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**Notes on Larval Ecology of Five Prevalent Culicini in Israel**

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**ABSTRACT**

Some chemical and biological criteria of breeding places for Culex pipiens molestus Forskal, C. univittatus Theobald, C. theileri Theobald, Culiseta longiareolata (Macquart) and Aedes caspius (Pallas) in Israel are presented. Collections of larvae are compared with adult catches. The epidemiological significance of these collections is discussed.

During a survey of adult mosquito populations in Israel (Margalit & Tahori, 1970a, 1970b) also larvae were collected. Chemical and biological criteria of breeding places for five prevalent culicine species were enumerated. From this information and from the relative larval abundance of a species it was hoped to obtain an indication of the adult prevalence of the species during the following weeks. This knowledge would help to forecast epidemiological outbreaks of diseases transmitted by mosquitoes. Information on breeding ecology of the 5 prevalent Culicini are also taken from the literature and discussed within the framework of own observations.

**MATERIAL AND METHODS**

Mosquito larvae were collected at the following places: the Ashqelon swamp (Hammama), Ramla, Pardes Hanna, Hadera (Agrobank), Hulata and Yir'on. Larvae were collected by dipping a 25 cm diameter sieve into water. Breeding water was analysed for pH, total chlorine, material dissolving in water after being dried at 110°C, and after being burned at 900°C, and for salt equivalent.

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## RESULTS AND DISCUSSION

Table I gives the total number of mosquito larvae collected at the various localities according to species. Table II summarizes some biological and chemical characteristics of the breeding places visited during this survey.

Culex pipiens molestus Forskål<sup>a</sup> was the most prevalent mosquito larva found in this survey (Table I). It bred mainly in waters rich in organic material. It preferred sewage over swamp; for example at the Ashqelon swamp, it was collected in relative small numbers only (Table I). This species can tolerate a very high sewage content in the water. When such a high concentration was encountered C. p. molestus were practically the only larvae collected.

This species was found in Egypt in water pools of all types, including artificial cisterns. It was abundant in cesspits and occasionally it occurred in stagnant drains. It was found at pH between 7.2 to 8.9 and at a salinity of up to 1.46% (Kirkpatrick 1925).

In the Ethiopian Region Culex pipiens had an immense range of breeding places, but it greatly preferred natural pools of all sorts, including borrow pits, pools at the edge of swamps, ditches and temporary pools. The water may be clear or dirty, shaded or unshaded, but in most cases it was dirty, unshaded and stagnant. Development of the larvae was not disturbed by a high organic content in the water (Hopkins 1936).

According to Kirkpatrick (1925) it was in general commonly found breeding alone, but it did also associate with Culiseta longiareolata and was often found breeding together with Culex antennatus C. univittatus and Aedes caspius.

Culex univittatus Theobald was collected at a low density at Yir'on and Hulata (Table I). This was probably due to the high sewage content of the collecting places visited (Table II). C. univittatus prefers water of lower organic material content than does C. p. molestus. When both species were reared in the laboratory, C. univittatus proved to be very sensitive to scum on the surface of the rearing pan, whereas C. p. molestus larvae developed even under severe scum conditions.

In Egypt C. univittatus was found to be essentially a fresh water species. It preferred clearer waters with less water weeds or reeds, and bred at pH between 7.2 to 9.7 (Kirkpatrick 1925). In the Ethiopian Region its breeding places were stagnant ditches. While vegetation was usually present, there rarely was a dense shade (Hopkins 1936). According to Martini (1931) this species breeds, in addition to stagnant ditches, also in artificial sweet water containers.

C. univittatus associated with C. antennatus, but also occurred frequently with C. pipiens and Ae. caspius. Only seldom did it breed alone (Kirkpatrick 1925).

Culex theileri Theobald was found mainly at Ashqelon during May, June and at Yir'on (Table I). At Ashqelon it was the most prevalent adult mosquito during spring (Margalit & Tahori 1970b). The reason for the relative abundance at Yir'on is that larvae were collected there from an overflow of a poultry shed (Table II) a preferred breeding place for this species (Saliternik & Barkai 1963). Otherwise we usually found it in muddy water without much vegetation.

In Egypt this species bred mainly in reedy and weedy pools, often in muddy and foul smelling water, less often in stagnant drains and then usually only in those with a thick growth of weeds. It bred mainly in sweet water but was also observed in distinctly brackish water of up to 1% salinity (Kirkpatrick 1925).

In South Africa larvae of this species were found in pools, dipping tanks and stagnant or slowly flowing streams (Bedford 1928). Martini (1931) states that this species is mainly found in sweet or slightly salty water. It breeds mostly in water abundant in vegetation such as flooded meadows, often in quite pure water, but sometimes in foul water.

This species has no definite associates, but was fairly often found with C. antennatus, C. univittatus and C. pipiens, and not infrequently it also occurred alone (Kirkpatrick 1925). In the Western Mediterranean Area it associates with C. molestus, C. pipiens and An. maculipennis (Rioux 1958). We found it breeding mainly with C. univittatus, and to a smaller extent with C. p. molestus.

In this survey Culiseta longiareolata (Macquart) was found in significant numbers at Yir'on only (Table I). However, it is a very common species in Israel (Margalit & Tahori 1970b). It breeds mainly in stagnant water, open temporary pools and unused wells.

In Egypt this species bred in almost every old well, in ponds, in pools and often in very foul water, but rarely in stagnant canals. In the desert, it bred in practically every rock pool of rain water. It was found in waters having a pH range from 7.2 to 8.4 (Kirkpatrick 1925). In South Africa C. longiareolata bred in pools, barrels, tarpaulins holding rain water or in dipping tanks (Bedford 1928). In the Western Mediterranean it was found in natural and artificial places with organic debris of plant origin (Rioux 1958).

This species associates mainly with C. laticinctus and C.p. molestus. According to Rioux (1958) it breeds together with C. hortensis, but in contrast to this species prefers more shaded places. In Egypt it bred together with C. pipiens and was seldom found alone or with other species (Kirkpatrick 1925). Saliternik & Barkai (1963) report it to breed in association with An. claviger, C. pipiens, C. hortensis and C. laticinctus.

Aedes caspius (Pallas) is a very common species in Israel (Margalit & Tahori 1970b). We observed it mainly breeding in brackish waters (Table II) and in places, periodically flooded such as Ashqelon (Table I). Saliternik & Barkai (1963) report that in Israel Ae. caspius prefers fish ponds, lakes, rock holes and rain waterpools.

In Egypt it bred in pits and at the reedy sides of large water areas, very often in stagnant or slowly moving drains, or in pools left from small stagnant irrigation channels. The pH range of the breeding waters was from 7.9 to 8.9. While it is usually a fresh water species it was once also found at a place with 7.02% salinity (Kirkpatrick 1925). In England Ae. caspius is primarily a seaside mosquito, but breeds occasionally in non-salt water (Marshall 1938). In the Western Mediterranean area it breeds in natural water with reeds such as Phragmitetum mediterraneum, in abandoned drainage canals, or in submerged prairie land (Rioux 1958). Martini (1931) designates Ae. caspius as a salinity-prefering species.

It associates in fresh water with C. antennatus, C. p. molestus and C. univittatus, in salt water with An. multicolor (Kirkpatrick 1925). Rioux (1958) found it to associate, among others, with C. pipiens, U. unguiculata, C. theileri, C. annulata and Ae. detritus.

In general the data obtained in this survey correspond to the adult catches reported elsewhere (Margalit & Tahori 1970a). However, during the period June till November larvae of C. univittatus formed a significantly higher percentage of all the larvae of Culicidae collected in the Central Area (Hadera-Zikhron Ya'aqov) than adults of C. univittatus of the corresponding adult population. While the method of collecting larvae may have favored C. univittatus over C. p. molestus, and that of collecting adults C. p. molestus, it is possible that the relative lower percentage of C. univittatus in the adult population indicates that C. univittatus is either less viable or has a shorter life span than does C. p. molestus. In one of the endemic areas of West Nile Fever (Hadera-Zikhron Ya'aqov) C. univittatus larvae were caught in relative large numbers during June-July. Since this species has been implicated as the vector of West Nile virus in this area (Nir et al. 1968), a larval survey during these months may provide a forecast on a possible West Nile Fever outbreak in this area in late summer-autumn.

Table I Number of mosquito larvae caught per month at various breeding places in 1955 - 8

Locality	Month	<i>C. molestus</i>	<i>C. univittatus</i>	<i>C. theileri</i>	<i>Culiseta longiareolata</i>	<i>Aedes caspius</i>
Ashqelon	January	200				5000
	May	100	19	147		
	June	800	57	20		
	July	300	75	1		
	August	300	52			
	September	100	45			
	October	400	987	1		
	Total	2200	1235	169		
Ramla	January	400			10	
	February	700				
	April	2000				
	May	1000				
	June	1100	20			
	July	6000	80			
	August	1000	110			
	September	200	500			
	October		400			
	Total	12400	1110		10	
Central Area (Hadera, Pardes-Hanna, Zikhron Ya'akov)	April	50				
	May	500				
	June	800	90	3		5000
	July	700	200			
	August	800	400			
	September	2000	1200			7000
	October	400	200	1		
	December	400				
	Total	5650	2090	4		12000
	Yir'on	January	40			
April		70			5	
May				10	20	
June		220	5	60	240	
July		680	150	140	220	
August		140	5	20	5	
October					10	
December		10			20	
Total		1160	160	220	520	
Hulata	April	130				
	May	150	2	2	8	
	June	240		6		
	July	350	1		9	
	August	80	4			
	September	40				
	October	170				
	Total	1160	7	8	17	
Grand Total	22570	4602	401	547	17000	

It associates in fresh water with C. antennatus, C. p. molestus and C. univittatus, in salt water with An. multicolor (Kirkpatrick 1925). Rioux (1958) found it to associate, among others, with C. pipiens, U. unguiculata, C. theileri, C. annulata and Ae. detritus.

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	August	800	400			
	September	2000	1200			7000
	October	400	200	1		
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October					10	
December		10			20	
Total		1160	160	220	520	
Hulata		April	130			
	May	150	2	2	8	
	June	240		6		
	July	350	1		9	
	August	80	4			
	September	40				
	October	170				
	Total	1160	7	8	17	
Grand Total		22570	4602	401	547	17000



Table II.

Some characteristics of the breeding places

Locality	Source of water	Water flow	Vegetation	Amount of plankton	Fauna	pH	Cl in ppm	Total salt equivalent in 1/2 l in ppm	Material not soluble after drying at 110°C for 1 h in ppm	Material not soluble after burning at 500°C in ppm	Material soluble after drying at 110°C for 1 h in ppm	Material soluble after burning at 500°C in ppm
Ashqelon	Swamp	Stagnant	<u>Phragmites</u> <u>Typha</u>	Average	Arthropod predators. (Odonata larvae, Dytiscid larvae) Copepoda, Ostracoda	8.6	333.7	19.9	37.1	26.4	900	361
Ramla	Sewage	Stagnant	No special vegetation	Low. In dry season, when swamp dries very high		8.6	236.7	14.4	50.0		870	300
Central area Hadera, Pardes-Hanna, Zikhron Ya'akov)	Sewage	Stagnant	<u>Phragmites</u> <u>Typha</u> <u>Polypodium</u>	Average	Arthropod predators, (Odonata larvae, Dytiscid larvae), Copepoda, Ostracoda	8.0	211.6	17.8	24.2	12.4	900	425
Yir'on	Overflow from poultry shed	Stagnant	<u>Typha</u> <u>Polypodium</u>	Average	Stratiomyid larvae, Syrphid larvae, Copepoda, Ostracoda, Tubifex, Dytiscid larvae	8.0	49.0	9.1	11.2		451	345
Hulara	Nature Reserve area high sewage contents	Stagnant	<u>Cyperus papyrus</u> , <u>Typha</u> , <u>Phragmites</u> , <u>Polypodium</u>	Average	arthropod predators (Odonate larvae, Dytiscid larvae) Copepoda, Ostracoda	8.0	53.8	11.3	34.9	31.2	567	200

The chemical data are average of 3 - 4 tests.

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