New Mosquito Collection Records for Southern Georgia[1]

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Abstract Twenty-nine species representing eight genera, numerous new county records and one state record, *Mansonia titillans* (Walker), were collected in a surveillance project conducted in 20 southern Georgia counties during the summer of 1997. A detailed report of species abundance and diversity is presented. Overall, as sampled by CO_2 light traps, *Culex quinquefasciatus* Say was the most widely distributed species and *Aedes vexans* (Meigen) was the most abundant species followed closely by *Aedes atlanticus* Dyer and Knab.

Key Words Culicidae, mosquitoes, arbovirus, surveillance

In 1994, Tropical Storm Alberto flooded northwest Florida, southeast Alabama and southwest Georgia. During the following year, an unprecedented number of hurricanes and tropical storms ravaged the southeastern U.S. causing additional flooding leading to multiple federal disaster declarations. Concerned of the potential increased risks of mosquito-borne disease, federal recovery funds were appropriated to the Florida, Alabama and Georgia State Health Departments to develop mosquito and arbovirus disease surveillance programs.

The purpose of this project was to provide the Division of Public Health of the Georgia Department of Human Resources (GDHR) an assessment of the incidence, abundance and vector potential of mosquitoes in the southern third of Georgia during the summer of 1997. This along with allied studies was used to begin a statewide compilation of potential disease vectors in Georgia (Irby 1997, Womack 1997a, Nolan et al. 1997).

Materials and Methods

Twenty sites were sampled across southern Georgia within approximately 0.02 to 3.2 km radius of target GPS coordinates prescribed by the GDHR (Table 1). The coordinates were based on 9.65-km diam regions centered on 48.3-km grid intersections covering the entire state. This study represents 20 of 67 sites of interest to the GDHR.

The sites were located using State of Georgia road maps, county maps provided by GDHR and locator maps acquired on the World Wide Web. After traveling to the general vicinity, a portable Garman GPS 45 Personal Navigator was employed to arrive as close to the target sampling site as practical. Based on accessibility, mos-

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Table 1. GPS coordinates (latitude/longitude) and Metadata description of land coverage for southern Georgia mosquito trapping sites

County	GDHR target site	Actual sampling site	Land coverage classification
Atkinson	N 31° 16′ 49.9″ W 083° 00′ 39.9″	N 31° 16′ 46.2″ W 083° 00′ 39.9″	Coniferous & Mixed Forest
Bacon	N 31° 38′ 58.7″ W 082° 26′ 06.0″	N 31° 38′ 58.7″ W 082° 16′ 06.0″	Coniferous & Mixed Forest
Ben Hill	N 31° 46′ 06.1″ W 083° 26′ 54.4″	N 31° 46′ 06.1″ W 083° 26′ 54.4″	Coniferous Forest
Brantley	N 31° 09′ 27.7″ W 082° 00′ 15.9″	N 31° 09′ 23.7″ W 082° 00′ 15.9″	Coniferous & Mixed Forest
Brooks	N 30° 54′ 29.4″ W 083° 34′ 54.5″	N 30° 54′ 33.1″ W 083° 35′ 02.7″	Clear-cut/Young Pine & Low Density Urban
Calhoun	N 31° 26′ 51.3″ W 084° 31′ 35.3″	N 31° 26′ 57.0″ W 084° 31′ 45.0″	Mixed Forest
Charlton	N 30° 43′ 41.4″ W 082° 04′ 43.0″	N 30° 43′ 37.3″ W 082° 04′ 33.0″	Coniferous Forest
Coffee	N 31° 42′ 36.7″ W 082° 56′ 29.0″	N 31° 42′ 32.1″ W 082° 56′ 01.3″	Coniferous & Mixed Forest
Decatur	N 31° 01′ 00.3″ W 084° 35′ 15.2″	N 30° 59′ 54.0″ W 084° 35′ 55.8″	Cultivated/Exposed Earth & Scrub/Shrub Wetland
Early	N 31° 29′ 55.2″ W 085° 01′ 58.7″	N 31° 30′ 17.8″ W 085° 01′ 12.3″	Cultivated/Exposed Earth & Scrub/Shrub Wetland
Echols	N 30° 51′ 01.6″ W 083° 04′ 48.1″	N 30° 51′ 09.5″ W 083° 05′ 30.9″	Coniferous Forest
Glynn	N 31° 05′ 34.4″ W 081° 30′ 08.2″	N 31° 06′ 10.9″ W 081° 29′ 29.3″	Scrub/Shrub Wetland
McIntosh	N 31° 31′ 18.2″ W 081° 25′ 29.1″	N 31° 31′ 25.5″ W 081° 25′ 35.0″	Coniferous & Mixed Forest
Mitchell	N 31° 23′ 39.0″ W 084° 01′ 14.3″	N 31° 23′ 34.5″ W 084° 01′ 13.4″	Clear-cut/Young Pine & Pasture
Quitman	N 31° 55′ 45.6″ W 084° 58′ 26.0″	N 31° 56′ 47.6″ W 084° 59′ 06.7″	Clear-cut/Young Pine
Terrell	N 31° 52′ 40.8″ W 084° 27′ 53.1″	N 31° 52′ 40.3″ W 084° 28′ 23.3″	Cultivated/Exposed Earth
Thomas	N 30° 57′ 49.0″ W 084° 05′ 03.7″	N 30° 57′ 49.1″ W 084° 05′ 03.7″	Pasture & Scrub/Shrub Wetland
Tift	N 31° 20′ 18.6″ W 083° 30′ 55.8″	N 31° 20′ 18.3″ W 083° 31′ 15.4″	Mixed Forest
Ware	N 31° 13′ 12.9″ W 082° 30′ 26.5″	N 31° 13′ 11.6″ W 082° 30′ 24.3″	Coniferous Forest
Worth	N 31° 49′ 27.7″ W 083° 57′ 22.5″	N 31° 49′ 22.9″ W 083° 57′ 27.7″	Mixed Forest

Table 2. Mosquito species and relative abundance collected with CO_2-enhanced ABC mosquito light traps in southern Georgia, June 8-July 6, 1997

County	Ae. vexans	Ae. atlanticus	Ae. albopictus	Ae. triseriatus	Ae. sollicitans	Ae. canadensis	Ae. fulvus pallens	Ae. taeniorhynchus	Ae. infirmatus	An. crucians	An. punctipennis	An. quadrimaculatus	Cq. perturbans	Cx. restuans	Cx. quinquefasciatus
Atkinson	12	67	30	14		2			2	161	20	1		534	16
Bacon	3	5								4					3
Ben Hill	20	25		5		3				10	2		6	9	2
Brantley	17	11	24			2								18	11
Brooks	23	11	12	9	3	5			5	24	18		2	9	24
Calhoun	321	60	6	68	43	10			13	186	41		2	33	68
Charlton		174	26		1	6		1		12	3	5	2	20	22
Coffee		29	13			2				3				22	59
Decatur		5		6	2				1	24	2	1		2	11
Early	1		1			3									
Echols	11	123	42	8	23	15				134		11	7	18	12
Glynn	6		2		24			28	4						
McIntosh						8								14	10
Mitchell	168	11	2	118		4			1	34	41	1	7	3	7
Quitman	138			4		4				21	39				15
Terrell	14		1	1	2			1		28	2			5	6
Thomas	26			1						28	16			19	12
Tift	78	1			4		3			5			4	7	16
Ware	3	365	122							27		3	9	12	21
Worth	170	61	1	16	6	1	42		2	150	25	2	4	32	28
Total	1011	948	282	250	108	65	45	30	28	851	209	24	43	757	343

quito traps were set at distances up to approximately 1.6 km from the desired point. Counties, actual sampling site GPS coordinates, and land cover classification for each location are presented in Table 1.

Twenty American Biophysics Corporation, Inc. portable mosquito light traps equipped with CO_2 delivery systems were deployed. Carbon dioxide was supplied from 9.1 kg cylinders at a release rate of 500ml/min. One trap was hung from a tree limb at each site so that the base of the trap net was suspended approximately 45 cm

Table 2. Continued

Cx. salinarius	Cx. territans	Cx. erraticus	Cx. tarsalis	Cx. nigripalpus	Culiseta sp.	Ma. titillans	Ps. columbiae	Ps. ferox	Ps. ciliata	Ps. discolor	Ps. horrida	Ps. howardii	Uranotaenia sp.	Unidentified (damaged)	males (non-speciated)	Total
97					1		10		1					8	1	977
														4		19
11						1	4	1							1	100
7							3	3						8		104
4							3		2					9	2	165
12			10			3	16	2	15	4	1	1		12	25	952
5						10	15	1	4	2				6		315
		2					2		3							135
6							46	2	2	14					5	129
														3		8
1		6		2	2		1						1	2	6	425
2				1			1	1	2			1		5	3	80
3																35
20			13		2		5	23	13	7		3		6	2	491
16	11						7		13		1			2	1	272
			2				1		1	2	1		1	4		72
2	42	1												3	5	155
		9				2		14	13			8			2	166
8							10	4	2	4	2	2		9	4	607
19		21	2		1	4	63	49	26		27	17		3	15	787
213	53	39	27	3	6	20	187	100	97	33	32	32	2	84	72	5994

from the ground. At the end of the project, equipment was transferred to GDPH to enhance the state's capacity for conducting future arbovirus surveillance.

Collections were taken weekly over 4 wks from the first week of June through the first week of July 1997. Trap nets containing mosquitoes were placed in a large styrofoam cooler supplied with a triethylamine-soaked paper towel used as a killing agent. Mosquitoes were transferred into labeled 1.9 cm H × 3.2 cm W × 5.7 cm L slide boxes. All collections were mailed to the John A. Mulrennan, Sr., Public Health Entomology Research and Education Center in Panama City, FL for counting, sexing and identification by location. Mosquitoes were identified to species using the keys of

Carpenter and LaCasse (1955), King et al. (1960), and Darsie and Ward (1981). Data were presented by tabulation and graphics using Microsoft Excel 2000 (Copyright 1985-1999 Microsoft Corporation). Species diversity also was determined using methods of Irby (1997).

Weather conditions during this study were relatively constant with nighttime temperatures averaging 26°C and daytime temperatures 35°C. Humidity averaged 70-80%.

Results

A total of 5,994 mosquitoes was captured (Table 2). Twenty-nine species representing eight genera were collected. All represent new county records with exception of the following: *Aedes albopictus* (Skuse) in Coffee, Glynn and Worth cos., *Culex restuans* Theobald in Decatur and Worth cos., *Culex territans* Walker and *Psorophora columbiae* (Dyar and Knab) in Decatur Co., *Aedes taeniorhychus* (Wiedemann) in Glynn Co., *Psorophora ferox* (Humboldt) and *Culex quinquefasciatus* Say in Worth Co. and all species listed for Thomas and Ware cos. except for *Psorophora horrida* (Dyar and Knab) and *Aedes triseriatus* (Say) (Womack 1997b). These two species were new records for those counties. *Mansonia titillans* (Walker), collected from Ben Hill, Calhoun, Charlton and Tift counties, was a new record for the State of Georgia. The most productive sampling sites, in terms of mosquito numbers, were Atkinson, Calhoun, Worth and Ware counties, although relatively moderate numbers (300 to 500) were also collected from Mitchell, Echols and Charlton counties. The greatest species diversity occurred in collections from Worth Co. (24 species) followed by Calhoun (21 species) and Mitchell (20 species) counties (Table 3). *Aedes* was the most commonly collected genus followed by *Culex. Culex quinquefasciatus* was the most widely distributed species having been collected in all but two counties. *Aedes vexans* (Meigen), *Anopheles crucians* Wiedemann and *Cx. restuans* were widespread and collected from 16 of the 20 counties (Table 2). Overall, the most abundant species were *Ae. vexans, Aedes atlanticus* Dyar and Knab, *An. crucians* and *Cx. restuans.* These four species made up 60% of the total mosquitoes collected. *Aedes albopictus, Ae. triseriatus, Anopheles punctipennis* (Say), *Cx quinquefasciatus, Culex salinarius* Coquilleft and *Ps. columbiae* were of secondary abundance while the remaining species were few in number (Fig. 1).

Discussion

The mosquito fauna of southern Georgia was similar to west central and east central Georgia (Irby 1997, Womack 1997a). *Aedes taeniorhynchus* and *Ma. titillans* were unique to south Georgia when compared to north Georgia's fauna. This was expected because *Ae. taeniorhynchus* thrive in salt marshes (Carpenter and LaCasse 1955). In Georgia, such habitats exist only in the southern coastal region. *Mansonia titillans* is a tropical species commonly found in Florida and Texas (Chamberlain and Duffey 1945, Eads and Ogden 1951). This species attaches to roots of aquatic plants particularly water hyacinth and water lettuce. These plants are not endemic to north Georgia.

The most abundant mosquito collected in this study was *Ae. vexans.* This species is among the most widely distributed and pestiferous mosquitoes in the United States (Carpenter and LaCasse 1955). It has been experimentally proven capable of trans-

Table 3. Southern Georgia mosquito species diversity by county, June 8-July 6, 1997

County	Number of species	*Aedes* spp.	*Anopheles* spp.	*Culex* spp.	*Psorophora* spp.	Other spp.*
Atkinson	15	6	3	3	2	1
Bacon	4	2	1	1	0	0
Ben Hill	13	4	2	3	2	2
Brantley	9	4	0	3	2	0
Brooks	15	7	2	3	2	1
Calhoun	21	7	2	4	6	2
Charlton	17	5	3	3	4	2
Coffee	9	3	1	3	2	0
Decatur	14	4	3	3	4	0
Early	3	3	0	0	0	0
Echols	17	6	2	5	1	2
Glynn	11	5	0	2	4	0
McIntosh	4	1	0	3	0	0
Mitchell	20	6	3	4	5	2
Quitman	11	3	2	3	3	0
Terrell	15	5	2	3	4	1
Thomas	9	2	2	5	0	0
Tift	13	4	1	3	3	2
Ware	15	3	2	3	6	1
Worth	24	8	3	5	5	3

* *C. perturbans, Culiseta* sp., *M. titillans* and *Uranotaenia* sp.

mitting eastern equine and St. Louis encephalitis as well as dog heartworm, diseases endemic to the Southeast (King et al. 1960).

Several other species collected in lower numbers namely, *Anopheles quadrimaculatus* Say, *Ae. albopictus, Ae. sollicitans* (Walker), *Culex nigripalpus* Theobald, *Cx. quinquefasciatus, Culex tarsalis* Coquillett, *Culiseta* sp., *Coquillettidia perturbans* (Walker) and *Ps. columbiae* are known vectors of a variety of mosquito-borne diseases including malaria, heartworm, dengue, yellow fever and encephalitis (Carpenter and LaCasse 1955, Pratt et al. 1976). *Culex quinquefasciatus* is the primary vector for St. Louis encephalitis in the central and eastern U.S. (Chamberlain 1969).

In this study, the number of mosquitoes collected per county was not necessarily an accurate reflection of counties with the greatest mosquito abundance. Collections were often related to trap proximity to standing water and other abiotic factors. Some of the GDHR GPS coordinates were not necessarily the best sites for collecting

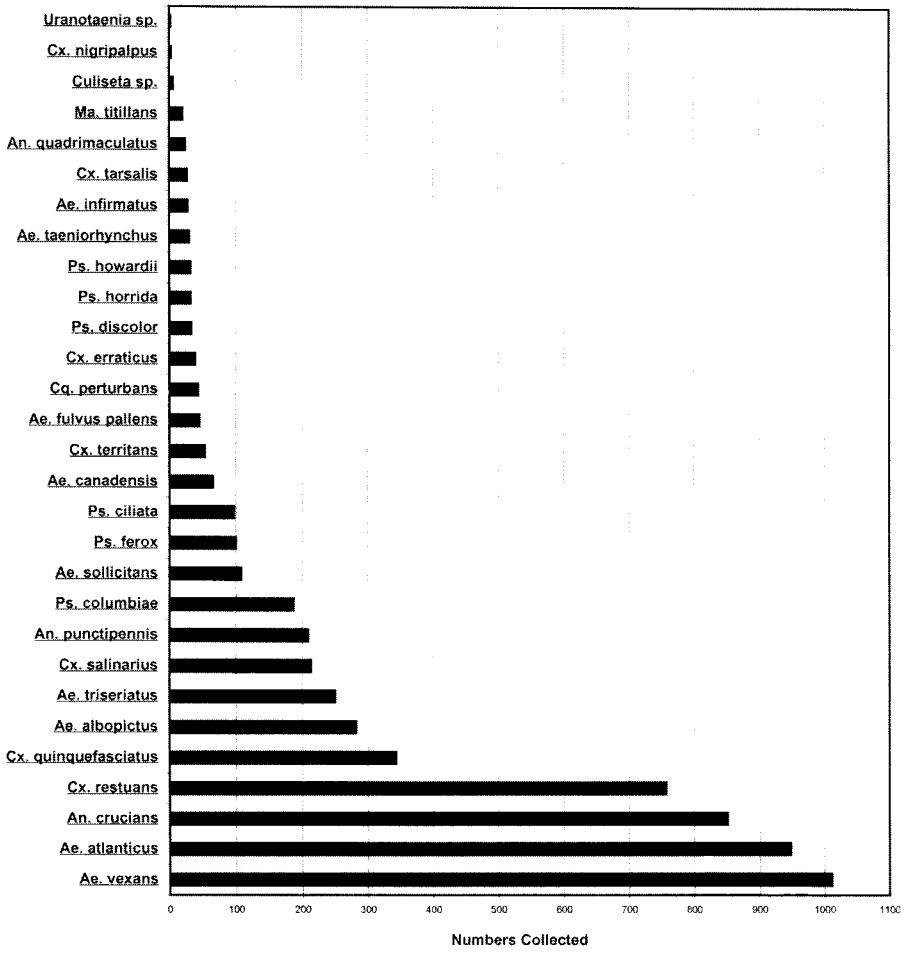

Fig. 1. Relative abundance of mosquitoes collected in southern Georgia, June 8-July 6, 1997.

mosquitoes. Additionally, we were unable to detect natural fluctuations in species composition and abundance associated with changes in weather and climate because the study was not conducted over the entire season. Further, our reliance on one sampling tool may have biased our findings because species vary in attractiveness to CO_2 light traps. A lengthened sampling period using a wider variety of collection techniques at more comparable habitats among counties would be needed to more fully account for species composition, prevalences and seasonal abundance.

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