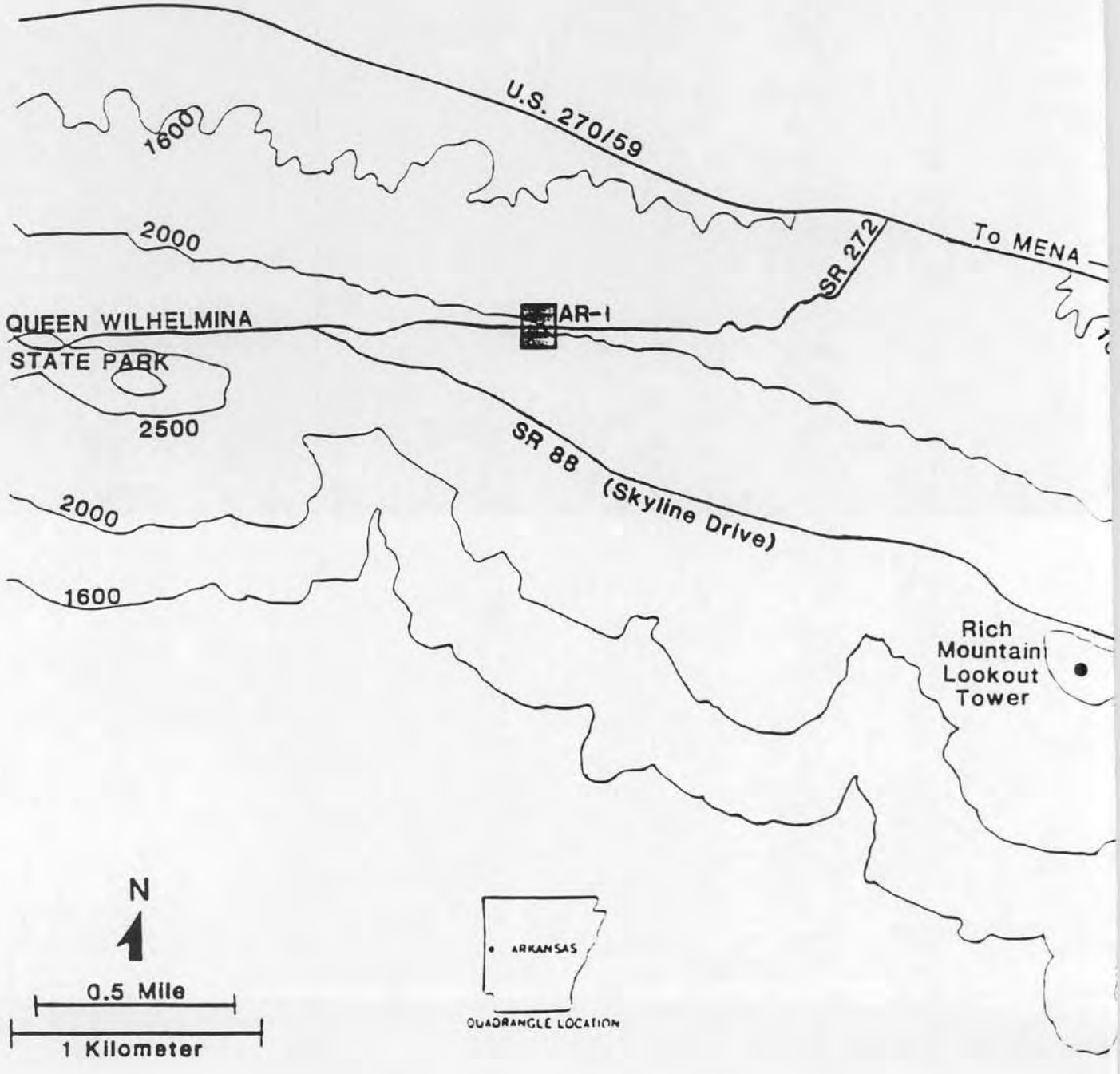
Table 5: Point-Quarter VEGETATION ANALYSIS - ALL NEGATIVE SITE SHRUBS

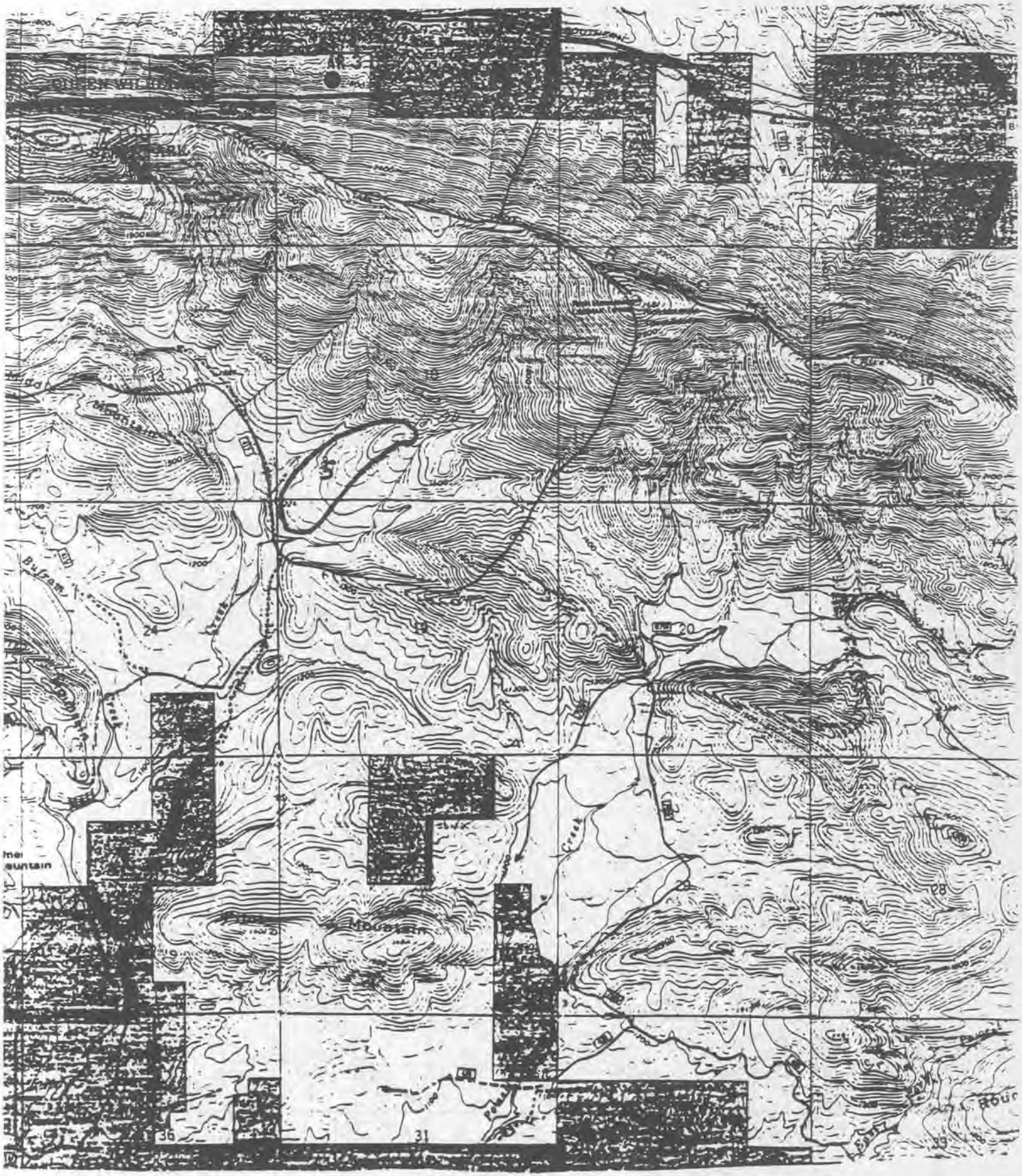
Species	Density #/224m²	Relative Density	Frequency	Relative Frequency	Coverage	Relative Coverage	Importance Value
Vaccinium stamineum	75	0.347	0.071	0.024	9.943	0.018	0.389
Carya tomentosa	6	0.028	0.214	0.071	154.394	0.286	0.385
Asimina triloba	14	0.065	0.357	0.119	104.788	0.194	0.378
Quercus rubra	23	0.106	0.286	0.095	33.856	0.063	0.260
Toxicodendron radicans	31	0.144	0.286	0.095	11.239	0.021	0.260
Liquidamber stryaciflua	2	0.009	0.143	0.048	77.173	0.143	0.200
Vitus sp.	7	0.032	0.214	0.071	50.273	0.093	0.196
Prunus serotina	5	0.023	0.143	0.048	44.713	0.083	0.154
Hamamelis virginiana	15	0.069	0.143	0.048	18.889	0.035	0.152
Acer rubrum	7	0.032	0.286	0.095	4.862	0.009	0.136
Nyssa sylvatica	10	0.046	0.143	0.048	9.024	0.017	0.111
Ptelea trifoliata	6	0.028	0.143	0.048	4.932	0.009	0.085
Robinia pseudoacacia	2	0.009	0.143	0.048	5.411	0.010	0.067
Amelanchier arborea	2	0.009	0.143	0.048	2.827	0.005	0.062
Ostrya virginiana	5	0.023	0.071	0.024	5.890	0.011	0.058
Rubus sp.	1	0.005	0.071	0.024	0.393	0.083	0.039
Quercus alba	2	0.009	0.071	0.024	1.005	0.002	0.035
Juglans nigra	1	0.005	0.071	0.024	0.071	0.0001	0.029
TOTAL	214	1.077		0.992		1.082	3.000

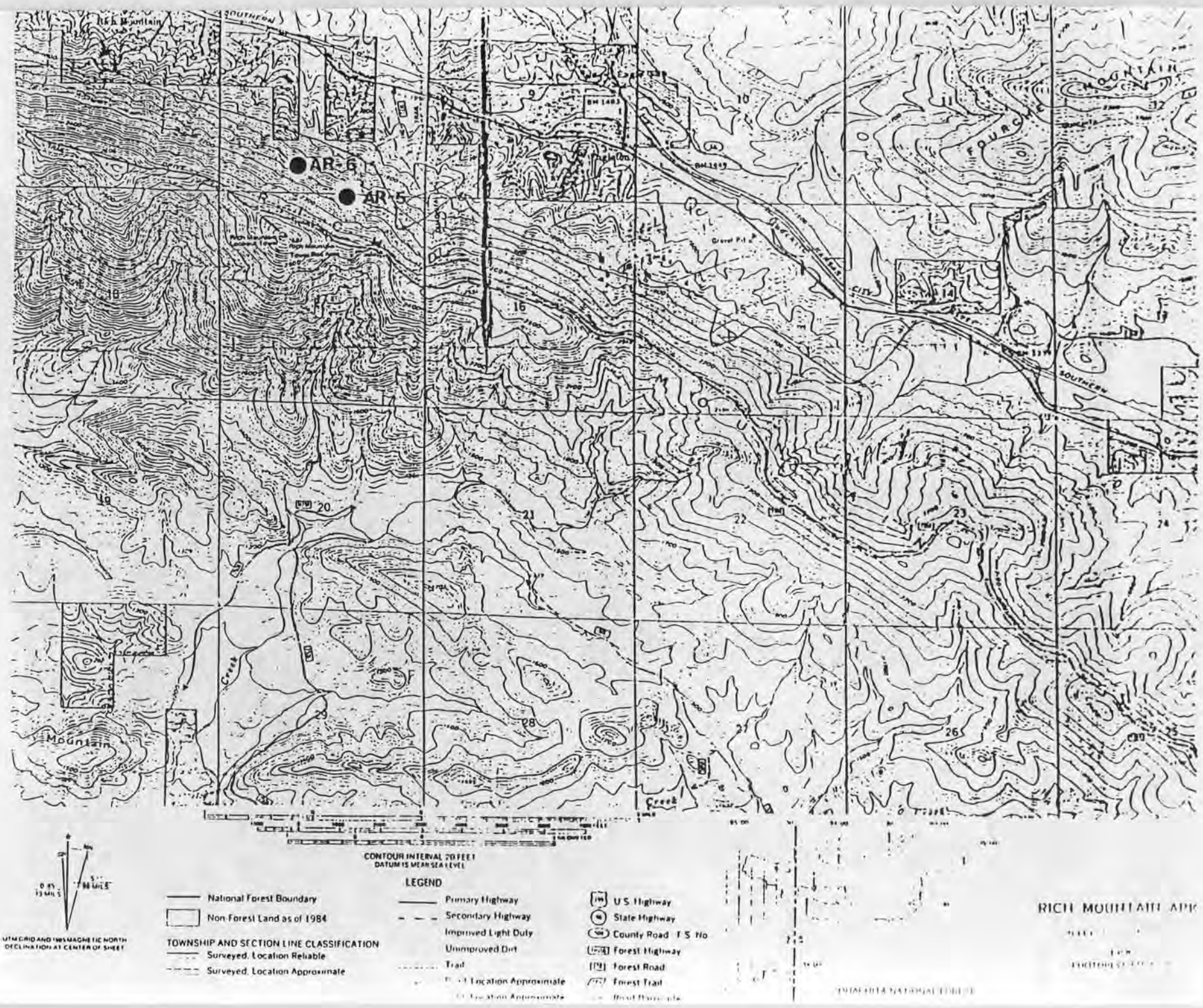
Table 6: Point-Quarter VEGETATION ANALYSIS - ALL NEGATIVE SITES HERBS

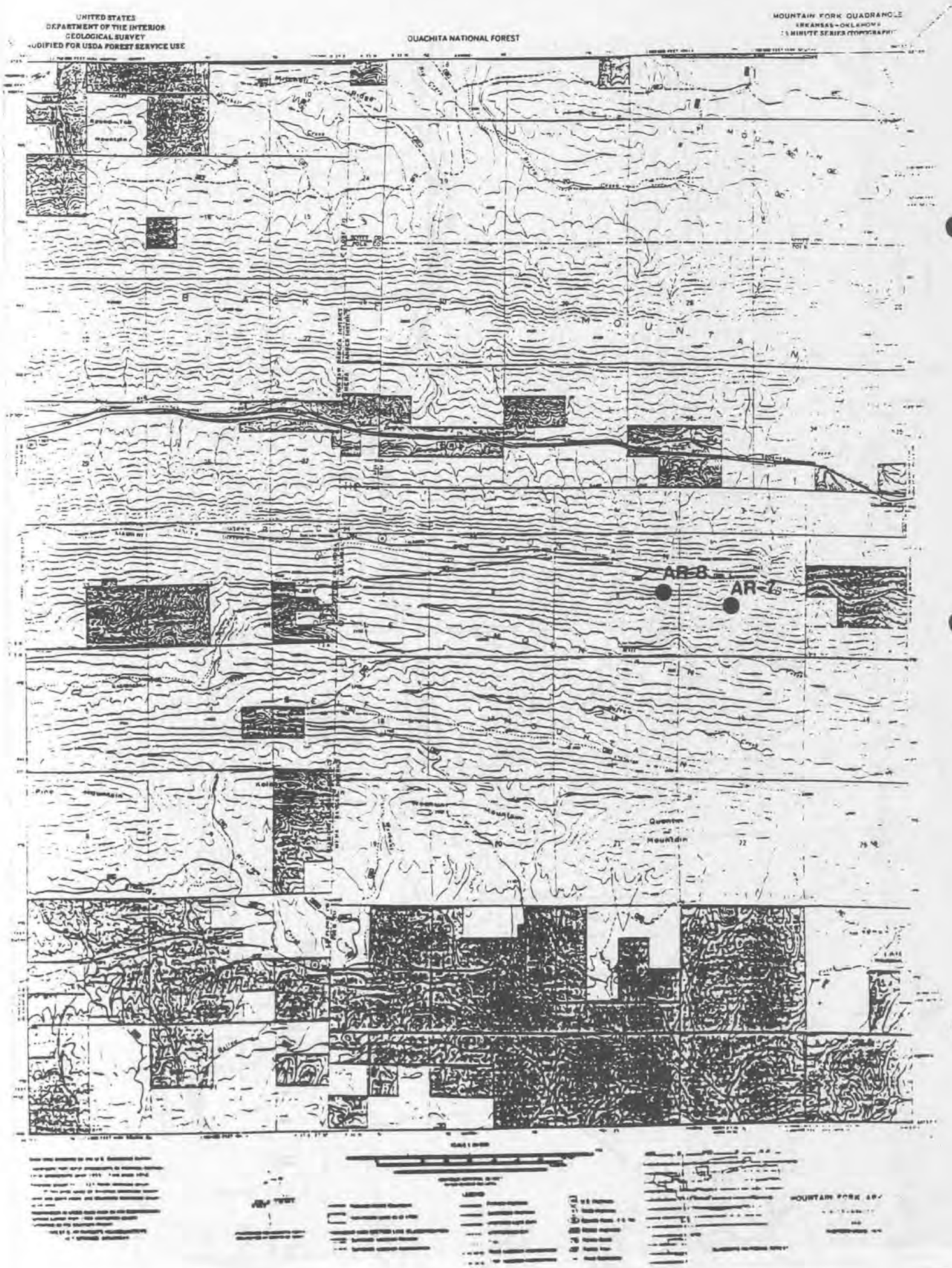
Species	Density #/14m²	Relative Density	Frequency	Relative Frequency	Coverage	Relative Coverage	Importance Value
Toxicodendron radicans	72	0.356	0.429	0.188	5.143	0.355	0.899
Parthenocissus quinquefolia	50	0.248	0.429	0.188	3.571	0.246	0.682
Polymnia canadensis	25	0.124	0.286	0.125	2.143	0.148	0.397
Dryopteris sp.	19	0.094	0.214	0.094	1.500	0.103	0.291
Acer rubrum	4	0.020	0.143	0.063	0.286	0.020	0.103
Unknown grass	11	0.124	0.171	0.031	0.214	0.015	0.100
Smilax sp.	4	0.020	0.143	0.063	0.214	0.015	0.098
Asplenium platyneuron	4	0.020	0.143	0.063	0.214	0.015	0.098
Quercus alba	2	0.010	0.143	0.063	0.286	0.020	0.093
Monarda sp.	5	0.025	0.071	0.031	0.286	0.020	0.076
Vaccinium stamineum	3	0.015	0.071	0.031	0.357	0.025	0.071
Asclepias sp.	2	0.010	0.071	0.031	0.214	0.015	0.056
Euonymus	1	0.005	0.071	0.031	0.071	0.005	0.041
TOTAL	202	1.001		1.002		1.002	3.005

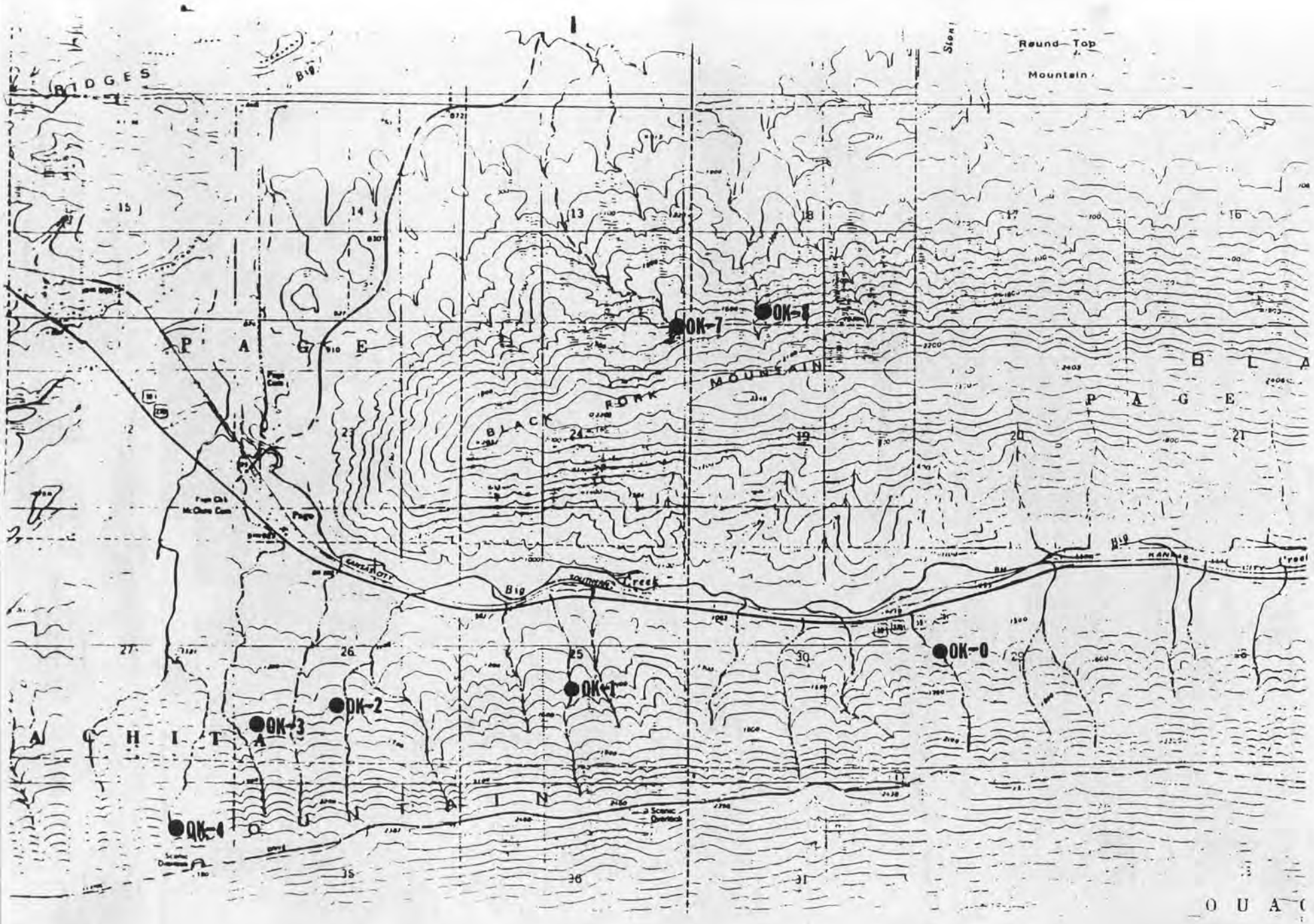
Appendix 1. *Stenotrema pilsbryi* localities in Oklahoma and Arkansas in addition to those shown in Figures 2 and 3.

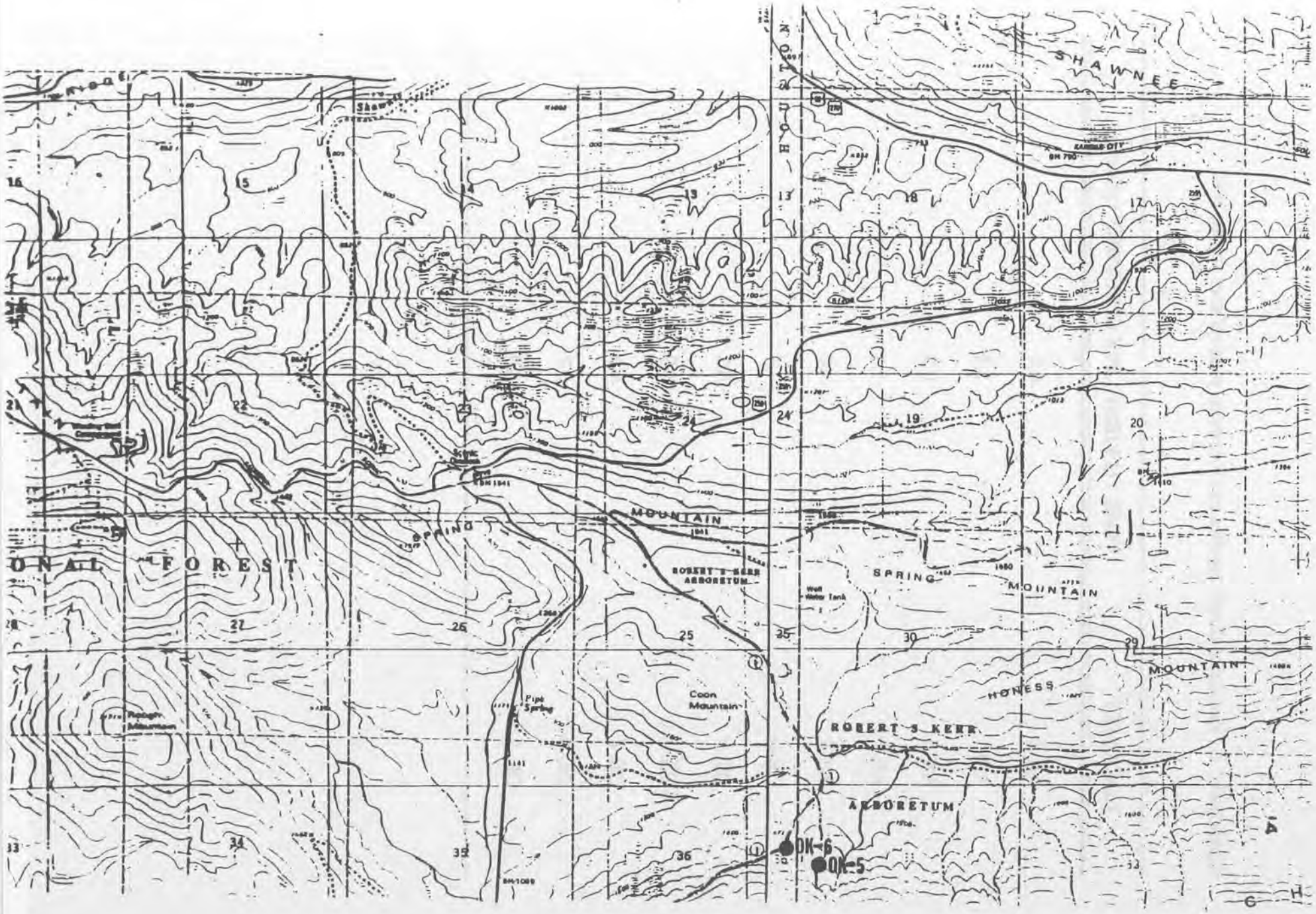

U.S. 270/59
1600
2000
SR 272
To MENA
QUEEN WILHELMINA
STATE PARK
AR-1
2500
SR 88 (Skyline Drive)
2000
1600
Rich
Mountain
Lookout
Tower
N
0.5 Mile
1 Kilometer
ARKANSAS
QUADRANGLE LOCATION


SCALE 1:24 000


AR-6
AR-5
CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL
LEGEND
National Forest Boundary
Non-Forest Land as of 1984
TOWNSHIP AND SECTION LINE CLASSIFICATION
Surveyed, Location Reliable
Surveyed, Location Approximate
Primary Highway
Secondary Highway
Improved Light Duty
Unimproved Dirt
Trail
U.S. Highway
State Highway
County Road F.S. No.
Forest Highway
Forest Road
Forest Trail
UTM GRID AND 1985 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET
RICH MOUNTAIN APK


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
MODIFIED FOR USDA FOREST SERVICE USE
OUACHITA NATIONAL FOREST
MOUNTAIN FORK QUADRANGLE
ARKANSAS-OKLAHOMA
7.5 MINUTE SERIES (TOPOGRAPHIC)
AR-8
AR-7
Quanton Mountain
MOUNTAIN FORK QUAD


Round Top
Mountain
BRIDGES
PAGE
BLACK FORK MOUNTAIN
PAGE
ACHITA
OK-0
OK-1
OK-2
OK-3
OK-4
OK-5
OK-6
OK-7
OK-8
Big
Scenic Overlook


SHAWNEE
MOUNTAIN
SPRING
ROBERT S KERR
ARBORETUM
Coon
Mountain
Pipe
Spring
HONESS
OK-6
OK-5

Appendix 2. Results of timed searches of *Stenotrema pilsbryi* sites spring 1989.

LOCALITY	TIME TO FIRST LIVE SPECIMEN (minutes)
AR-3	0.4
AR-5	1.2
AR-6	0.9
AR-7	1.4
AR-8	4.0
OK-0	1.4
OK-5	0.2
OK-7	4.0
OK-8	0.6
OK-9	0.2
OK-12	2.0