VECTOR POTENTIAL OF CULICINE MOSQUITOES IN FAIYUM GOVERNORATE, EGYPT[1]

JOHN C. BEIER[2], MOHAMED A. KENAWY[3], SHERIF EL SAID[3] AND ADEL I. MERDAN[3]

ABSTRACT. Culicine mosquito populations were studied for 1 year in 2 neighboring villages in Faiyum Governorate, Egypt. Dominant species in larval collections included *Culex pipiens, Cx. univittatus, Cx. antennatus, Aedes caspius* and *Uranotaenia unguiculata; Culiseta longiareolata* was less common. *Culex pipiens* accounted for 98% of 3,743 mosquitoes captured in human-biting collection (164 man-nights), 96% of 1,136 mosquitoes collected inside houses and animal sheds (396 inspections), and 98% of 15,000 mosquitoes from 22 donkey-baited traps. Adult *Cx. univittatus, Cx. antennatus* and *Ae. caspius* were infrequently captured by any of the collection techniques. Although larval collections identified 5 common species, only *Cx. pipiens* showed a significant association with the human population.

INTRODUCTION

Culicine mosquitoes in Egypt are vectors of filariasis (Southgate 1979), Rift Valley fever (RVF) virus (Hoogstraal et al. 1979, Meegan et al. 1980), West Nile virus (Taylor et al. 1956), and several other viruses (Darwish and Hoogstraal 1981). Quantitative seasonal studies on culicine mosquitoes have been made only in the Nile Delta using light traps (Hurlbut and Weitz 1956, Zimmerman et al. 1985). During RVF epizootics in 1977–78, Hoogstraal et al. (1979) reexamined mosquito populations in the Nile Delta since the only study of culicine abundance and distribution was done about 25 years previously (Hurlbut and Weitz 1956). *Culex pipiens* (Linn.) is the most abundant and widely distributed mosquito species in the Nile Delta (Hurlbut and Weitz 1956, Hoogstraal et al. 1979); quantitative information on culcine abundance from other areas in Egypt is lacking.

The population ecology of culicine mosquitoes in 2 neighboring villages in Faiyum Governorate, Egypt, was evaluated in coordination with malaria vector studies (El Said et al. 1986). This study examines seasonal patterns of species abundance and resting behavior in relation to human contact and vector potential.

MATERIALS AND METHODS

Culicine mosquitoes were sampled over 1 year, beginning in February 1983, in Abheet and El Zawya villages, Sinnuris District, Faiyum Governorate, Egypt (ca 90 km southwest of Cairo). Study sites and collection techniques were described in detail for a concurrent anopheline study (El Said et al. 1986). Briefly, the 2 agricultural villages are 1 km apart, both contain ca 650 houses and 3,000 residents, and are socioeconomically similar.

Each village was usually sampled twice per month. Larval surveys and spray captures of resting adults inside houses and animal sheds were conducted throughout the year. Additional techniques used from April to December included: human-biting collections, donkey-baited traps, and outdoor collections of resting mosquitoes.

Larval surveys consisted of collections from regularly positive sites to determine the presence of culicine species; larval density was not quantified. Indoor collections were made by spray capture (0.2% pyrethrum in kerosene) using the index sheet technique. Normally, 12 houses and 2 to 5 animal sheds were sampled from 6 fixed sampling areas. Mosquitoes attracted to human baits were collected at 6 fixed sampling stations (3 inside houses and 3 outdoors) with collectors working every ½ hr from sunset to sunrise. Four donkey-baited traps were used throughout the night in 4 sectors of villages. Because of the large number of culicines captured in traps, identification of culicines were made only on 3 nights in each village for comparison with human biting rates. Outdoor resting mosquitoes were collected by aspiration (Nasci 1981) from representative habitats 1–2 hr before sunset and again in the morning. Adult mosquitoes were identified on the collection night by a 2-man team; larvae were transported to Cairo for identification. Abdominal stages of mosquitoes were classified according to methods described by the World Health Organization (1975).

RESULTS AND DISCUSSION

LARVAL SURVEYS. *Aedes caspius* (Pallas), *Culex antennatus* (Becker), *Cx. pipiens* and *Cx. univit-*

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[2] National Institutes of Health (NIAID) resident consultant to the Ain Shams Center. Present address: Department of Immunology, WRAIR, Walter Reed Army Medical Center, Washington, DC 20307-5100.

[3] Ain Shams Research and Training Center on Vectors of Diseases, Ain Shams University, Abbassia, Cairo, Egypt.

tatus Theobald larvae were consistently detected in both villages from April 1983 to February 1984. *Uranotaenia unguiculata* Edwards larvae were also common, except from June to September. *Culiseta longiareolata* (Macquart) was collected only in April, August and September. These six species and *Cx. pusillus* Macquart, collected as adults, are common throughout Faiyum; *Cx. theileri* Theobald is also known from this Governorate (El Said and Kenawy 1983).

Larval breeding sites in Faiyum are primarily associated with irrigation and drainage systems; rainfall averages less than 7 mm per year (El Said and Kenawy 1983). In Abheet and El Zawya, major culicine breeding sites are primarily on the periphery of villages in irrigated fields and canals, and in drainage water within villages. Larvae of the 6 species occurred in a range of aquatic habitats, and all 6 were often found in the same sites, frequently in association with *Anopheles* species (El Said et al. 1986).

HUMAN-BITING ACTIVITY. Mosquito biting activity was determined by human-bait collections in both villages from April to December 1983, the usual period of adult mosquito activity in this area. In Abheet, during 84 man-nights, collections included 1,471 *Cx. pipiens,* 4 *Cx. univittatus,* 2 *Cx. antennatus* and 4 *Ae. caspius.* In El Zawya, 80 man-nights yielded 2,217 *Cx. pipiens,* 18 *Cx. univittatus,* 8 *Cx. antennatus,* and 19 *Ae. caspius.* This sampling showed that *Cx. pipiens* was the primary, nocturnal, man-biting species. Most species detected in these 2 villages are exclusively nocturnal, but *Ae. caspius* in Faiyum is partially diurnal, especially near breeding sites. Thus, night-biting rates may not adequately reflect human exposure to this species.

Culex pipiens, which accounted for 98% of human-biting collections, was seasonally active from April through November (Fig. 1). Highest *Cx. pipiens* biting rates were during May in both Abheet (115 bites/man/night) and El Zawya (173 bites/man/night). In Abheet, rates were less than 30 per night through October, then rates increased to 41 per night in November before activity stopped in December. In El Zawya, biting activity increased in August, reaching a second seasonal peak in September (88 bites/man/night), then declined with no detectable activity after October. *Culex pipiens* biting rates were similar for indoor and outdoor collections, with 53% collected indoors in Abheet and 49% in El Zawya.

ANIMAL-BITING ACTIVITY. For comparison with human biting rates, mosquitoes from donkey-baited traps were identified during 3 nights in both villages during April and May 1983. *Culex pipiens* comprised 98% of collections, averaging 701 mosquitoes per trap night in Abheet (10 traps) and 664 in El Zawya (12 traps). After standardization, the animal:human biting ratio for *Cx. pipiens* was 5.7:1 in Abheet and 7.2:1 in El Zawya. *Aedes caspius* represented 1.8% of collections and other species included *Cx. antennatus, Cx. univittatus* and *Cx. longiareolata.*

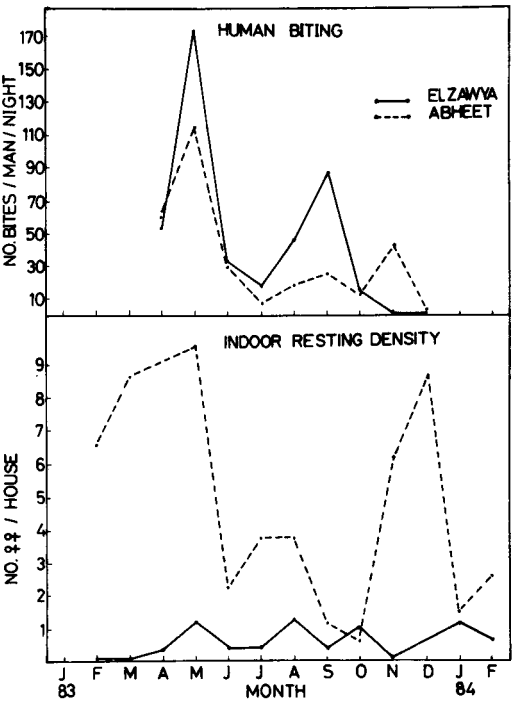

Fig. 1. Seasonal abundance of *Culex pipiens* determined by human-biting collections and spray capture inside houses in El Zawya and Abheet villages.

In general, culicine mosquitoes in Egypt are largely zoophilic (Hurlbut and Weitz 1956, Zimmerman et al. 1985). During a concurrent blood-feeding study in the 2 villages, *Cx. pipiens, Cx. antennatus, Cx. univittatus* and *Ae. caspius* showed low forage ratios for humans but high ratios for bovines, ovines, and equines (Beier et al. 1986). Thus, the common culicines feed most frequently on non-human, mammalian hosts. Also, *Ur. unguiculata* apparently never feeds on humans, and is strictly an amphibian-reptile feeder (Beier et al. 1986).

NOCTURNAL BITING PERIODICITY. *Culex pipiens* biting activity occurred throughout the night with similar periodicity in both villages (Fig. 2). Biting activity indoors was highest during the second hour after sunset and lowest just before sunrise. Outdoors, an activity peak occurred during the first hour after sunset in El Zawya but this was a low point in Abheet. In both villages, increased activity occurred just after midnight then steadily decreased until sunrise.

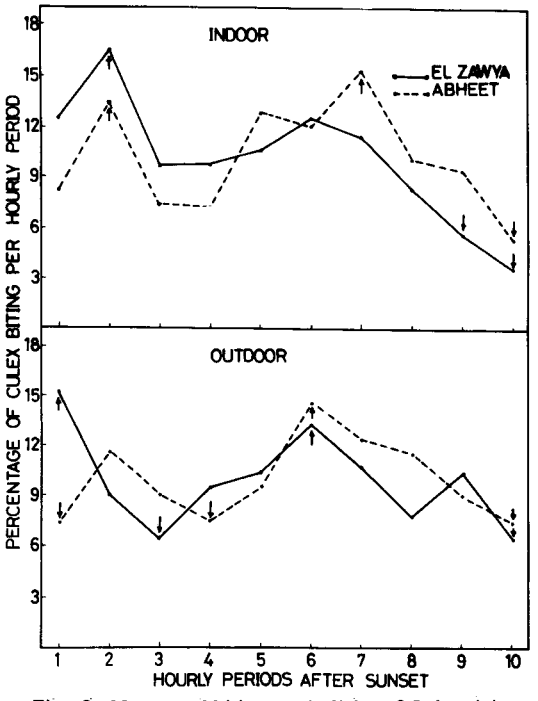

Fig. 2. Nocturnal biting periodicity of *Culex pipiens* determined by indoor and outdoor human-biting collections in El Zawya and Abheet villages (April to December 1983).

Human exposure to *Cx. pipiens* can occur anytime during the night. Residents mostly slept indoors but during the summer, many slept outdoors near houses; exposure to *Cx. pipiens* was likely similar regardless of where they slept.

RESTING BEHAVIOR. Six mosquito species were collected resting indoors by the spray capture technique during 311 house and 85 animal shed inspections (Table 1). *Culex pipiens* dominated, and indoor density averaged 4.6 mosquitoes per house in Abheet but only 0.7 in El Zawya, a 6.6-fold difference. In Abheet, highest *Cx. pipiens* densities were from February to May, and November to December; in El Zawya, this species occurred at low densities from April to February (Fig. 1).

The seasonal discrepancies between indoor resting densities and human biting rates for *Cx. pipiens* suggest seasonal variation in endophilic behavior. This was confirmed by classifying abdominal stages; the proportion of half-gravid (HG) and gravid (G) compared to the number freshly-fed (F) varied seasonally (Fig. 3). The ratio HG + G/F ranged from 0.40 to 0.88 (n = 681) during November to May, compared to 0.08–0.28 (n = 245) from June to October. Thus, *Cx. pipiens* rests comparatively more indoors during the winter than in the summer. A similar seasonal shift in resting patterns was observed for *Cx. pipiens* in Aswan Governorate, Egypt (M.A. Kenawy and J. C. Beier, unpublished).

Outdoor aspiration sampling (>100-5 min collections) in both villages from April to July yielded 1169 *Cx. pipiens*, 75 *Ae. caspius*, 47 *Cx. antennatus*, 28 *Cx. pusillus*, 14 *Cx. univittatus*, 1 *Cx. longiareolata* and 20 *Ur. unguiculata*. Most productive resting sites were irrigated fields and in vegetation along drainage canals. *Culex pipiens*, which accounted for 86% of the total, showed differences in abdominal stages between villages. in Abheet, the HG + G/F ratio was 0.47 (n = 288) compared to 1.42 (n = 881) in El Zawya (χ^2 = 39.7, $p<0.05$). This suggests

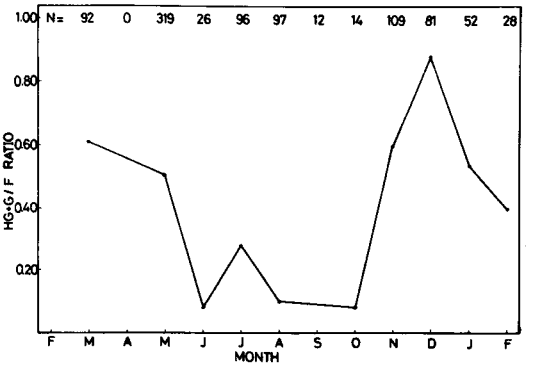

Fig. 3. Seasonal patterns of *Culex pipiens* endophilic resting behavior based on abdominal stages of females collected by spray capture inside houses. The proportion half-gravid (HG) and gravid (G) to freshly blood-fed (F) is shown for each month, along with the number sampled each month (N).

Table 1. Culicine mosquitoes collected by spray capture inside houses and animal sheds in Abheet and El Zawya villages (February 1983 to February 1984).

	No. female mosquitoes					
	Abheet		El Zawya			
Species	House (161)*	Shed (37)	House (150)	Shed (48)	Total	%
Aedes caspius	1	2	2	0	5	0.4
Culex antennatus	11	3	5	0	19	1.7
Cx. pipiens	741	197	102	55	1,095	96.4
Cx. pusillus	5	0	0	0	5	0.4
Cx. univittatus	5	4	2	0	11	1.0
Uranotaenia unguiculata	1	0	0	0	1	0.1

* Number of house/animal shed inspections.

that the El Zawya population was more exophilic. During the same months, April to July, indoor collections showed similar HG + G/F ratios for Abheet (0.46) and El Zawya (0.31) ($\chi^2 = 1.53$, $p > 0.05$), despite substantially higher indoor resting densities in Abheet. The differences detected in the outdoor populations between villages could partially explain why low indoor resting densities were observed throughout the year in El Zawya.

Differences in *Cx. pipiens* resting behavior between Abheet and El Zawya are difficult to explain since the 2 villages are only 1 km apart, and are similar in size, structure and agricultural conditions. The behavioral and taxonomic variability displayed by the *Cx. pipiens* complex presents a worldwide taxonomic problem. Until recently, two members of this complex were considered to occur in Egypt, *Cx. pipiens pipiens* and *Cx. pipiens molestus* Forskal, based upon behavioral (i.e., egg-laying capacity, mating behavior, breeding site preference, etc.) and taxonomic differences (Southgate 1979). Harbach et al. (1984) recently reviewed the taxonomic status of *Cx. molestus* from Egypt and decided that populations, despite differences, are all behavioral/physiological variants of *Cx. pipiens*. This species in Faiyum, as in the Nile Delta (A. Gad, personal communication) appears to be highly adaptable to local selective pressures, and it is difficult to make generalizations about *Cx. pipiens* behavior since populations vary even on a limited geographical scale.

VECTOR POTENTIAL. *Culex pipiens* was the only culicine species that was closely associated with man. Biting rates in both villages exceeded an estimated 10,000 bites/man/year. This species is not only a nuisance to residents, but also a potential public health threat. Filariasis is apparently not endemic in Faiyum (Southgate 1979) but since *Cx. pipiens* biting rates are comparable to those in villages of the Nile Delta where microfilaremia rates exceed 20% (A. Gad, unpublished), Faiyum would appear receptive to filariasis. During a malaria survey in Abheet and El Zawya during 1983, where most samples were taken in the early evening, one slide was positive for microfilaria; this person had recently moved to the village from the Nile Delta (M. Hussein, personal communication). High population densities of *Cx. pipiens* in Faiyum Governorate villages thus present a potential public health problem and mosquito control programs which focus on *Anopheles* should also be aware of the culicine vector potential.

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