

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

Black Fork Mountain

Rich Mountain

Shawnee Creek

Ouachita River Drainage

Ouachita Headwaters

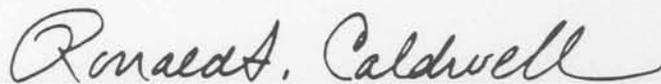
Major threats to *S. pilsbryi* would be linked to loss of habitat. Forest removal around the rock glaciers or above them in their watershed could cause drying conditions that would reduce or eliminate populations. Any forest removal projects (e.g., harvesting, power lines, road construction, etc.) should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

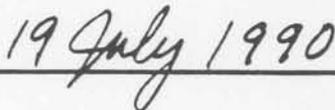
4. On two rock glaciers of the north face of the Shawnee Divide, a large form *Stenotrema cf. aliciae* was found. This form may be an undescribed species. In light of this, rock glaciers west of the Shawnee Divide should be surveyed for this potential ecological equivalent to *Stenotrema pilsbryi*.
5. 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.

Prepared by:

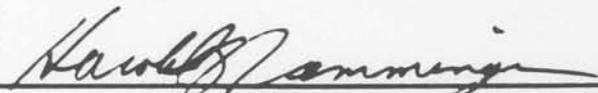


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Date:



Approved by:



Harold Namminga
Federal Aid/Research Coordinator

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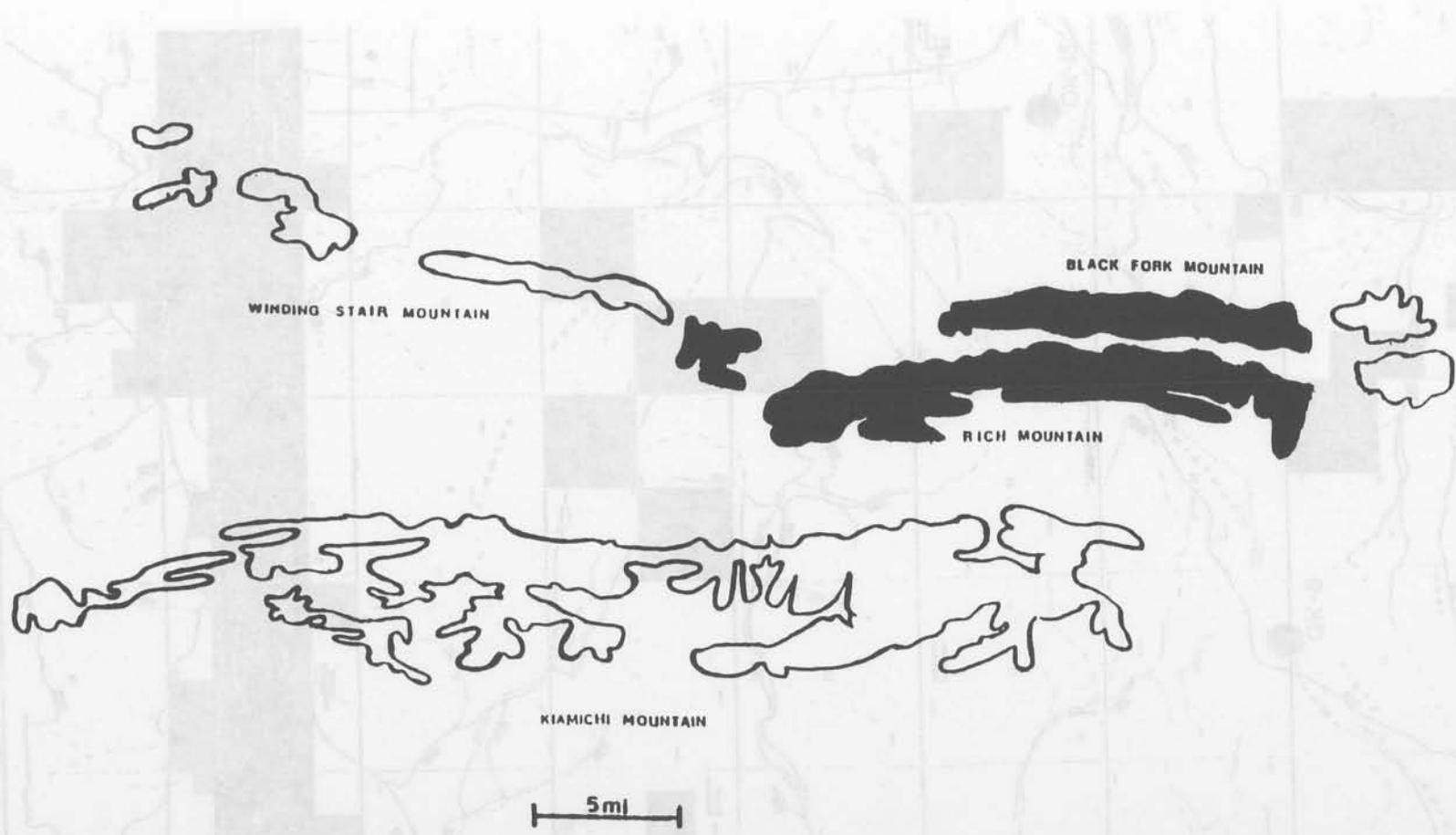


Figure 1. Range of *Stenotrema pilsbryi* (black) shown in relation to other mountain ranges in immediate vicinity. The map was drawn using the 1220 foot contour interval as the minimum elevation.

OUACHITA NATIONAL FOREST

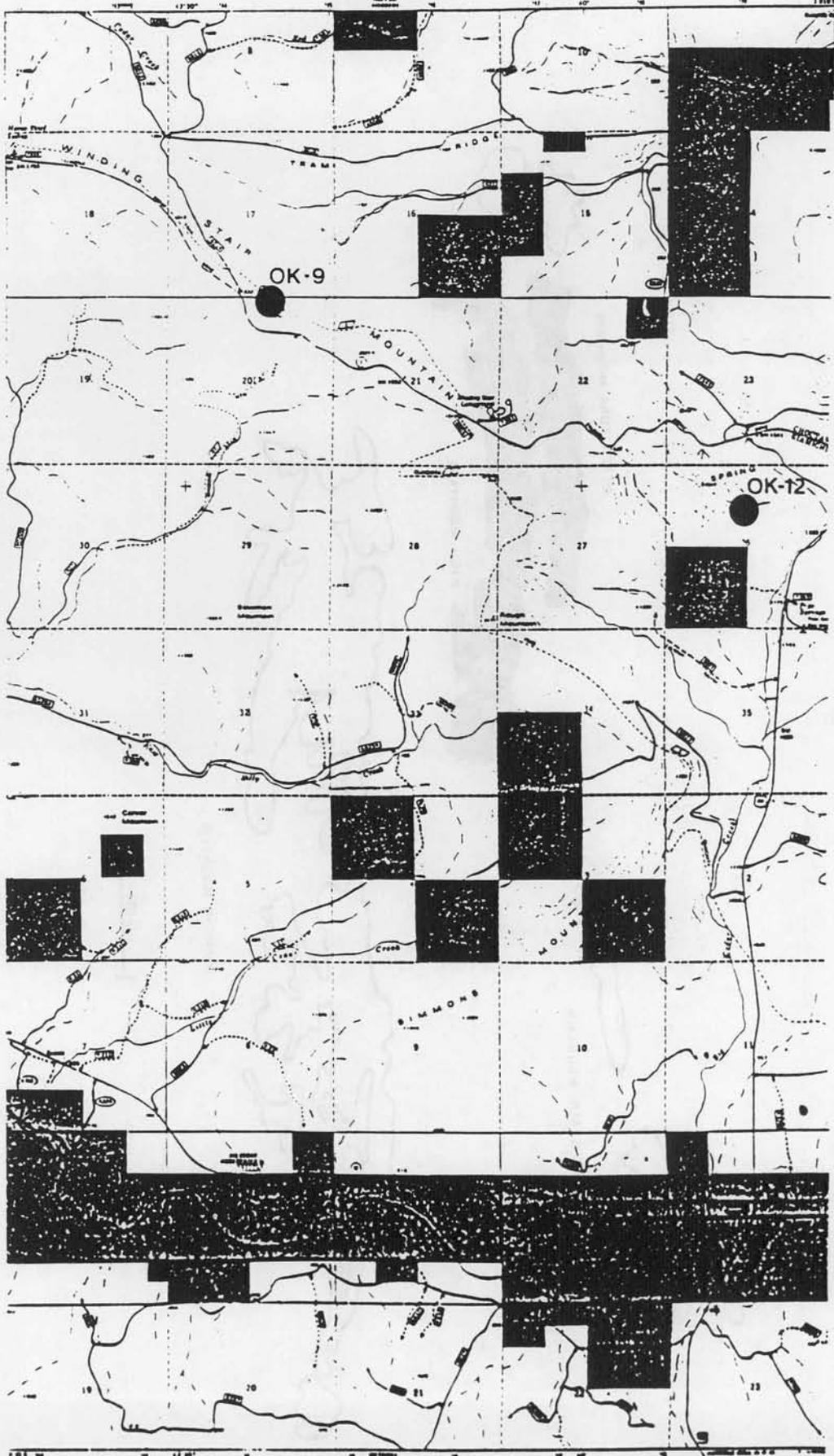


Figure 2. Map marking the western-most locality for *Stenotrema pilsbryi* (OK-9).

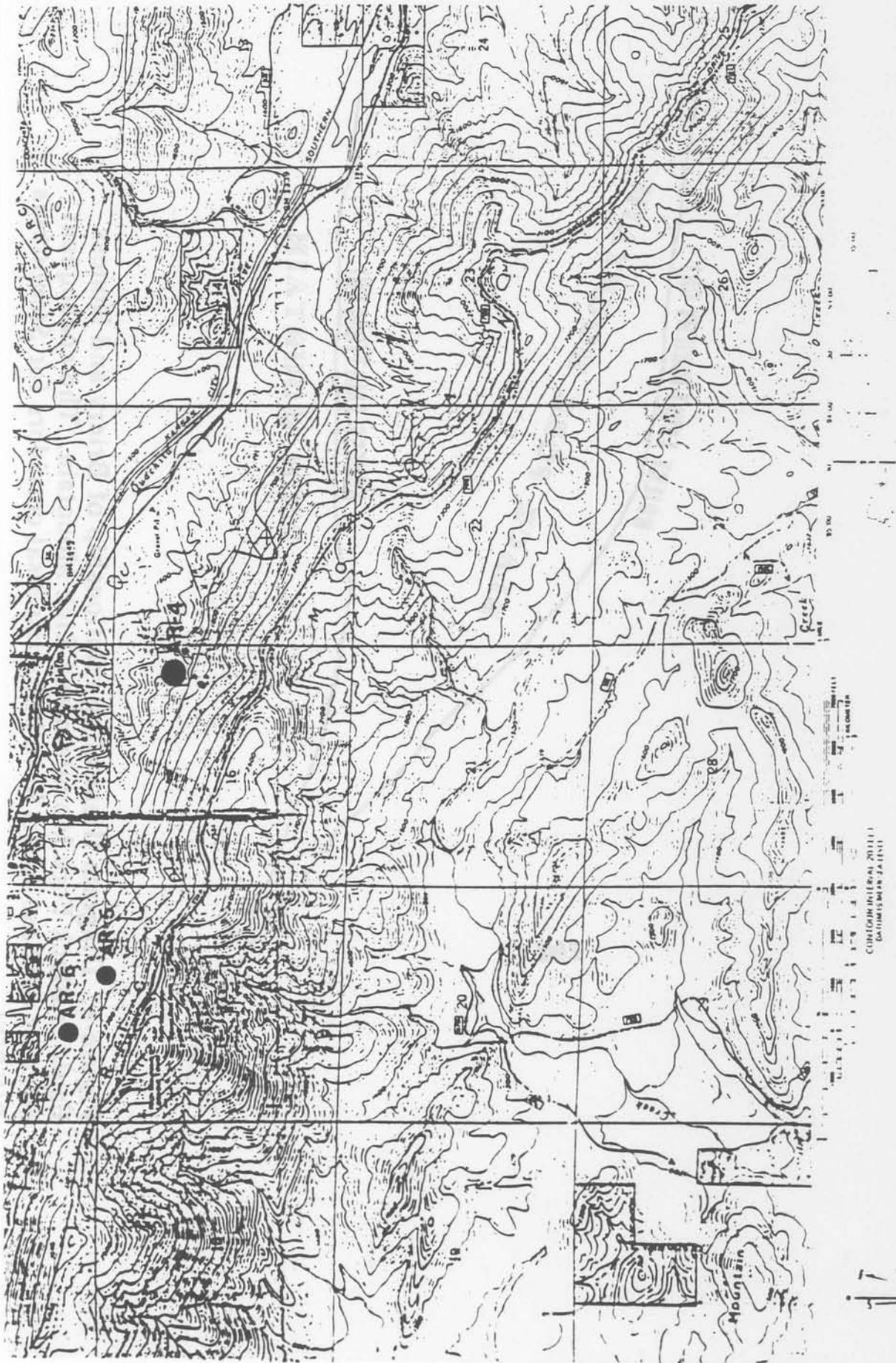


Figure 3. Map marking the eastern-most locality for *Stenotrema pilsbryi* (AR-5)

RICH MOUNTAIN, ARK

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UNITED STATES GEOLOGICAL SURVEY

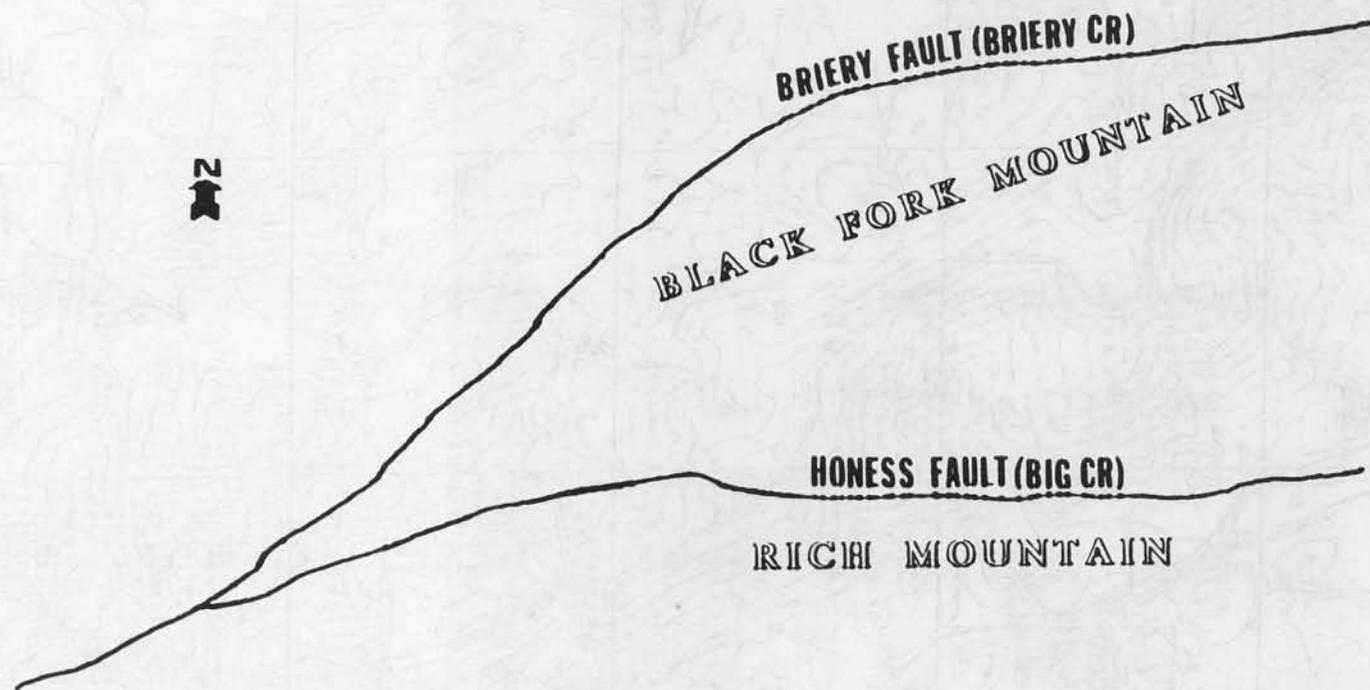


Figure 4. Diagram illustrating relationship of Briery and Honess Fault to Black Fork Mountain and Rich Mountain. The consequent streams of these faults have been dispersal corridors for *Stenotrema pilsbryi*.

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
<i>Quercus rubra</i>	36	0.153	48.991	0.458	0.156	89019.125	0.256	0.565
<i>Nyssa sylvatica</i>	42	0.178	57.155	0.373	0.127	30499.040	0.088	0.393
<i>Acer rubrum</i>	18	0.076	24.495	0.254	0.087	47245.277	0.136	0.299
<i>Quercus alba</i>	17	0.072	23.134	0.169	0.058	58066.267	0.167	0.297
<i>Carya tomentosa</i>	21	0.089	28.577	0.271	0.092	36303.074	0.104	0.285
<i>Sassafras albidum</i>	27	0.114	36.742	0.288	0.098	17744.328	0.051	0.263
<i>Ostrya virginiana</i>	21	0.089	28.577	0.305	0.104	8166.430	0.023	0.216
<i>Robinia pseudoacacia</i>	10	0.042	13.608	0.169	0.058	8362.268	0.024	0.124
<i>Tilia americana</i>	8	0.034	10.884	0.119	0.040	11871.477	0.034	0.108
<i>Cornus florida</i>	8	0.034	10.884	0.119	0.040	2760.917	0.008	0.082
<i>Prunus serotina</i>	5	0.021	6.802	0.068	0.023	11322.712	0.033	0.077
<i>Magnolia acuminata</i>	4	0.017	5.441	0.068	0.023	8862.252	0.025	0.065
<i>Carya texana</i>	5	0.021	6.802	0.068	0.023	5569.085	0.016	0.060
<i>Acer saccharum</i>	3	0.013	4.082	0.034	0.012	2049.437	0.006	0.031
<i>Quercus velutina</i>	2	0.008	2.720	0.034	0.012	3535.282	0.010	0.030
<i>Tilia caroliniana</i>	2	0.008	2.720	0.034	0.012	2845.651	0.008	0.028
<i>Asimina triloba</i>	3	0.013	4.082	0.034	0.012	669.139	0.002	0.027
<i>Fraxinus americana</i>	1	0.004	1.359	0.017	0.006	1864.282	0.005	0.015
<i>Bumelia lanuginosa</i>	1	0.004	1.359	0.017	0.006	1085.777	0.003	0.013
<i>Liquidambar styraciflua</i>	1	0.004	1.359	0.017	0.006	273.149	0.001	0.011
<i>Cotinus obovatus</i>	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 #/944m ²	Relative Density	Frequency	Relative Frequency	Coverage	Relative Coverage	Importance Value
<i>Asimina triloba</i>	180	0.200	0.339	0.110	590.085	0.228	0.538
<i>Ostrya virginiana</i>	35	0.039	0.271	0.088	507.336	0.196	0.323
<i>Toxicodendron radicans</i>	180	0.200	0.271	0.088	80.166	0.031	0.319
<i>Hamamelis virginiana</i>	101	0.112	0.288	0.094	135.340	0.052	0.258
<i>Nyssa sylvatica</i>	39	0.043	0.220	0.072	225.079	0.088	0.203
<i>Ribes cynobati</i>	110	0.122	0.186	0.061	40.228	0.016	0.199
<i>Cornus florida</i>	17	0.019	0.153	0.050	140.893	0.054	0.123
<i>Smilax</i> sp.	59	0.065	0.153	0.050	10.163	0.004	0.119
<i>Acer rubrum</i>	39	0.043	0.203	0.066	15.323	0.006	0.115
<i>Cotinus obovatus</i>	4	0.004	0.017	0.006	253.424	0.098	0.108
<i>Quercus rubra</i>	11	0.012	0.085	0.028	152.414	0.059	0.099
<i>Carya tomentosa</i>	8	0.009	0.119	0.039	116.459	0.045	0.093
<i>Vitus</i> sp.	17	0.019	0.169	0.055	47.132	0.018	0.092
<i>Sassafras albidum</i>	13	0.014	0.136	0.044	83.134	0.032	0.090
<i>Cercis canadensis</i>	4	0.004	0.068	0.022	32.657	0.013	0.039
<i>Rubus</i> sp.	16	0.018	0.051	0.017	5.144	0.002	0.037
<i>Tilia americana</i>	9	0.010	0.017	0.006	48.027	0.019	0.035
<i>Viburnum</i> sp.	11	0.012	0.017	0.006	43.220	0.017	0.035
<i>Prunus serotina</i>	4	0.004	0.051	0.017	18.433	0.007	0.028
<i>Carya texana</i>	6	0.007	0.051	0.017	4.186	0.002	0.026
<i>Vaccinium arborea</i>	10	0.011	0.034	0.011	1.791	0.001	0.023
<i>Amelanchier arborea</i>	7	0.008	0.017	0.006	16.022	0.006	0.020
<i>Castanea ozarkensis</i>	5	0.006	0.017	0.006	21.583	0.008	0.020
<i>Robinia pseudoacacia</i>	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
<i>Quercus alba</i>	3	0.003	0.017	0.006	1.704	0.001	0.010
<i>Bumelia lanuginosa</i>	3	0.003	0.017	0.006	0.463	0.0002	0.009
<i>Rhus aromatica</i>	1	0.001	0.017	0.006	0.071	0.00003	0.007
<i>Magnolia acuminata</i>	1	0.001	0.017	0.006	0.283	0.00001	0.007
TOTAL	201	0.200	0.339	0.110	590.085	0.228	0.538

Table 3: Point-Quarter

VEGETATION ANALYSIS - ALL POSITIVE SITES HERBS

Species	Density #/59m ²	Relative Density	Frequency	Relative Frequency	Coverage	Relative Coverage	Importance Value
<i>Polymnia canadensis</i>	467	0.497	0.542	0.283	5.949	0.328	1.108
<i>Toxicodendron radicans</i>	197	0.210	0.424	0.221	6.153	0.340	0.771
<i>Parthenocissus quinquefolia</i>	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
<i>Acer rubrum</i>	10	0.011	0.119	0.062	0.356	0.020	0.093
<i>Dryopteris</i> sp.	19	0.020	0.051	0.027	0.424	0.023	0.070
<i>Hamamelis virginiana</i>	10	0.011	0.068	0.035	0.339	0.019	0.065
<i>Quercus rubra</i>	6	0.006	0.068	0.035	0.220	0.012	0.053
<i>Vitis</i> sp.	1	0.001	0.017	0.009	0.508	0.028	0.038
<i>Carya tomentosa</i>	3	0.003	0.051	0.027	0.051	0.003	0.033
<i>Nyssa sylvatica</i>	4	0.004	0.034	0.018	0.119	0.007	0.029
<i>Ribes cynobati</i>	4	0.004	0.034	0.018	0.102	0.006	0.028
<i>Ostrya virginiana</i>	4	0.004	0.034	0.009	0.102	0.003	0.028
<i>Asplenium platyneuron</i>	3	0.003	0.034	0.018	0.034	0.002	0.023
<i>Smilax</i> sp.	2	0.002	0.017	0.018	0.085	0.005	0.016
<i>Rubus</i> sp.	2	0.002	0.017	0.009	0.068	0.004	0.010
<i>Polystichum acrostichoides</i>	3	0.003	0.017	0.062	0.034	0.002	0.014
<i>Vaccinium</i> sp.	1	0.001	0.017	0.027	0.051	0.003	0.013
<i>Castanea ozarkensis</i>	1	0.001	0.017	0.009	0.034	0.002	0.012
<i>Prunus serotina</i>	1	0.001	0.017	0.009	0.017	0.001	0.011
<i>Botrychium</i> 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
<i>Quercus alba</i>	9	0.164	90.924	0.500	0.200	137399.690	0.386	0.750
<i>Quercus rubra</i>	15	0.273	151.356	0.500	0.200	98635.677	0.277	0.750
<i>Carya tomentosa</i>	14	0.255	141.099	0.643	0.257	39518.731	0.111	0.623
<i>Nyssa sylvatica</i>	8	0.145	80.390	0.214	0.086	41883.961	0.118	0.349
<i>Tilia americana</i>	2	0.036	19.959	0.143	0.057	27079.095	0.076	0.169
<i>Asimina triloba</i>	3	0.055	30.216	0.214	0.086	3375.977	0.009	0.150
<i>Robinia pseudoacacia</i>	2	0.036	19.959	0.143	0.057	4346.027	0.012	0.105
<i>Quercus velutina</i>	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 #/224m ²	Relative Density	Frequency	Relative Frequency	Coverage	Relative Coverage	Importance Value
<i>Vaccinium stamineum</i>	75	0.347	0.071	0.024	9.943	0.018	0.389
<i>Carya tomentosa</i>	6	0.028	0.214	0.071	154.394	0.286	0.385
<i>Asimina triloba</i>	14	0.065	0.357	0.119	104.788	0.194	0.378
<i>Quercus rubra</i>	23	0.106	0.286	0.095	33.856	0.063	0.260
<i>Toxicodendron radicans</i>	31	0.144	0.286	0.095	11.239	0.021	0.260
<i>Liquidambar styraciflua</i>	2	0.009	0.143	0.048	77.173	0.143	0.200
<i>Vitis sp.</i>	7	0.032	0.214	0.071	50.273	0.093	0.196
<i>Prunus serotina</i>	5	0.023	0.143	0.048	44.713	0.083	0.154
<i>Hamamelis virginiana</i>	15	0.069	0.143	0.048	18.889	0.035	0.152
<i>Acer rubrum</i>	7	0.032	0.286	0.095	4.862	0.009	0.136
<i>Vyssa sylvatica</i>	10	0.046	0.143	0.048	9.024	0.017	0.111
<i>Ptelea trifoliata</i>	6	0.028	0.143	0.048	4.932	0.009	0.085
<i>Robinia pseudoacacia</i>	2	0.009	0.143	0.048	5.411	0.010	0.067
<i>Amelanchier arborea</i>	2	0.009	0.143	0.048	2.827	0.005	0.062
<i>Astrya virginiana</i>	5	0.023	0.071	0.024	5.890	0.011	0.058
<i>Rubus sp.</i>	1	0.005	0.071	0.024	0.393	0.083	0.039
<i>Quercus alba</i>	2	0.009	0.071	0.024	1.005	0.002	0.035
<i>Juglans nigra</i>	1	0.005	0.071	0.024	0.071	0.0001	0.029
TOTAL	214	1.077		0.992		1.082	3.000

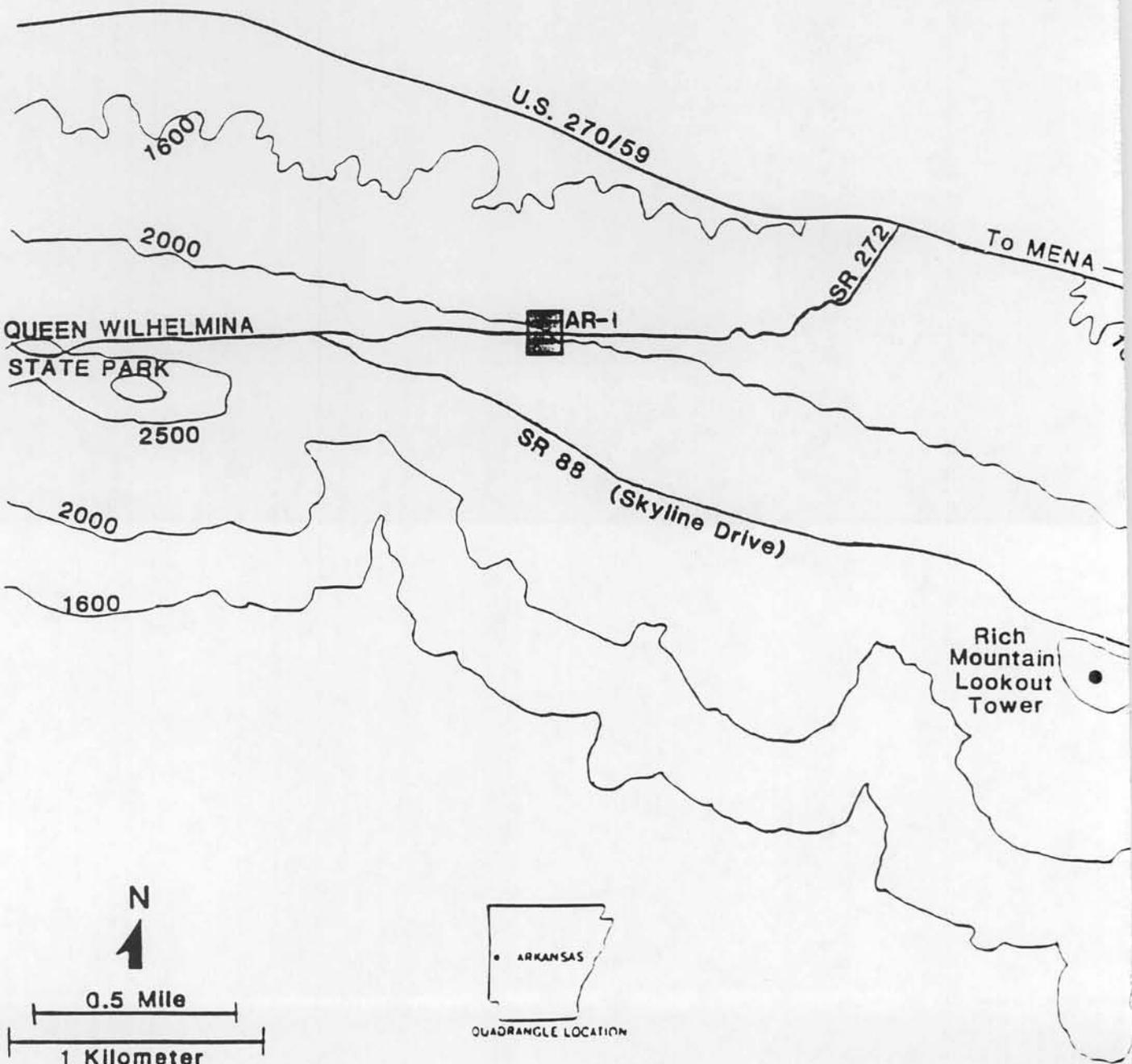
Table 6: Point-Quarter

VEGETATION ANALYSIS - ALL NEGATIVE SITES HERBS

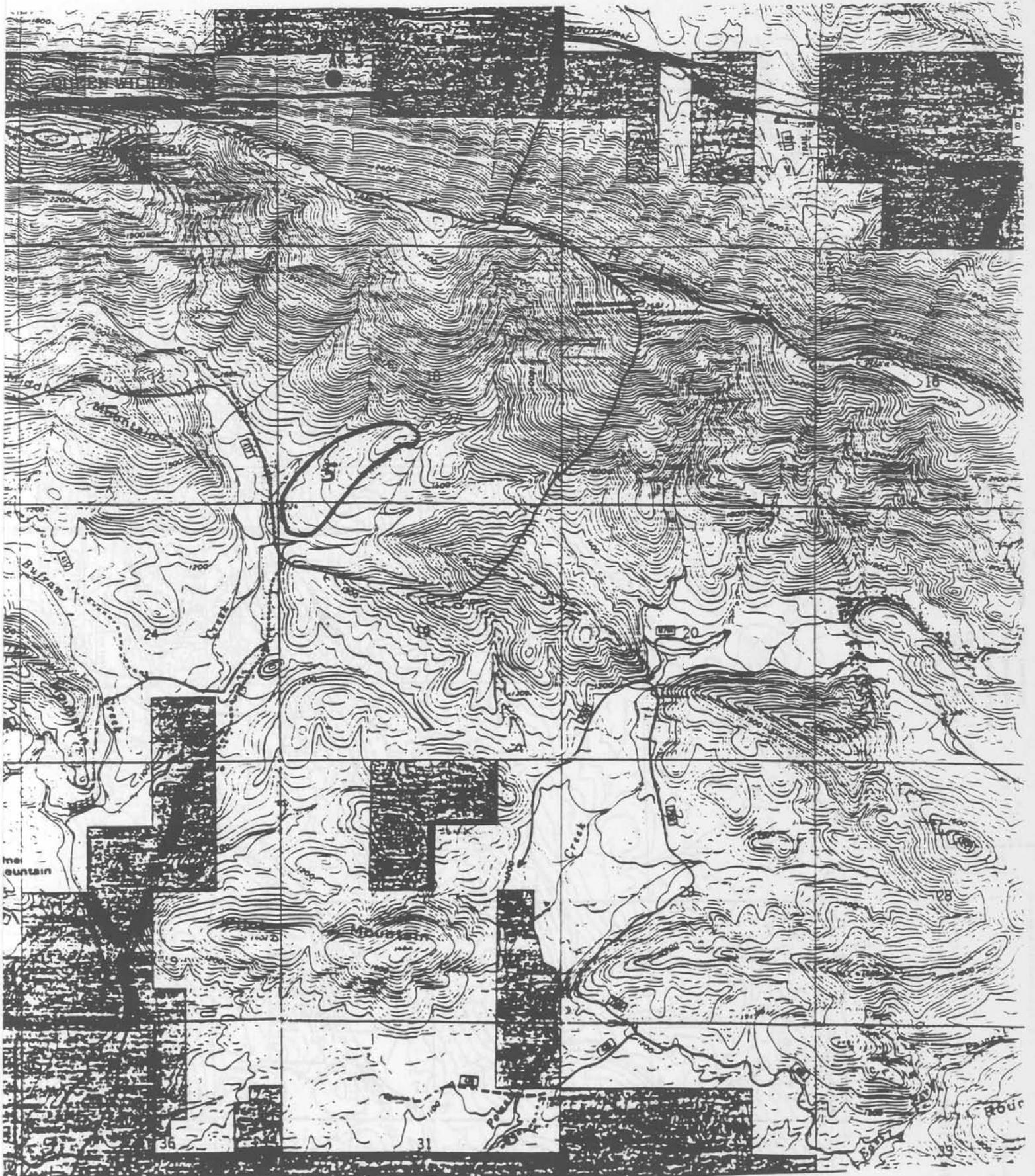
Species	Density #/14m ²	Relative Density	Frequency	Relative Frequency	Coverage	Relative Coverage	Importance Value
<i>Toxicodendron radicans</i>	72	0.356	0.429	0.188	5.143	0.355	0.899
<i>Parthenocissus quinquefolia</i>	50	0.248	0.429	0.188	3.571	0.246	0.682
<i>Polymnia canadensis</i>	25	0.124	0.286	0.125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



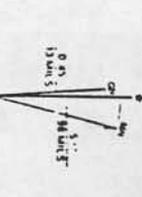
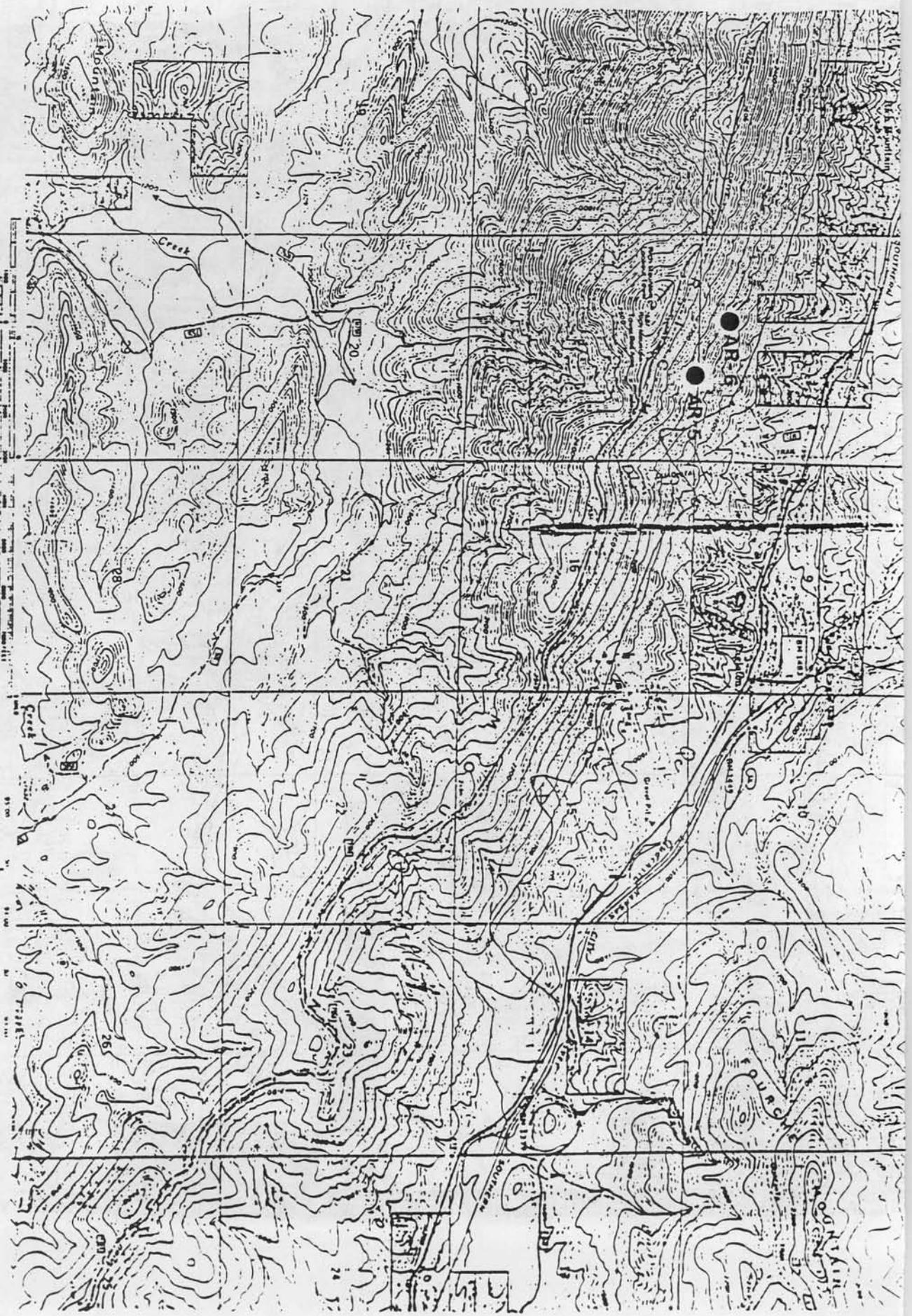


Appendix I. Topographic map of the study area in Arkansas and Missouri in addition to other states shown in Figures 1 and 2.



SCALE 1:24 000





VERTICAL AND HORIZONTAL CONTROL
 DATUM IS MEAN SEA LEVEL

CONTOUR INTERVAL: 20 FEET
 DATUM IS MEAN SEA LEVEL

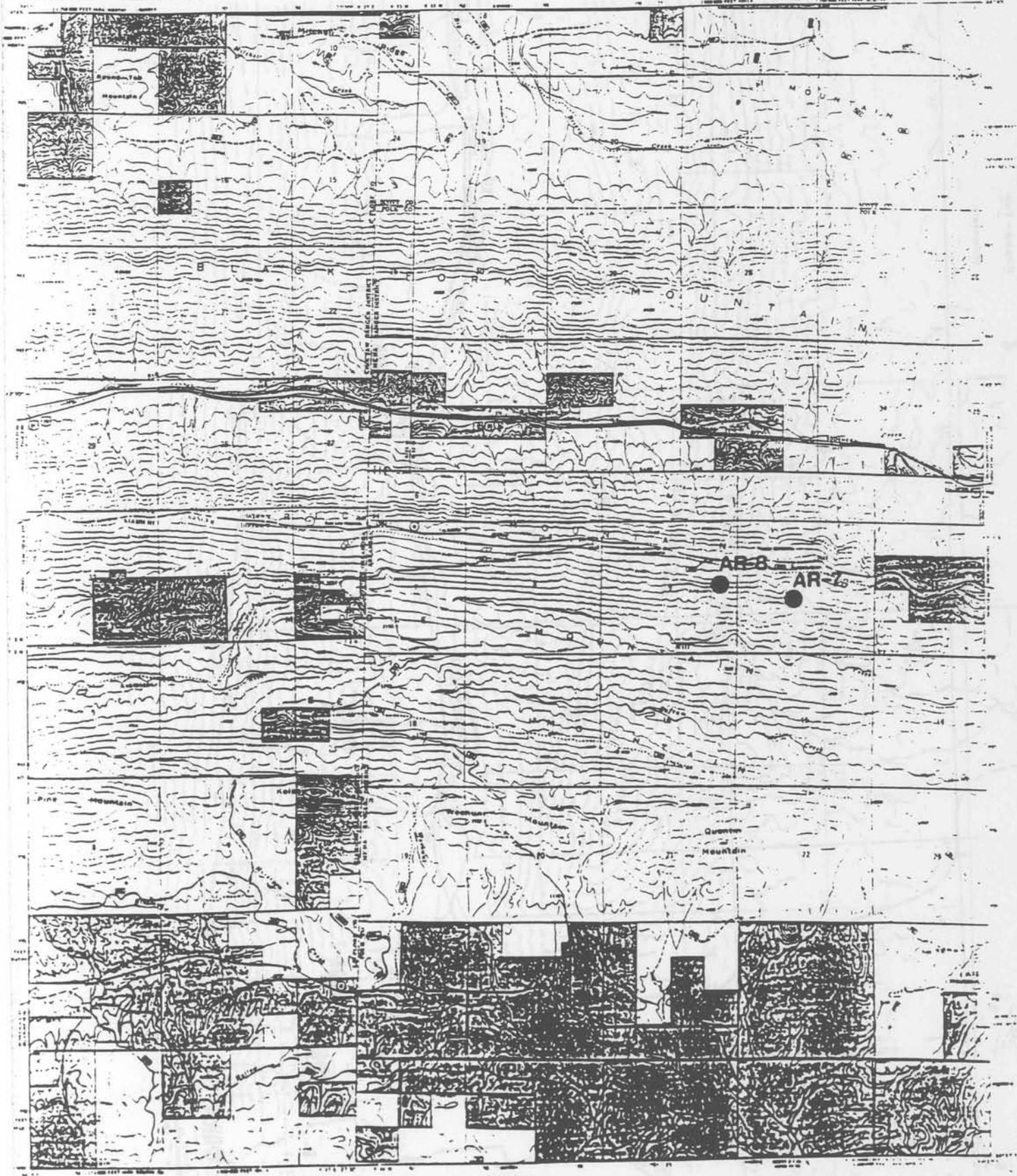
LEGEND

- 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
- F-1 Location Approximate
- F-2 Location Approximate
- U.S. Highway
- State Highway
- County Road / S No.
- Forest Highway
- Forest Road
- Forest Trail
- Road Through

RICH MOUNTAIN AREA

FROM THE NATIONAL FOREST

PRODUCTION

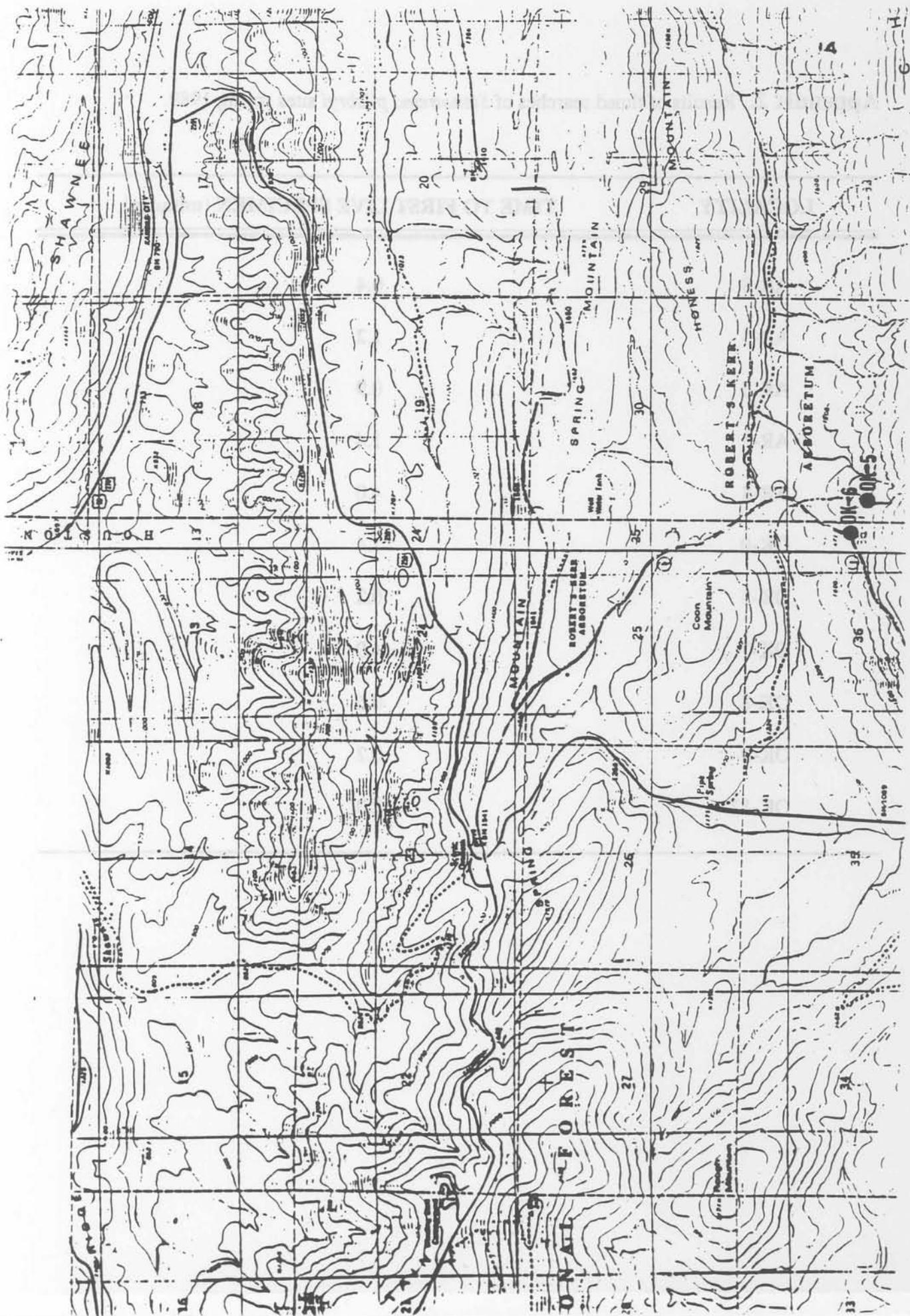


Scale 1:50,000
Horizontal distance in feet
Vertical distance in feet
Contour interval 20 feet
Elevation in feet
Spot elevation in feet
Elevation in meters
Spot elevation in meters



LEGEND	
Contour lines	Elevation in feet
Spot elevation	Elevation in meters
Water	Water
Highway	Highway
Road	Road
Trail	Trail
Boundary	Boundary
Settlement	Settlement
Vegetation	Vegetation
Rock	Rock
Soil	Soil
Other features	Other features

MOUNTAIN FORK QUADRANGLE	
AR-8	AR-75
Other locations	Other locations
Scale	Scale
Other details	Other details



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

