

SOME OBSERVATIONS ON THE MOSQUITO FAUNA OF THE OKEFENOKEE SWAMP

FRANK G. FAVORITE AND ROBERT DAVIS¹

In June and September, 1957, visits were made to the Okefenokee Swamp as part of an arthropod-borne encephalitis study being conducted by this laboratory.² Recently there have been clinical cases of eastern equine encephalomyelitis near Waycross, Georgia, just north of the Okefenokee Swamp, and isolation of the virus of EEE was reported from three arthropod pools: *Anopheles crucians*, *Aedes mitchellae*, and *Culicoides* spp., collected in south Georgia in 1956 (1).

The Okefenokee Swamp lies for most of its 420,000 acres in Georgia, with a smaller portion extending over the state line into Florida (Fig. 1). By Executive Order in 1937, 329,000 acres of the Georgia swamp were designated a National Wildlife Refuge and ever since, a successful effort has been made by the Fish and Wildlife Service of the Department of the Interior to prevent further destruction of its flora and fauna. During two periods in the last hundred years the Okefenokee Swamp has been invaded by large groups of people for various purposes. In the 1830's General Charles Floyd and his Dragoons put to rout the renegade Creeks (the Seminoles), under the leadership of Chief Billy Bowlegs (2). Floyd and Billys Islands in the interior of the swamp were named for the leaders of the two forces. From 1850 until the 1920's lumbering was the major attraction. In 1891, hoping to gain access to the magnificent stands of virgin cypress, slash pine, red bay, and black gum, there was an unsuccessful attempt to drain the swamp (3). Commercial and sport hunters found the Okefenokee Swamp wildlife abundant. Alligators, deer, bear, and

wildcat were harvested in quantity before wildlife protection was instituted. Now, as a refuge, the Okefenokee Swamp is meticulously managed. No animal may be killed, no tree cut, or plant removed without specific permission of the Fish and Wildlife Service. Many areas are now inaccessible though visitors are invited to see as much of the swamp as can be navigated safely from three access areas: Camp Cornelia to the east near Folkston, Camp Stephen Foster to the west near Fargo, and Okefenokee Swamp Park to the north near Waycross.

Two rivers, the Suwanee and St. Marys, have headwaters in the swamp. The coffee-colored, tannic acid water flows gently, almost imperceptibly through the swamp to form these two rivers. Within the swamp there are islands with luxuriant growth and "prairies" where water lilies abound so thickly that the tangled root system will support foraging bears, which occasionally are seen. Through the prairies are apparent channels two to four feet wide, called boat runs. Actually these are the paths of flowing water and passage ways for alligators. Clumps of trees surrounded by bog peat to give the appearance of an island occur throughout the prairies and are known as "houses." Some of the larger houses will support the weight of a man, but the floating bog will sink and recover with each step giving rise to the Indian name, Ouaguaphenogaw, corrupted to Oke-fe-no-kee, meaning "trembling earth."

HABITATION AND DISEASE. More than thirty years ago, when the Hebard Cypress Company and Twin Tree Lumber Company were at peak lumbering activity within the Swamp, probably more than a thousand people inhabited the inner islands. On Billys Island in 1924 the census was "450 people, 105 cattle, 3 mules, 162

¹ Third U. S. Army Medical Laboratory, Fort McPherson, Georgia.

² This study is conducted with funds allocated by the Research and Development Division, Office of The Army Surgeon General.

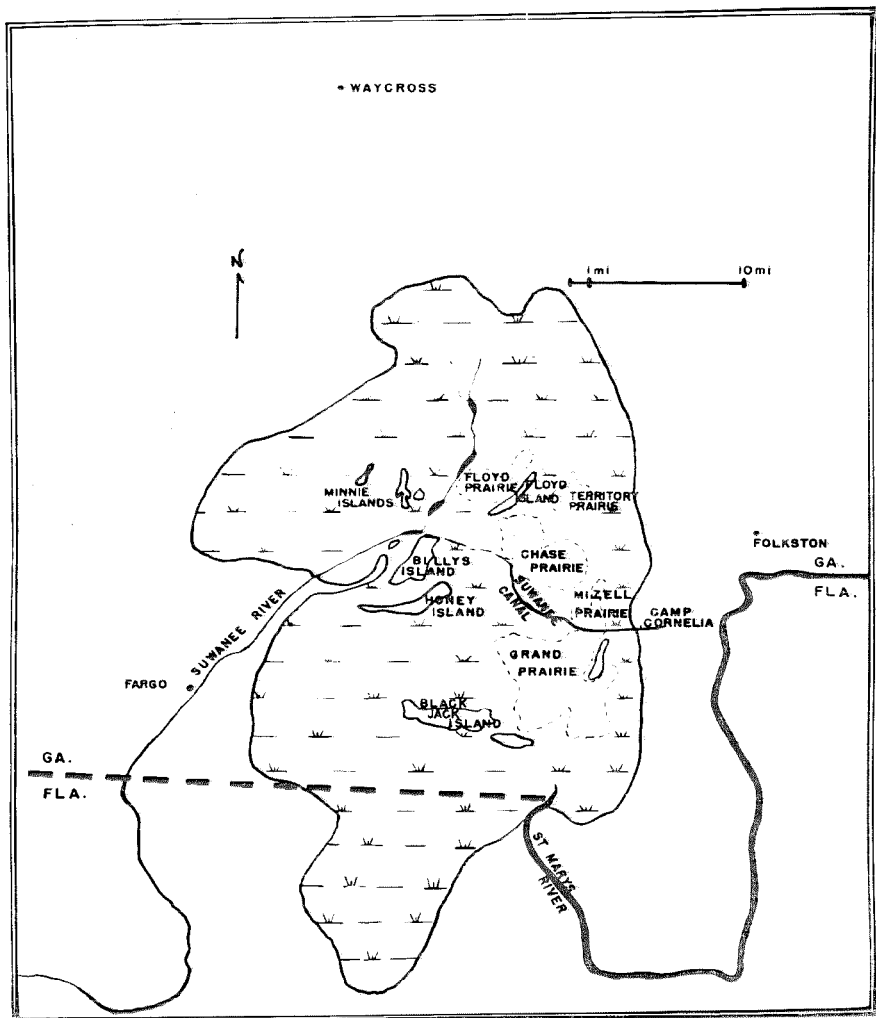


FIG. 1.—Okefenokee Swamp.

swine, and approximately 1,000 fowls" (4). When lumbering ceased to be profitable the companies dissolved, leaving behind some permanent residents. Gradually, the families moved or died out until today there are no families living within the swamp and no evidence of surviving domestic animals.

The Okefenokee always has been considered a healthy area. Even today the local people pridefully make this point. In the 1920's, when malaria was rampant in the southeastern United States, through the more accurate record-keeping period of the 1940's, the Okefenokee has been "mysteriously" free of malaria. According to legend, and some records, life in the Okefenokee seems to exert therapeutic as well as prophylactic effect against clinical malaria. Early explorers traveled the St. Marys River to the swamp in order to obtain its fresh water for drinking purposes (3).⁸ Many people employed by the lumbering companies of the 1920's came to the Swamp with histories of malaria and recrudescences, but no relapses occurred in these people after settling in the swamp. Of 933 histories and 347 blood films taken from persons residing within the swamp during the years of 1924-1925, not one was positive for malaria (4).

MOSQUITO SURVEYS. Mayne (4) reports the capture of a female *Anopheles quadrimaculatus* from a fringe area and its transport to the swamp where it was induced to lay eggs on water collected from the swamp. The female specimen was then destroyed. The eggs hatched in the swamp water and the larvae developed without incident for six days, at which time they were killed.

Fletcher (5) in a report on the pH tolerance of some anophelines points out that *Anopheles crucians* favors a more acid environment than *Anopheles quadrimaculatus*. During the 1957 survey pH read-

ings were made by paper colorimetric method. The pH of the swamp water ranged between 4.8 and 5.5 by this method.

The results of the 1957 survey are presented in Table 1. As will be observed, *Anopheles quadrimaculatus* still was not taken in the swamp proper, though it was taken in limited numbers at Camp Cornelia during both visits. The genus *Aedes* was represented by five species on Floyd Island with *Aedes atlanticus-tormentor* being the most aggressive daytime biter. At Camp Cornelia two species of *Aedes* were encountered in June but none in September.

Evaluating the data in Table 1, one observes the low catch of *Anopheles crucians* and the relatively high catch of *Mansonia perturbans*. The portable light trap taken into the swamp proved inefficient, resulting in a reduced catch of *Anopheles crucians*, whereas *Mansonia perturbans*, a more active anthropophilic species, was taken readily in biting collections.

At Camp Cornelia in June 1957, combined light trap and biting collections produced a normal picture. In September 1957, however, the complete absence of *Aedes*, particularly *Aedes infirmatus* and *Aedes atlanticus-tormentor*, from both light trap and biting collections is an interesting void.

Larval collections were, in the main, unproductive. This also was true in the 1924-25 survey (4). Apparently most of the breeding takes place in semi-permanent to permanent pools of water well protected by undergrowth. Larval sampling in the prairies consistently was unproductive though it is quite likely that *Mansonia perturbans* thrives in this environment. Samplings from the pitcher plant, *Saracennia flava*, were negative. The most productive larval catches were made in the cypress swamps of Floyd Island, where *Culex territans*, *Anopheles crucians*, and *Culiseta melanura* were taken from a common source. *Aedes triseriatus* was taken from a magnolia tree hole.

⁸ Bacteriological examination of Okefenokee Swamp water collected in November, 1957, was performed by the Third U. S. Army Medical Laboratory. The MPN coliforms/100 ml sample was 50.

TABLE 1.—Mosquito collections, Okfehenokee Swamp, Georgia, June and September 1957

Species	3 June to 12 June 1957				Third Week, September 1957				
	Total Speci- mens	Floyd Island		Camp Cornelia Adults	Total Speci- mens	Camp Stephen Foster		Camp Cornelia Adults	Grand Total
		Adults	Larvae			Adults	Larvae		
<i>Anopheles crucians</i>	616	1	6	609	986	451	—	535	1602
<i>Anopheles quadrimaculatus</i>	2	—	—	2	16	—	—	16	18
<i>Uranotaenia sapphirina</i>	1	—	—	1	389	258	—	131	390
<i>Culiseta melanura</i>	102	—	7	95	104	91	—	13	200
<i>Mansonia perturbans</i>	35	22	—	13	57	37	—	20	92
<i>Psorophora ciliata</i>	26	—	—	26	1	—	—	1	27
<i>Psorophora fanningi</i>	12	—	—	12	11	—	—	11	23
<i>Aedes ail.-tormentor</i>	15	12	—	3	—	—	—	—	15
<i>Aedes canadensis</i>	7	1	—	—	—	—	—	—	7
<i>Aedes infirmatus</i>	26	26	—	—	—	—	—	—	26
<i>Aedes mitchellae</i>	2	—	—	2	—	—	—	—	2
<i>Aedes triseriatus</i>	4	2	2	—	—	—	—	—	4
<i>Culex nigripalpus</i>	—	—	—	—	1	1	—	—	1
<i>Culex salinarius</i>	1	—	—	1	6	6	—	—	7
<i>Culex pilosus</i>	—	—	—	—	54	—	54	—	54
<i>Culex</i> (Mel.) spp.	1	—	—	1	1	1	—	—	2
<i>Culex territans</i>	40	—	40	—	—	—	—	—	40
Total	884	64	55	765	1626	845	54	727	2510

Of further interest is the high percentage of *Culiseta melanura*, *Mansonia perturbans*, and *Anopheles crucians*, all natural vectors of EEE, on the fringe area of the swamp.

From these specimens a total of eighty-nine species-pure pools were formed and each was inoculated into groups of five, 21-day-old mice. In one, P-522,⁴ an agent not yet identified is active. No passage has been successful, though replicates from the original material have produced the same lethal pattern.

SUMMARY. The Okfehenokee long has been an area of special interest, first as a hiding area for Creek Indians, then as an area for harvesting by lumberers and hunters, finally obtaining its present stature as a refuge for wildlife, a tourist attraction, and an area ideally suited for the student of nature.

The swamp is free of human malaria and the southeastern malaria vector,

Anopheles quadrimaculatus, will not breed in its acid waters. Known vectors of EEE are present in abundance throughout the swamp, and the clinical disease is seen in the equine population of the bordering villages. Of eighty-nine arthropod pools collected during 1957 and inoculated into mice, none produced a recognizable disease.

References

1. KARSTAD, L. H., et al. Eastern equine encephalomyelitis virus isolated from three species of Diptera from Georgia. *Science* 125:395-396, 1 March 1957.
2. McLEAN, R. The Okfehenokee. *Georgia Mineral Newsletter*, 8(1):Spring, 1955.
3. BAKER, W. B. The Okfehenokee Swamp—Land of trembling earth. *The Emory University Quarterly*, June, 1949.
4. MAYNE, B. Report of a survey to determine the malaria prevalence in the Okfehenokee Swamp. *Public Health Reports* 41:1652-1660, August 6, 1926.
5. FLETCHER, O. K. Apparent anomalies in the behavior of anopheline mosquitoes in southwestern Georgia. *Jour. of the Nat'l. Malaria Society* V(2):147-150, June 1946.

⁴ Third U. S. Army Medical Laboratory accession number. Ft. McPherson, Ga.