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MOSQUITOES CAPTURED IN A HORSE-BAITED STABLE TRAP IN SOUTHEAST LOUISIANA

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ABSTRACT. A mosquito study based on collections from horse-baited stable traps was conducted in 1993 and 1994 at 3 sites in geographically and ecologically distinct areas of St. Tammany Parish (southeastern Louisiana) to determine the major horse-feeding mosquito species that could be possible bridging and epidemic vectors of eastern equine encephalomyelitis virus. A total of 4,535 mosquitoes in 1993 and 23,906 in 1994 involving 26 species were collected, of which, depending on the site, *Culex salinarius, Cx.* (*Melanoconion*) spp., *Aedes vexans, Psophora ferox, Coquillettidia perturbans, Anopheles quadrimaculatus, An. crucians, Ps. columbiae, Ae. albopictus,* and *Ochlerotatus atlanticus* were captured in relatively high numbers with high engorgement rates and were therefore considered important horse-feeding species in the parish.

KEY WORDS Horse feeding, blood meals, eastern equine encephalomyelitis, Louisiana, *Aedes, Coquilletidia, Culex, Ochlerotatus, Psorophora*

INTRODUCTION

Eastern equine encephalitis is a viral disease transmitted by mosquitoes that affects horses; birds such as pheasants, quail, and emus; dogs; and even humans (Day and Stark 1996). The disease is known to have occurred in Louisiana since 1937, although the 1st recorded epidemic occurred in 1945 (Oglesby 1948). Even though owners in Louisiana and Mississippi are strongly advised to vaccinate their horses twice a year, this recommendation is not always followed, resulting in new cases appearing periodically. In 1993, more than 170 horses were diagnosed to have died of this disease in the 2 states. During 1999, more than 97 horse cases were confirmed throughout Louisiana, with some 20 horses dying in the southern part of the state. However, the number of cases may have been higher, because the disease is often seriously underreported (S. Nicholson, Extension Service veterinarian, personal communication, to M. Hugh-Jones, August 27, 1999, ProMed). The disease also affected and killed a flock of 300 unvaccinated emus in Vermillion Parish, and at least 2 human cases were reported during the outbreak (M. P. Pollack, personal communication, September 15, 1999, ProMed).

The eastern equine encephalomyelitis virus (EEE) enzootic cycle involves wild birds and mosquitoes (Komar et al. 1999), and transmission occurs mostly during warm months (Morris 1988). The cycle is usually maintained in the enzootic foci in hardwood swamp areas or low-lying woodlands featuring broad-leafed trees, because ornithophagic *Culiseta melanura* (Coquillett) is the primary enzootic mosquito vector (Pierson and Morris 1982, Mahmood and Crans 1997). Under ecological conditions that favor large mosquito populations, the virus can escape these foci in bridge birds or vectors such as *Coquilletidia perturbans* (Walker), *Culex salinarius* Coquillett, *Ochlerotatus sollicitans* Walker, and *Aedes vexans* (Meigen). These species feed both on birds and mammals and can thus transmit the disease to horses, humans, and other tangential hosts (Scott and Weaver 1989, Ross and Kaneene 1996, Vaidyanathan et al. 1997, Andreadis et al. 1998).

Virus isolations obtained either during epizootics or from experimental infections of mosquito species common to the upper gulf states have been from *Culex nigripalpus* Theobald, *Cq. perturbans, Oc. sollicitans, Anopheles quadrimaculatus* sensu lato Say, *Cx. salinarius, Cx. restuans* Theobald, *Oc. canadensis* (Theobald), *Oc. atlanticus-tormentor* (Dyar and Knab), *Oc. infirmatus* Dyar and Knab, *An. crucians* Weidemann, *Cx.* (*Melanoconion*) spp., *Ae. vexans, Cx. territans* Walker, *Uranotaenia sapphrinna* Osten Sacken, *Cx. quinquefasciatus* (Say), *Oc. triseriatus* (Say), *Oc. mitchellae* (Dyar), *Oc. punctipennis* Say, *Cx. erraticus* Dyar and Knab, and *Oc. taeniorhynchus* (Weidemann) (Howitt et al. 1949, Kissling et al. 1955, Crans et al. 1986, Morris 1988, Day and Stark 1996). Most of these species are abundant in Louisiana and are suspected epidemic vectors of EEE. *Aedes albopictus* (Skuse), a newcomer to the United States thought to have originated from Asia (CDC 1986), could be an important epidemic vector of EEE at any endemic focus because this species exhibits an opportunistic feeding behavior (Savage et al. 1993). Isolations of EEE have been made from this mosquito in the field (Mitchell et al. 1992), plus it has been demonstrated to be a competent laboratory vector (Turell et al. 1994), and infection with EEE has no observable effect on survivorship (Moncayo et al. 2000).

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The majority of studies on the feeding habits of most suspected EEE epidemic vectors have been based on blood-meal typing with vector species being reported as primarily avian or mammalian feeders, or both (Edman 1971, 1974; Irby and Apperson 1988). Among the mammalian feeders, *Cs. inornata* Williston (Anderson and Gallaway 1987) and *Ae. vexans* (Nasci 1984) were recorded as feeding primarily on cattle and horses. Other species were assumed or suspected to be horse feeders based on their "preference" for mammalian blood and suspected involvement in epizootics in horses (Ross and Kaneene 1996).

In this study we present a list of mosquitoes that were captured in horse-baited stable traps in St. Tammany Parish, Louisiana. Because the parish is historically enzootic for EEE (Howitt et al. 1948), mosquitoes that are attracted to and feed on horses could be possible bridging and epidemic vectors in this part of the EEE range.

MATERIALS AND METHODS

Sampling device: The stable trap used in this study was modified from the Bates trap with the laterally placed baffles having an internal opening 2.3 cm wide. The Bates-type baffle consists of 2 10.2-cm-wide wooden planks placed to form a horizontal V-shaped trough with a 15.2- to 20.3-cm opening to the outside and converging to leave a 2.3- to 2.5-cm opening within the trap (Bates 1944). The stable trap also differed from the standard Bates trap in the size of the wooden frame (i.e., 3.1 m long, 1.5 m wide, and 2.4 m high), which was suitable for a full-size horse. Mosquito wire screen covered the longer sides, the roof, three quarters of the rear door, and one quarter of the front door for maximum escape of odors. The floor was eliminated for complete portability and tether ring-bolts were installed for immobilization of the bait horse.

Study sites: Trapping sites were selected in the Folsom, Mandeville, and Slidell areas within St. Tammany Parish based on the history of EEE transmission at this locality and continuous availability of bait horses. The Folsom site was located on an approximately 243-ha ranch with open grass and woodland pastures, ponds and creeks, and a relatively small swamp to the east. The site is reportedly the highest part of the parish and has moderate- to well-drained loamy soils. In addition to cattle, the ranch had 9 horses in 1993 and 27 horses in 1994, 40 miniature donkeys, some housed pigs and goats, and a few geese and cats. In 1994, a dog kennel was built approximately 30 m from the trap location. The trap was located approximately 20 m from a pond and approximately 5 m from the horse-grazing paddock. The donkeys roamed freely all over the ranch and around the trap so a metal frame was erected around the trap to protect it. In 1993, water-holding containers and debris were abundant around stalls, barns and holding pens approximately 91 m away. The premises were partially cleaned-up in 1994.

The Mandeville site was located at the horse unit (for therapeutic purposes) of the Southeastern Louisiana Hospital. This is mainly coastal pine forest with light to moderately dense underbrush and level to gently sloping, poorly drained, loamy soils, some 5 km from Lake Pontchartrain. The horse unit had 3 large horses, 2 miniature horses, 2 miniature donkeys, 2 goats, and a few rabbits and guinea pigs. The last were absent in 1994. The trap was located approximately 5 m from the horse stalls on the forest side and along a power line. The surrounding woods held scattered semipermanent to permanent water pools and also potholes. A brackish marsh was located some 2 km southeast of the site. Also, a few tires and other small containers were present near the horse stalls.

The Slidell site was located along the suburban Pearl River interface with low-lying, poorly to moderately well-drained land with thick brush and grasses. Thirty goats grazed nearby, and a dog kennel was located some 15 m from the trap location. Some permanent water pools were present in the goat pasture, potholes occurred in a thick oak wood about 30 m to the northwest of the site, and a brackish marsh was located some 2 km south. Barns near the kennel and halfway from the oak wood were strewn with debris and containers, some holding water. These were partially cleaned-up in 1994.

At all sites, heavy rainfall left water pools that remained for several days and only dried when it did not rain for 2–3 wk. The sites were not lit at night and no people came near after sunset.

Mosquito collections: Mosquito trapping began on June 22, 1993, with the Folsom trap, which was in operation 3 days a week for 5 wk before the other traps and sites were ready. The Mandeville and Slidell sites were in operation from July 28 and 29, respectively. All traps were in operation from April 12, 1994. Because the horses had to be tethered and therefore could not feed, they were usually in the trap only from 6:00 pm to 11:00 pm or 7:00 pm to 12:00 pm as opposed to an overnight trapping. Mosquitoes were removed with a handheld aspirator, transported live to the St. Tammany Mosquito Abatement District laboratory, killed by chilling, and sorted out on a chill table for determination to species and number collected. During the 1993 trapping period, only a portion of the collected mosquitoes were placed in vials, properly labeled, and maintained at minus 45°C for future reference. In 1994, all the collected mosquitoes were pooled (maximum of 100/pool) and sent to the Centers for Disease Control and Prevention (CDC), Fort Collins, CO, on dry ice by overnight mail to be tested for virus. Rainfall data for the 1993 trapping period were obtained from the St. Tammany Mosquito Abatement District and the Louisiana Monthly Climate Review. The 1994 rainfall data were obtained

Table 1. Total female mosquito catches in horse-baited traps, 1993 and 1994. Proportion relative to total catch per site is given in parentheses.

	Folsom		Mandeville		Slidell	
Species	1993	1994	1993	1994	1993	1994
Aedes albopictus	2 (<1)	2 (<1)	11 (<1)	12 (<1)	29[1] (1.9)	83 (<1)
Ae. fulvus pallens	0 (0)	0 (0)	7 (<1)	6 (<1)	9 (<1)	9 (<1)
Ae. vexans	48[1] (4.2)	128[1] (5.7)	164[1] (8.9)	151[1] (2.7)	46[1] (3)	309[1] (1.9)
Anopheles crucians	58[1] (5.1)	176[1] (7.9)	71[1] (3.8)	267[1] (4.8)	46[1] (2.9)	412[1] (2.5)
An. punctipennis	6 (<1)	12 (<1)	0 (0)	0 (0)	0 (0)	2 (<1)
An. quadrimaculatus	8 (<1)	34 (1.5)	2 (<1)	112[1] (2)	2 (<1)	257[1] (1.6)
Coquillettidia perturbans	3 (<1)	23 (1)	156[1] (8.3)	92[1] (1.6)	135[1] (8.7)	305[1] (1.9)
Culiseta inornata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (<1)
Cs. melanura	1 (<1)	0 (0)	0 (0)	1 (<1)	0 (0)	0 (0)
Culex (*Melanoconion*)	248[1] (21.8)	645[1] (28.8)	951[1] (50.8)	1,705[1] (30.5)	803[1] (51.6)	6,033[1] (37.3)
Cx. nigripalpus	6 (<1)	11 (<1)	7 (<1)	20 (<1)	9 (<1)	93[1] (<1)
Cx. quinquefasciatus	21 (1.9)	37 (1.7)	12 (<1)	41 (<1)	1 (<1)	75 (<1)
Cx. restuans	0 (0)	63[1] (2.8)	0 (0)	0 (0)	0 (0)	10 (<1)
Cx. salinarius	49[1] (4.3)	775[1] (34.7)	186[1] (10)	3,066[1] (54.8)	189[1] (12.1)	8,157[1] (50.4)
Cx. territans	0 (0)	1 (<1)	0 (0)	3 (<1)	0 (0)	12 (<1)
Ochlerotatus atlanticus	0 (0)	0 (0)	226[1] (12.5)	15 (<1)	22[1] (1.4)	10 (<1)
Oc. cinereus	1 (<1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Oc. infirmatus	0 (0)	0 (0)	0 (0)	2 (<1)	1 (<1)	1 (<1)
Oc. mitchellae	1 (<1)	0 (0)	0 (0)	1 (<1)	0 (0)	3 (<1)
Oc. taeniorhyncus	0 (0)	0 (0)	0 (0)	0 (0)	1 (<1)	0 (0)
Oc. triseriatus	0 (0)	0 (0)	0 (0)	3 (<1)	0 (0)	12 (<1)
Psorophora ciliata	71[1] (6.3)	17 (<1)	0 (0)	1 (<1)	0 (0)	9 (<1)
Ps. columbiae	607[1] (53.5)	304[1] (13.6)	26[1] (1.4)	7 (<1)	143[1] (9.2)	44 (<1)
Ps. cyanescens	0 (0)	0 (0)	0 (0)	0 (0)	1 (<1)	0 (0)
Ps. ferox	0 (0)	6 (<1)	53[1] (2.9)	91[1] (1.6)	119[1] (7.6)	334[1] (2.1)
Ps. howardii	5 (<1)	2 (<1)	1 (<1)	1 (<1)	1 (<1)	12 (<1)

[1] Species considered to be important horse feeders.

from rain gauges attached to the roofs of the traps. Temperature data were obtained from the Louisiana Monthly Climate Review. Trapping at all the sites was discontinued on September 1, 1993, and September 23, 1994.

RESULTS

A total of 28,581 mosquitoes was captured from the 3 stable trap sites: Folsom, 3,371; Mandeville, 7,470; and Slidell, 17,740. Twenty-six species were captured, with 19 from the Folsom site, 20 from the Mandeville site, and 24 from the Slidell site. These species, their numbers, and proportions relative to the total catch per site (i.e., trap %) are listed in Table 1.

A species was considered an important horse feeder if its trap percentage was greater than 1 and the engorgement rate greater than 50% (Table 2). Thus, 7 species were considered important horse feeders at the Folsom site, 9 at the Mandeville site, and 10 at the Slidell site (displayed with a superscript 1 in Table 1). Five species, *Ae. vexans, An. crucians, Cx.* (*Melanoconion*) spp., *Cx. salinarius,* and *Psorophora columbiae* (Dyar and Knab), were predominant at all sites, whereas other species were major horse feeders at the different sites either in 1993 or 1994. Thus, *Ae. albopictus, An. quadrimaculatus* s.l., *Cq. perturbans, Oc. atlanticus,* and *Ps. ferox* (Humboldt) predominated at the Mandeville and Slidell sites and *Ps. ciliata* (Fabricius) only occurred at the Folsom site. More than 50% of the species at each site were caught in small numbers, but their engorgement rates were generally high, between 80 and 100% (Tables 1 and 2).

Mosquito abundance and species dominance patterns of the 5 most abundant species at each site are illustrated in Figures 1A–1C. *Culex salinarius,* followed by *Cx.* (*Melanoconion*) spp., had a tendency to dominate all the sites. *Culex salinarius* was highly abundant in the spring, peaked towards the end of May, and gradually decreased as the weather became hotter during the summer (Figs. 1 and 2). *Culex* (*Melanoconion*) spp. increased in abundance as the summer advanced, and peaked in July and August. Other important horse feeder species such as *Ae. vexans, An. crucians,* and *Cq. perturbans* were more abundant during the spring, whereas increases in *Ps. columbiae* were detected both in spring and summer (Fig. 1).

The effect of rainfall and temperature on the abundance of the predominant horse-feeding mosquitoes common to the 3 sites was assessed (by pooling data from those sites) in order to provide an insight on factors influencing their feeding habits and abundance. Figure 3 shows monthly rainfall at the different sites. Significant positive correlations were shown between the number of *An. crucians*

Table 2. Average engorgement rate of female mosquitoes collected in horse-baited traps, 1993 and 1994.

Species	Folsom	Mandeville	Slidell
Aedes albopictus	75.0	91.0	98.8
Ae. fulvus pallens	—[1]	100.0	94.5
Ae. vexans	97.2	95.7	97.2
Anopheles crucians	97.6	95.4	97.9
An. punctipennis	95.9	0.0	100.0
An. quadrimaculatus	86.1	96.5	99.4
Coquillettidia perturbans	100.0	91.9	97.5
Culiseta inornata	95.9	—	0.0
Cs. melanura	100.0	0.0	0.0
Culex (*Melanoconion*)	93.0	86.3	89.5
Cx. nigripalpus	65.6	58.8	78.4
Cx. quinquefasciatus	9.7	0.0	0.0
Cx. restuans	88.9	—	0.0
Cx. salinarius	84.2	95.0	94.6
Cx. territans	0.0	0.0	50.0
Ochlerotatus atlanticus	—	94.7	92.5
Oc. cinereus	100.0	—	—
Oc. infirmatus	—	100.0	50.0
Oc. mitchellae	100.0	0.0	0.0
Oc. taeniorhyncus	—	—	0.0
Oc. triseriatus	100.0	66.7	100.0
Psorophora ciliata	97.0	100.0	100.0
Ps. columbiae	98.2	100.0	95.1
Ps. cyanescens	100.0	100.0	100.0
Ps. ferox	83.3	97.4	93.2
Ps. howardii	100.0	100.0	100.0

[1] —, the species was not captured at that site.

and *Ps. columbiae* collected and rainfall accumulated in the previous 2 wk before each collection ($r = 0.33$, $n = 59$, $P = 0.01$ and $r = 0.56$, $n = 28$, $P < 0.01$, respectively), whereas abundance of *Ae. vexans* correlated to rainfall accumulated in the previous 3 wk before each collection ($r = 0.33$, $n = 53$, $P = 0.01$). When sites and sampling year were considered independently, a positive significant correlation also was found between abundance of *Cx.* (*Melanoconion*) spp. and rainfall at the Folsom site during 1994 ($r = 0.69$; $n = 14$; $P < 0.01$). Significant negative correlations were found between abundance of *Ae. vexans, An. crucians,* and *Cx. salinarius* and monthly temperatures (mean, minimum, and maximum; Table 3).

DISCUSSION

A wide variety of mosquito species were collected in the horse-baited stable traps in St. Tammany Parish (Table 1). Mosquitoes that enter a stable trap may or may not be attracted to horses, and mosquitoes that do enter stable traps and feed on horses within the trap may or may not feed on horses in nature. To minimize the possibility of confounding factors, only species that were proportionately more abundant and with engorgement rates greater than 50% were considered to be horse feeders. Further studies including blood-meal identification of engorged mosquitoes collected with different traps should be carried out to confirm bloodfeeding preferences. *Culex salinarius, Cx.* (*Melanoconion*) spp., *Ae. vexans,* and *An. crucians* were dominant and important horse feeders at all the sites during both years. These species have a history of EEE isolations from the field throughout North America (Chamberlain et al. 1958, Sudia et al. 1968, Howard et al. 1996, Andreadis et al. 1998, Wozniak et al. 2001). *Culex salinarius* is mammalophagic, but also is likely to feed on birds (Hayes 1961, Murphey et al. 1967, Vaidyanathan et al. 1997). Although laboratory transmission by *Ae. vexans* has been demonstrated (Davis 1940), the role of this species in epidemic transmission may vary because of geographic variability and other local factors (Vaidyanathan et al. 1997).

Long flight range from forested resting sites to host-seeking habitats can enhance the chances of a vector serving as a bridge between birds and horses or humans (Moncayo and Edman 1999). *Aedes vexans* disperses for considerable distances, with reported flight ranges of 5–15 miles from breeding sites (O'Malley 1990). Laboratory trials that show maximal flights of 10–17 km in a single night for *Ae. vexans* are consistent with data on host-seeking mosquitoes in the field (Briegel et al. 2001). Long flight ranges also have been reported for *Cx. salinarius* in Massachusetts from forested resting sites to host-seeking habitats (Moncayo and Edman 1999).

Several other species were major horse feeders either in 1993 or 1994 at the different sites. *Anopheles quadrimaculatus* s.l. is a complex of 5 cryptic species (Reinert et al. 1997), 4 of which have been recorded in Louisiana (Rutledge and Meek 1998). This species has been incriminated as a potential vector of EEE and several other viruses (Sudia et al. 1968, DeFoliart et al. 1986, Vaidyanathan et al. 1997). A high proportion of engorged females were collected in the horse traps in Mandeville and Slidell during 1994. Other reports indicate that females of *An. quadrimaculatus* have been observed feeding on large domesticated animals, with engorged females being collected from horse stables and cattle barns (Holck and Meek 1991, Reinert et al. 1997), and also from a pheasant-breeding farm in St. Tammany Parish (Reinert et al. 1997). Considering habitat variation and host preferences between sibling species (Apperson and Lanzaro 1991, Reinert et al. 1997), further studies are needed to characterize the role of these species in the EEE enzootic cycle in Louisiana.

Coquillettidia perturbans was restricted to the wet lowlands in the southern portion of the parish (Mandeville and Slidell areas). This species has been cited as a likely epidemic vector of EEE because laboratory transmission of EEE has been demonstrated (Chamberlain et al. 1954, Boromisa et al. 1987, Vaidyanathan et al. 1997) and the virus has been isolated from the species, including detection by antigen-capture assay (Nasci et al. 1993,

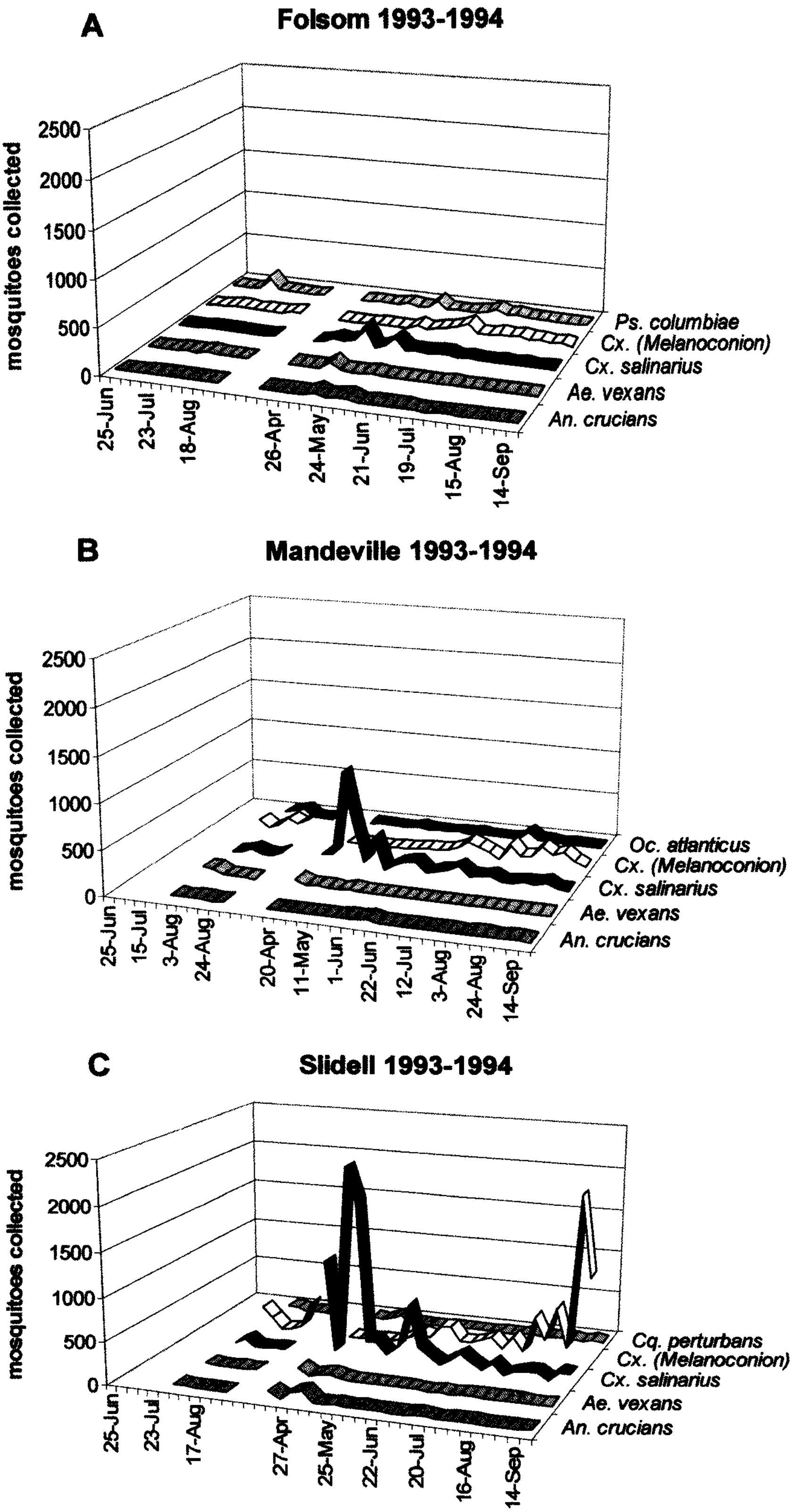

Fig. 1. Major (female) mosquito species collected in horse-baited traps per week from June to September 1993 and April to September 1994 at A, Folsom site; B, Mandeville site; C, Slidell site.

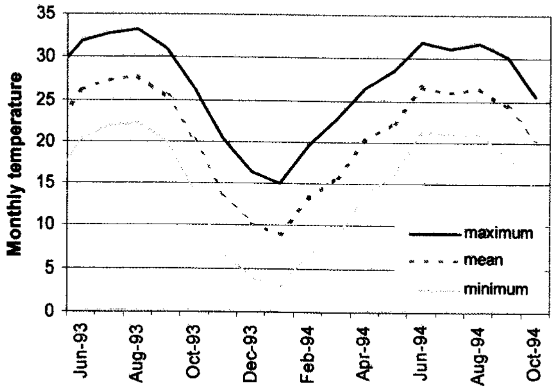

Fig. 2. Monthly minimum, maximum, and mean temperature profiles from June 1993 to October 1994 in St. Tammany Parish.

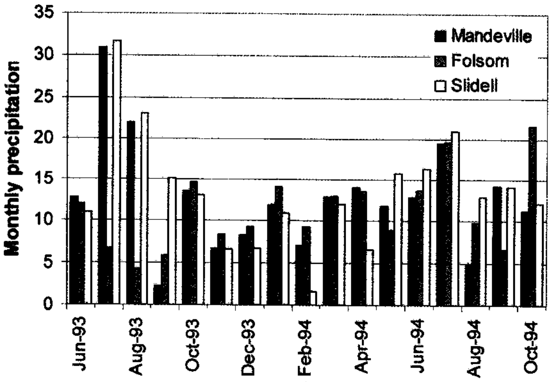

Fig. 3. Total monthly precipitation (mm) at each study site.

Howard et al. 1996, Andreadis et al. 1998, Wozniak et al. 2001). This species is predominantly mammalophagic, but also may feed on passerine and wading birds (Edman 1971). In Massachusetts, adults are abundant during July, concurrent with documented horse cases, and decrease by mid-August (Edman et al. 1993). In the present study, *Cq. perturbans* was more abundant during April and August and collections decreased in June and July. In New Jersey, although *Cq. perturbans* normally feeds in forest habitats where the roosting and nesting habitats of birds have been shown to be associated with a high prevalence of EEE viremic individuals (Crans et al. 1994), it has been reported to host-seek near the ground (Bosak et al. 2001). This habit of host-seeking below the predominant nesting height of birds with the highest percentage of individuals positive for EEE virus antibodies (Crans et al. 1994) indicates that its role in EEE transmission may be limited. Although it is a nuisance species in Louisiana, its specific role in the epidemiology of EEE has not been determined (Meek and Hayes 1993). Further studies are needed to assess the role of this mosquito in EEE transmission in Louisiana.

Psorophora columbiae was an important horse feeder at all sites during 1993, but during 1994 it predominated only in Folsom, probably in relation to mosquito control, which was more intense in the southern sites. Collections of females in a livestock occupied barn in southwestern Louisiana indicated that mosquito density and species density were not related to either trap location, type of habitat surrounding the trap, or brush density near the trap (Holck and Meek 1991).

Populations of *Ae. albopictus* were generally low in the parish in 1994 because of a spate of spontaneous clean-ups. The sites were almost totally devoid of water-holding containers, which are the usual breeding habitat for this species. However, this species may not show a high preference for horses, because, for example, at the Folsom site only 2 mosquitoes were captured both in 1993 and 1994. Larvae of *Ae. albopictus* were seen in containers around the farm house, feed sheds, and animal stalls approximately 183 m from the trap. Although this species is a competent experimental vector of EEE, the virus is not frequently isolated from *Ae. albopictus* collected in nature (Mitchell et al. 1992, Moore and Mitchell 1997).

Although large adult populations of *Oc. atlanticus* were observed in the oak wood approximately 30 m from the Slidell trap, very few were caught in the trap, suggesting that adults would be restricted to their breeding habitats in woodlands. Edman (1971) reported that in Florida, *Oc. atlanticus* fed mostly on mammalian hosts present in or near

Table 3. Linear correlations between the abundance of female mosquitoes collected in horse-baited traps and temperature at all sites, 1993 and 1994 (only significant correlations are shown).[1]

Species	Minimum monthly temperature	Maximum monthly temperature	Mean monthly temperature
Aedes vexans	$r = -0.37$**	$r = -0.37$**	$r = -0.38$**
	$y = 63.1 - 2.6x$	$y = 115 - 3.4x$	$y = 89 - 3.1x$
Anopheles crucians	$r = -0.23$ ($P = 0.07$)	$r = -0.31$**	$r = -0.27$*
	$y = 45.8 - 1.7x$	$y = 105.7 - 3.1x$	$y = 71.4 - 2.4x$
Culex salinarius	$r = -0.19$**	$r = -0.54$**	$r = -0.50$**
	$y = 1,470 - 62.9x$	$y = 3,380 - 103.9x$	$y = 2,317 - 83.3x$

[1] * = $P \leq 0.05$; ** = $P \leq 0.01$; $n = 60$.

woodlands, but only 14% of the identified mammalian blood was from ruminants that were abundant within a 1.6- to 4.8-km radius of the study habitat. This habitat-related behavior pattern supporting previous observation suggests this species appears reluctant to leave woodland habitat to search for a blood meal. The woods surrounding the Mandeville site were repeatedly sprayed locally in 1994 including on trapping days, thus drastically reducing the *Oc. atlanticus* catch from 226 in 1993 to only 15 in 1994 (Table 1).

Figure 1 shows temporal variations in dominance of some significant species, especially *Cx. salinarius* and *Cx.* (*Melanoconion*) spp. The former was highly abundant in the spring and gradually decreased as the weather became hotter during the summer, showing a negative correlation between temperature and abundance (Table 3), whereas the latter increased in abundance as the summer advanced, and peaked in July and August. Collections of *Ps. columbiae* showed peaks during late spring and summer (Fig. 1A), with corresponding abundance positively correlated with the rainfall accumulated 15 days before each collection.

Female *An. crucians* were more abundant during May and early June, with a 2nd increase in August (Fig. 1), showing a negative correlation with temperature (Table 3), and a positive significant correlation with rainfall accumulated in the previous 2 wk before each collection. Previous studies in the rice fields in southwestern Louisiana showed higher densities of larval *An. crucians* during June and late July, around the documented 13- to 20-day postirrigation period (McLaughlin et al. 1987).

Although some significant correlations between mosquito abundance and rainfall and temperature were detected, the influence and interactions of these factors in mosquito populations were not consistent, and were due in part to the impact of mosquito control activities. After very heavy rainfall in June and July 1994, an upsurge in mosquito populations occurred. Carbon dioxide–baited CDC light traps were netting up to 120,000 mosquitoes on average per trap night (C. Palmisano, personal communication). Likewise, horse trap catches that had dropped from more than 2,000 at the beginning of May to about 200 at the end of the month also increased. A comparison between CO_2-baited CDC trap and horse trap catches at that time revealed that a horse trap catch of 500 mosquitoes could be converted to a CDC trap collection of 120,000. Subsequently horse trap catches were used to judge the prevailing populations of host-seeking mosquitoes and a catch of 200 and above would trigger aerial spraying. The appearance of EEE in chickens in August (Samui 1995) led to intensification of mosquito control measures that resulted in a marked reduction in horse trap catches. The extra local spraying on trap days at the Mandeville site similarly impacted catch size.

In summary, *Cx. salinarius*, *Cx.* (*Melanoconion*) spp., *Ae. vexans*, and *An. crucians* could potentially be bridging or epidemic vectors, or both, of EEE in southeastern Louisiana. These species are avid horse feeders, are present in abundance at the time when EEE activity peaks (Moore et al. 1993), and have a relatively long flight range. *Ochlerotatus atlanticus* and *Ae. albopictus* could play a role in EEE transmission where their habitats bring them in contact with EEE epidemic hosts (humans and horses) coupled with little or no human interference. Other species such as *Ps. columbiae*, *Ps. ferox*, and *Cq. perturbans* also could serve as potential vectors, but are more restricted by local ecological conditions. The fact that these species have been associated with past EEE outbreaks, and that virus has been isolated from all, eludes to their potential role in EEE transmission in Louisiana. A EEE vector competence study of the species would provide confirmation of their vector potential. Further studies should be pursued to better assess the influence of environmental factors related to host feeding patterns.

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