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DISTRIBUTION AND SEASONAL ABUNDANCE OF *CNEPHIA PECUARUM* (DIPTERA: SIMULIIDAE) IN ARKANSAS

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ABSTRACT. Studies were conducted during 1990–92 to determine the distribution and abundance of the southern buffalo gnat (*Cnephia pecuarum*) in Arkansas. Field collection of adults near streams throughout Arkansas demonstrated adult occurrence in 24 counties. Abundance studies were conducted by using tent traps baited with dry ice in 3 counties in southeastern Arkansas. In 1990, studies were conducted in Bayou Meto (Ashley County); Seven Devils Swamp (Drew County); and Crocketts Bluff, Bayou Meto, and Little LaGrue Bayou (Arkansas County). During 1991 and 1992, abundance studies were limited to Arkansas County. Results and previous field observations suggest 3 distinct populations in Arkansas (southwestern, southeastern, and central). Seasonal occurrence extended from December to April but varied by location and year. Abundance studies indicated variation in both seasonal occurrence and adult density by year and trap location. Although investigations during 1990–91 showed similar seasonal occurrence trends (peaking in early March), higher adult densities were noted during 1990. In contrast, peak adult density during 1992 occurred in late January. Greatest adult density during the course of these investigations was 7,160 gnats/24 h during 1990 at Crocketts Bluff (Arkansas County). Results suggest that additional studies are warranted to determine the impact of environmental and river factors on seasonal occurrence and abundance of this pest.

KEY WORDS *Cnephia pecuarum,* southern buffalo gnat, distribution, abundance, Arkansas, Simuliidae, black flies

INTRODUCTION

The southern buffalo gnat (*Cnephia pecuarum* Riley; Diptera: Simuliidae) has again become established as a yearly livestock pest in the southern USA. As indicated by historical records (Riley 1886; Bradley 1935a, 1935b) and recent outbreaks, occurrence of the southern buffalo gnat is at best sporadic. These sporadic outbreaks include not only yearly variation in population density but also extended periods of nonpest status. Nevertheless, delineation of the current area of infestation is important to determining magnitude of the problem, rate of spread, and effectiveness of pest control measures. In addition, data are necessary to determine periods of black fly activity for development of additional control programs. Subsequently, it is important to understand the distribution as well as seasonal abundance of this pest in the state. Riley (1886) reported occurrence of the southern buffalo gnat in Arkansas, Louisiana, Mississippi, Tennessee, Missouri, Kentucky, Indiana, Illinois, and Kansas. Although not mentioned in the early reports of Riley (1886) or Bradley (1935a), outbreaks of the southern buffalo gnat have also occurred in Texas (Robinson, personal communication). Riley (1886) further indicated that all of Arkansas, with the possible exception of the western counties, was susceptible to population fluctuations of the pest.

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MATERIALS AND METHODS

Distribution studies of the southern buffalo gnat via adult survey were conducted during the winter and spring seasons of 1990–92. Survey sites for adult buffalo gnats corresponded with major stream systems in 53 counties in southern, southwestern, and eastern Arkansas (Fig. 1).

Sampling sites were along streambeds or roadways adjacent to streams. Adult flies generally were attracted to the researcher and research vehicle, which contained an ice chest with dry ice, and could be readily collected in a few minutes. Adults were collected with battery-powered aspirators and sweep nets and then transferred to screened plastic cages, labeled, and placed in an ice chest for transportation to the laboratory. All samples were frozen for later identification.

When adults were not immediately attracted for collection, a minimum of 20 min was spent searching the associated stream banks for adults and stream substrates (submerged grasses, leaves, tree branches, and roots) for immature black flies. Stream search for immatures was limited to areas accessible by wading. Sites found positive for larvae or pupae were revisited at a later date in an effort to collect emerged adults. If no adults were collected and no larvae were found, collection was discontinued at the site. All locations were sampled at least twice during January to April to gather seasonal occurrence information. Because of the disparity in populations among sampling sites, time constraints, and the distance covered in these investigations, quantitative sampling was not attempted as part of the statewide survey.

Seasonal abundance studies of the southern buffalo gnat were conducted during the spring of 1990–92. Collection sites were chosen from areas

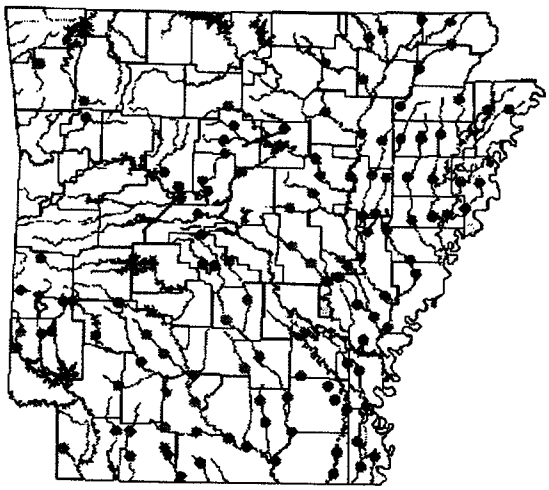

Fig. 1. Sampling sites, indicated by circles, in Arkansas for *Cnephia pecuarum.*

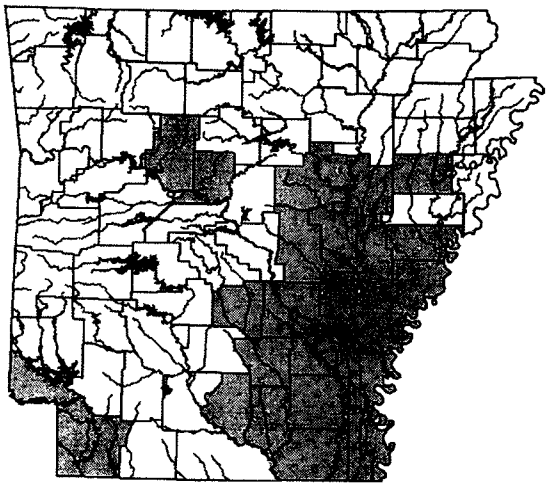

Fig. 2. Distribution of *Cnephia pecuarum* in southern and eastern Arkansas with positive counties indicated in gray.

previously identified as supportive of high adult densities. During 1990, studies were conducted in 3 counties in southeastern Arkansas (Arkansas, Drew, and Ashley counties). Sampling sites were Bayou Meto (Ashley County); Seven Devils Swamp (Drew County); and Crocketts Bluff, Bayou Meto, and Little LaGrue Bayou (Arkansas County). During 1991 and 1992, studies were limited to the 3 sampling sites located in Arkansas County.

Adult gnats were sampled for seasonal abundance studies by using 1.8 × 1.8 × 1.2-m canopy traps supported by 2.2-cm diameter center poles, with an entrance height of 0.6 m above the ground (Catts 1970, Atwood and Meisch 1993). Carbon dioxide was used as a black fly attractant. Dry ice (2.7–3.2 kg) was packed in 2-liter Coleman PolyLite® insulated jugs and attached at a height of 1.1 m to the center pole of the trap. Visual observation indicated that full opening of the jug spigots (66.3 mm^2) provided a similar constant rate of CO_2 release in all traps, with a small amount of dry ice remaining after 24 h.

Adults were captured by aspirating the inner surfaces of each tent trap with a battery-powered backpack aspirator, and from collection cages mounted on top of each tent trap. Collection cages consisted of 25.4-cm-long sections of 10.2-cm-diameter polyvinyl-chloride (PVC) pipe. A 10.2 × 20.3-cm section was removed from opposite sides of each pipe and covered with fine-mesh vinyl window screen; PVC pipe collars secured each trap to the top of the tent. The top 5 cm of a 3-liter plastic beverage bottle was fitted to the inner lip of each pipe collar at the junction of the cage to serve as an entrance cone. The top of each cage was sealed with a 4-mm-thick clear vinyl sheet secured by rubber bands. Assembly of trap components required no adhesive and allowed easy disassembly for removal of captured adults. After 24 h, trapped adults were collected then transported to the laboratory for storage, and later identification and total count.

RESULTS AND DISCUSSION

Adult southern buffalo gnats were collected from 24 Arkansas counties (Fig. 2). Streams associated with each collection site in each country are listed in Table 1.

Table 1. Stream locations associated with adult *Cnephia pecuarum* collection in 24 Arkansas counties.

County	Stream collection site
Arkansas	Bayou Meto, LaGrue Bayou, Little LaGrue Bayou
Ashley	Bartholomew Bayou
Bradley	Moro Creek, Saline River
Calhoun	Moro Creek
Chicot	Bartholomew Bayou, Big Bayou
Cleveland	Saline River, Bayou River
Conway	Point Remove Creek
Cross	L'Anguille River
Desha	Bayou Macon
Drew	Bartholomew Bayou, Sandy Creek, Cutoff Creek
Grant	Saline River
Jefferson	Plum Bayou, Wabbuseka Bayou
Lafayette	Sulphur River
Lee	Big Creek, L'Anguille River
Lincoln	Bartholomew Bayou
Little River	Walnut Bayou
Lonoke	Bayou Meto, Wabbuseka Bayou
Miller	Sulphur River
Monroe	White River, Piney Creek
Pope	Galla Creek
Phillips	Big Creek, Little Cyprus, Big Cyprus
Prairie	LaGrue Bayou
White	Bull Creek, Cane Creek, Cutoff Creek
Woodruff	Cache River, Hill Bayou

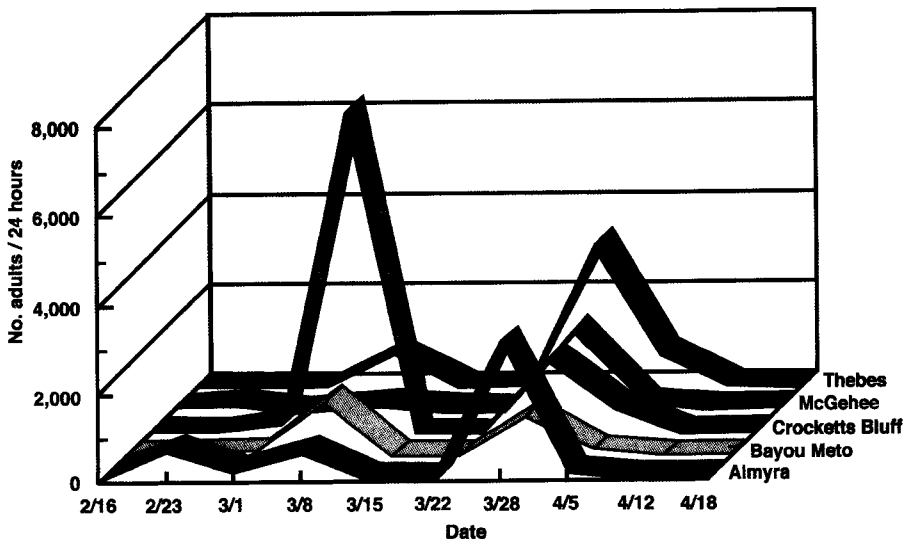

Fig. 3. Seasonal abundance of adult *Cnephia pecuarum* at Almyra, Bayou Meto, and Crocketts Bluff sites in Arkansas County; McGehee site in Drew County; and Thebes site in Ashley County during 1990.

A number of streams in Arkansas appear to be suitable for development of the southern buffalo gnat; however, collection of adults at any site does not necessarily confirm breeding in the associated stream. Because the gnat has an approximate flight range of 24 km (Robinson, personal communication), adults collected at one location may have developed in a different stream system. Furthermore, because some black fly species have flight ranges from 8 to 182 km (Thompson 1976, Davies 1978), further studies are necessary to positively identify breeding sites through larval and pupal collection. In addition, a single adult specimen was obtained in Ashley County at the boundary with Union County; therefore, Union County also may be a breeding site.

Highest adult fly densities were noted in Miller, Arkansas, Prairie, Drew, Ashley, and Conway counties. Although quantitative samples were only taken for Arkansas County, our observations suggest that the highest densities occurred in Miller and Arkansas counties. Overall, collection of the southern buffalo gnat was limited primarily to southern and eastern Arkansas with the positive counties indicated in gray in Fig. 2. The absence of adult buffalo gnats in northern Arkansas appears to confirm a restricted range for this species.

The southern buffalo gnat typically develops in small to medium streams characterized by a sandy bed, severe seasonal spates, and reduced rate of water flow. Eggs are laid singly on the water surface and rapidly sink to the bottom sediment, where they remain in a state of diapause until the following year. The transition from sand bed geomorphology in southern parts of the state to rock and gravel streambeds in northern areas of Arkansas may be the most important factor limiting the distribution of the southern buffalo gnat. As an example, high densities of larvae and adults were located in the southern reaches of Point Remove Creek (Conway County) where the streambed has a sand geomorphology. In this area, stream characteristics were typical for development of this species. In contrast, investigations of the swifter, shallower, and rockier northern reaches of the same stream were negative for both larvae and adults. Other river factors such as water temperature, turbidity, food abundance, and food quality may be responsible for or contribute to the limited range of this species. Further studies will be needed to precisely define stream parameters associated with the development of the southern buffalo gnat.

Seasonal adult occurrence of the southern buffalo gnat in Arkansas during 1990 extended from February through April (Fig. 3). First positive collections were recorded on February 16 and last collections were obtained on April 18. Peak occurrence at Crocketts Bluff was recorded on March 8 (7,160 gnats/24 h). In contrast, peak density at all other locations occurred on March 28 (ranging from 898 gnats/24 h at Bayou Meta to 3,200 gnats/24 h at Thebes). Collections were not taken on March 15 or March 22.

Abundance of the southern buffalo gnat during 1990 displayed 2 separate seasonal peaks, suggesting that this species may be divoltine. The collection sites at Almyra and Crocketts Bluff are separated by less than 32 km; thus, the early peak density at Crocketts Bluff may indicate that the southern buffalo gnat is able to successfully complete development in the White River. Because the trapping site at Crocketts Bluff was located on a height overlooking the river, additional studies should be conducted to determine larval presence

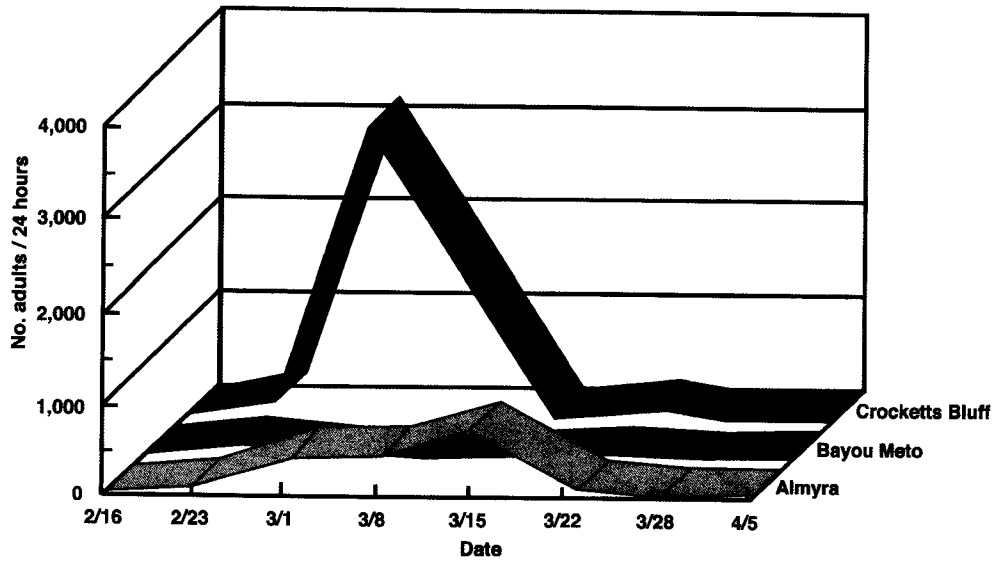

Fig. 4. The 1991 seasonal abundance of adult *Cnephia pecuarum* in Arkansas County.

or absence in the White River. Because a more constant environment (water flow and temperature) is associated with a large river, it may be hypothesized that development begins earlier and that habitat parameters may be more conductive to optimal larval growth. However, because this site was more densely wooded than all other collection sites, the high adult density recorded may indicate an adult refuge from environmental factors.

During 1991, adults were collected from mid-February through early April (Fig. 4). The highest numbers again were recorded at the Crocketts Bluff collection site (3,152 adults/24 h). However, as noted previously, it is uncertain whether the higher adult density at this location represents immature development in the White River or an impact of other environmental factors. Adult density at all locations was reduced from levels observed in 1990, with extremely low comparative adult collections at Bayou Meto. A divoltine pattern was not evident this season.

Seasonal collection of the southern buffalo gnat in Arkansas County during 1992 did not follow the pattern observed during 1990 and 1991 (Fig. 5). Adult trapping was begun during mid-January after reports of southern buffalo gnat activity. The high

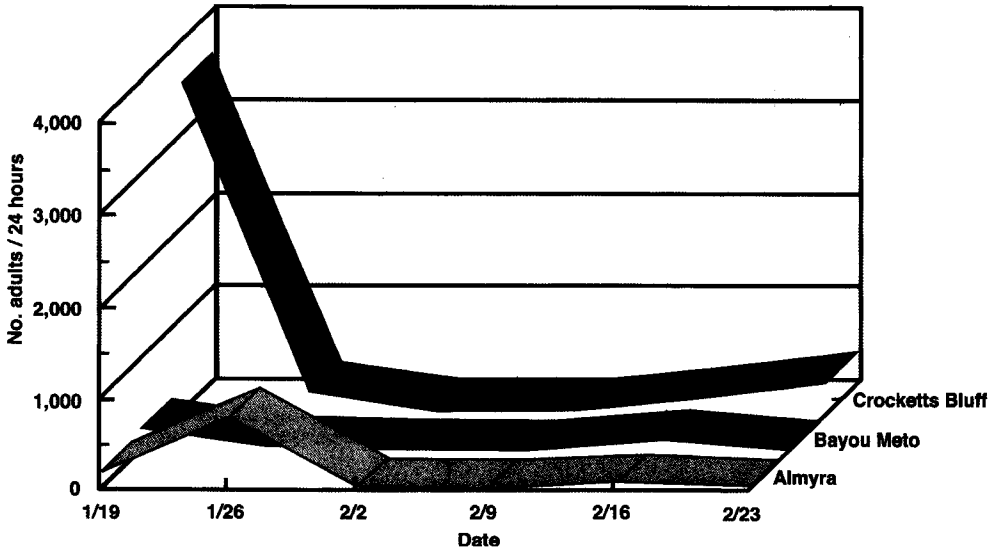

Fig. 5. Seasonal abundance of adult *Cnephia pecuarum* in Arkansas County during 1992.

densities observed at time of initiation of collection suggest that adult emergence may have begun as early as December. In contrast, adult emergence was not observed until mid-February during 1990 and 1991. The early adult occurrence during 1992 is unexplained.

The varied seasonal occurrence observed during the course of this investigation is consistent with the sporadic occurrence reported by Riley (1886). It is hypothesized that the sporadic seasonality of this pest is dependent upon environmental factors such as water temperature and stream flow to initiate and terminate diapause. Bradley (1935b) observed that eggs held in the laboratory did not hatch until agitated; he suggested that scouring might be necessary to break the state of egg diapause. Examination of the 1992 data shows that peak adult density occurred in early January at Crocketts Bluff and late January at the Bayou Meto and Almyra sampling sites. Because collection was initiated after adult populations were in abundance, estimates of maximum density during this period cannot be reliable. Nevertheless, observed densities during 1992 appeared to be comparable to those noted during 1991.

Conversely, field observations made in the Sulphur River during 1985–88 indicate an earlier adult occurrence in southwest Arkansas. Adult southern buffalo gnats were 1st observed in low numbers during early January, with peak density occurring in mid-February. By April, adult gnats were scarce. Thus, the seasonal occurrence of black flies in the Sulphur River drainage system extends from January to April.

Field observations made during 1990–92 in Conway County, Arkansas, indicate a 3rd seasonal pattern for the southern buffalo gnat. Peak adult abundance in Conway County was observed during late March and April. In contrast to the other sampling areas, adult population density was not extended and was observed to rapidly decline. It is hypothesized that the later-occurring adult population was more subject to environmental stress from warm weather. Further investigations are required to test this hypothesis.

Results of these investigations and earlier field observations indicate seasonal variation in abundance of the southern buffalo gnat in Arkansas. Whether these differences in adult occurrence are the result of differing environmental and river factors is not known. These seasonal differences may indicate the presence of discrete sibling species. Additional taxonomic investigations are warranted to determine the specific makeup of each population. Regardless, these investigations indicate a wide distribution and variable pattern of seasonal occurrence for the southern buffalo gnat in Arkansas.

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