FINAL REPORT

SECTION 6

ENDANGERED SPECIES ACT

OKLAHOMA
DEPARTMENT OF WILDLIFE CONSERVATION

FEDERAL AID PROJECT E-48

Monitoring Populations of the Rich Mountain Slitmouth Snail (Stenotrema pilsbryi) in Oklahoma

SEPTEMBER 26, 1997 - SEPTEMBER 25, 1998

FINAL REPORT

State: Oklahoma Project Number: E-48

Project Period: September 26, 1997 - September 25, 1998

Project Title: Monitoring Populations of the Rich Mountain Slitmouth Snail (*Stenotrema pilsbryi*) in Oklahoma

Objective:

Revisit rock glaciers previously identified as harboring populations of the Rich Mountain slitmouth snail and obtain a quantitative measurement of the population size or density which can be used as a baseline for future monitoring.

Abstract:

Four of the rock glaciers from which populations of the Rich Mountain slitmouth snail are known, were revisited during this study. At these sites, estimates were made of population density, overall population size and the abundance of *Stenotrema pilsbryi* relative to all other land snails. To determine population density and size, a technique was used which combined timed search and transect methodology. *S. pilsbryi* was absent at one historic site, but was one of the three most commonly encountered land snails at the other three sites. Population estimates for the three historic locations were the species were found ranged from 232 to 1056 individuals. *S. pilsbryi* showed a strong correlation with a species of composite (*Polymnia canadensis*) and were collected on several wooded talus slopes where this herbaceous plant grew and where no prior searches for *S. pilsbryi* had been conducted. It appears that this species of land snail is more evenly distributed within its range on Rich and Winding Stair mountains than earlier believed and a greater probability exists for gene flow between populations on rock glaciers.

INTRODUCTION

The Rich Mountain Slitmouth Snail, *Stenotrema pilsbryi* (Ferriss) is an unusual terrestrial snail found in a very limited area of Oklahoma and Arkansas. It is atypical in that it has its shell surface covered with long, hairlike pili, which gives the snail the appearance of being "hairy." Ferriss (1900) first described the species as *Polygyra pilsbryi* from two specimens collected at "Rich Mountain Station, Polk Co., Arkansas, on mountain, by roadside leading to R. R. station to the hotel." Pilsbry (1940) lists the type specimen as 81474 in the Academy of Natural Sciences of Philadelphia. He also describes its habitat as "in a shallow, rocky ravine just beyond the beginning of the forest. The ravine is paved with large rocks and quartzite boulders, under which *S. pilsbryi* lives; also under charred wood upon the rocks, or rarely under old logs in stony places." Because of the very limited range of this species there has been some interest by the U. S. Fish and Wildlife Service, the Arkansas Nongame Preservation Committee and the Oklahoma Department of Wildlife Conservation. As a result, several studies were commissioned that resulted in status reports by Caldwell (1988, 1989, 1990) and Hartfield (1991). These studies focused primarily on locating populations, finding the limits of its range, habitat analysis and, to a limited extent, population analysis. However, for future monitoring of the population it was felt that techniques for simple population analysis and base-line data on populations be developed so that trends in the population could be detected in the future for management purposes. Thus the need for the present study and report was established. Further historical summaries of *Stenotrema pilsbryi* may be found in Caldwell (1988 and 1989).

Discussions of *S. pilsbryi* habitat have centered on "rock glaciers" and "talus slopes." In most cases these terms have been used loosely and little or no distinction has been made between the two and the terms are usually used interchangeably. However, we found two distinctly different geological structures and are making the following distinctions in this report:

1. Rock Glaciers are characterized by large (up to a couple of meters in diameter) rounded boulders with deep crevasses extending possibly several meters below the surface. These areas are mostly open with no canopy cover and most vegetation (except for mosses and lichens) are confined to the margins (lateral, upslope and downslope ends). These rocks

tend to be bare with some leaf litter and humus collected in the deep recesses of the crevasses. The surface regions of these glaciers also tend to dry quickly and have extremes of heat and cold.

2. Smaller, (up to 0.5 meters) more angular rocks characterize talus Slopes. These seem to be fragments of rock outcrops that are exposed on the slopes and gradually come loose and work their way downslope in a longitudinal pattern. These conditions are fairly uniformly distributed throughout the mountainsides, but in areas of greater drainage, more of these rocks are actually exposed on the surface. Wherever there is less drainage, soil tends to accumulate around and on these rocks and they are not exposed in those areas. These talus slopes also tend to have deep crevasses but are much smaller than those of the rock glaciers. The talus slopes are usually well vegetated with trees of varying sizes both marginal and within the slopes. A great deal of understory woody and herbaceous vegetation usually inhabits these sites. Consequently, there is abundant leaf litter and humus accumulated on these rocks and especially within the small crevasses. As a result of this accumulation of organic matter, the shade provided by the vegetation and wind protection, these talus slopes tend to have more near surface moisture and less extremes of heat and cold.

Because of the presence of several salamander species in the same habitat as *S. pilsbryi*, it was felt that it would be worthwhile to attempt to assess their status along with the snails. Three species were considered for sampling, the Ouachita Dusky Salamander (*Desmognathus brimleyorum*), the Kiamichi Salamander (*Plethodon glutinosus ssp.*) and the Rich Mountain Salamander (*Plethodon ouachitae*). However, only two species were encountered during the study and these were the Rich Mountain Salamander (*P. ouachitae*) and the Southern Redback Salamander (*P. serratus*).

METHODS AND MATERIALS

In conducting population surveys of *Stenotrema pilsbryi*, several factors had to be considered:

1. Limited time and money available.
2. Difficult access to many of the previously documented populations.

3. Unusual habitat conditions of the species that make use of standard techniques difficult or impossible.

4. Variable weather conditions that influence activity and accessibility of the species.

5. Variable weather conditions that affect effectiveness of field workers.

6. Time available to conduct the fieldwork.

7. Availability of assistance to conduct the field work.

With these considerations, it was reasoned that optimum temperature and moisture conditions would occur in April, May and June of 1998. The fieldwork was conducted in late April and May. This turned out to be fortuitous because of the extreme and unusual heat and drought that occurred in June of 1998. Actual fieldwork occurred during the period of April 29 to May 14.

Although Caldwell's (1989, 1990) studies were not directed toward analyzing populations of *S. pilsbryi*, he did record time needed to collect a live specimen at nine Oklahoma sites in 1988 and six Oklahoma sites in 1989. The 1988 study also included time to collected any *S. pilsbryi* (live or dead) at the nine Oklahoma sites. Those data are summarized in Table 1.

Table 1. Report of results of timed searches for *Stenotrema pilsbryi* in Oklahoma by Ronald S. Caldwell.

Site	Shell Time (minutes) (Caldwell, 1989) 13-17 May 1988	Live Specimen Time (minutes) (Caldwell, 1989) 13-17 May 1988	Live Specimen Time (minutes) (Caldwell, 1990) 16-30 May 1989
OK – 0	0.6	1.4	1.4
OK – 1	4.0	4.0	
OK – 2	0.5	0.5	
OK – 3	0.8	9.0	
OK – 4	0.5	0.5	
OK – 5	1.0	2.0	0.2
OK – 6	0.6	2.1	
OK – 7	2.0	2.0	4.0
OK – 8	3.0	9.0	0.6
OK – 9			0.2
OK – 12			2.0

In the present study, an effort was made to develop an easily repeatable method for population analysis that would include a more through analysis and at the same time be comparable to that used by Caldwell.

The steep, rocky terrain made access to and work within the habitat difficult. Compounding the problem at higher elevation was an ice storm that devastated the large woody vegetation in late November of 1996 (Jerry W. Davis, pers. comm.). This destructive force opened the canopy at a number of sites and the resulting proliferation of understory vegetation made movement through and work within some of the areas exceedingly difficult.

The technique utilized was a timed/transect method. Suitable rock glaciers and talus slopes were located. These geological features tended to run longitudinally up and down slope, thus the axis of the sites ran parallel with the slope from high elevation to low elevation (or perpendicular to the elevation contour lines). The procedures for sampling were in general as follows (also see Figure 1):

1. Locate a site, either a previously identified one in Caldwell (1988, 1989, and 1990) or a site with a presumed population of *S. pilsbryi*.
2. Lay out a transect line, marked at one meter intervals, perpendicular to the longitudinal axis of the rock glacier or talus slope. The transect line should include some peripheral vegetation on the margin of the site.
3. The one-square meter above and one square-meter below each meter section on the transect line is designated as a sample plot. Thus each sample plot is an area of two square meters.
4. Twenty man/minutes of search is expended on each sample plot. Two persons searching for 10 minutes or one person searching the plot for 20 minutes can accomplish this.
5. At each sample plot, each gastropod encountered was recorded. Information recorded included:
   a. species
   b. time
   c. live or dead
   d. size (greatest shell diameter) recorded only for *S. pilsbryi*

6. All sample plots were sampled along the transect.

7. When a transect was completed, a new transect was established 50 meters down (or up) the site.

8. This was repeated until the entire site was sampled (or in very large sites, until several transects were completed).

This method of sampling allows several types of information to be obtained:

1. Time elapsed until first shell or first live *S. pilsbryi* was located. This makes some comparison with Caldwell's 1988, 1989, 1990 data possible.

2. Number of *S. pilsbryi* found per unit of search time at each site.

3. Number of *S. pilsbryi* found per unit area at each site.

4. Total population estimate in each site sampled.

5. Spatial distribution of *S. pilsbryi* in each site sampled.

6. The above information can also be derived for other species (gastropods, salamanders, etc.) found.

7. Miscellaneous information could also be recorded concerning location, size and species of trees in the area and evidence of other species of possible significance to gastropods on the site.

The intense method of sampling meant that the number of sites capable of being sampled would be limited. All known sites could not be visited and/or sampled. These techniques also allowed the accumulation of similar data on individuals of *Plethodon ouachitae* and *P. serratus*.

RESULTS AND DISCUSSION

A summary of sample results from each site is discussed below. Sites are numbered based on the number assigned by Caldwell.

Site OK – 1A - This is a talus slope about 0.4Km southeast of Caldwell's site OK-1 (S25 – T3N – R26E). This was mistakenly sampled as OK – 1. The site is a wooded talus slope with a well-developed

canopy and little understory shrubby or herbaceous vegetation. It is just east of a rocky ravine that crosses US Highway 59 and 270 about 2.2 Km east-southeast of the intersection at Page, LeFlore Co., Oklahoma. The site itself is about 1.0Km south of US Highway 59 and 270 upslope toward the crest of Rich Mountain (Talimena Scenic Drive). Three transects were made here with a total of 12 sample sites ($24m^2$) searched. A total of four live *S. pilsbryi* were found. This resulted in 0.16 live specimens/m^2 or 60 search minutes per live specimen found. Although this was not one of the sites we intended to sample, it showed that less typical sites than previously reported can and do support populations of *S. pilsbryi* even if at very low levels. More of this will be discussed later in this report.

Site OK – 1 - This is a rock glacier about 0.6Km upslope on the same ravine as OK-1A. It is located on the west side of the ravine (also in S25 – T3N – R26E) and is about 150m long and 10 to 19m wide (See Figure 2), and covered an area of about $2575m^2$. This was a typical rock glacier with large rounded boulders, mostly open except where there was some canopy along the margins from overhanging trees. The margins were thus semi-exposed to sunlight and were thickly tangled with poison ivy (*Toxicodendron radicans*). The main body of the glacier was fully exposed and supported no woody or herbaceous vegetation. A total of twelve live *S. pilsbryi* were found. This amounted to 0.09 specimens/m^2 or 110 search minutes per live specimen found. The estimated population of *S. pilsbryi* for this rock glacier was 232.

Site OK – 4 – This site is a talus slope about 0.3Km north northwest of the scenic overlook on the Talimena Scenic Drive in S34 – T3N – R26E. This site was heavily impacted by the November 1996 ice storm. Although this site was apparently an open forest before the ice event, the heavy destruction of trees and limbs has resulted in a thick growth of woody and herbaceous understory vegetation. Only the upper 100 meters of this site was sampled (Figure 3). A total of 43 live *S. pilsbryi* were found. This was 0.86 live specimens/m^2 and 11.6 search minutes per live specimen. The estimated population for the upper $825m^2$ area was 710.

Site OK – 6 – This is a small rock glacier located adjacent to the Talimena Scenic Drive at the east edge of S36 – T3N – R25E. Four transects were established here with 31 sample points and 620 sample minutes. No *S. pilsbryi* were found during sampling. However, an earlier visit to this site on 29 April 1998 yielded

Figure 1. Illustration of time/transect method of sampling rock glaciers and talus slopes for *Stenotrema pilsbryi*. (Not to scale)

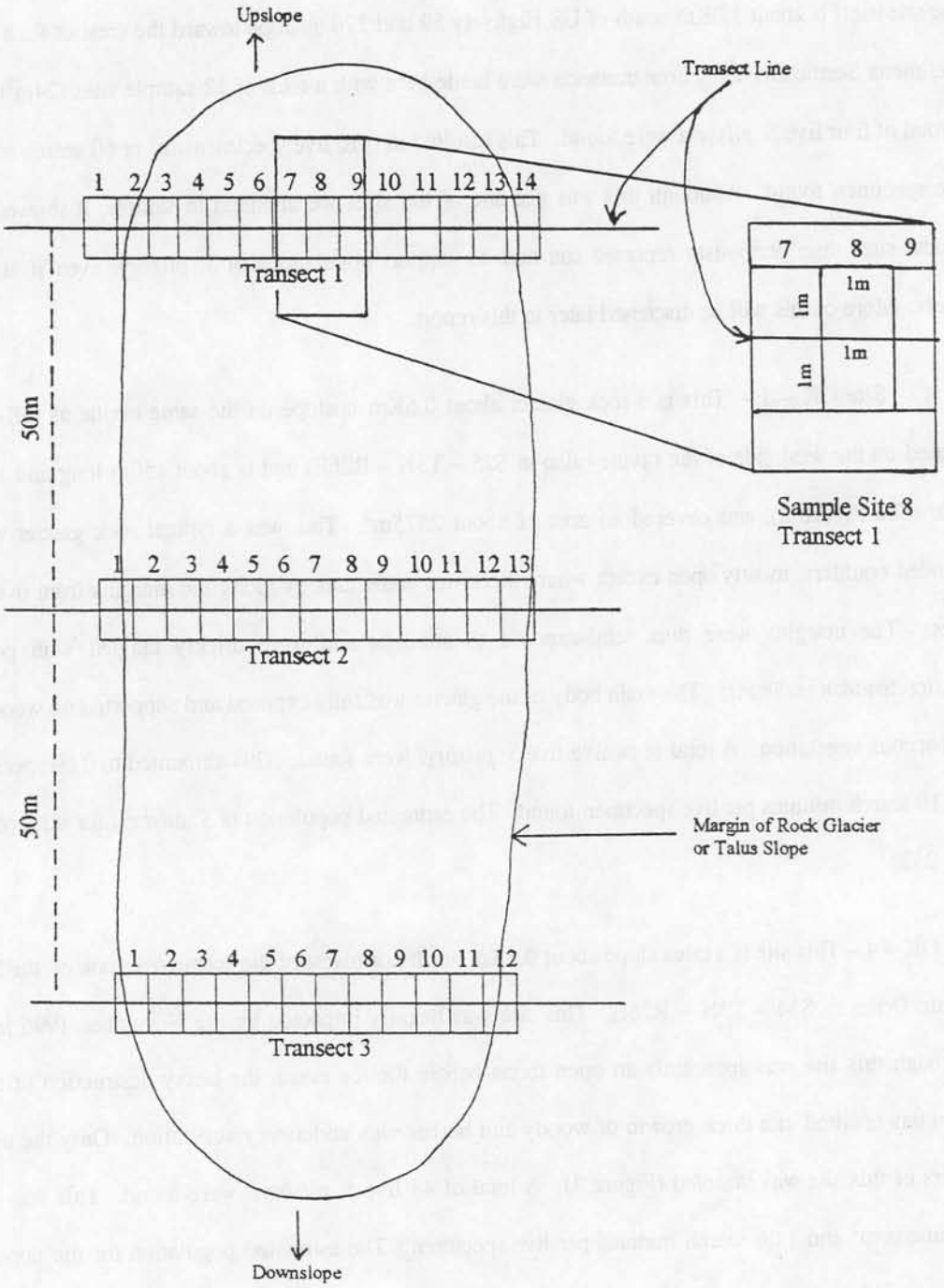


Figure 2. Rock Glacier site OK – 1. Distribution of transects, sample sites and specimens on a 2575m^2 rock glacier with wooded margin. (Not to scale)

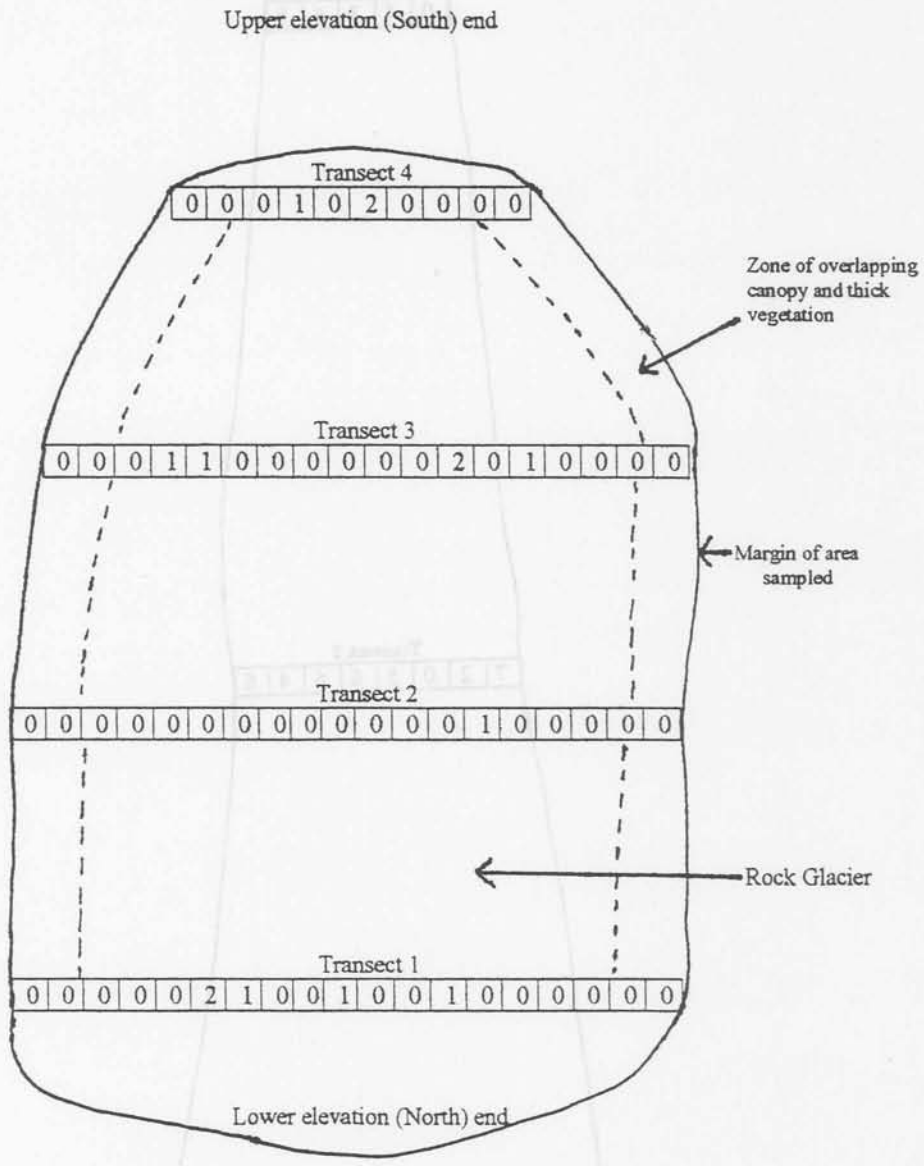


Figure 3. Talus slope Site OK – 4. This is a 825m^2 wooded talus slope, relatively open canopy, because of ice damage in November 1996, and relatively heavy ground cover of woody and herbaceous vegetation. (Not to scale)

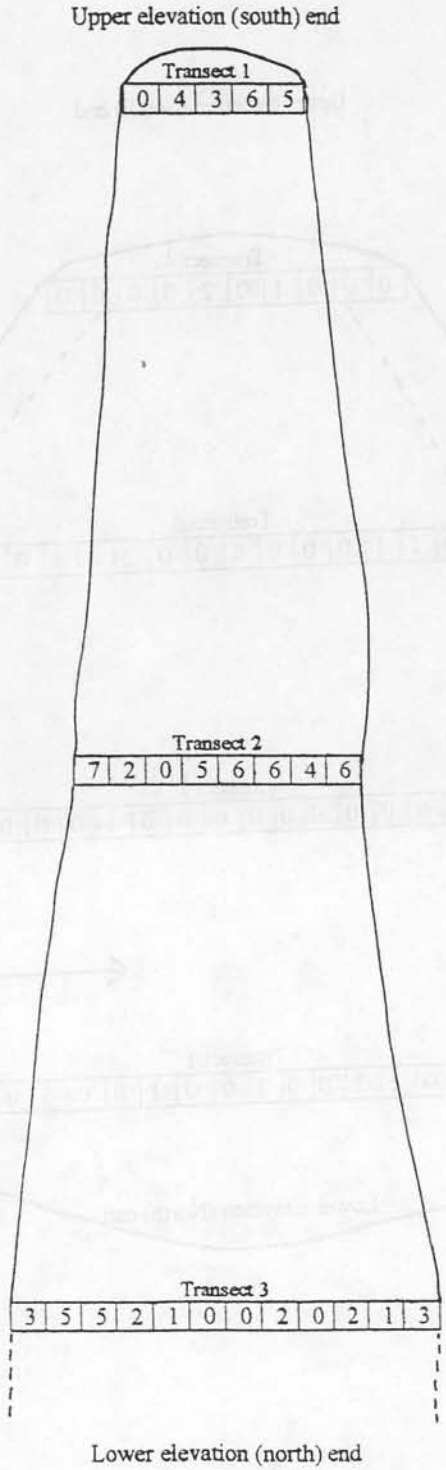
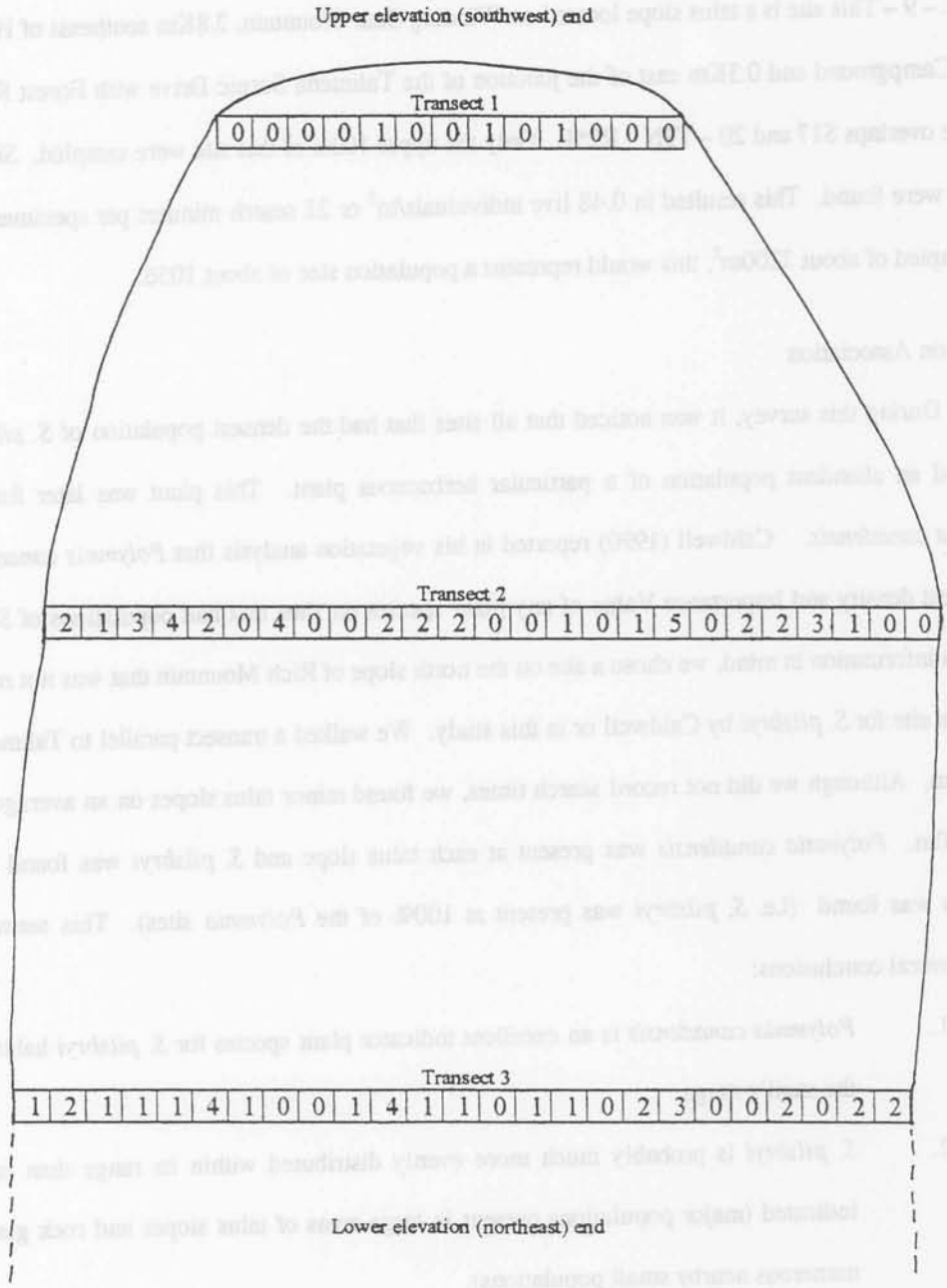


Figure 4. Talus slope Site OK – 9. This is a 2200m^2 wooded talus slope, with relatively open canopy and ground level woody and herbaceous vegetation. (Not to scale)



one juvenile *S. pilsbryi* in 360 search minutes, indicating that the species does exist there, but at very low levels.

Site OK – 9 – This site is a talus slope located on Winding Stair Mountain, 2.8Km southeast of Horse Thief Spring Campground and 0.3Km east of the junction of the Talimena Scenic Drive with Forest Road 6012. This site overlaps S17 and 20 – T3N – R25E. Only the upper 100m of this site were sampled. Sixty live *S. pilsbryi* were found. This resulted in 0.48 live individuals/m^2 or 21 search minutes per specimen. For the area sampled of about 2200m^2, this would represent a population size of about 1056.

Vegetation Association

During this survey, it was noticed that all sites that had the densest population of *S. pilsbryi* also supported an abundant population of a particular herbaceous plant. This plant was later found to be *Polymnia canadensis.* Caldwell (1990) reported in his vegetation analysis that *Polymnis canadensis* had the highest density and Importance Value of any plant species on sites that had populations of *S. pilsbryi.* With this information in mind, we chose a site on the north slope of Rich Mountain that was not reported as a positive site for *S. pilsbryi* by Caldwell or in this study. We walked a transect parallel to Talimena Drive for 0.5Km. Although we did not record search times, we found minor talus slopes on an average of every 50 to 100m. *Polymnia canadensis* was present at each talus slope and *S. pilsbryi* was found wherever *Polymnia* was found (i.e. *S. pilsbryi* was present at 100% of the *Polymnia* sites). This seems to lead toward several conclusions:

1. *Polymnia canadensis* is an excellent indicator plant species for *S. pilsbryi* habitat within the snail's range.
2. *S. pilsbryi* is probably much more evenly distributed within its range than previously indicated (major populations present in large areas of talus slopes and rock glaciers but numerous nearby small populations).
3. Small populations are much closer together with greater possibility of movement between populations and greater possible gene flow than previously thought.

Salamanders

Populations of salamanders were found at all sites sampled. The Redback Salamander (*Plethodon serratus*) was found at all sites sampled and ranged in density from $0.02/m^2$ to $0.5/m^2$. A total of 13 specimens of this species was found on the five sites sampled. Only six specimens of the Rich Mountain Salamander (*Plethodon ouachitae ssp.*) were found at four of the five sites sampled and ranged in density at those sites from $0.01/m^2$ to $0.06/m^2$. See Appendix E.

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Prepared by:

Charles M Mather
Professor of Biology
University of Science and Arts of Oklahoma
Chickasha, OK 73018

And

Aaron T. Edwards
4512 SE 27th St.
Del City, OK 73115

Date: Dec. 21, 1998

Approved by:

Harold Namminga
Federal Aid/Research Coordinator

APPENDIX A

Results of Timed/Transect searches for *Stenotrema pilsbryi* at various sites

Results of Timed/Transect searches for *Stenotrema pilsbryi* (and other gastropod species) at Site 1A (S25 – T3N – R26E), Rich Mountain, LeFlore County, Oklahoma. Wooded talus slope.

Species	Total Live Specimens	Total Dead Specimens	Number of Live Specimens/m^2	Number of Man-Minutes/Live Specimen
Stenotrema pilsbryi	4	0	0.16	60
Stenotrema unciferum	2	0	0.08	120
Inflectarius inflectus	3	1	0.13	80
Patera binneyana	3	0	0.13	80
Ventridens brittsi	30	6	1.25	8
Anguispira strongylodes	1	0	0.04	240

Results of Timed/Transect searches for *Stenotrema pilsbryi* (and other gastropod species) at Site 1 (S25 – T3N – R26E), Rich Mountain, LeFlore Co., Oklahoma. Rock Glacier.

Species	Total Live Specimens	Total Dead Specimens	Number of Live Specimens/m^2	Number of Man-Minutes/Live Specimen
Stenotrema pilsbryi	12	2	0.09	110
Stenotrema unciferum	4	1	0.03	330
Inflectarius inflectus	7	1	0.05	189
Patera binneyana	8	4	0.06	165
Mesodon zaletus	1	0	0.01	1320
Ventridens brittsi	27	18	0.20	49
Anguispira strongylodes	1	2	0.01	1320
Glyphyalinia indentata	2	0	0.02	660
Paravitrea simpsoni	17	2	0.13	78

Results of Timed/Transect searches for *Stenotrema pilsbryi* (and other gastropod species) at Site 4 (S34 – T3N – R26E), Rich Mountain, LeFlore Co., Oklahoma. Talus slope.

Species	Total Live Specimens	Total Dead Specimens	Number of Live Specimens/m^2	Number of Man-Minutes/Live Specimen
Stenotrema pilsbryi	43	35	0.86	11.6
Stenotrema unciferum	2	1	0.04	250
Stenotrema fraternum imperferatum	2	0	0.04	250
Inflectarius inflectus	11	45	0.22	45.4
Patera binneyana	1	5	0.02	500
Mesodon zaletus	2	1	0.04	250
Ventridens brittsi	22	13	0.44	22.7
Anguispira strongylodes	1	5	0.02	500
Mesomphix friabilis	1	8	0.02	500
Paravitrea simpsoni	1	0	0.02	500

Results of Timed/Transect searches for *Stenotrema pilsbryi* (and other gastropod species) at Site 6 (S36 – T3N – R25E), Rich Mountain, LeFlore Co., Oklahoma. Rock glacier.

Species	Total Live Specimens	Total Dead Specimens	Number of Live Specimens/m^2	Number of Man-Minutes/Live Specimen
Stenotrema fraternum imperferatum	2	0	0.03	310
Inflectarius inflectus	1	1	0.02	620
Patera binneyana	0	1	0	-
Ventridens brittsi	4	3	0.07	155
Paravitrea simpsoni	1	1	0.02	620

Results of Timed/Transect searches for *Stenotrema pilsbryi* (and other gastropod species) at Site 9 (S20 – T3N – R25E), Winding Stair Mountain, LeFlore Co., Oklahoma. Talus slope.

Species	Total Live Specimens	Total Dead Specimens	Number of Live Specimens/m^2	Number of Man-Minutes/Live Specimen
Stenotrema pilsbryi	60	11	0.48	21.0
Stenotrema fraternum imperferatum	10	12	0.08	126
Inflectarius inflectus	43	54	0.34	29.3
Patera binnevana	14	11	0.11	90
Mesodon zaletus	1	0	0.01	1260
Ventridens brittsi	72	68	0.57	17.5
Mesomphix friabilis	0	3	0	-
Paravitrea simpsoni	23	8	0.19	54.8

APPENDIX B
Associated species

Comments on species of gastropods found in the present survey and those reported by Caldwell (1988 and 1990).

Caldwell (1988 and 1990)	Present Study
Stenotrema labrosum	We found *S. pilsbryi* in various stages of depiliation. Those that were dompletely depiliated strongly resembled *S. labrosum.* We did not find specimens of *S. labrosum.*
Stenotrema leai aliciae	We found *S. fraternum imperferatum* which strongly resembles *S. leai.* We did not find specimens of *S. leai aliciae.*
Stenotrema unciferum	Yes
Mesodon binneyanus	We have followed the revision of Emberton, (1991) in using the name *Patera binneyana.*
Mesodon zaletus ozarkensis	Yes
Mesodon inflectus	We have followed the revision of Emberton (1991) in using the name *Inflectarius inflectus.*
Mesomphix friabilis	Yes
Ventridens brittsi	Yes
Anguispira stongylodes	Yes
Not reported	*Glyphyalinia indentata*
Not reported	*Paravitrea simpsoni*

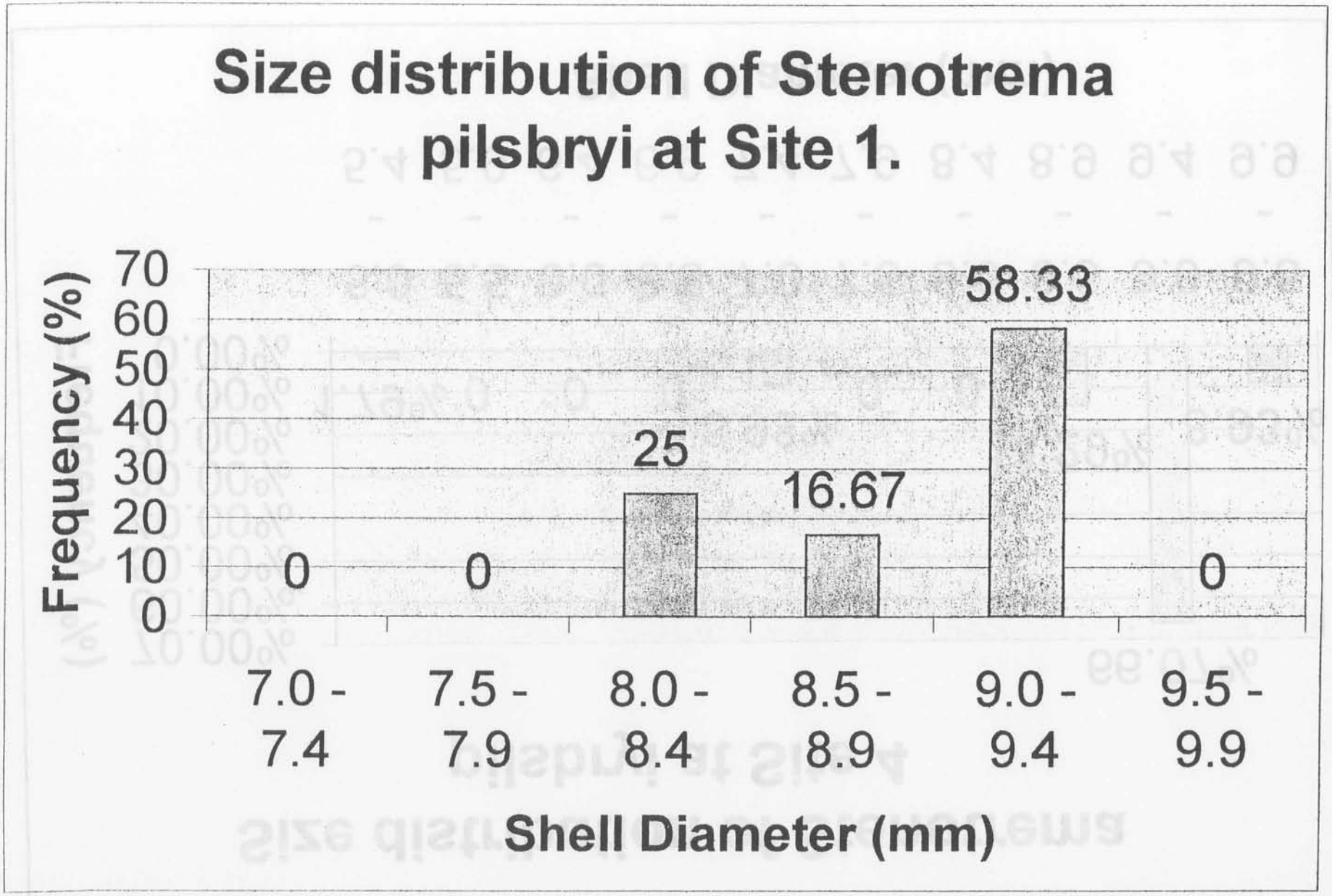
Relative abundance of *Stenotrema pilsbryi* and other gastropod species at sample sites.

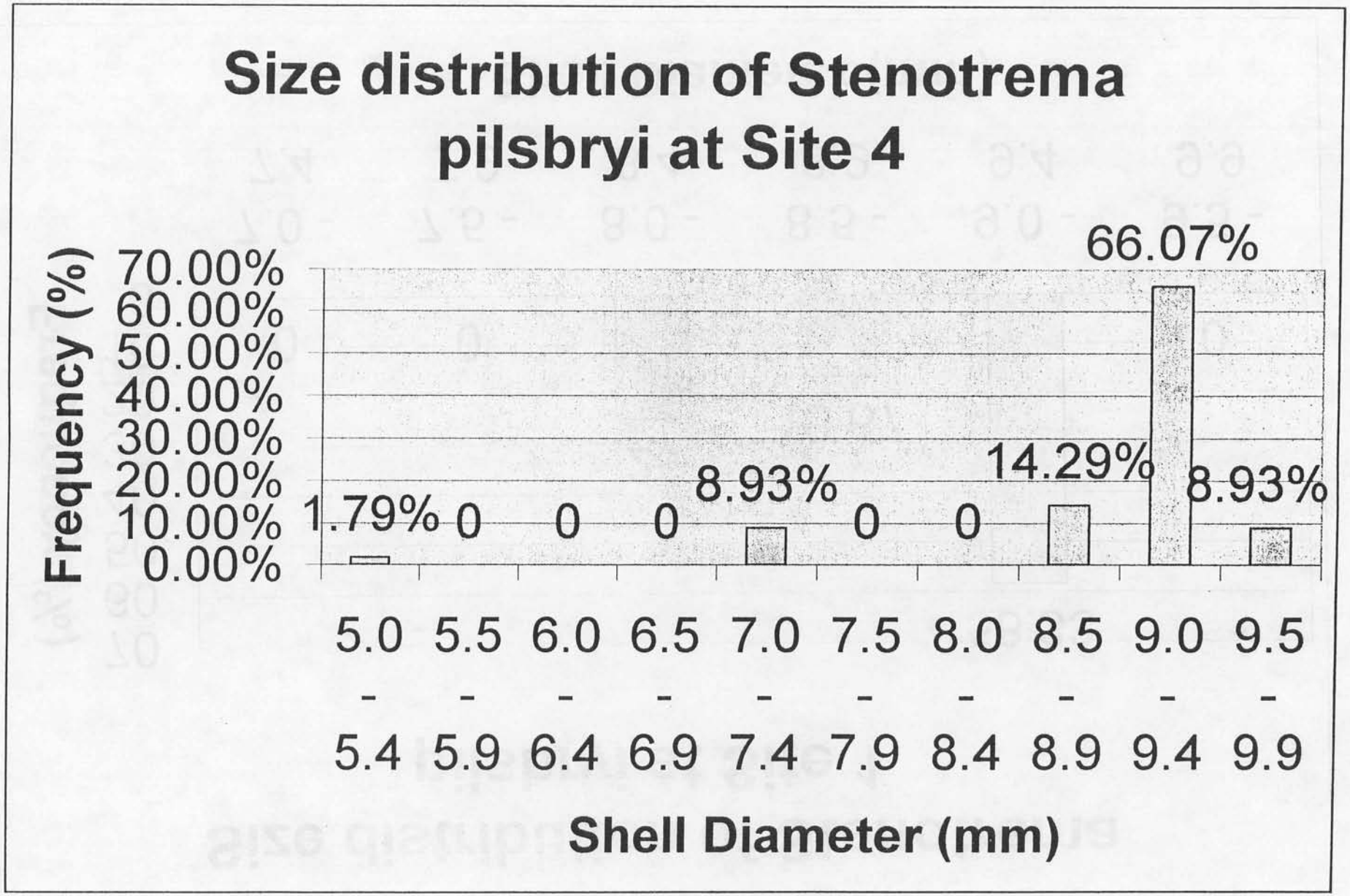
Species	Relative Abundance (Pooled live and dead specimens)				
	Site 1A	Site 1	Site 4	Site 6	Site 9
Stenotrema pilsbryi	8.00%	12.84%	39.20%	-	18.21%
Stenotrema unciferum	4.00%	4.59%	1.51%	-	-
Stenotrema fraternum imperferatum	-	-	1.01%	14.29%	5.64%
Inflectarius inflectus	8.00%	7.34%	28.14%	14.29%	24.87%
Patera binneyana	6.00%	11.01%	3.02%	7.14%	6.41%
Mesodon zaletus	-	0.92%	1.51%	-	0.26%
Ventridens brittsi	72.00%	41.28%	17.59%	50.00%	35.90%
Anguispira strongylodes	2.00%	2.75%	3.02%	-	-
Glyphyalinia indentata	-	1.83%	-	-	-
Paravitrea simpsoni	-	17.43%	0.50%	14.29%	7.95%
Mesomphix friabilis	-	-	4.52%	-	0.77%

Associated vertebrate species.

Scientific Name	Common Name
Crotalus horridus	Timber Rattlesnake
Eumeces fasciatus	Five-lined Skink
Plethodon serratus	Southern Redback Salamander
Plethodon ouachitae	Rich Mountain Salamander
Thamnophis sp.	Garter Snake

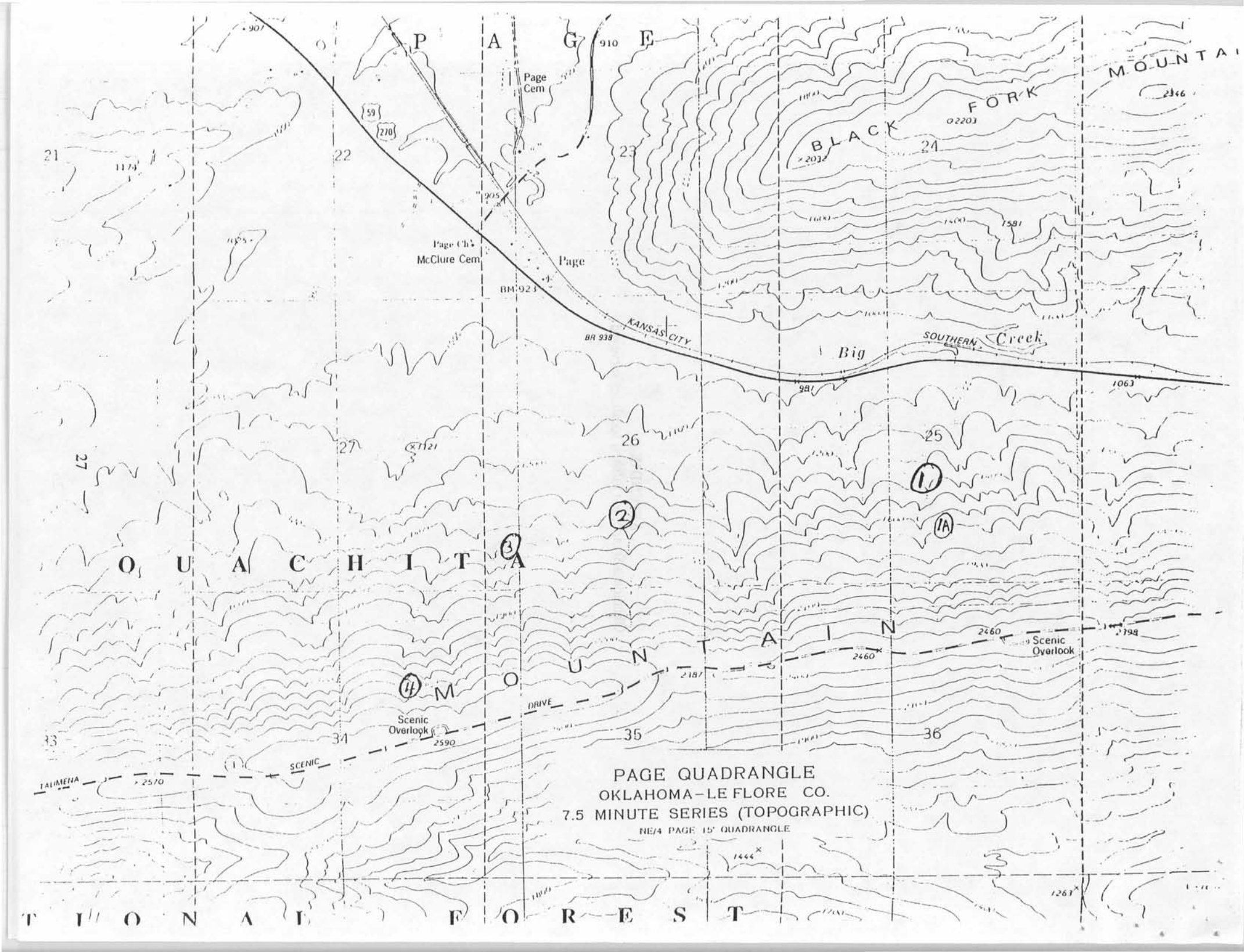
APPENDIX C
Size distribution of *Stenotrema pilsbryi*

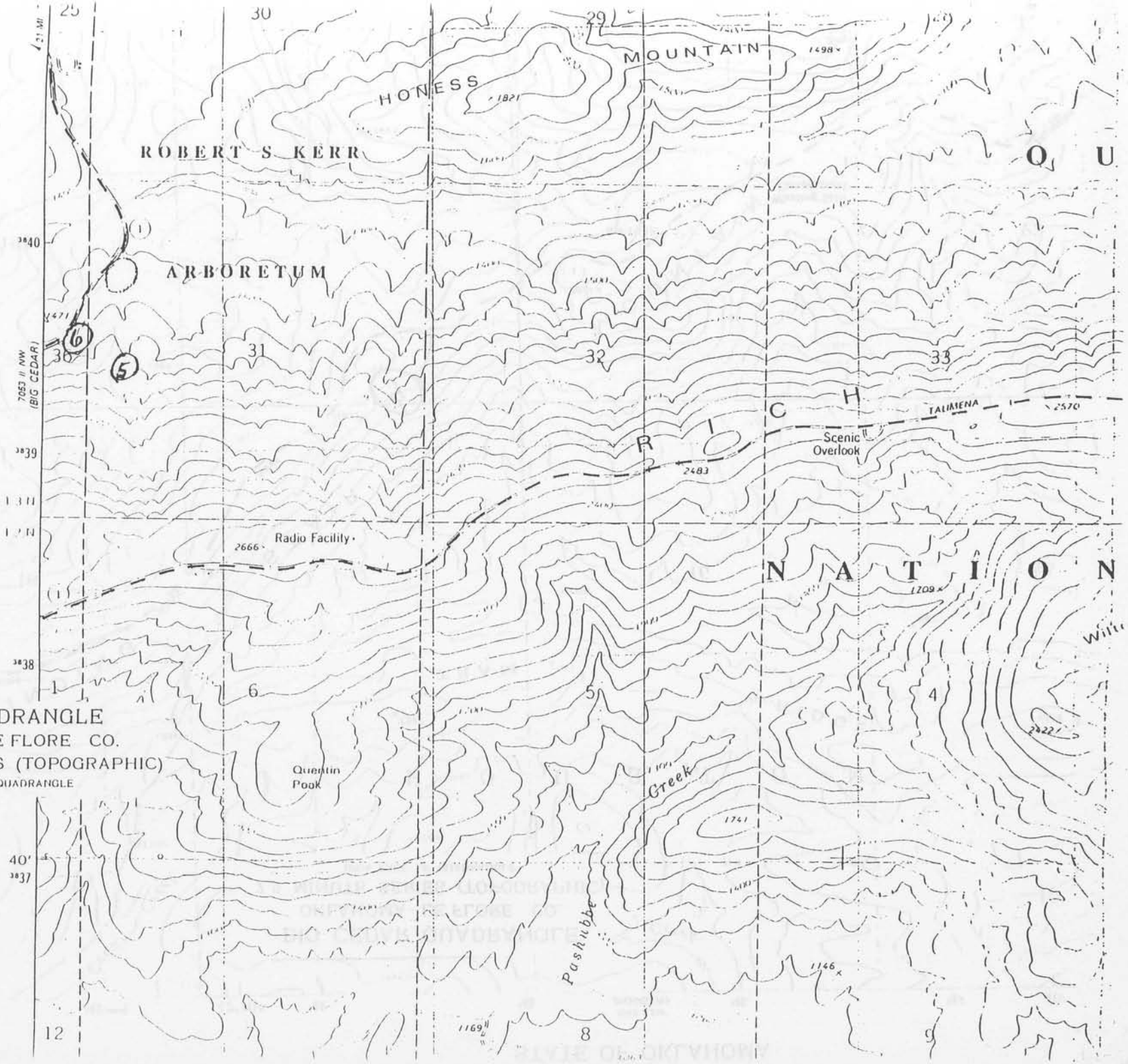

Size distribution of Stenotrema pilsbryi at Site 1.
Frequency (%)
70
60
50
40
30
20
10
0
0
0
25
16.67
58.33
0
7.0 - 7.4
7.5 - 7.9
8.0 - 8.4
8.5 - 8.9
9.0 - 9.4
9.5 - 9.9
Shell Diameter (mm)


Size distribution of Stenotrema pilsbryi at Site 4
Frequency (%)
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
1.79%
0
0
0
8.93%
0
0
14.29%
66.07%
8.93%
5.0 - 5.4
5.5 - 5.9
6.0 - 6.4
6.5 - 6.9
7.0 - 7.4
7.5 - 7.9
8.0 - 8.4
8.5 - 8.9
9.0 - 9.4
9.5 - 9.9
Shell Diameter (mm)

APPENDIX D

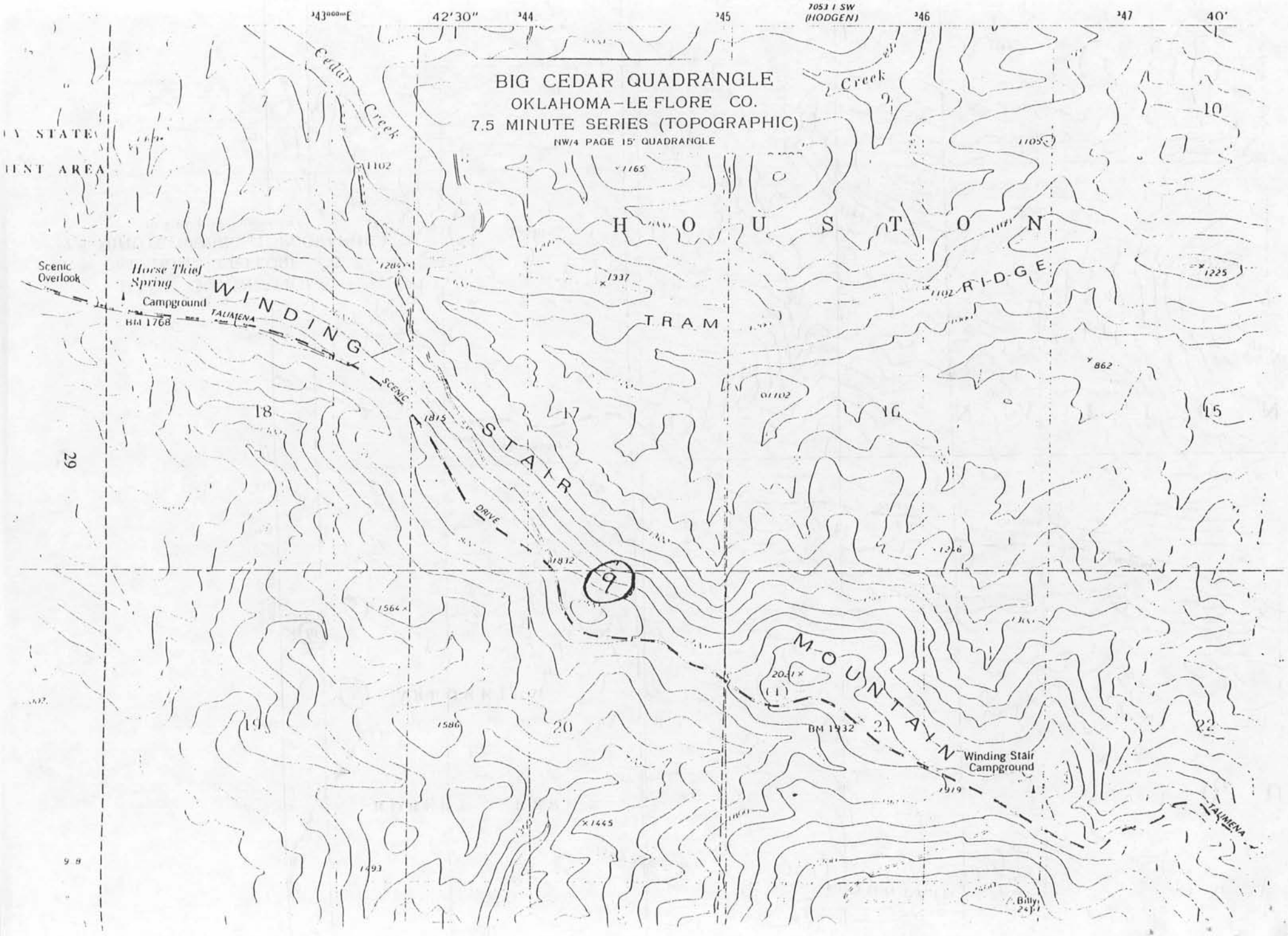
Oklahoma *Stenotrema pilsbryi* localities surveyed


P A G E
Page Cem
59
210
Page Ch
McClure Cem
Page
BM 923
KANSAS CITY
BR 938
Big
SOUTHERN
Creek
BLACK FORK
MOUNTAI
O U A C H I T A
M O U N T A I N
Scenic Overlook
Scenic Overlook
DRIVE
SCENIC
TALIMENA
T I O N A L F O R E S T
PAGE QUADRANGLE
OKLAHOMA-LE FLORE CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NE/4 PAGE 15' QUADRANGLE



PAGE QUADRANGLE
OKLAHOMA-LE FLORE CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NE/4 PAGE 15' QUADRANGLE

STATE OF OKLAHOMA



APPENDIX E

Results of Timed/Transect searches for *Plethodon ouachitae* and *Plethodon serratus* at various sites

Results of Timed/Transect searches for *Plethodon ouachitae* at various sites on Rich Mountain and Winding Stair Mountain, LeFlore County, Oklahoma

SITE	TOTAL SPECIMENS	NUMBER OF SPECIMENS/M^2	NUMBER OF MAN-MINUTES/SPECIMEN
1A	1	0.04	240
1	0	-	-
4	3	0.06	167
6	1	0.02	620
9	1	0.01	1260

Results of Timed/Transect searches for *Plethodon serratus* at various sites on Rich Mountain and Winding Stair Mountain, LeFlore County, Oklahoma.

SITE	TOTAL SPECIMENS	NUMBER OF SPECIMENS/M^2	NUMBER OF MAN-MINUTES/SPECIMEN
1A	1	0.04	240
1	5	0.04	264
4	1	0.02	500
6	3	0.05	207
9	3	0.03	420