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SCIENTIFIC NOTE

SEASONALITY OF *AEDES ALBOPICTUS* IN NORTH AND CENTRAL MISSISSIPPI

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ABSTRACT. Container-breeding mosquitoes are increasingly important in public health due to recent outbreaks of Zika virus, chikungunya, and dengue. This paper documents seasonality of the most prevalent container-breeding mosquito species in Mississippi—*Aedes albopictus*. Ten sites in 5 counties in both northern and central Mississippi (20 sites, 10 counties total) were sampled by larval dipping and oviposition traps biweekly from September 2016 to June 2019, totaling 22 months and potentially yielding 440 egg or larval collections. However, 22 collections were missed due to inclement weather and personnel issues during the study period, so actually only 418 site visits were performed. Sites were chosen to maximize chances of finding *Ae. albopictus*. Of the total 1,310 mosquito larvae collected during the study period, 717 larvae and 50 positive egg papers belonged to *Ae. albopictus. Aedes albopictus* was found in all 10 northern and central counties. No eggs were collected at any of the sites from December through February, although larvae were occasionally collected during that time frame. This study demonstrates that *Ae. albopictus* is active in central and northern Mississippi beginning in March each year and continuing through November or December. There is little activity during the coldest months of the year (January and February). These data represent the first extensive analysis of *Ae. albopictus* seasonality in Mississippi, and as such, allow for better public health awareness of diseases transmitted by this species and design of more effective vector control programs.

KEY WORDS *Aedes albopictus*, ecology, habitat, Mississippi, seasonality

Container-inhabiting mosquitoes are a timely topic in public health due to the Zika virus outbreak of 2015–17 in the Western Hemisphere (Anonymous 2016, Fauci and Morens 2016). Zika virus is primarily transmitted by the container-inhabiting *Aedes aegypti* (L.) (yellow fever mosquito), although *Ae. albopictus* (Skuse) (Asian tiger mosquito) is also a potential secondary vector (Wong et al. 2013, Grard et al. 2014). Previous surveys in Mississippi have revealed approximately 61 species overall (Goddard et al. 2010), with at least 16 of those species occurring in artificial containers around the state (Goddard et al. 2010; Yee et al. 2012, 2015). Records from 1989 show the first known presence of the introduced species *Ae. albopictus* in Mississippi (USAF 1989), which subsequently spread across the state and now occurs abundantly in every county (Goddard et al. 2010). A recent container-breeding mosquito surveillance program was initiated in Mississippi, focused on *Ae. albopictus* and (potentially) *Ae. aegypti* (Goddard et al. 2017). This current study complements that surveillance effort by documenting the seasonality of the primary container-inhabiting mosquito species in Mississippi, *Ae. albopictus*.

Twenty sites in 5 counties in northern Mississippi and 5 counties in central Mississippi were sampled biweekly from September 2016 through June 2019 (22 months) (Table 1). At each visit, a rural site and an urban site were sampled in each county, potentially yielding 440 individual collections (however, there were 22 times when sampling was impossible due to inclement weather or changes in personnel, so 418 visits were made). Sampling-site locations were designated prior to the onset of surveillance activity, and they did not change throughout the course of the work. Sites were chosen to maximize chance of finding *Ae. albopictus* and were mostly tire piles and cemeteries, although in some places, debris or trash (e.g., bottles, cans, buckets) were also sampled. Sampling at each site, including one oviposition cup placement and larval collections using a dipper, was previously described in a parallel study (Goddard et al. 2017). Back at the laboratory, the number of larvae in each collection was counted, then 1–3 larvae from each collection were preserved in vials containing 70% ethanol; the remaining larvae were reared to adults over approximately the next 2 wk. Larvae (in alcohol) and any adults reared from the collections were identified using standard keys (Darsie and Ward 2005, Harrison et al. 2016). Eggs were hatched and larvae reared to adults for identification.

A total of 1,310 mosquito larvae were collected during this survey; 717 of them (54.7%) were *Ae. albopictus*. In addition, 50 positive egg papers were collected. Several other mosquito species were collected as both larvae and eggs, but they are not

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Table 1. Locations for *Aedes albopictus* surveillance for each of the 10 counties. Coordinates for each site were obtained using Garmin Global Positioning System (GPS, Garmin Ltd., Kansas City, KS) and remained the same throughout the project.

County	Rural or urban	GPS coordinates	Description of location
Desoto	Rural	34°53.791′N, 089°59.844′W	Nesbit
	Urban	34°49.105′N, 089°59.429′W	Hernando
Lafayette	Rural	34°13.392′N, 089°21.623′W	Tula Cemetery
	Urban	34°22.276′N, 089°30.777′W	Oxford Memorial Cemetery
Lee	Rural	34°24.470′N, 088°46.009′W	Saltillo
	Urban	34°11.573′N, 088°42.740′W	Verona Cemetery
Chickasaw	Rural	33°46.593′N, 088°58.711′W	Pleasant Ridge Church
	Urban	33°54.668′N, 089°00.254′W	Chickasaw Tire Store
Oktibbeha	Rural	33°23.233′N, 089°49.297′W	Bradley
	Urban	33°28.001′N, 088°00.150′W	Henderson Cemetery
Lauderdale	Rural	32°54.388′N, 088°65.835′W	Daleville Cemetery
	Urban	32°38.728′N, 088°70.115′W	Meridian Cemetery
Neshoba	Rural	32°71.206′N, 089°15.953′W	Good Hope Cemetery
	Urban	32°77.209′N, 089°10.737′W	Philadelphia Tire Store
Rankin	Rural	32°31.500′N, 089°79.675′W	Pelahatchie
	Urban	32°27.132′N, 090°14.284′W	Pearl
Hinds	Rural	32°35.030′N, 090°46.140′W	Bolton
	Urban	32°31.382′N, 090°19.423′W	Jackson
Madison	Rural	32°51.806′N, 090°10.605′W	Gluckstadt
	Urban	32°46.229′N, 090°12.232′W	Ridgeland

the subject of this report. This project documented the presence of *Ae. albopictus* in all 10 counties. For our analysis, a positive result was defined as documenting *Ae. albopictus* in a county at either the urban or rural site for at least one of the visits to that site during the month (Table 2). *Aedes albopictus* was collected slightly more often in urban sites than in rural sites. Positive results were obtained 96 out of 209 times (45.9%) in rural sites sampled; and 104 out of 209 (49.7%) at the urban sites. As for seasonality, there were only 2 months out of the 22 months of the project, December 2017 and February 2018, when no evidence of *Ae. albopictus* was documented at any of the 20 sites, either rural or urban. During both January 2017 and 2018, there was only 1 positive collection made. No eggs were collected at any of the sites for the 3-month period, December through February, although larvae were occasionally collected during that time frame. Finding *Ae. albopictus* larvae during winter is not indicative of active populations as this species may overwinter as larvae, but finding eggs is evidence of adult *Ae. albopictus* activity. This study demonstrates that *Ae. albopictus* is active in central and northern Mississippi beginning in March each year and continuing through November or December. There is little activity during the coldest months of the year (January and February). These data are important as this species is a known vector of several human diseases, as well as dog heartworm to canines (Gratz 2004, Ledesma and Harrington 2011). Finding the species active in both rural and urban areas from March until December should be of concern to public health and vector control officials in the southern USA.

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Table 2. Positive collections of *Aedes albopictus* for each of the 10 counties recorded here by month. Part A, rural sites (R); Part B, urban sites (U). If *Aedes albopictus* eggs were collected at that site/date, the R or U is highlighted for the site. Percentages on the right show the number of months out of the 22 months of the project that a county was positive.

A. Rural sites	2016				2017												2018							
County	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	#	%
Desoto	R	R	R			R	R	R	R	R	R	R		R							R	R	13	68.4%
Lafayette	R	R	R						R	R	R	R		R							R	R	10	52.6%
Lee	R	R	R							R	R	R	R	R					R	R	R	R	12	63.2%
Chickasaw													R							R	R	R	4	21.1%
Oktibbeha	R	R	R					R	R	R	R	R	R	R	R				R		R	R	14	73.7%
Madison									R			R		R	R							R	5	26.3%
Neshoba							R		R	R	R	R	R	R							R		8	42.1%
Lauderdale	R	R	R					R	R	R	R	R		R								R	10	52.6%
Rankin	R	R	R							R	R	R		R	R						R		9	47.4%
Hinds	R	R	R						R	R	R	R	R	R							R	R	11	57.9%
Total per month	7	7	7	0	0	1	2	3	7	8	8	9	5	9	3	0	0	0	2	2	8	8	96	

B. Urban sites	2016				2017												2018							
County	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	#	%
Desoto	U	U	U	U		U			U	U	U	U									U	U	11	57.9%
Lafayette	U	U	U	U						U	U	U	U	U							U	U	11	57.9%
Lee	U	U	U	U						U	U	U	U	U	U					U		U	12	63.2%
Chickasaw			U	U				U	U	U	U	U	U	U							U	U	11	57.9%
Oktibbeha	U	U	U	U	U		U	U	U	U	U	U		U			U			U	U	U	16	84.2%
Madison				U					U	U	U	U		U									6	31.6%
Neshoba				U		U	U	U	U	U	U	U							U		U	U	11	57.9%
Lauderdale	U	U	U	U				U	U	U		U	U	U							U		11	57.9%
Rankin	U	U	U	U						U	U	U										U	8	42.1%
Hinds	U	U	U	U					U	U	U										U		8	42.1%
Total per month	7	7	8	10	1	2	2	4	7	10	9	9	4	6	1	0	1	0	1	2	7	7	105	

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