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Abundance and Seasonal Occurrence of Psorophora columbiae in a Northeast Arkansas Ricefield Community

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ABUNDANCE AND SEASONAL OCCURRENCE OF *PSOROPHORA COLUMBIAE* (DIPTERA: CULICIDAE) IN A NORTHEAST ARKANSAS RICEFIELD COMMUNITY

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ABSTRACT

Increased population levels of the dark ricefield mosquito, *Psorophora columbiae* (Dyar and Knab), have been shown to be associated with rice cultivation in Arkansas and several other states.

Four standard New Jersey light traps were operated daily between May 30 and October 2 of 1981 and 1982 to determine the relative abundance and seasonal occurrence of this species in NE Arkansas. The effect of trap distance from nearby rice on the number of adult *P. columbiae* collected was assessed by comparing weekly totals from 2 traps located within 0.9 km of rice fields with totals from 2 traps situated beyond 1.2 km.

A total of 68,155 mosquitoes representing five genera was trapped during this study. Of this number, 45,760 (67.1% of all mosquitos captured) were *P. columbiae*. Female adults comprised 98.8% of the trapped ricefield mosquitoes. The peak period of abundance for this species was found to occur between mid-July and late August and was closely associated with area rice-culture practices. The capture of more than 95.0% of all *P. columbiae* adults within 0.9 km of rice fields confirmed the reported short flight range of this species.

INTRODUCTION

Since rice was first grown as a commercial crop in Arkansas in 1904 (Whitehead, 1951b), Arkansas has become one of the five leading rice-producing states in the U.S. with ca. 6,000,000 ha in rice production (Meisch et al., 1980). Although some rice acreage exists in central Arkansas counties bordering the Arkansas River, and some occurs in the southwestern counties, most rice cultivation is limited to the eastern half of the state. The largest rice-producing region in E Arkansas is centered in the "Grand Prairie" area which includes Arkansas, Lonoke, Monroe, and Prairie counties. In Craighead County in NE Arkansas, 33,590 ha of rice were planted in 1981 and 33,376 ha were grown in 1982 (Fagala, pers. comm.). Of this amount, an estimated 7,500 ha in 1981 and 7,000 ha in 1982 were cultivated within a 2.5 km radius of Jonesboro.

It has been well established that the rice agroecosystem provides suitable breeding sites for several mosquito species including the dark ricefield mosquito, *Psorophora columbiae* (Dyar and Knab). Schwardt (1939) and Horsfall (1942b) reported that *P. columbiae* was the dominant mosquito species in Arkansas rice-producing areas and that rice-culture conditions permit the development of several generations of this species during the growing season. The suddenness with which a local population of this mosquito may increase further emphasizes its importance. Whitehead (1951b) stated that ricefield mosquitoes in Arkansas have increased in direct proportion to the state's increased rice acreage and that mosquitoes present a serious problem wherever rice is grown. Studies of the flight habits of ricefield mosquitoes by Horsfall (1942a), Quarterman et al. (1955), and Whitehead (1957) have shown that the majority of mosquitoes produced by rice fields remain within 1.2 km of the field in which they developed and are more likely to be of importance near rice acreage.

Host-preference precipitin tests conducted by Whitehead (1951a) indicated that cattle serve as the major bloodmeal source for female *P. columbiae*. Experiments by Sudia et al. (1971) showed that this species was capable of transmitting Venezuelan equine encephalitis (VEE) and that it was an important vector of VEE in nature. Steelman et al. (1972, 1973) and Steelman and Schilling (1977) reported that mosquitoes produced in Louisiana rice-growing areas could be important vectors of anaplasmosis to cattle and cause significant and economically-damaging reductions in the average daily weight gain of cattle. Additionally, Meisch and Coombes (1975) have reported that *P. columbiae* in Arkansas have a population peak from mid-June to mid-July which can be an extreme nuisance to farmers and residents near rice fields.

Several Arkansas investigators, including Schwardt (1939) and Horsfall (1937, 1942a) have published lists of mosquito species collected with light traps in Arkansas rice-growing regions. However, no light trap studies of mosquitoes in NE Arkansas have been reported and there are no reports of identified mosquito species collected from the NE rice section (Meisch et al., 1980).

The primary objective of this two-year study was to determine the relative abundance and seasonal occurrence of adult *P. columbiae* in a NE Arkansas rice-producing area using the New Jersey trap as a sampling device. Previous investigations in the "Grand Prairie" region of Arkansas have shown that there is a rather abrupt decrease in the number of ricefield mosquitoes collected as distance from rice fields is increased. Therefore, a secondary aim of this study was to evaluate the effect of light trap location, with respect to nearby rice acreage, on the number of *P. columbiae* collected in a NE Arkansas ricefield community.

MATERIALS AND METHODS

To assess *P. columbiae* abundance and seasonal occurrence, a standard New Jersey light trap was placed at each of four locations within the city limits of Jonesboro, Arkansas in 1981 and 1982. The effect of relative distance from surrounding rice fields on the number of adults collected was evaluated by placing two traps near the periphery and two traps closer to the center of the city.

One of the two peripheral traps (designated Airport) was located on the SW corner of the Jonesboro Municipal Airport. This trap was in an open, grassy area isolated from competing light sources and was within 0.3 km of a large rice field. The power source for this trap was regulated by a photocell. The second peripheral trap (designated Race Street) also was situated in a relatively remote area and was photocell controlled. This trap was within 0.9 km of several rice fields and was immediately surrounded by grassy patches intermixed with brush and clumps of small trees.

A third light trap (designated ASU, and one of the two central traps) was located on the campus of Arkansas State University in a grassed area and near several large buildings. Lack of photocell necessitated operation of this trap on a continuous basis. Although there was some

attraction competition from nearby lights, it was considered to be minimal. The nearest rice field was over 1.2 km away. The second centrally-located trap (designated Culberhouse Street) was at the margin of a small park and also was operated continuously. The distance from this trap to the nearest rice field exceeded 1.9 km.

Light trap catches from all locations were collected daily between May 30 and October 2 during both study years. Mosquitoes in each sample were sorted and identified utilizing the taxonomic keys of Carpenter et al. (1946), Carpenter and LaCasse (1955), and Stojanovich (1960). Daily trap totals were summed for each week of the 18-week study period.

RESULTS AND DISCUSSION

A total of 68,155 mosquitoes representing five genera was collected in four light traps during the two years of sampling. Of this total, 34,041 (49.9%) and 34,114 (50.1%) were captured in 1981 and 1982, respectively. It should be noted that all traps were in areas subjected to periodic applications of a mosquito adulticide by ground-operated, ULV cold-aerosol generators. This undoubtedly lowered the total number of mosquitoes collected during the study and may have had more of an impact on the central trap locations which were farther from the main source of reinfestation. The two-year total for the number of *P. columbiae* trapped was 45,760 which represented 67.1% of all mosquitoes captured. The remaining 32.9% of the two-year total was composed of the genera *Anopheles* (16.6%), *Aedes* (8.5%), *Culex* (7.7%), and *Culiseta* (0.1%). The high percentage of the mosquito population attributable to *P. columbiae* in this study generally corresponds with the results of Schwardt (1939) and Horsfall (1942a) who reported percentages ranging from 37 to near 90% of the mosquito fauna in the "Grand Prairie" region. These data also confirm the conclusions of Whitehead (1957) and Meisch and Coombes (1975) that *P. columbiae* is the primary pest-mosquito species associated with rice culture in Arkansas.

In 1981, a total of 21,085 *P. columbiae* was collected and this number represented 61.9% of all mosquitoes captured for that year. In 1982, 24,675 were trapped representing 72.3% of the year's total catch. The periods of greatest abundance for this species in each of the two years were generally between late June and mid-to-late August (Figs. 1 & 2).

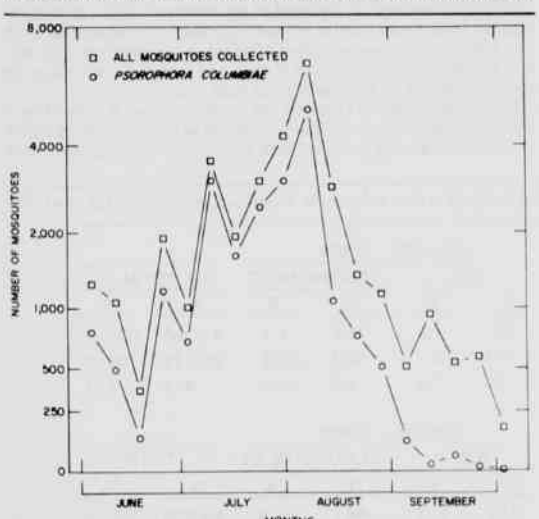

Figure 1. Comparison of weekly totals of adult *Psorophora columbiae* with all adult mosquitoes trapped at four locations in Jonesboro, Arkansas in 1981. (Semi-Log. Scale)

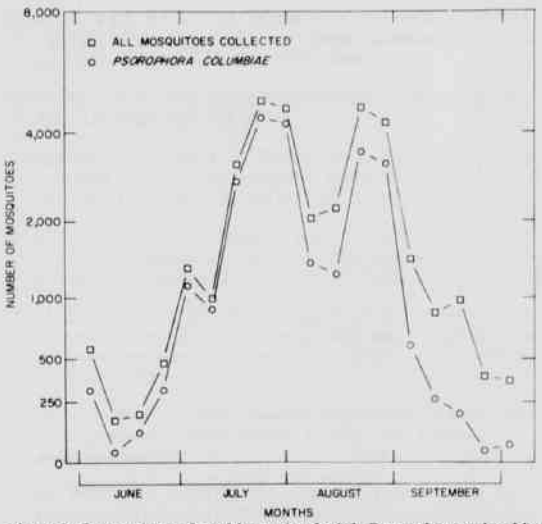

Figure 2. Comparison of weekly totals of adult *Psorophora columbiae* with all adult mosquitoes trapped at four locations in Jonesboro, Arkansas in 1982. (Semi-Log. Scale)

This finding is in agreement with results published by Schwardt (1939), Horsfall (1942a), Whitehead (1957), and Meisch and Coombes (1975). It also is consistent with observations made by the authors in Craighead County between 1975 and 1980.

In 1982, the highest weekly total for *P. columbiae* (5,227) was collected during the first week in August (Fig. 1). In 1982, population peaks of 4,492 and 3,452 occurred in late July and late August, respectively (Fig. 2). The gradual rise and rather sharp fall of the *P. columbiae* population in both years was closely associated with area rice-culture practices. The population increased quite rapidly in late June and early July of both years as more fields were flooded. The abrupt decline of ricefield mosquito numbers in late August of each year corresponded closely with fall drainage. According to Horsfall (1942a), *P. columbiae* normally exhibits two periods of maximum abundance during the summer. Variation in the timing of these peaks and the extent of their overlapping is primarily determined by the spread of rice planting dates over a given area. A short planting interval, as occurred in 1982 in NE Arkansas, will result in two definite peaks of abundance because adults emerging after the initial flood will have largely disappeared before the second peak of abundance appears following normal, mid-season cultural drainage and reflooding. When the planting interval extends over several weeks, as it did in 1981 due to frequent rains, the two peak periods of abundance will overlap because adults produced by early-planted fields that have been reflooded after cultural drainage will be emerging at the same time as those coming from the initial flooding of late-planted fields.

The relatively higher numbers of *P. columbiae* in early June of 1981 were believed to be the result of a greater amount of rainfall (21.13 cm) in May of that year than that experienced in May of 1982 (12.60 cm). Following the decline of ricefield mosquitoes in September of both years, *Culex*, *Aedes*, and *Anopheles* mosquitoes represented the main components of the population.

Figures 3 and 4 present a comparison of the combined adult male and female *P. columbiae* collected in the two peripherally-located traps (Airport and Race Street) with those captured by the centrally-located traps (ASU and Culberhouse Street) for 1981 and 1982, respectively. In both years, the data clearly indicated that light traps located within 0.9 km of rice fields caught a significantly greater number of *P. columbiae* than did traps situated from 1.2 km to 1.9 km away. This

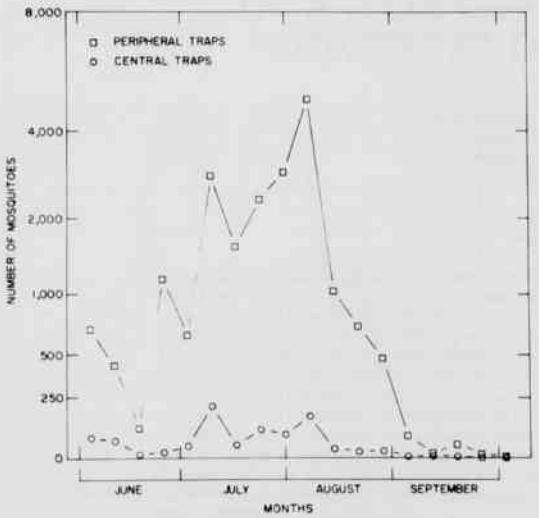

Figure 3. Comparison of weekly totals of adult *Psorophora columbiae* trapped at two peripheral and two central locations in Jonesboro, Arkansas in 1981. (Semi-Log. Scale)

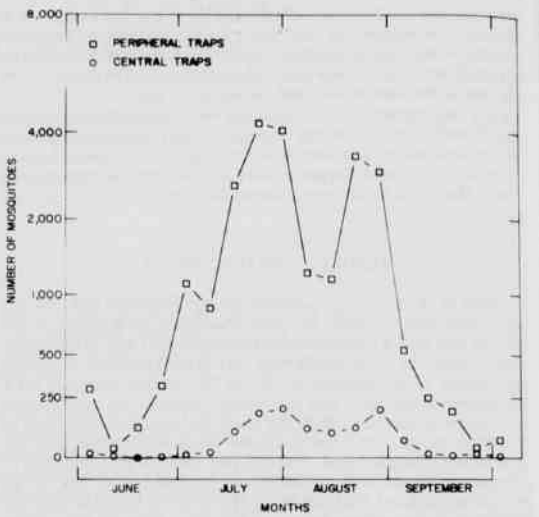

Figure 4. Comparison of weekly totals of adult *Psorophora columbiae* trapped at two peripheral and two central locations in Jonesboro, Arkansas in 1982. (Semi-Log. Scale)

finding further substantiated earlier work by several investigators in Arkansas including Schwardt (1939), Horsfall (1942a), Quarterman et al. (1955), and Whitehead (1957).

A more detailed comparison of the number of *P. columbiae* collected in the peripheral and centrally-located traps is presented in the Table. In 1981, the two peripheral traps, which were within 0.9 km of several rice fields, accounted for 95.8% of the adults captured. In 1982, the same peripheral traps caught 95.6% of all ricefield mosquitoes collected. The two centrally-located traps, which were 1.2 km to 1.9 km from the nearest rice, caught only 4.2% of the 1981 *P. columbiae* adults and 4.4% in 1982.

In addition to the effects of trap distance from rice acreage, it is believed that competing light sources and the physical barriers presented by trees and buildings may have had a negative influence on the number of ricefield mosquitoes found in the central traps. Horsfall (1942a) concluded that this species does not readily enter wooded areas and the tendency of females to fly close to the ground for host and oviposition-site location may restrict their movements to more open, treeless regions between wooded areas.

The Table also shows that 98.0% of the captured *P. columbiae* adults in 1981 were females as were 98.7% in 1982. Reasons for the comparatively low numbers of males in all traps in both years are not completely understood. However, in ricefield mosquito flight-habit studies by Horsfall (1942a), it was noted that the majority of the males normally do not fly over 274 m from their breeding sites. In samples with whirling-cone traps at 1.2 m and 2.4 m levels, it was found that 73.0% of all males were collected at the higher elevation. It also was suggested that males may fly in greater numbers still higher than 2.4 m thus reducing the chances of their being taken in a standard light trap. It is not known by the authors if male and female *P. columbiae* are equally attracted to an incandescent light source.

In summary, our data support the conclusion that *P. columbiae* is the main component of the mosquito fauna in the rice-growing region of NE Arkansas. The period of peak abundance for this species occurs

Table. Comparison of numbers of adult female and male *Psorophora columbiae* collected at four locations in Jonesboro, Arkansas in 1981 and 1982.

1981	PERIPHERAL TRAPS				CENTRAL TRAPS					
	AIRPORT		RACE ST.		ASU		CULBERHOUSE ST.		TOTAL	
	N	%	N	%	N	%	N	%	N	%
SEASON TOTAL / TRAP	15,031	71.3	5,171	24.5	531	2.5	352	1.7	21,085	100.0
FEMALES	14,784	98.4	5,094	98.5	492	92.7	302	85.8	20,672	98.0
MALES	247	1.6	77	1.5	39	7.3	50	14.2	413	2.0

1982	PERIPHERAL TRAPS				CENTRAL TRAPS					
	AIRPORT		RACE ST.		ASU		CULBERHOUSE ST.		TOTAL	
	N	%	N	%	N	%	N	%	N	%
SEASON TOTAL / TRAP	11,599	47.0	11,996	48.6	619	2.5	461	1.9	24,675	100.0
FEMALES	11,464	99.0	11,893	99.0	565	91.3	441	95.7	24,363	98.7
MALES	135	1.0	103	1.0	54	8.7	20	4.3	312	1.3

between mid-July and late August and is closely associated with area rice-cultivation practices. The trapping of more than 95.0% of all *P. columbiae* adults within 0.9 km of rice fields confirms the previously-reported short flight range of this species.

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LITERATURE CITED

CARPENTER, S. J., and W. J. LACASSE. 1955. Mosquitoes of North America (north of Mexico). Univ. Calif. Press, Los Angeles. 360 p.

CARPENTER, S. J., W. W. MIDDLEKAUFF, and R. W. CHAMBERLAIN. 1946. The mosquitoes of the southern United States east of Oklahoma and Texas. Amer. Mid. Nat., Monog. 3:292 p.

HORSFALL, W. R. 1937. Mosquitoes of Southeastern Arkansas. J. Econ. Ent. 30(5):743-748.

HORSFALL, W. R. 1942a. Biology and control of mosquitoes in the rice area. Ark. Agr. Expt. Sta. Bul. 427.

HORSFALL, W. R. 1942b. Breeding habits of a rice field mosquito. J. Econ. Ent. 35(4):478-482.

MEISCH, M. V., and L. E. COOMBES. 1975. A pilot abatement district in rice growing areas of Arkansas. N. J. Mosq. Exterm. Assoc., Proc. 62:190-195.

MEISCH, M. V., A. L. ANDERSON, R. L. WATSON, and L. A. OLSON. 1980. Mosquito species inhabiting rice fields in five rice growing regions of Arkansas. Mosq. News. 42(3):341-346.

QUARTERMAN, K. D., J. A. JENSEN, W. MATHIS, and W. M. SMITH. 1955. Flight dispersal of rice field mosquitoes in Arkansas. J. Econ. Ent. 48(1):30-32.

SCHWARDT, H. H. 1939. Biologies of Arkansas rice field mosquitoes. Ark. Agr. Expt. Sta. Bul. 377.

STEELMAN, C. D., and P. E. SCHILLING. 1977. Economics of protecting cattle from mosquito attack relative to injury threshholds. J. Econ. Ent. 70(1):15-17.

STEELMAN, C. D., T. W. WHITE, and P. E. SCHILLING. 1972. Effects of mosquitoes on the average daily gain of feedlot steers in Southern Louisiana. J. Econ. Ent. 65(2):452-466.

STEELMAN, C. D., T. W. WHITE, and P. E. SCHILLING. 1973. Effects of mosquitoes on the average daily gain of Hereford and Brahman breed steers in Southern Louisiana. J. Econ. Ent. 66(5):1081-1083.

STOJANOVICH, C. J. 1960. Illustrated key to common mosquitoes of Southeastern United States. Cullom and Ghertner Co., Atlanta, GA. 36 p.

SUDIA, W. D., V. F. NEWHOUSE, and B. E. HENDERSON. 1971. Experimental infection of horses with three strains of Venezuelan equine encephalomyelitis virus. II Experimental vector studies. Amer. J. Epidemiol. 93:206-211.

WHITEHEAD, F. E. 1951a. Host preference of *Psorophora confinnis* and *P. discolor*. J. Econ. Ent. 44(6):1019.

WHITEHEAD, F. E. 1951b. Rice field mosquito control by pellet-borne insecticides. Ark. Agr. Expt. Sta. Bul. 511.

WHITEHEAD, F. E. 1957. Flight range of rice field mosquitoes. Ark. Agr. Expt. Sta. Bul. 590.