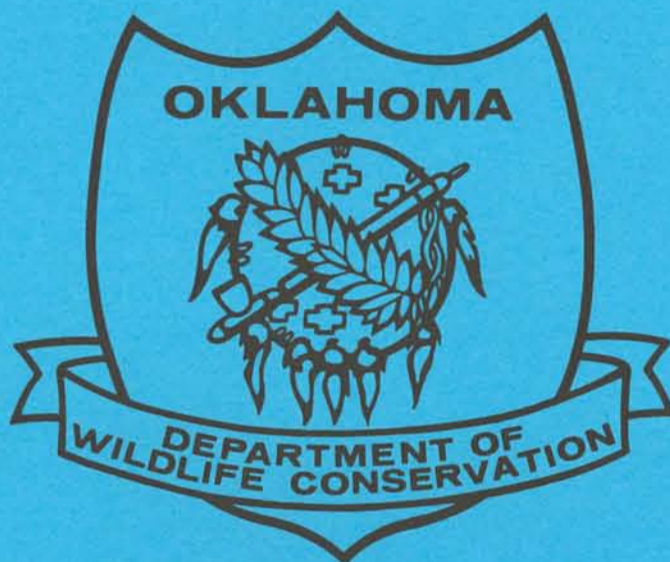


FINAL REPORT  
SECTION 6  
ENDANGERED SPECIES ACT



FEDERAL AID PROJECT E-24

STATUS SURVEY OF THE OUACHITA DUSKY SALAMANDER

MAY 1, 1993 - APRIL 30, 1995

## FINAL REPORT

STATE: OKLAHOMA

PROJECT NUMBER: E-24

PROJECT TITLE: Status Survey of the Ouachita Dusky Salamander

PERIOD COVERED: 1 May 1993 - 30 April 1995

## ABSTRACT

We conducted a survey of the status and distribution of the Ouachita Dusky Salamander (*Desmognathus brimleyorum*) in the Ouachita Mountains of southeast Oklahoma. We used a standardized survey technique to identify the locations of extant populations of salamanders. Once populations were located, relative population density was estimated by determining the number of salamanders encountered during time-constrained searches. We then used GIS (Geographic Information System) to identify appropriate conditions of habitat parameters known to be important to plethodontid salamanders. We used GIS to predict the occurrence of *D. brimleyorum* within the five county region surveyed. In Oklahoma, we found the Ouachita Dusky Salamander to be locally abundant given the appropriate habitat conditions (in and around seeps, springs, and high gradient streams). We believe the species is likely sensitive to certain disturbances that could disrupt the hydrology of these fragile habitats.

## OBJECTIVES

The objective of this study was to determine the current status and distribution of the Ouachita Dusky Salamander (*D. brimleyorum*) by sampling localities of known historic occurrence and reviewing museum records to document any changes in distribution or abundance. This information is necessary to evaluate the impact, if any, that anthropogenic activities may have upon the species as well as to help guide future management decisions. Notes on microhabitat collected during the study, moreover, add to our current knowledge of the biology of this species.

## INTRODUCTION AND LITERATURE REVIEW

Stejneger (1895) first described the Ouachita Dusky Salamander, (*Desmognathus brimleyorum*) as a relatively large and robust plethodontid salamander that is often aquatic or semiaquatic. Although it is known that *D. brimleyorum* is restricted to the Ouachita Mountains (Conant and Collins 1991), there has been only limited study of the status of the species (Burt 1935; Grobman 1950; Means 1974). Until recently the range of this species was poorly defined and its abundance virtually unknown. Aside from this study, the most recent collections were made from 1977 and 1984 when Karlin et al. (1993) obtained 861 individuals from 49 locations, 11 of which were in Oklahoma.

The Ouachita dusky salamander generally inhabits areas near streams, springs and seeps where it is often found under submerged rocks, woody debris or buried in wet gravel (Conant and Collins 1991). The physiographic region which is home to this species extends from Atoka County, Oklahoma, east approximately 300 km to near Hot Springs, Arkansas (Dowling 1956). This narrow mountainous strip of unique pine-oak forest is only 80-90 km wide in places (Bruner 1931) and is made up of a series of east-west ridges and valleys that lie between the Gulf Coastal Plain to the south and the broad Arkansas River valley to the north. Elevations range from 150 to 760 m (Dowling 1956). The positioning of the Ouachita Mountains effectively isolates the region from similar habitat found in the Ozark Plateau and the southern Appalachian Mountains. The relatively small island created by this topographical situation is home to several endemic salamander species as well as *D. brimleyorum* (Conant and Collins 1991). Other species include the Many-ribbed Salamander (*Eurycea multiplicata*), Rich Mountain Salamander (*Plethodon ouachitae*), Caddo Mountain Salamander (*Plethodon caddoensis*), and Fourche Mountain Salamander (*Plethodon fourchensis*).

The Ouachitas are made up mostly of sedimentary rocks: sandstone, limestone, and conglomerate, along with metamorphic rocks such as shale and chert (Mohlenbrock 1993). Soils are predominately silty clay and silty loam and are very shallow and stony on the ridgetops, becoming progressively deeper downslope. These soils are of medium texture and are moderately permeable (Reagan 1974).

Several geologic factors contribute to the unique flora and fauna of the region. (1) Unlike the southwestern United States, the Ouachitas were not covered by shallow inland seas during the Cretaceous period and served as an island refuge for species.

(2) The region also may have served as a refuge for plants and animals during the Pleistocene epoch, when glaciers covered adjacent northern regions. (3) During the late Cenozoic era, sediments that were deposited by inland seas were eroded, further defining boundaries and isolating the uplift. (4) Finally, during the Pleistocene, the river systems were formed (Dowling 1956).

Topography in the mountainous areas of the Ouachitas is often too steep for intensive agricultural use. This has led to a local economy which is heavily reliant upon livestock, poultry production, and a large timber industry.

Even-aged silviculture employing clearcutting, site preparation, and planting has been the primary method of pine regeneration in these forests for the last 25 years. Although young pine plantations provide excellent habitat for many wildlife species adapted to early successional stages (such as deer, rabbits, and quail), even-aged management on short rotations, as typically practiced by the forest industry (especially on private lands), may be detrimental to those species that require mature forest habitat features (Thill 1990).

Clearcutting can cause changes in soil structure, hydrology, and both horizontal and vertical vegetation structure that subsequently affect temperature and moisture regimes. These altered characteristics in turn affect microhabitats that are important to salamanders (Heatwole and Lim 1961; Heatwole 1962; Bury 1983; Pough et al. 1987; Ash 1988; Pechman et al. 1991; Matlack 1994). Also, the water quality of streams may be degraded by increased sedimentation. These changes in microclimatic conditions on the forest floor and the erosion of stream quality are in part facilitated by canopy removal, elimination of the moisture-retaining forest floor litter, and soil compaction (Bury 1983; Raymond and Hardy 1991; Bratton 1994).

Contemporary logging practices have also altered the spatial and temporal disturbance regimes of forest ecosystems (Bratton 1994). Pough et al. (1987) suggested that small scale modifications to a forest may have little effect on salamander populations; after clearcutting, however, return of *Plethodon cinereus* was slow due to inadequate litter accumulation, which appeared to be a prerequisite for colonization. In general, deciduous leaf litter seems to be a very important habitat requirement for many terrestrial salamander species. Deciduous leaf litter retains moisture that plays a significant role in the distribution and activity patterns of terrestrial salamanders (Jaeger 1971). Pure stands of conifers are generally unsuitable for salamanders in the eastern and central United States (Bennett et al. 1980; Pough et al. 1987; Williams and Mullin 1987). In loblolly-shortleaf pine (*Pinus taeda* and *P. echinata*) stands of east Texas, Whiting et al. (1987) found that understory development and the degree of deciduous litter accumulation strongly influenced herpetofaunal communities. Petranka et al. (1993) compared clearcuts <5 years old with mature stands >80 years old and found that terrestrial salamanders were completely eliminated or reduced to very low numbers after the mature forest was cut. Petranka et al. estimated that 75-80% of salamanders from a variety of taxonomic groups are lost following timber harvest by clearcutting. Furthermore, it is estimated to require a century or more for populations to return to predisturbance levels following clearcutting (Petranka et al. 1994). There is concern that this reduction could produce

population bottlenecks that result in decreased genetic diversity. In some cases local populations may be prone to extinction.

On a regional scale, survival of a reduced population depends upon recolonization through immigration from undisturbed areas (Fahrig and Merriam 1994). Constraints on such immigration, however, are that (1) salamanders generally only migrate under a narrow set of environmental conditions, (2) migrating individuals may have difficulty establishing territories in new areas due to interspecific competition with other taxa, and (3) adult salamanders are often strongly philopatric (Petranka et al. 1993; Petranka 1994). As a result of these factors, recolonization of heavily disturbed areas is slow.

Salamanders are important components of the food chain and contribute a surprising amount of biomass to the community (Burton and Likens 1975; Pough et al. 1987). For example, population densities of *Plethodon cinereus* in the deciduous forests of the eastern United States have been recorded as high as 0.9-2.2 individuals/m<sup>2</sup> (Heatwole 1962; Jaeger 1980). Furthermore, because salamanders are often habitat specialists with restricted distributions, they may be valuable indicator species to reveal the overall health and stability of the ecosystem. Despite the evidence that salamanders are important components in many ecosystems, these animals continue to be neglected by land managers (Pough et al. 1987). Some management plans may even promote mid-successional stages to maximize alpha diversity of other taxa at the cost of sensitive reptile and amphibian species (Faaborg 1980; Sampson and Knopf 1982). Recently, public awareness of the importance of the wildlife community as a whole has led to the concern for nongame wildlife and associated habitats (Jones 1986). One factor of concern regarding *Desmognathus brimleyorum* is the concordance of its range with an intensive timber industry. Several timber companies in the Ouachita Mountains practice clearcutting, which may potentially alter hydraulic features around springs and seeps that are primary habitats for the species. The species' limited distribution and potential threat with regard to habitat alteration resulted in identifying *D. brimleyorum* as a Category 2 candidate species for possible addition to the list of endangered and threatened wildlife under the Endangered Species Act.

## MATERIALS AND METHODS

We compiled regional collection records to evaluate the historical distribution of the Ouachita Dusky Salamander (Appendix I). We obtained records from the following sources: Oklahoma State University, University of Oklahoma, University of Kansas, University of Texas, American Museum of Natural History, and consultation with other researchers. A representative survey of streams, springs and seeps was then conducted in Choctaw, Latimer, LeFlore, McCurtain and Pushmataha counties in southeastern Oklahoma. During the period from June 1993-September 1994, we visited a total of 57 sites in these five southeastern counties (Appendix II). Both sites of historic occurrence and those where the species could potentially occur were sampled. The total number of sites visited by county were McCurtain, 20; LeFlore, 21; Latimer, 8;

Pushmataha, 6; Choctaw, 2. Our sampling sites were selected based on historical distribution of *D. brimleyorum* and presence of available habitat as determined by Geographic Information System (GIS) analysis. Predicted areas of available habitat were identified after completing the 1993 field season, during which time we visited historic collection sites throughout southeastern Oklahoma. After confirming the presence of substantial populations of *D. brimleyorum* at several locations, we used GIS to identify appropriate conditions of habitat parameters known to be important to plethodontid salamanders. Assuming that the species attains its greatest densities in those locations with ideal habitats we were able to select a set of optimal habitat characteristics. The following habitat parameters were identified to be a subset of those believed to be important to the species: soil type, land use category, slope, aspect, and elevation. For each parameter an ideal range was determined within which we expected *D. brimleyorum* to be found. A set of maps was produced indicating the predicted range for the species in southeastern Oklahoma, i.e., those areas satisfying all the habitat criteria. After returning to the field to sample sites within the predicted range, we were able to identify additional extant populations. After collecting habitat information on these new sites, we constructed a final set of maps that we believe accurately predicts the occurrence of *D. brimleyorum* within the five county region surveyed.

Salamanders were sampled by dip net, 3.6 m x 1.8 m nylon seine (3.2 mm mesh), and by hand. Microhabitat parameters (e.g., stream depth and width, water temperature, and substrate type for aquatic locations; and slope, aspect, solar exposure, litter depth, substrate, and moisture for terrestrial and aquatic/terrestrial locations) were collected at each site where appropriate. Land-use practices were determined at these locations using GIS. Relative population density was estimated by determining the number of salamanders encountered during time-constrained searches (Appendix II).

Voucher specimens were taken in order to verify identification of larvae. Salamanders were collected in a manner designed for minimal impact on the local population. Based upon estimates of density, no more than 6% of the population was taken from any one site, and no animals were taken from sites that appeared to harbor less than 15 individuals. Most of our voucher specimens were collected from a single locality in LeFlore County (Horse Thief Spring), which appeared to harbor the largest, healthiest populations of *Desmognathus brimleyorum*. In order to minimize the impact of our collecting and in accordance with the collecting restrictions outlined above, we systematically sampled 5% of the habitat at Horse Thief Spring by collecting salamanders only along 1-m wide transects placed every 20 m for 200 m along the flow of the spring. Voucher specimens were preserved in 10% formalin and transported to the laboratory where they were examined and transferred to a solution of 45% isopropyl alcohol. These reference collections were catalogued into the Collection of Vertebrates, Department of Zoology, Oklahoma State University.

## RESULTS

One hundred thirty *D. brimleyorum* were observed at 18 localities in southeastern Oklahoma (Table 1). We located extant populations at 6 localities in McCurtain County, 9 in LeFlore County, 1 in Latimer County, and 2 in Pushmataha County (Appendix II). Populations were most dense in LeFlore County along north-facing slopes of Winding Stair and Rich Mountains within the Ouachita National Forest. The most dense population of adult *D. brimleyorum* was encountered at Horse Thief Springs Park (Appendix II). This site was visited on four different occasions in order to establish periods of activity for salamanders.

In the field we recorded detailed notes on various habitat parameters of each site and although these were not analyzed quantitatively, we used them to gain a subjective impression of conditions associated with the occurrence of salamanders. We found *D. brimleyorum* and several other plethodontid salamanders-- Southern Redback Salamander (*Plethodon serratus*), Northern Slimy Salamander (*P. glutinosus*), Rich Mountain Salamander (*P. ouachitae*), Sequoyah Slimy Salamander (*P. sequoyan*), Kiamichi Slimy Salamander (*P. kiamichi*), and Many-ribbed Salamander (*Eurycea multiplicata*)-- in riparian zones adjacent to and within high gradient streams of the Ouachita Mountains of southeastern Oklahoma. *Desmognathus brimleyorum* was most often found in or near 1<sup>st</sup> and 2<sup>nd</sup> order streams with depths ranging from 3-20 cm and widths from 0.2-5.0 m. Salamanders seemed to be associated with streams having a well developed deciduous canopy. Water temperatures at sites where *D. brimleyorum* were present ranged from 4-21° C. Structural heterogeneity of the stream habitat seemed to be important as well as slope and aspect. Dusky Salamanders were most often found in streams that contained coarse rocky or gravel substrates with at least some rocks >10 cm in width and where both pools and riffles existed. We never found *D. brimleyorum* in or near streams with sand or silt substrates. The salamanders utilized cracks and crevices in and between rocks for shelter. We found most adult salamanders under rocks in flowing water; most larvae were observed on the bottom of partially shaded pools. We also observed that salamanders typically did not occur in streams that supported large populations of predatory fish; e.g., sunfish, (*Lepomis* sp.); bass, (*Micropterus* sp.); and catfish, (*Ictalurus* sp.).

From the habitat conditions associated with all extant populations of *D. brimleyorum*, we determined that the species was most likely to be found within shortleaf pine/oak mixed forest with elevations of 152-666 m and slopes ranging from 1-21%. We also found *D. brimleyorum* to be most often associated with the following soil classifications: Carnasaw-Goldston association, Carnasaw-Octavia complex, Ceda-Rubble land complex, Clebit-Carnasaw-Pirum complex, Goldston-Carnasaw-Sacul association, Kenn-Ceda complex, and Octavia-Carnasaw complex. In general these soils tend to be well drained, shallow, and stony with relatively low fertility and are associated with steep upland areas (Abernathy et al. 1983; Reasoner 1974). Using these data we refined our predictive habitat criteria and used GIS to produce a final set of maps for southeastern Oklahoma that estimate the occurrence of the species (the area in red on color plates I-V). Our GIS analysis approximated the percent suitable

habitat for *D. brimleyorum* by county to be McCurtain, 10.7%; Pushmataha, 5.6%; LeFlore, 4.9%; Latimer, 1.8%; and Choctaw, 0.0%.

## CONCLUSIONS AND RECOMMENDATIONS

In Oklahoma, the Ouachita Dusky Salamander appears to be locally common given the appropriate habitat conditions. Although the species may attain relatively high densities in and around seeps, springs, and high gradient streams, we believe the species to be sensitive to certain disturbances that could disrupt the hydrology of these fragile habitats. Consequently, we found the most productive sites within the Ouachita National Forest, places protected from intensive agriculture and silviculture. We found *D. brimleyorum* almost exclusively in upland areas and populations appear to be geographically isolated by expanses of lowland habitat and river flood plains. These lowland areas also tend to be centers for agriculture, which may further inhibit gene flow between populations.

Our GIS analysis produced maps that predict the occurrence of *D. brimleyorum* in southeastern Oklahoma, but there are some limitations to this methodology. (1) The land use/cover categories produced by GIS are coarse. We believe, however, that the use of such ancillary information as soils and topography refine the predicted occurrence so as to make the maps useful. (2) The habitat may be more extensive than the population. That is, even though the correct set of habitat conditions may exist at a site, geographic isolation of this relatively immobile species may result in the local absence of a salamander population or the habitat patch may be too small or patches too fragmented to sustain a viable population. In order to overcome this problem one must increase the number of sample sites within the predicted range.

With respect to changes in the status and distribution of the species, we found the Ouachita Dusky Salamander to be absent from 7 of 13 historic collection sites examined (Appendix 1). At least one new population was discovered that is noteworthy. We found an isolated population of *D. brimleyorum* in an isolated upland stream called Goat Creek (T3N,R20E,S3) in northern Latimer County. To the best of our knowledge, this is the western-most record for the species.

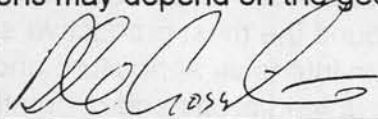
Dry conditions often prevented us from making an ideal systematic examination of the entire region within which *D. brimleyorum* is known to occur. Several of the sites we visited during the sampling period seemed to have appropriate microhabitat characteristics, but stream flow was subterranean; salamanders are likely inactive under such conditions. With these considerations in mind, we make the following recommendations for future study of *Desmognathus brimleyorum*.

1. Study of microhabitat preferences and natural history of the Ouachita Dusky Salamander. Knowledge of microhabitat requirements and natural history is vital for management and protection of *D. brimleyorum* in Oklahoma, but only limited work has been done on these topics. We recommend a more rigorous examination of microhabitat preferences for streamside salamanders in order to determine their sensitivity to agricultural and silvicultural activities common in the region.



2. Assessment of the geographic pattern of genetic variation. We recommend that genetic diversity of isolated populations of *D. brimleyorum* be assessed using electrophoretic analysis to determine geographic patterns of genetic variation. Knowledge gained from this type of work would provide information for questions regarding management of the species. For example, can the species be treated as a single management unit, or should efforts be made to maintain several different populations? In fact, are all the populations really one species? Recent genetic work on the Slimy Salamander complex in this region (Highton et al. 1989) has identified 13 separate species from what was originally considered one species (*P. glutinosus*). Management decisions may depend on the geographic distribution of genetically distinct populations.

PREPARED BY

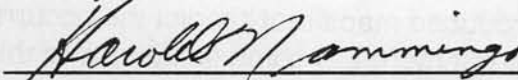


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31 May 1995

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Table 1. Sites surveyed and salamanders observed by county and year.

County	Sites Surveyed		Sites With <i>D. brimleyorum</i>		Total <i>D. brimleyorum</i>		Vouchers Collected <sup>1</sup>
	1993	1994	1993	1994	1993	1994	
McCurtain	11	9	3	3	6	7	3
LeFlore	9 <sup>2</sup>	13 <sup>2</sup>	4	6	66	38	28
Latimer	6	2	1	0	9	0	0
Pushmataha	3	3	0	2	0	4	0
Choctaw	2	0	0	0	0	0	0
Total	31	27	8	11	81	49	31

<sup>1</sup>Vouchers are available from Collection of Vertebrates, Department of Zoology, OSU.

<sup>2</sup>One site (Horse Thief Spring) was surveyed two times each in 1993 and 1994, but counted only once as a site in each year.

## APPENDIX I

Historic collection sites for the Ouachita Dusky Salamander, *Desmognathus brimleyorum*. In situations where the exact location of a historic site could not be determined we visited the closest location within the same watercourse. With regard to museum records, outdated names and/or mistaken identifications or erroneous localities are likely to occur for various reasons including expertise of the collectors. These problems pertain to all large museum collections therefore records should be interpreted with caution. Ideally each specimen should be examined in order to verify identifications.

Oklahoma: LeFlore Co.

1. Edge of Cucumber Cr., 1/8 miles W of Jct. Hwy 259 (T1N,R25E,S7)<sup>1</sup>
2. Winding Stair Mt., Hwy 1, 1.6-1.2 miles W Jct. Hwy 259 (T3N,R25E,S21); October 1991; J. R. Mendelson; University of Kansas, Museum of Natural History<sup>1,3</sup>
3. North slope of Winding Stair Mt., .2 miles W Horse Thief Springs (T3N,R25E,S21)<sup>1,2,3</sup>
4. North slope of Winding Stair Mt., below Horse Thief Springs (T3N,R25E,S7)<sup>1,2</sup>
5. North slope of Rich Mt., 8.3 miles W of the Arkansas state line on Hwy 1 (T2N,R25E,S1)<sup>1,2</sup>
6. North slope of Rich Mt., 7.9 miles W of the Arkansas state line on Hwy 1 (T2N,R25E,S1)<sup>1,2</sup>
7. Round Mt. Forest Rd. 6025, 0.8 miles NE Jct. forest Rd. 6026 (T5N,R26E,S5)
8. Little Cedar Cr., 5.0 miles E of Big Cedar (T2N,R25E,S7&8); July 1949; collector unknown; Oklahoma State University, Collection of Vertebrates<sup>1,2,3</sup>
9. Kiamichi R. and tributaries, Hwy 63 ~7-9 miles W of Arkansas state line (T2N,R26E,S18&29)
10. Hwy 270 E of Page (T3N,R27E,S20&30); March 1951; H.A. Dundee; American Museum of Natural History<sup>1,3</sup>
11. Hwy 1 near Jct. 259 (T3N,R25E,S20&26); April 1982; S. Fox; Oklahoma State University, Collection of Vertebrates<sup>1,2</sup>
12. Hwy 1 near Buffalo Wallow Mt. and Jct. Hwy 271 (T4N,R23E,S19&23)
13. Wheeler Hollow Cr. (T4N,R24E,S16&20)
14. Beech Cr. (T1N,R26E,S11&27)
15. Hwy 63 (T2N,R26E,S20&24)
16. Cow Cr. Mt., (T1N,R27E,S20)
17. Murry Cr. (T1N,R27E,S28)
18. Near Hwy 63 (T2N,R26E,S20&33)
19. Big Eagle Cr. (T1N,R24E,SE1/4,S3); June 1983; B. Wagoner; Oklahoma State University, Collection of Vertebrates
20. Blackfork Mt., W of Arkansas state line near Hwy 270 (T3N,R27E,S22); March 1951; collector unknown; Oklahoma State University, Collection of Vertebrates<sup>1,3</sup>

21. East of Page (T3N,R26E,S24); June 1965; H. G. Dowling; American Museum of Natural History <sup>1,3</sup>
22. 1 mile E of Page; Rich Mt.; February 1947; B. Glass; Oklahoma State University, Collection of Vertebrates
23. Billy Creek 2 miles NE of Muse; March 1977; L. Hatch; Oklahoma State University, Collection of Vertebrates
24. North slope of Rich Mt. 5 miles E of jct. 259 and 270; April 1977; R. VanDevender; Oklahoma State University, Collection of Vertebrates
25. 7 miles E of Hwy. 259 on Hwy 1; April 1977; W. Justice; Oklahoma State University, Collection of Vertebrates

Oklahoma: Latimer Co.

1. Hwy 1 and 63 SW of Buffalo Mt., (T3N,R20E,S10&26) <sup>1,3</sup>
2. Hwy 63 near Lake Carl Albert (T3N,R21E,S10)
3. Jackson Cr., near Hwy 63 (T3N,R21E,S21) <sup>1,3</sup>

Oklahoma: McCurtain Co.

1. Two Mile Cr., near Hwy 70 (T6S,R27E,S5)<sup>1</sup>
2. West of Smithville, Eagle Fork Hwy 259 (T1S,R25E,S22)
3. Mountain Fork River bridge Hwy 70 (T6S,R26E,S7); 1964; B. Glass; Oklahoma State University, Collection of Vertebrates
4. Cedar Cr., at Hwy 21 (legal description unknown); 1947; B. Glass; Oklahoma State University, Collection of Vertebrates
5. Creek 1 mile W of Eagletown (legal description unknown); 1947; B. Glass; Oklahoma State University, Collection of Vertebrates
6. 2 miles W of Beavers Bend on Hwy 259A and 1 mile South; April 1977; J. Summers; Oklahoma State University, Collection of Vertebrates
7. Beavers Bend State Park .8 miles N of spillway; April 1988; S. Fox; Oklahoma State University, Collection of Vertebrates
8. 2 miles W of Broken Bow; March 1966; collector unknown; Oklahoma State University, Collection of Vertebrates
9. 3 miles North of Broken Bow; March 1966; R. Williams; Oklahoma State University, Collection of Vertebrates
10. Beavers Bend State Park, Creek near headquarters; March 1966; R. Williams; Oklahoma State University, Collection of Vertebrates

<sup>1</sup> Site visited.

<sup>2</sup> *Desmognathus brimleyorum* present

<sup>3</sup> For various reasons exact historic site was not visited due to inaccessibility or inadequate locality description, but a nearby site in the same watercourse was surveyed.

## APPENDIX II

This appendix contains information concerning the location and the habitat conditions at each of the sites that were visited during the course of this survey. This document will help future investigators by providing precise legal descriptions, field observations, local microhabitat and general habitat conditions and abundance data on *Desmognathus brimleyorum* and other sympatric species. In some cases, sites were visited more than once, and the results of each visit are documented separately. Locations at which *D. brimleyorum* were found have been noted by an asterisk in the margin.

## Summary of Sites: Oklahoma

COUNTY: McCURTAIN

LOCATION: McCurtain County Wilderness Area, small creek ~0.5 miles north of the wilderness area boundary at the low water bridge, 1.0 miles southwest of the Hee Mountain Tower.

LEGAL DESCR: T2S,R25E,S34

DATE: 01 July 1993;13:00

SAMPLING TIME: 120 minutes

HABITAT: medium cobble, low flow (~0.14 m/s), water temperature 22 C, width 4.5-5.0 m, depth .12 m, canopy closed with dense cover.

COMMENTS: predatory fish present (*Ictalurus natalis*, *Lepomis* sp., and *Micropterus*)

SOIL: Goldston-Carnasaw-Sacul association, steep.

LANDUSE/COVER: forest-shortleaf pine/oak (mixed forest).

SLOPE/ASPECT: 6%, 75 degrees

ELEVATION: 222 m

LOCATION: McCurtain County Wilderness Area, intermittent stream 2.4 miles from the entrance gate, south of the Hee Mountain tower.

LEGAL DESCR: T3S,R25E,S3

DATE: 01 July 1993; 07:00

SAMPLING TIME: 120 minutes

HABITAT: medium cobble, very low flow, water temperature 22 C, width 2.5 m, depth .12 m, deciduous forest with closed canopy.

COMMENTS: Ideal habitat conditions, soil along the stream bank rocky with abundant leaf litter.

SOIL: Goldston-Carnasaw-Sacul association, steep.

LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)

SLOPE/ASPECT: 4%, 56 degrees

ELEVATION: 243 m

LOCATION: McCurtain County Wilderness Area, nature trail near area manager's home, 8 miles east of Highway 259, intermittent stream.

LEGAL DESCR: T3S,R25E,S4

DATE: 01 July 1993; 12:00

SAMPLING TIME: 90 minutes

HABITAT: substrate with medium cobble, water temperature 22 C, width 2.5-4.0 m, depth .25 m, closed canopy

COMMENTS: lowland hardwood habitat with abundant woody debris.

SOIL: Goldston-Carnasaw-Sacul association, steep.

LANDUSE/COVER: forest-shortleaf pine/oak (mixed forest).

SLOPE/ASPECT: 4%, 182 degrees

ELEVATION: 210 m



LOCATION: Beaver Creek, Beavers Bend State Park near the nature center bridge.

LEGAL DESCR: T5S,R25E,S10

DATE: 07 June 1993; 08:00

SAMPLING TIME: 240 minutes; 0.75 larval *D. brimleyorum*/person-hour

HABITAT: substrate with coarse gravel and medium cobble (<10 cm) and exposed bedrock slabs, very low flow, water temperature 21 C, width 3-5 m, depth .03 m, partial canopy

\*COMMENTS: (3) *Desmognathus brimleyorum* (larvae)

SOILS: Goldston-Carnasaw-Sacul association, moderately steep.

LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)

SLOPE/ASPECT: 1%, 20 degrees

ELEVATION: 152 m

LOCATION: Beaver Creek (seep), Beavers Bend State Park, single pool 1.5 mile south of nature center.

LEGAL DESCR: T5S,R25E,S10

DATE: 07 June 1993; 13:00

SAMPLING TIME: 15 minutes; 8 larval *D. brimleyorum*/person-hour

HABITAT: substrate with cobble <10 cm, water temperature 20 C, width 1.2 m, depth .1 m, partial canopy

\*COMMENTS: (2) *Desmognathus brimleyorum* (larvae)

SOIL: Goldston-Carnasaw-Sacul association, moderately steep.

LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)

SLOPE/ASPECT: 8%, 230 degrees

ELEVATION: 161 m

LOCATION: Two Mile Creek, near Highway 70 bridge.

LEGAL DESCR: T6S,R27E,S5

DATE: 06 June 1993; 18:00

SAMPLING TIME: 60 minutes

HABITAT: substrate with coarse gravel and silt, low flow, moderate growth of aquatic vegetation, water temperature 24 C, width 1.5 m, average depth .16 m, canopy closed.

COMMENTS: heavy siltation from nearby forest roads

SOIL: Tiak fine sandy loam, 3 to 5 percent slopes.

LANDUSE/COVER: forest-pine plantation (clearcut/reforested).

SLOPE/ASPECT: no data.

ELEVATION: 121 m

LOCATION: Buck Creek, Weyerhaeuser road number 10,000 at the bridge crossing.

LEGAL DESCR: T6S,R27E,S18

DATE: 06 June 1993; 16:00

SAMPLING TIME: 120 minutes

HABITAT: substrate with large cobble >10 cm, low flow, some aquatic vegetation, water temperature 23.5 C, width 1-5 m, average depth 0.25 m, partial canopy.

COMMENTS: appropriate habitat; predatory fish present

SOIL: Felker loam, 0 to 2 percent slopes.

LANDUSE/COVER: forest-bottomland hardwoods.

SLOPE/ASPECT: no data.

ELEVATION: 121 m

LOCATION: Yanubee Creek, Highway 70 east of Broken Bow, Oklahoma at the Yanubee Creek bridge.

LEGAL DESCR: T6S,R25E,S17

DATE: 08 June 1993; 09:00

SAMPLING TIME: 60 minutes

HABITAT: substrate with coarse gravel and cobble < 10 cm, low flow, water temperature 24 C, width 4.8 m, average depth .2 m, open canopy.

COMMENTS: heavily disturbed due to road construction.

SOIL: Sallisaw loam.

LANDUSE/COVER: pastureland.

SLOPE/ASPECT: 0%, 321 degrees

ELEVATION: 122 m

LOCATION: Yanubee Creek, 1/2 mile south of the Highway 70 bridge adjacent to railway.

LEGAL DESCR: T6S,R25E,S17

DATE: 08 June 1993; 11:30

SAMPLING TIME: 60 minutes

HABITAT: substrate with medium cobble and coarse gravel, low flow, water temperature 24 C, width 5 m, depth .2 cm, closed canopy

COMMENTS: *Lepomis megalotis* abundant; nesting

SOIL: Sallisaw loam.

LANDUSE/COVER: Pastureland.

SLOPE/ASPECT: no data

ELEVATION: 121 m

LOCATION: Bokluklo Creek, 3.7 miles north of the bridge on Highway 3 west of Broken Bow, near forest road number D4620.

LEGAL DESCR: T5S,R23E,S25

DATE: 08 June 1993; 14:00

SAMPLING TIME: 90 minutes; 0.67 adult *D. brimleyorum*/person-hour

HABITAT: substrate with medium cobble and bedrock slabs, low flow, water temperature 22 C, width 1.8 m, depth .1 cm, closed canopy

\*COMMENTS: (1) *Desmognathus brimleyorum* (adult) observed in shallow pool. Predatory fish present (*Ictalurus natalis* and *Lepomis* sp.).

SOIL: Carnasaw-Goldston association, moderately steep.

LANDUSE/COVER: forest-pine plantation (clearcut reforested)

SLOPE/ASPECT: 4%, 174 degrees

ELEVATION: 171 m

LOCATION: Yashau Creek, 3 miles south of Broken Bow, Oklahoma on Highway 259/70 at bridge.

LEGAL DESCR: T6S,R24E,S36

DATE: 08 June 1993; 12:00

SAMPLING TIME: 60 minutes

HABITAT: small cobble < 5 cm with a few scattered large stones, flow vigorous, water temperature 22.5 C, width 4.7 m, average depth .2 m, closed canopy

COMMENTS: *Lepomis macrolophus* present.

SOIL: Guyton silt loam.

LANDUSE/COVER: forest-bottomland hardwoods.

SLOPE/ASPECT: 1%, 348 degrees

ELEVATION: 109 m

LOCATION: Ephemeral seep near road D4733.  
LEGAL DESCR: T5S,R25E,SW1/4,S24  
DATE: 15 March 1994; 16:30  
SAMPLING TIME: 60 minutes  
HABITAT: cobble of all sizes, low flow, no aquatic vegetation, water temperature 12.5 C, width 2.5 m, depth .2 m, closed canopy, very rocky.  
COMMENTS: (5) *Plethodon serratus*  
SOIL: Goldston-Carnasaw-Sacul association, steep  
LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)  
SLOPE/ASPECT: 5%, 190 degrees  
ELEVATION: 128 m

LOCATION: Intermittent spring near road D4733.  
LEGAL DESCR: T5S,R26E, NW1/4 S30  
DATE: 15 March 1994; 17:30  
SAMPLING TIME: 60 minutes; 1 adult *D. brimleyorum*/person-hour  
HABITAT: gravel and cobble >10 cm, low flow, water temperature 12.5 C, stream width 0.75 m, depth .5 m, closed canopy, pools and riffles present, little down woody material.  
\*COMMENTS: (1) *Desmognathus brimleyorum*, (1) *Plethodon sequoyah*, (3) unidentified larvae.  
SOIL: Carnasaw-Goldston association, moderately steep  
LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)  
SLOPE/ASPECT: 3%, 257 degrees  
ELEVATION: 187 m

LOCATION: Intermittent stream near road 71400.  
LEGAL DESCR: T5S,R23E,S6  
DATE: 16 March 1994; 10:20  
SAMPLING TIME: 80 minutes  
HABITAT: heterogeneous substrate with mud, gravel, and cobble of all sizes, low flow, water temperature 10.8 C, width 1-2 m, depth .5 m, algae and periphyton, partial deciduous canopy, little exposed rock or down wood.  
COMMENTS: (3) *Eurycea multiplicata*  
SOIL: Goldston-Carnasaw-Sacul association, moderately steep  
LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)  
SLOPE/ASPECT: 3%, 187 degrees  
ELEVATION: 212 m

LOCATION: intermittent stream west of road 53500.  
LEGAL DESCR: T4S,R23E,S11  
DATE: 15 March 1994; 12:30  
SAMPLING TIME: 60 minutes  
HABITAT: medium gravel and cobble <10 cm, low flow, water temperature 11.4 C, width 1 m, depth .5 m, partial canopy of pine-hardwood mix, little exposed rock and down wood.  
COMMENTS: predatory fish and *Chelydra serpentina*.  
SOIL: Goldston-Carnasaw-Sacul association, moderately steep  
LANDUSE/COVER: forest-pine plantation (clearcut/reforested)  
SLOPE/ASPECT: 10%, 45 degrees  
ELEVATION: 304 m

LOCATION: intermittent spring near road 28600 approximately 0.6 mile East of Mt. Fork River.  
 LEGAL DESCR: T2S,R25E,S10  
 DATE: 16 March 1994; 14:30  
 SAMPLING TIME: 120 minutes; 2.5 adult *D. brimleyorum*/person-hour  
 HABITAT: gravel and cobble of all sizes, low flow, water temperature 11.2 C, width 1 m, depth .5 m, closed pine canopy.  
 \*COMMENTS: (5) *Desmognathus brimleyorum*, (3) *Eurycea multiplicata*, and (4) *Plethodon serratus*.  
 SOIL: Hector-Rock outcrop complex, 35-60% slopes  
 LANDUSE/COVER: forest-oak/hickory/associate species; > 70% deciduous  
 SLOPE/ASPECT: 21%, 262 degrees  
 ELEVATION: 335 m

LOCATION: Intermittent stream near road 28000.  
 LEGAL DESCR: T2S,R26E,S21  
 DATE: 16 March 1994; 17:05  
 SAMPLING TIME: 90 minutes  
 HABITAT: gravel and cobble, low flow, water temperature 10.9 C, width 1.25 m, depth .5 m, algae present, rock and down wood present.  
 \*COMMENTS: (1) *Desmognathus brimleyorum*, (1) *Plethodon glutinosus*, (4) *Plethodon serratus*, and (5) *Eurycea multiplicata*  
 SOIL: Ceda-Rubble land complex  
 LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)  
 SLOPE/ASPECT: 1%, 84 degrees  
 ELEVATION: 243 m

LOCATION: McCurtain County Wilderness Area, North Linson Creek.  
 LEGAL DESCR: T3S,R25E,S13  
 DATE: 2 April 1994; 11:30  
 SAMPLING TIME: 90 minutes  
 HABITAT: cobble >10 cm, gravel, and bedrock, moderate flow, water temperature 14 C, width 7 m, depth 14.25 cm, epilithic algae, pine-oak woodland, open canopy.  
 COMMENTS: (1) *Eurycea multiplicata*  
 SOIL: Goldston-Carnasaw-Sacul association, steep  
 LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)  
 SLOPE/ASPECT: 9%, 109 degrees  
 ELEVATION: 232 m

LOCATION: McCurtain County Wilderness Area, Upper Linson Creek.  
 LEGAL DESCR: T3S,R25E,S12  
 DATE: 2 April 1994; 12:45  
 SAMPLING TIME: 60 minutes  
 HABITAT: gravel and cobble > 10 cm, low flow, water temperature 14 C, width 0.5-2.0 m, depth .1m, closed deciduous canopy.  
 COMMENTS: (1) *Eurycea multiplicata*, (2) *Plethodon serratus*  
 SOIL: Goldston-Carnasaw-Sacul association, moderately steep  
 LANDUSE/COVER: forest-pine plantation (clearcut/reforested)  
 SLOPE/ASPECT: 1%, 89 degrees  
 ELEVATION: 216 m

LOCATION: McCurtain County Wilderness Area  
 LEGAL DESCR: T3S,R25E,S27  
 DATE: 2 April 1994; 15:00  
 SAMPLING TIME: 90 minutes  
 HABITAT: cobble > 10 cm, gravel and large stones, moderate flow, water temperature 14 C, width 1-2 m, depth 5-15 cm, algae and periphyton present, closed deciduous canopy.  
 COMMENTS: (3) *Eurycea multiplicata*  
 SOIL: Goldston-Carnasaw-Sacul association, steep  
 LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)  
 SLOPE/ASPECT: 8%, 119 degrees  
 ELEVATION: 241 m

COUNTY: LeFLORE

LOCATION: Ephemeral stream, forest road D4585.  
 LEGAL DESCR: T3N,R23E,S34  
 DATE: 03 October 1993; 11:00  
 SAMPLING TIME: 120 minutes  
 HABITAT: large boulders with cobble >10 cm, flow moderate, water temperature 20 C, width 0.5-2.0 m, depth .2 m, closed deciduous canopy with abundant leaf litter and down woody material.  
 COMMENTS: no salamanders observed.  
 SOIL: Speer-Neff association, occasionally flooded, undulating.  
 LANDUSE/COVER: pastureland-brushy; canopy > 20%.  
 SLOPE/ASPECT: no data.  
 ELEVATION: 213 m

LOCATION: Winding Stair Mountain-north slope; Horse Thief Spring.  
 LEGAL DESCR: T3N,R25E,S7  
 SOIL: Carnasaw-Octavia complex, 35 to 50 percent slopes.  
 LANDUSE/COVER: forest-shortleaf pine/oak (mixed forest)  
 SLOPE/ASPECT: 9%, north  
 ELEVATION: 400-516 m

SURVEY 1

DATE: 02 July 1993; 06:00  
 SAMPLING TIME: 120 minutes; 4 adult *D. brimleyorum*/person-hour  
 HABITAT: seep, substrate with gravel and large rocks >10 cm, water temperature 18 C, width 0.5-2.0 m, depth <.05 m, closed canopy. The surrounding terrestrial habitat includes abundant down woody material, rocks, and abundant leaf litter.  
 \*COMMENTS: (8) *Desmognathus brimleyorum*

SURVEY 2

DATE: 19 September 1993; 08:00  
 SAMPLING TIME: 240 minutes; 3.8 *D. brimleyorum*/person-hour  
 HABITAT: seep habitat with large rocks and soil substrate, flow subterranean, water temperature 18 C, width 0.2 m, depth .05 m, closed canopy, abundant leaf litter and down woody material.  
 \*COMMENTS: (19) *Desmognathus brimleyorum*, (8) *Plethodon ouachitae*, (1) *Rana palustris*, (1) *Bufo americanus*

## SURVEY 3

DATE: 26 February 1994; 12:00

SAMPLING TIME: 120 minutes

HABITAT: cobble &gt;10 cm, moderate flow, water temperature 4 C, width .5 m, depth .1 m, lichens and periphyton present, closed canopy.

\*COMMENTS: (2) *Desmognathus brimleyorum* (larvae)

## SURVEY 4

DATE: 17 March 1994; 09:00

SAMPLING TIME: 120 minutes

HABITAT: cobble &gt;10 cm, moderate flow, water temperature 4 C, width .5 m, depth .1 m, lichens and periphyton present, closed canopy.

\*COMMENTS: (22) *Desmognathus brimleyorum* (adults) and (3) *Eurycea multiplicata*

LOCATION: Cucumber Creek at the junction of Highway 259 and Weyerhaeuser road number 65,000 near the old bridge.

LEGAL DESCR: T1N,R25E,S8

DATE: 01 July 1993; 13:00

SAMPLING TIME: 150 minutes

HABITAT: substrate with medium cobble, gravel, and large stones, low flow (~0.19 m/s), water temperature 24 C, width 5-15 m variable, depth .05-1.5 m, open canopy with some overhanging shrubs providing shade.

COMMENTS: appropriate habitat conditions however some predatory fish were observed (*Lepomis* sp.)

SOIL: Pirum-Octavia-Panama association, steep.

LANDUSE/COVER: forest- shortleaf pine (mixed forest).

SLOPE/ASPECT: 9 %, 29 degrees

ELEVATION: 350 m

LOCATION: Intermittent stream 0.9 miles west of the Arkansas state line on Highway 270.

LEGAL DESCR: T3N,R27E,S28

DATE: 03 July 1993; 11:00

SAMPLING TIME: 60 minutes

HABITAT: substrate with cobble &gt;10 cm, low flow, water temperature 20 C, width, 0.2 m, depth .05-.1 m, canopy partial abundant leaf litter and down woody material

COMMENTS: appropriate habitat conditions

SOIL: Kenn-Ceda complex, occasionally flooded.

LANDUSE/COVER: forest-shortleaf pine/oak (mixed forest)

SLOPE/ASPECT: 15%, 84 degrees

ELEVATION: 414 m

LOCATION: Intermittent stream 1.4 miles west of the Arkansas state line on Highway 270.

LEGAL DESCR: T3N,R27E,S28

DATE: 03 July 1993; 13:00

SAMPLING TIME: 180 minutes; 4 larval *D. brimleyorum*/person-hour

HABITAT: fine silt, cobble >10 cm, large boulders, and gravel, water temperature 21 C., stream width 1 m, depth .05-.1 m, closed deciduous canopy with abundant leaf litter.

\*COMMENTS: (12) *D. brimleyorum* (larvae) in a single shallow pool, (10) *Desmognathus brimleyorum* (adults).

SOIL: Octavia-Carnasaw complex, cool, 15 to 35 percent slopes.

LANDUSE/COVER: forest-shortleaf pine/oak (mixed forest).

SLOPE/ASPECT: 14%, east.

ELEVATION: 422 m

LOCATION: Intermittent stream, north side of Highway 270.

LEGAL DESCR: T3N,R27E,S30

DATE: 03 July 1993; 15:00

SAMPLING TIME: 180 minutes

HABITAT: cobble >10 cm, flow moderate, water temperature 23 C., width 3 m, depth .01-.03 m, open canopy

COMMENTS: no salamanders observed.

SOIL: Octavia-Carnasaw complex, cool, 15 to 35 percent slopes.

LANDUSE/COVER: forest-shortleaf pine/oak (mixed forest).

SLOPE/ASPECT: 23%, 96 degrees

ELEVATION: 426 m

LOCATION: Small intermittent stream 0.2 miles east of forest road number 6029-2 on Highway 1 (2.5 miles from the jct. of Hwy1 and Hwy 259).

LEGAL DESCR: T3N,R26E,S31

DATE: 02 July 1993; 09:00

SAMPLING TIME: 120 minutes; 8 larval *D. brimleyorum*/person-hour

HABITAT: substrate with cobble >10 cm, subterranean flow, water temperature 21 C., width 1-2 m, depth .15 m, closed canopy, leaf packs and epilithic algae abundant

\*COMMENTS: (16) *D. brimleyorum* (larvae) observed. Crayfish abundant in pools.

SOIL: Octavia-Carnasaw complex, cool, 15 to 35 percent slopes.

LANDUSE/COVER: forest-shortleaf pine/oak (mixed forest).

SLOPE/ASPECT: 25%, 85 degrees

ELEVATION: 502 m

LOCATION: Rich Mountain, 1.5 miles southeast of the Robert Kerr Arboretum off Highway 1. Seep along the north facing slope of Rich Mountain.

LEGAL DESCR: T2N,R25E,S1

DATE: 03 July 1993; 08:00

SAMPLING TIME: 180 minutes; 0.3 adult *D. brimleyorum*/person-hour

HABITAT: seep with large boulders and gravel, isolated pools about 0.5 m wide and 3 cm deep, canopy closed leaf litter and down woody material abundant.

\*COMMENTS: (1) *D. brimleyorum* (1) *Plethodon ouachitae*

SOIL: Clebit-Carnasaw-Pirum complex, cool, 4-35 percent slopes.

LANDUSE/COVER: forest-shortleaf pine/oak (mixed forest).

SLOPE/ASPECT: 11%, 232 degrees

ELEVATION: 666 m

LOCATION: Winding Stair Campground, north of campsite number 14.

LEGAL DESCR: T3N,R25E,S22

DATE: 03 July 1993; 12:00

SAMPLING TIME: 120 minutes

HABITAT: seeps, closed deciduous canopy, abundant leaf litter, large rocks, and down wood.

COMMENTS: very dry, possibly appropriate habitat during wetter periods.

SOIL: Carnasaw-Octavia complex, 35 to 50 percent slopes.

LANDUSE/COVER: forest- shortleaf pine (mixed forest).

SLOPE/ASPECT: 26%, 55 degrees

ELEVATION: 482 m

LOCATION: Bohannon Creek

LEGAL DESCR: T3N,R23E,S3

DATE: 25 February 1994; 14:30

SAMPLING TIME: 90 minutes

HABITAT: coarse gravel <10 cm and large boulders, moderate flow, water temperature 8 C, width 1.5 m, depth .05-.15 m, algae and periphyton, closed deciduous canopy, abundant rock and litter.

COMMENTS: (2) *Eurycea multiplicata*

SOIL: Carnasaw stony loam, 15 to 35 percent slopes

LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)

SLOPE/ASPECT: 6%, 153 degrees

ELEVATION: 283 m

LOCATION: North slope of Kiamichi Mountain.

LEGAL DESCR: T2N,R24E,S22

DATE: 25 February 1994; 16:00

SAMPLING TIME: 180 minutes

HABITAT: large cobble >10 cm, flow subterranean and intermittent, water temperature 8 C, stream width 0.5 m, depth .05 m, lichens and periphyton, no pool development, closed deciduous canopy, rocks and down wood present.

COMMENTS: (2) *Eurycea multiplicata*

SOIL: Ceda-Rubble land complex, frequently flooded

LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)

SLOPE/ASPECT: 4%, 88 degrees

ELEVATION: 285 m

LOCATION: Near Lifford Creek, North face of Winding Stair Mt.

LEGAL DESCR: T4N,R23E,NW1/4,S34

DATE: 26 February 1994; 11:00

SAMPLING TIME: 90 minutes

HABITAT: large boulders and cobble >10 cm, flow moderate, water temperature 8 C, width 1 m, depth .03 m, closed deciduous canopy, algae and lichens present, rock and litter present.

COMMENTS: No salamanders observed.

SOIL: Carnasaw-Octavia complex, 35 to 50 percent slopes

LANDUSE/COVER: forest- shortleaf pine; > 70% pine

SLOPE/ASPECT: 28%, 46 degrees

ELEVATION: 370 m



LOCATION: Natural spring and wildlife pond.

LEGAL DESCR: T3N,R24E,NE1/4,S11

DATE: 26 February 1994; 11:00

SAMPLING TIME: 20 minutes

HABITAT: large boulders, flow low, water temperature 4 C, width 0.5 m, depth 0.2 m, a large pool (impoundment) below a spring, closed deciduous canopy, leaf litter abundant, grass at pool edge.

COMMENTS: Hiking trail nearby

SOIL: Carnasaw stony loam, 4-15% slopes

LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)

SLOPE/ASPECT: 6%, 81 degrees

ELEVATION: 353 m

LOCATION: Hiking trail west of Horse Thief Spring.

LEGAL DESCR: T3N,R24E,S9

DATE: 26 February 1994; 13:00

SAMPLING TIME: 10 minutes

HABITAT: cobble >10 cm, moderate flow, water temperature 4 C, width 1.5 m, depth .1 m, lichens present, open canopy.

\*COMMENTS: (1) *Desmognathus brimleyorum* (larvae)

SOIL: no data

LANDUSE/COVER: forest-shortleaf pine/oak (mixed forest).

SLOPE/ASPECT: no data, north

ELEVATION: no data

LOCATION: Rich Mountain, ephemeral stream.

LEGAL DESCR: T3N,R25E,NE1/4,S36

DATE: 26 February 1994; 16:00

SAMPLING TIME: 90 minutes; 0.67 larval *D. brimleyorum*/person-hour

HABITAT: large boulders and cobble >10 cm, moderate flow, water temperature 4 C, width 1 m, depth .05-.2 m, closed deciduous canopy, rock and litter abundant.

\*COMMENTS: (1) *Desmognathus brimleyorum* (larvae)

SOIL: Carnasaw-Pirum complex, 15-35% slopes

LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)

SLOPE/ASPECT: 17%, 128 degrees

ELEVATION: 424 m

LOCATION: Ephemeral stream.

LEGAL DESCR: T3N,R26E,SE1/4,S21

DATE: 26 February 1994; 16:30

SAMPLING TIME: 60 minutes

HABITAT: cobble >10 cm, moderate flow, water temperature 4 C, width 1 m, depth .01-.1 m, algae and lichens abundant, closed deciduous canopy, abundant rock and down woody material.

COMMENTS: (6) *Eurycea multiplicata* (1) unidentified larvae

SOIL: Carnasaw-Pirum complex, 15-35% slopes

LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)

SLOPE/ASPECT: 1%, 17 degrees

ELEVATION: 304 m

LOCATION: Spring, North slope of Rich Mountain.  
 LEGAL DESCR: T3N,R26E,NW1/4,S29  
 DATE: 27 February 1994; 10:15  
 SAMPLING TIME: 60 minutes  
 HABITAT: large boulders, low flow, width 0.5 m, depth .005 m, closed deciduous canopy, rock and litter abundant.  
 COMMENTS: (1) *Plethodon serratus*  
 SOIL: Ceda-Rubble land complex, frequently flooded  
 LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)  
 SLOPE/ASPECT: 11%, 81 degrees  
 ELEVATION: 333 m

LOCATION: Pipe Spring at Winding Stair Mountain, near forest road 6029-2.  
 LEGAL DESCR: T3N,R25E,SE1/4,S26  
 DATE: 27 February 1994; 12:00  
 SAMPLING TIME: 60 minutes; 2 adult *D. brimleyorum*/person-hour  
 HABITAT: rocks of all sizes, gravel and silt, moderate flow, water temperature 8 C, width 0.5 m, depth .15 m, no large pools, closed pine-hardwood canopy, leaf litter abundant, algae and lichens abundant.  
 \*COMMENTS: (2) *Desmognathus brimleyorum*, (2) *Eurycea multiplicata*; picnic area nearby.  
 SOIL: Bengal- Octavia-Tuskahoma complex, 4-20% slopes  
 LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)  
 SLOPE/ASPECT: 7%, 209 degrees  
 ELEVATION: 344 m

LOCATION: Cedar Creek near Winding Stair Mountain.  
 LEGAL DESCR: T3N,R25E,NW1/4,S7  
 DATE: 3 April 1994; 11:30  
 SAMPLING TIME: 90 minutes; 0.67 adult *D. brimleyorum*/person-hour  
 HABITAT: cobble >10 cm, gravel, moderate flow, water temperature 12 C, width 1-5 m, depth .05-.15 m, closed deciduous canopy, rock and down wood abundant, leaf litter abundant.  
 \*COMMENTS: (1) *Desmognathus brimleyorum*; forest road nearby.  
 SOIL: Kenn-Ceda complex occasionally flooded  
 LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)  
 SLOPE/ASPECT: 4%, 47 degrees  
 ELEVATION: 290 m

LOCATION: North face of Winding Stair Mountain.  
 LEGAL DESCR: T3N,R25E,NE1/4,S5  
 DATE: 3 April 1994; 10:00  
 SAMPLING TIME: 150 minutes; 2.9 larval and 0.8 adult *D. brimleyorum*/person-hour  
 HABITAT: cobble of all sizes, boulders and gravel, moderate flow, water temperature 9 C, width 2 m, depth .05-.15 m, closed deciduous canopy, abundant litter and rock, down wood abundant, leaf packs in the stream, algae and lichens present.  
 \*COMMENTS: (7) *Desmognathus brimleyorum* (larvae), (2) *D. brimleyorum* (adult), (3) *Plethodon ouachitae*, (1) *Plethodon serratus*, (1) *Plethodon glutinosus*, (1) *Eurycea multiplicata*.  
 SOIL: Kenn-Ceda complex occasionally flooded  
 LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)  
 SLOPE/ASPECT: 1%, 57 degrees  
 ELEVATION: 274 m

LOCATION: Cavanal Mt. intermittent stream.  
 LEGAL DESCR: T7N,R25E,NE1/4,S16  
 DATE: 28 September 1994; 13:30  
 SAMPLING TIME: 60 minutes  
 HABITAT: Cobble, bedrock, much rock, little woody material, low flow, water temperature 13 C, width 2 m, depth .05-.1 m, pools, periphyton, closed canopy.  
 COMMENTS: Residential area.  
 SOIL: Carnasaw-Octavia complex 15-35 % slopes  
 LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)  
 SLOPE/ASPECT: 13, 50 degrees  
 ELEVATION: 550 m

COUNTY: LATIMER

LOCATION: Intermittent stream ~5.5 miles east of Highway 2.  
 LEGAL DESCR: T6N,R19E,NE 1/4,S23  
 DATE: 18 September 1993; 12:00  
 SAMPLING TIME: 225 minutes  
 HABITAT: small gravel <5 cm, some large rocks >10 cm, low flow, water temperature 18 C, stream width 0.5 m, depth .1-.15 m, canopy partially closed.  
 COMMENTS: Hardwood forest, observed: *Rana clamitans*, *Bufo americanus*, *Acris crepitans*.  
 SOIL: Carnasaw-Clebit-Pickens variant association, steep.  
 LANDUSE/COVER: forest-shortleaf pine/oak (mixed forest)  
 SLOPE/ASPECT: 6%, 325 degrees  
 ELEVATION: 365 m

LOCATION: Goat Creek.  
 LEGAL DESCR: T3N,R20E,S3  
 DATE: 18 September 1993; 19:00  
 SAMPLING TIME: 450 minutes; 1.2 larval *D. brimleyorum*/person-hour  
 HABITAT: intermittent stream with medium cobble and large boulders, low flow, water temperature 19 C, width 5 m, depth .01-.1m, leaf packs, partial deciduous canopy with abundant leaf litter and down woody material.  
 \*COMMENTS: (9) *D. brimleyorum* larvae, (1) *Eurycea multiplicata*, (1) *Crotalus horridus*.  
 SOIL: Ceda-Rubble land complex  
 LANDUSE/COVER: forest-shortleaf pine/oak (mixed forest)  
 SLOPE/ASPECT: 14% , 105 degrees  
 ELEVATION: 285 m

LOCATION: Robbers Cave State Park, near the cave along an intermittent stream.  
 LEGAL DESCR: T6N,R19E,E1/2,S7  
 DATE: 17 September 1993; 19:00  
 SAMPLING TIME: 240 minutes  
 HABITAT: small gravel, low flow, water temperature 20 C, width 0.5 m, depth .05-.1 m, closed deciduous canopy with abundant down wood and leaf litter.  
 COMMENTS: (1) *Eurycea multiplicata* and (1) *Rana utricularia*.  
 SOIL: Carnasaw-Clebit association, moderately steep  
 LANDUSE/COVER: forest-shortleaf pine/oak (mixed forest).  
 SLOPE/ASPECT: 0%, 208 degrees  
 ELEVATION: 302 m

LOCATION: CCC impoundment, 3/4 mile northwest of Highway 2.

LEGAL DESCR: T6N,R18E,NE1/4,S7

DATE: 18 September 1993; 10:00

SAMPLING TIME: 375 minutes

HABITAT: substrate with medium gravel and some large stones, low flow, water temperature 17 C, width 0.5-1 m, depth .1-.15 m, closed canopy, abundant epilithic algae and leaf packs. Deciduous woods with abundant leaf litter and down woody material.

COMMENTS: (3) *Eurycea multiplicata*

SOIL: Carnasaw-Pirum-Clebit association, strongly sloping.

LANDUSE/COVER: pastureland-brushy; canopy > 20%.

SLOPE/ASPECT: 5%, 284 degrees

ELEVATION: 232 m

LOCATION: small creek, 1.5 miles SW of the junction 63A and 63 off Highway 1/63 at the creek bridge.

LEGAL DESCR: T3N,R20E,S9

DATE: 19 September 1993; 07:00

SAMPLING TIME: 120 minutes

HABITAT: medium-small cobble with some silt, low flow, water temperature 19 C, width 3-5 m, depth 0.5 m, pools present, lowland deciduous hardwoods

COMMENTS: predatory fish present (*Lepomis* sp., *Micropterus*)

SOIL: Freestone variant-Bernow variant complex, 0 to 2 % slopes.

LANDUSE/COVER: pastureland.

SLOPE/ASPECT: no data.

ELEVATION: 213 m

LOCATION: Buffalo Creek, 1.5 miles SW of junction 63A and 63 off Highway 1/63.

LEGAL DESCR: T3N,R20E,S9

DATE: 19 September 1993; 09:00

SAMPLING TIME: 120 minutes

HABITAT: gravel and medium cobble, moderate flow, water temperature 20 C, width 2.5-10 m, depth .1-.15 m, leaf packs present, open canopy

COMMENTS: *Lepomis* sp. present.

SOIL: Ceda cherty silt loam, frequently flooded.

LANDUSE/COVER: pastureland-brushy; canopy > 20%.

SLOPE/ASPECT: 1%, 94 degrees

ELEVATION: 222 m

LOCATION: Bobcat Mt. Intermittent seep.

LEGAL DESCR: T4N,R20E,NE1/4,S8

DATE: 28 September 1994; 09:30

SAMPLING TIME: 60 minutes

HABITAT: gravel, cobble, rock, some down woody material, low flow, water temperature 13 C, width 1 m, depth .04 m, pools, periphyton and algae present, open canopy.

COMMENTS: Road cut disturbance.

SOIL: no data

SLOPE/ASPECT: 10, SE

ELEVATION: no data

LOCATION: Bobcat Mt. intermittent seep (along power line cut).  
LEGAL DESCR: T4N,R20E,NE1/4,S8  
DATE: 28 September 1994; 10:30  
SAMPLING TIME: 90 minutes  
HABITAT: heterogeneous substrate with gravel, cobble, mud, rock and woody material, low flow, water temperature 13 C, width 1.25 m, depth .5 m, pools, periphyton and algae present, open canopy.  
COMMENTS: (1) *Eurycea multiplicata*; Road cut disturbance.  
SOIL: no data  
SLOPE/ASPECT: 10, SE  
ELEVATION: no data

COUNTY: PUSHMATAHA

LOCATION: ephemeral stream adjacent to county road.  
LEGAL DESCR: T2N,R17E,S6  
DATE: 02 October 1993; 16:00  
SAMPLING TIME: 240 minutes  
HABITAT: medium gravel, moderate flow, water temperature 19 C, width 0.5 m, depth 10-20 cm, closed deciduous canopy with abundant down wood, leaf litter and rock.  
COMMENTS: No salamanders observed.  
SOIL: Enders-Hector complex, 30 to 60 percent slopes.  
LANDUSE/COVER: Forest-Postoak/Blackjack Oak  
SLOPE/ASPECT: 6%, 263 degrees  
ELEVATION: 230 m

LOCATION: small creek, crosses the road.  
LEGAL DESCR: T2N,R17E,N1/2,S36  
DATE: 02 October 1993; 14:00  
SAMPLING TIME: 240 minutes  
HABITAT: medium cobble and gravel, fast flow, water temperature 18 C, width 2-3 m, depth 0.15 -0.7 m, deciduous forest with abundant leaf litter.  
COMMENTS: No salamanders observed.  
SOIL: Carnasaw-Pirum-Clebit association, dry, moderately steep.  
LANDUSE/COVER: Forest-Shortleaf Pine/Oak (mixed forest).  
SLOPE/ASPECT: 0%, 298 degrees  
ELEVATION: 456 m

LOCATION: Maxwell Creek, bridge north side of Highway 43.  
LEGAL DESCR: T2N,R18E,S14  
DATE: 02 October 1993; 09:30  
SAMPLING TIME: 240 minutes  
HABITAT: medium to large cobble, fast flow, water temperature 19.5 C, width 3 m, depth .4-.5 m, open canopy  
COMMENTS: lowland habitat; crayfish present.  
SOIL: Tuskahoma-Clebit-Sobol association, strongly sloping.  
LANDUSE/COVER: Forest- Oak/Hickory/Associate Species > 70% deciduous.  
SLOPE/ASPECT: 1%, 80 degrees  
ELEVATION: 182 m

LOCATION: intermittent stream. North side of road 61000.

LEGAL DESCR: T1N,R22E,S36

DATE: 17 March 1994; 10:30

SAMPLING TIME: 60 minutes

HABITAT: rock of all sizes, low flow, water temperature 13 C, width 2 m, depth .05 m, closed pine-hardwood canopy, algae and periphyton present, some litter and down wood.

COMMENTS: (1) *Plethodon serratus*

SOIL: Clebit-Pirum-Carnasaw association, steep

LANDUSE/COVER: forest- shortleaf pine/oak (mixed forest)

SLOPE/ASPECT: 4%, 322 degrees

ELEVATION: 443 m

LOCATION: tributary of Jackfork Creek, hwy 43 near lake Sardis.

LEGAL DESCR: T2N,R19E,S19

DATE: 1 May 1994; 08:30

SAMPLING TIME: 60 minutes; 3 larval *D. brimleyorum*/person-hour

HABITAT: cobble of all sizes, boulders, moderate flow, water temperature 12 C, width 1-2 m, depth .05-.2 m, lichens and algae present, closed deciduous canopy, some rock and litter.

\*COMMENTS: (3) *Desmognathus brimleyorum* (larvae); Highway nearby.

SOIL: Tuskahoma-Clebit-Sobol association, strongly sloping

LANDUSE/COVER: recreation land

SLOPE/ASPECT: 10%, 8 degrees

ELEVATION: 182 m

LOCATION: Kiamichi Mt. intermittent spring.

LEGAL DESCR: T2N,R21E,S1/4,S25

DATE: 17 March 1994; 11:50

SAMPLING TIME: 100 minutes; 0.6 adult *D. brimleyorum*/person-hour

HABITAT: Gravel, cobble, moderate rock and woody material, low flow, water temperature 12.6 C, width 1 m, depth .03 m, pools, periphyton and algae, closed canopy.

\*COMMENTS: (1) *Desmognathus brimleyorum*, (2) *Plethodon kiamichi*; road nearby

SOIL: Clebit-Pirum-Carnasaw association, steep

LANDUSE/COVER: shortleaf pine/oak (mixed forest)

SLOPE/ASPECT: 22%, 130 degrees

ELEVATION: 421

COUNTY: CHOCTAW

LOCATION: Bull Creek.

LEGAL DESCR: T5S,R20E,S29

DATE: 09 June 1993; 08:00

SAMPLING TIME: 30 minutes

HABITAT: heavy siltation and interstitial fill some broken concrete, low flow, water temperature 20 C, width 2.5 m, depth 0.75 m pools, abundant epilithic algae, closed canopy

COMMENTS: adjacent land heavily managed.

SOIL: Boggy fine sandy loam.

LANDUSE/COVER: Forest-Shortleaf Pine/Oak (mixed forest).

SLOPE/ASPECT: no data.

ELEVATION: 152 m

LOCATION: Spenser Creek, at bridge on county road.

LEGAL DESCR: T5S,R19E,S5

DATE: 09 June 1993; 09:00

SAMPLING TIME: 90 minutes

HABITAT: sediment and sand, some bricks and concrete, low flow, water temperature 24 C, highly turbid,  
width 0.5 m, depth .05-.1 m, open canopy.

COMMENTS: heavy sedimentation very disturbed near road.

SOIL: Smithdale fine sandy loam, 2 to 8 percent slopes, eroded.

LANDUSE/COVER: Pastureland-Brushy; Canopy > 20%

SLOPE/ASPECT: 2-8%, 64 degrees

ELEVATION: 152 m

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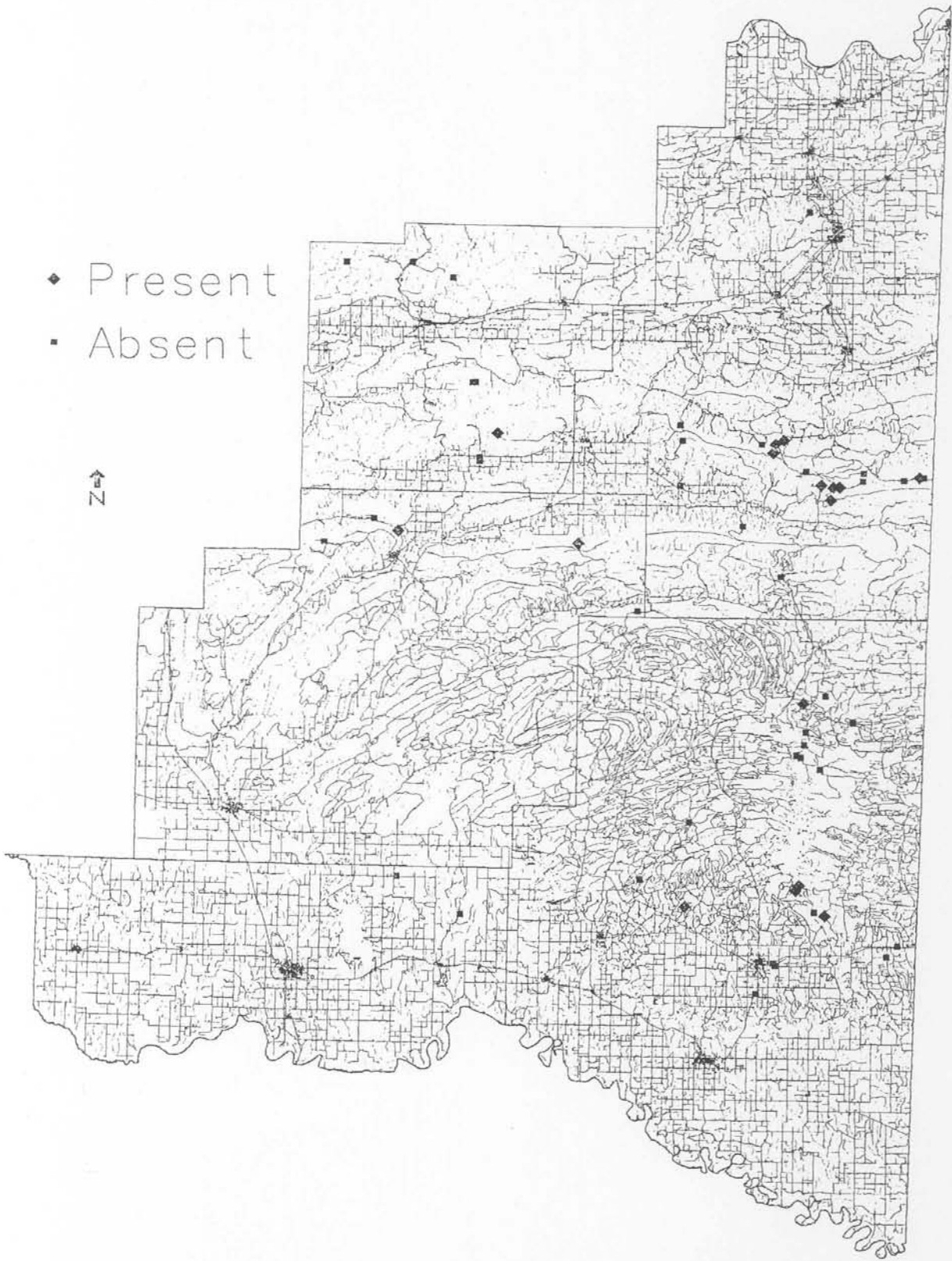
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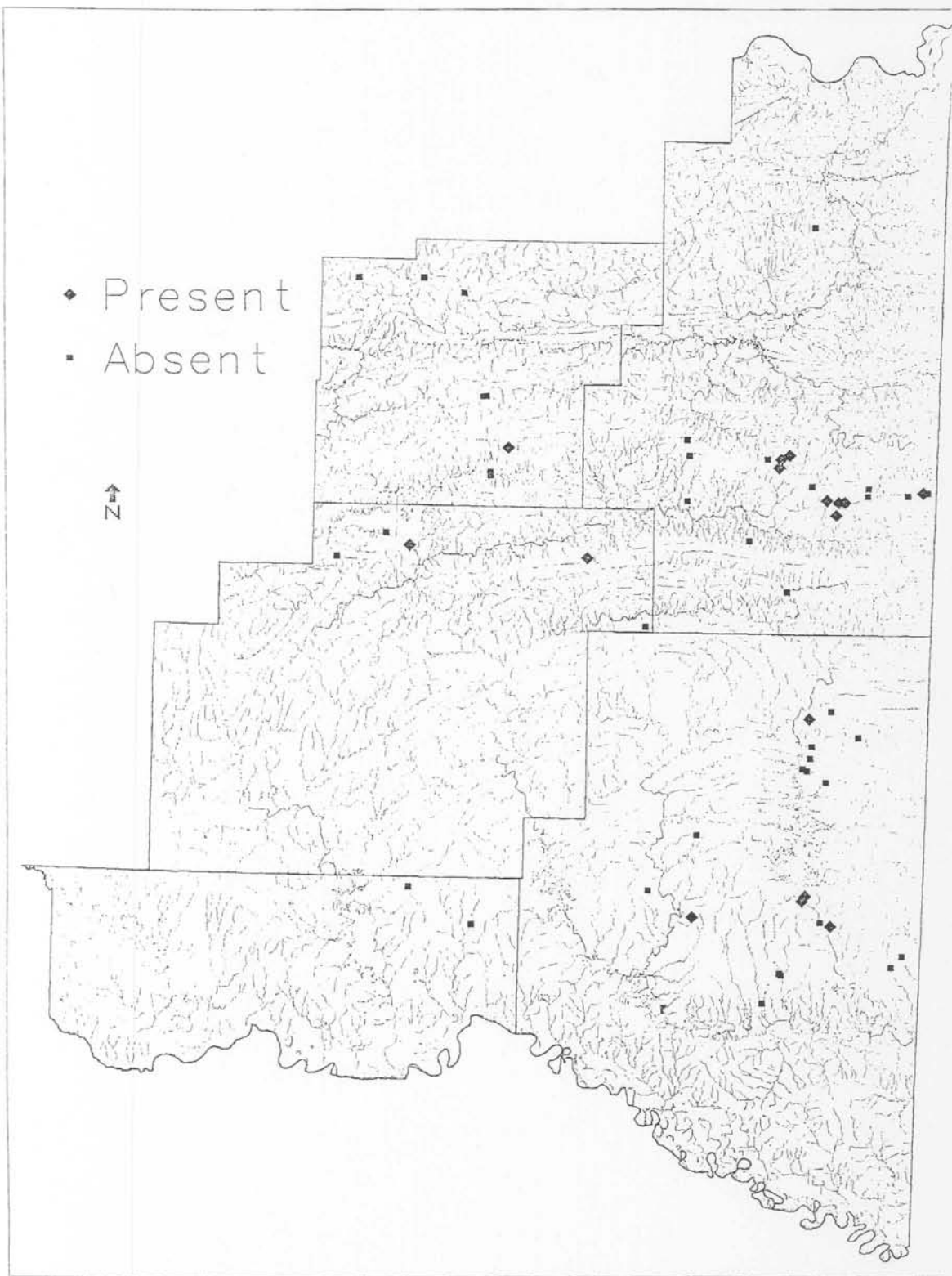


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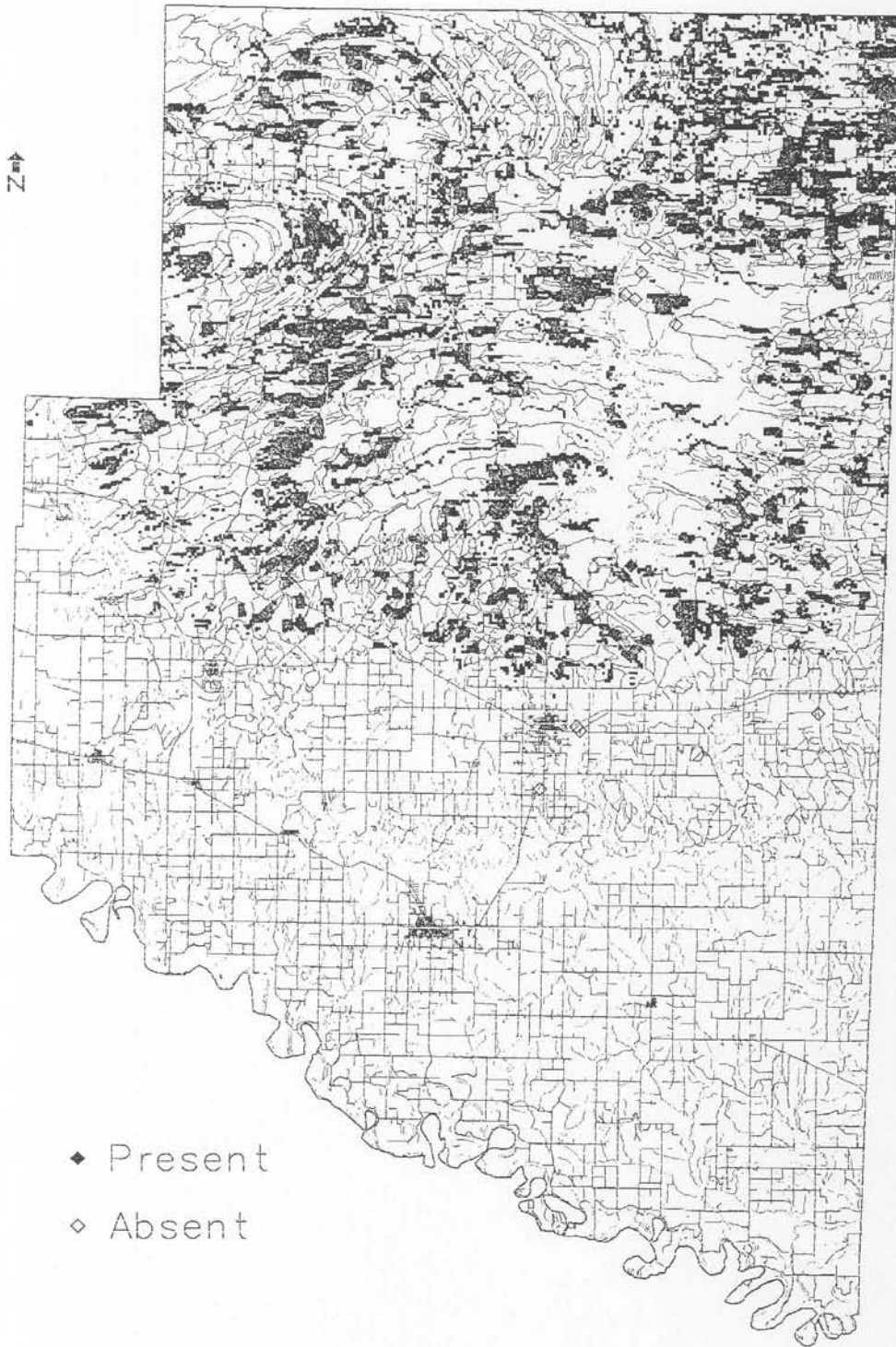




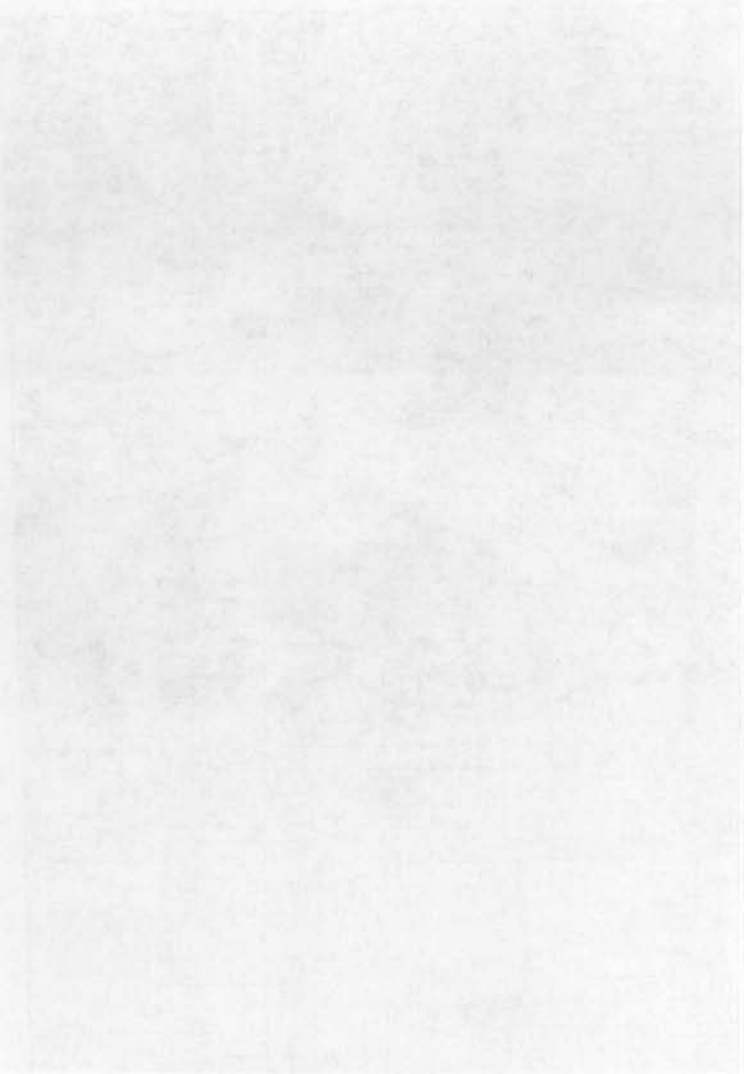




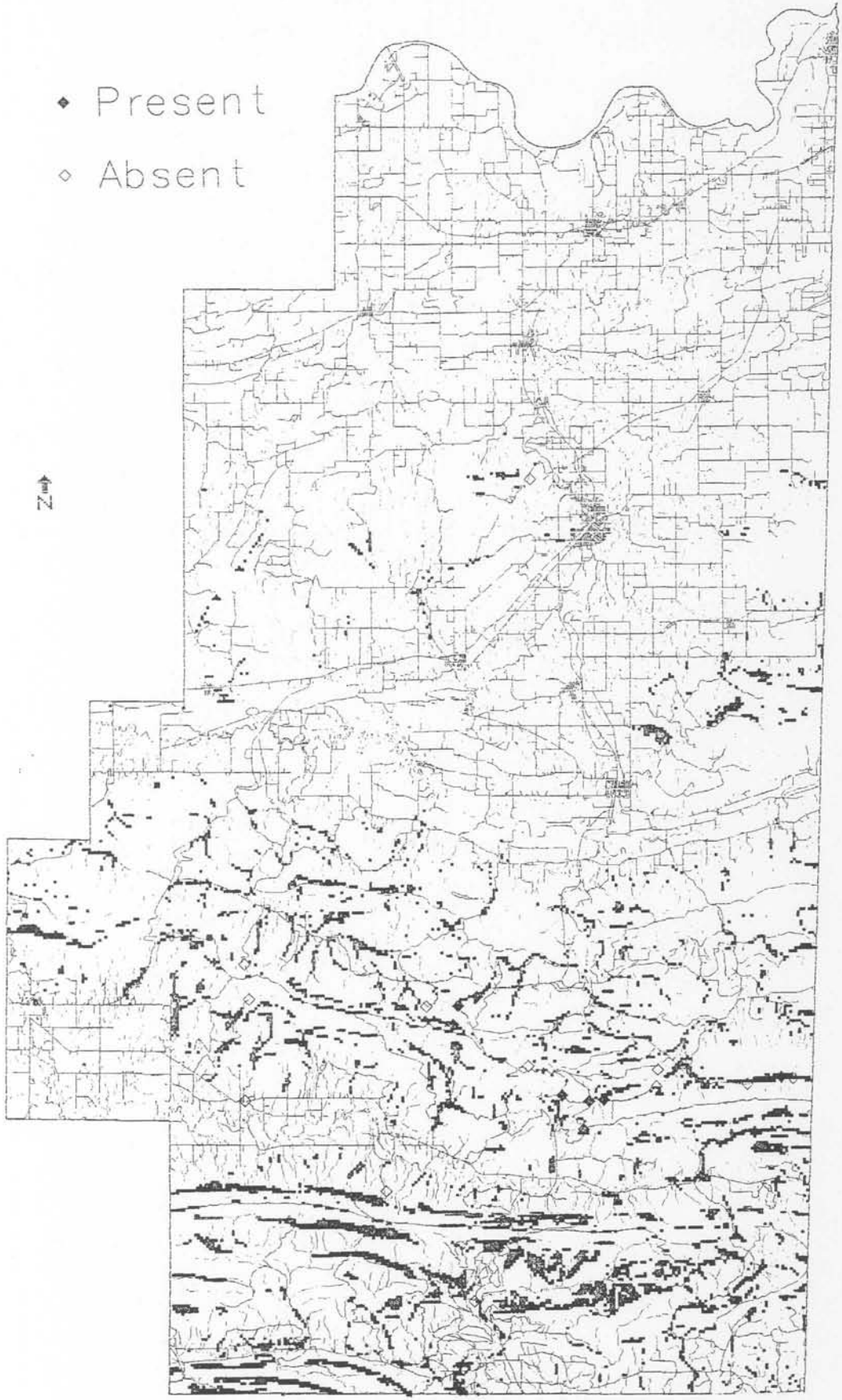
# McCurtain County, OK







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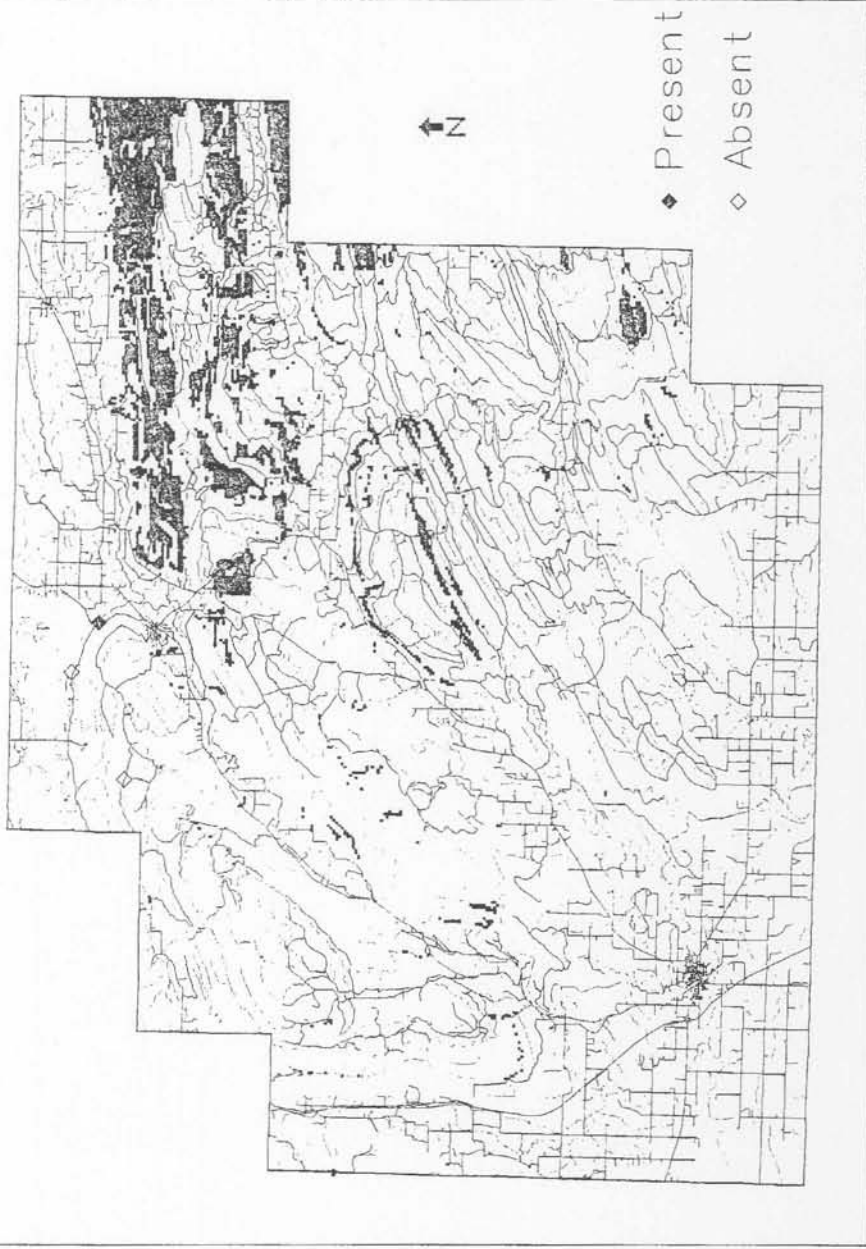


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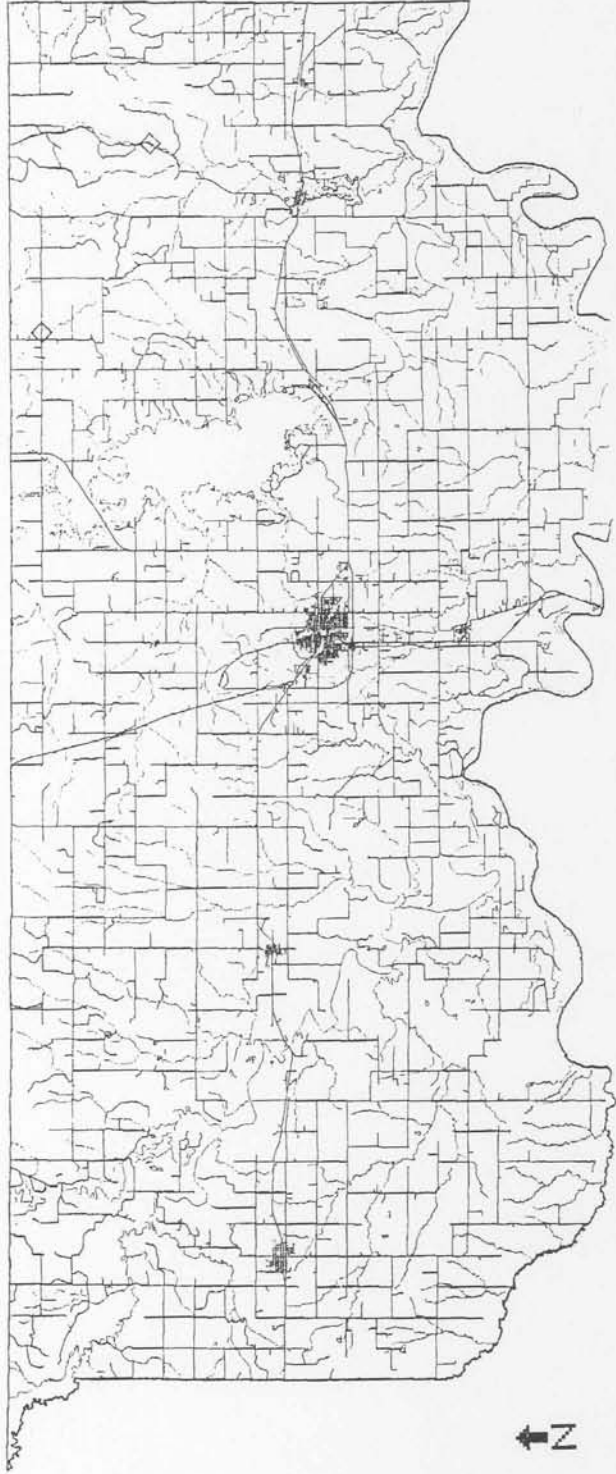


# Pushmataha County, OK





# Choctaw County, OK







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