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SURVEY OF 1985 PERIODICAL CICADA (Homoptera: *Magicicada*) EMERGENCE SITES IN WASHINGTON COUNTY, ARKANSAS, WITH REFERENCE TO ECOLOGICAL IMPLICATIONS

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ABSTRACT

Systematic roadside surveys were conducted in June 1985 in Washington County, Arkansas, to locate areas where 13-year periodical cicadas had emerged during May. Although cicadas were found in a variety of upland and bottom land forest habitats, the present cicada distribution reflects the original forest and prairie pattern in the county, even though those boundaries are now largely lost. This suggests a high degree of philopatry whereby emergency areas have remained in the same area for the last 100 years. All present day emergence areas are within the White River drainage, suggesting that it was the main cicada dispersal route into northwestern Arkansas. It now probably marks the western limit of Brood XIX in northwestern Arkansas.

INTRODUCTION

Three species of periodical cicadas (Homoptera: *Magicicada*) emerge together in great numbers once every 13 years in southern parts of the United States. All periodical cicadas that emerge in a given year are considered members of the same brood (Marlatt, 1907) and year of emergence of each brood is one of the most highly predictable events in nature. The most extensive emergence involves cicadas of Brood XIX, which emerges from Virginia through the south to western Arkansas and southeastern Oklahoma (Marlatt, 1907; Simon, 1979). Brood XIX cicadas emerged in 1985 throughout most of Arkansas and are the focus of this report. (Brood XXIII cicadas also occur in Arkansas along Crowley's Ridge and are due to emerge in 1989.)

Although the emergence of periodical cicadas in Brood XIX occurs over a large area, the cicadas are patchily distributed within this range. In conjunction with research to study the effects of the cicada emergence on bird communities in northwestern Arkansas, we sought to locate specific emergence sites in 1984 (one year prior to emergence) to obtain baseline information on avian populations. We knew that Brood XIX would emerge in 1985, but we had no information concerning specific emergence sites in Washington and adjacent counties. Therefore, we had to rely on reports of others who had observed former periodical cicada emergences.

Surprisingly, we found no one who recalled details of the emergence in 1972. However, Lloyd O. Warren, Department of Entomology, University of Arkansas, was able to suggest several sites where periodical cicadas had emerged in 1959. One of the sites, near Durham, Arkansas, was visited during the emergence peak in 1959 by Jessie L. Lancaster and Robert Watson, who collected 6 specimens for the University of Arkansas Entomology Collection. Based on these specimens and Lancaster's and Watson's descriptions of high cicada densities at the Durham site, we selected that site for our study. Subsequently, we searched for ovipostion scars on tree limbs made by periodical cicadas during previous emergences (White and Lloyd, 1979) and we found scars from both 1959 and 1972. Based on our finding, we began our research in 1984 and indeed, large numbers of cicadas emerged on that site in 1985.

Because of our difficulty in finding periodical cicada emergence sites, we decided that during the 1985 emergence we would survey Washington County and map emergence areas for use by future researchers. This paper is the result of that effort. In addition to identifying specific cicada sites and forest habitats, however, we discovered that the pattern of present-day sites has some interesting ecological implications concerning the location of former prairie areas. Our survey also showed that present cicada locations are confined to the White River drainage.

METHODS

The cicada survey routes were driven between 8-15 June 1985 (Figure 1), when periodical cicadas had emerged from the ground. After cicadas emerge, they molt into adult forms, and males aggregate in adjacent groups of trees and sing during daylight hours. Female cicadas are attracted to such "chorus centers", where mating occurs. Although cicadas may move short distances to congregate at choruses (Karban, 1981; Lloyd and Karban, 1983), choruses are always in immediate areas of periodical cicada emergences. Survey routes were travelled only in the middle portion of the day when cicada chorusing was maximal. Before driving a survey route, a known cicada site was visited to ascertain that conditions were appropriate for cicada chorusing. Frequent stops were made on the survey routes to listen for cicadas. Often all three species were heard *(Magicicada tredecassini, M. tredecim, M. tredecula)*, frequently only two, sometimes only one. However, this aspect was not emphasized. Since the focus was on finding cicada sites regardless of species represented, details about the species present will not be mentioned.

DESCRIPTION OF PERIODICAL CICADA EMERGENCE SITES

The following is a list of periodical cicada emergence sites found in Washington County. Each site has been given a name which may or may not refer to an accepted local name. Detailed locations for each site are given, plus an overview of the forest habitat. Each cicada area is shown in Figure 2, located by site position. (Tree taxonomy and terminology is from Moore, 1972.)

1. Ten-mile rock: at West Fork, Arkansas, east of highway U.S. 71 in Sec. 4, T14N, R30W. The chorus was heard from the highway. This is an extensive upland forest area dominated by White Oak *(Quercus alba)* and Black Oak *(Q. velutina)* with many Winged Elms *(Ulmus alata)*, some American Elm *(U. americana)*, Shagbark Hickory *(Carya ovata)*, Mockernut Hickory *(C. tomentosa)*, Eastern Redcedar *(Juniperus virginiana)*, and many Chinkapin Oaks *(Q. muehlenbergii)*.
2. Tilly Willy Road: road that courses along east bank of the West Fork of the White River, east of the Fayetteville airport. Periodical cicada choruses were heard along both sides of this road where it crosses the NE corner of Sec. 9, SE corner of Sec. 4, and to the center of Sec. 3, T15N, R30W. This area is upland forest east of the road, bottom land forest west of the road. The upland is dominated by Black and White Oak, Shagbark and Black Hickory, with almost no cedars and very little elm, some White Ash *(Frax-*

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inus americana). The predominant trees in the bottom land are American Sycamore *(Platanus occidentalis)*, River Birch *(Betula nigra)*, Black Willow *(Salix nigra)*, Box Elder *(Acer negundo)*, Silver Maple *(Acer saccharinum)*, Hackberry *(Celtis occidentalis)* and White Ash.

3. Wilson Lake: chorusing cicadas surrounded a small reservoir named Wilson Lake south of Fayetteville, mostly in the SW half of Sec. 2, northern part of Sec. 11, and a portion of the NE part of Sec. 3, T15N, R30W. The forest around the lake is upland forest dominated by Black Oak, Post Oak *(Q. stellata)*, Shagbark and Black Hickory, with a moderate number of Winged Elms and a few Eastern Redcedars in the understory.
4. Wilson Lake Road: along the north side of the road leading from Fayetteville to Wilson Lake, before the road crosses the West Fork of the White River. Includes SW and SE quarters of the NE quarter of Sec. 34 and the SW quarter of the NW quarter of Sec. 35, T16N, R30W. This upland forest area consists primarily of Post and Black Oak, Blackjack Oak *(Q. marilandica)*, Winged Elm, Black Hickory, and a small number of cedars.
5. West Fork Crossing: along both sides of the road, mainly west of the bridge, where a road crosses the West Fork of the White River south of Fayetteville. The bridge is on the section line between Sections 35 and 36, T16N, R30W, and the cicada area extends along the road in the NE quarter of Sec. 35. This site is mostly bottom land forest along the river with a mixed variety of trees including Sycamore, Silver Maple, White Ash, Box Elder, River Birch, Hackberry and Black Oak. West of where the road turns north, the cicadas occupied upland forest containing Black Oak, Winged Elm, Post Oak, Black Hickory, with some Eastern Redcedar in the understory.
6. Black Oak, Arkansas: a site a little over a mile on the road NW of Black Oak community. The cicadas were on both sides of the road where another road joins the Black Oak road in the north-central part of Sec. 7, T15N, R29W. This is upland forest dominated by Black Oak, White Oak and Shagbark Hickory.
7. South of Elkins: just west of state highway 16 south of Elkins, slightly north of the center of Sec. 12, T15N, R29W. This is a densely overgrown old field dominated by Eastern Redcedar, Winged and American Elm, with Silver Maple along a creek; and is adjacent to extensive upland forest dominated by Black Oak, Post Oak, White Oak, and some Black Hickory, with cedar and Flowering Dogwood *(Cornus florida)* in the understory.
8. Brey Cave: an area of upland forest around the cave located SW of Mount Olive in the NW quarter of Sec. 8, T15N, R28W. The most common tree is Post Oak followed by Winged Elm, then Black Hickory, Eastern Redcedar and Black Oak.
9. White River Ford: the bottom land forest where the road fords the White River north of Durham at the NE edge of Sec. 18, T15N, R28W. Sycamore, River Birch, Silver Maple, American Elm, Hackberry, and Black Willow trees predominate.
10. Bridge North of Durham: an upland forest on a hillside south of the first bridge on state highway 16 NW of Durham. The site is SE of the creek in the NW corner of Sec. 19, T15N, R28W, and is almost all Post Oak in the overstory, but also has some Blackjack Oak and Shagbark and Black Hickory. The understory is Eastern Redcedar and Winged Elm.
11. Middle Fork Valley: just west of the road between Durham and the middle fork of the White River, slightly NW of the center of Sec. 26, T15N, R29W. This upland ravine forest is dominated by Black Oak, Post Oak and White Oak, and has Sycamore and Red Maple *(A. rubrum)* along a creek.
12. West of Durham: this cicada emergence site occupies the second ridge on the road leading westward from Durham. It is on both sides of the road where it crosses the boundary between Sections 25 and 26, and includes the adjacent corners of Sections 23 and 24, T15N, R29W. This extensive upland forest contains mainly White and Post Oak, Shagbark and Black Hickory, Red Maple, with Winged Elm and Flowering Dogwood in the understory.
13. Stewart's Place: along the road going west of Durham, mainly north of the road but also west and south of it in Sec. 25. The site occupies the NW edge of Sec. 30, T15N, R28W, and most of the NE corner of Sec. 25, T15N, R29W. This is on the first ridge west of Durham and is mixed upland forest with Black, Post and White Oak, Eastern Redcedar, Winged Elm and Shagbark Hickory.
14. Cassidy's Place: our main cicada study area, NE of Durham across the White River. It occupies the western half of Sec. 20, T15N, R28W, and also along the White River in that section, dipping into the northern part of Sec. 29. This is an extensive upland forest of Post Oak, Eastern Redcedar, Shagbark Hickory and Black Oak. It also includes some bottom land forest along the river dominated by Sycamore, River Birch and Silver Maple.
15. West of Thompson: overlapping the county line, the site is SW of state highway 16 covering the common corner for Sections 33 and 34, T15N, R28W, and Sections 3 and 4, T14N, R28W. It is an area of upland forest composed of White and Post Oak, Southern Red *(Q. falcata)*, Black Oak, and Shagbark Hickory.
16. East of Thompson: This area is over the line in Madison County on the east side of the White River in the SE corner of Sec. 34, T15N, R28W. It is covered by upland forest of Post and Black Oak, Southern Red and White Oak and Shagbark Hickory, with an understory of Winged elm; and also includes a strip of bottom land forest of Silver Maple, River Birch, Sycamore, Box Elder and Sweetgum *(Liquidambar styraciflua)* along the river.

In addition to cicada emergences in and near Washington County described above, we visited an active site in Carroll County NE of Eureka Springs along the road to Lake Leatherwood. Also, active cicada chorus centers were reported to us from Benton County in the vicinity of Molder Hollow, which is a major inlet on Beaver Lake in Sec. 24, T20N, R28W. There may have been many other cicada emergence sites in those two counties, but no systematic surveys were conducted there.

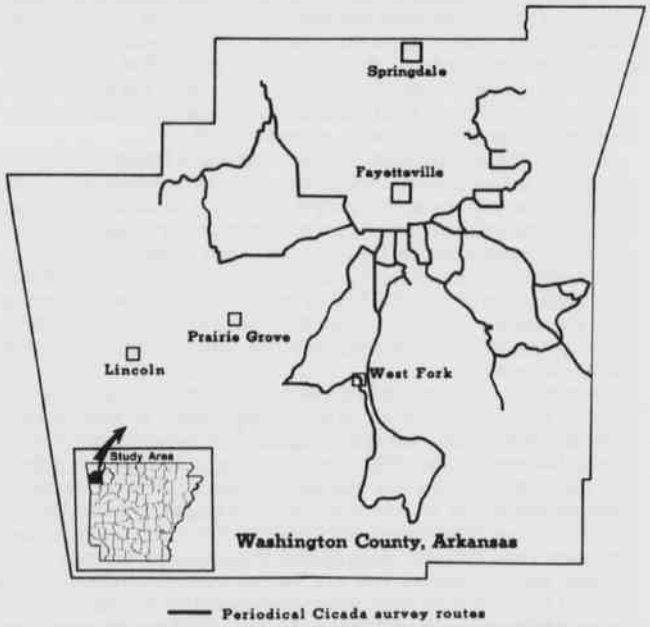

Figure 1. Outline of Washington County, Arkansas, showing the routes (solid lines) driven when conducting cicada site surveys.

DISCUSSION

Although survey routes radiated in all directions from Fayetteville (Figure 1), the 16 cicada emergence areas located were all positioned in the south and southeast part of Washington County (Figure 2), corresponding to that region of the county that is most heavily wooded. None of the present cicada positions in Washington County overlap

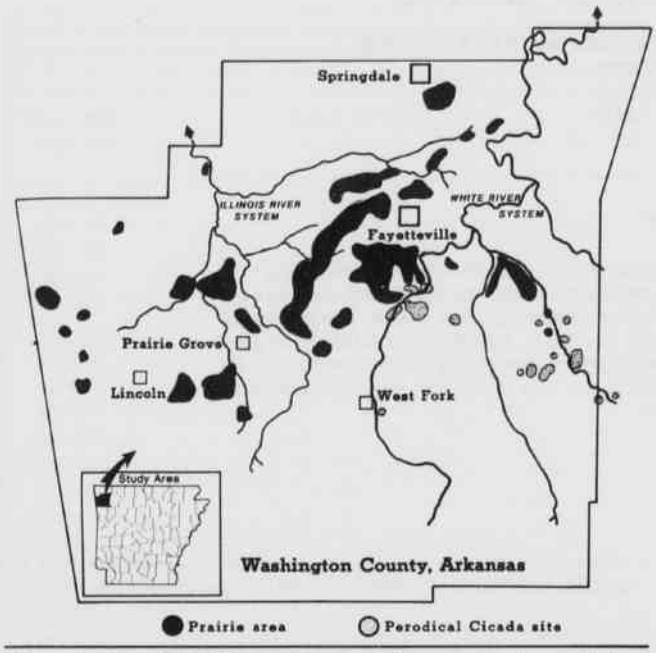

Figure 2. Map of Washington County, Arkansas, showing periodical cicada sites (stippled), original prairie areas (black), and the Illinois and White River drainage systems (thinner and wider solid lines, respectively).

areas of prairie grasslands (Figure 2) shown in a detailed map of Arkansas published by Langtree in 1866. Subsequent maps of Arkansas that detailed prairie areas were essentially the same as Langtree's (Sargent, 1884; Allred and Mitchell, 1955). Lesquereux (1860) corroborated the overall pattern shown on Langtree's map with his descriptions of the extensive prairie flatlands underlain by limestone in Benton and Washington counties. Lesquereux further commented that the area between the White River and Lee Creek had trees present, which includes the area occupied by periodical cicadas today (Figure 2).

Although forest stands have now spread across many of the former prairie areas in Washington County, the periodical cicadas apparently have not followed. Based on the present distribution pattern, we found no evidence that periodical cicadas exist in western Washington County near the Oklahoma border, as shown in the map published by Marlatt (1907). Rather, our results suggest that periodical cicadas have extended their range very little over the last century in Washington County and that their present distribution probably still marks the original forest areas. Several researchers have debated the dispersal capabilities of periodical cicadas (e.g., Karban, 1981; Lloyd et al., 1982; White et al., 1983). Our results suggest a large historical component influences the present distribution of periodical cicadas. Lack of apparent dispersal is no doubt due to the aggregative behavior and long generation time that 13-year periodical cicadas have. Even if the destruction of prairies began in 1866, there could have been only 10 generations of 13-year periodical cicadas in the 119 years since that date.

Several of the present cicada emergence sites are close to former prairie margins (Figure 2). This may represent the persistence of a former pattern resulting from a close ecological relationship. Female periodical cicadas seem to favor forest edge trees for oviposition and move toward forest edge habitats (e.g., Lloyd and White, 1976). The pattern of original prairies next to forest stands would produce relatively stable boundaries of forest edge, which apparently remain represented by the patterns of some cicada emergences.

Finally, we note that all the cicada emergences are positioned in the White River drainage in the eastern half of Washington County, and none are in the Illinois River drainage in the western half of the county. This situation also probably reflects a prairie and forest distribution. The Illinois River drainage widely embraces the prairie areas in Washington County, drains even more prairie areas in Benton County to the north, and then flows westward into Oklahoma. The White River drains extensive forest areas, and flows northward and eastward into forested areas of the Ozarks. The Illinois River flows into regions where 13-year periodical cicadas were virtually absent, the White River traverses a region where cicadas were abundant (Marlatt, 1907). Therefore, the forests adjacent to the White River could have served as a main avenue of cicada dispersal into northwestern Arkansas, thus providing the present distribution of cicada sites (Figure 2) are near branches of the White River. The White River drainage in fact may represent the western limit of Brood XIX of the periodical cicada in the United States, which is the most widespread of any 13-year brood, extending eastward to Virginia.

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