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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 mos- quitoes. 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.**

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 was the most prevalent mosquito larva found in this survey (Table I). It bred mainly in waters rich in organic material. It prefered 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 occured 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 Ethiopean Region Culex pipiens had an immense range of breeding places, but it greatly prefered 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 prefered clearer waters with less water weeds or reeds, and bred at pH between 7.2 to 9.7 (Kirkpatrick 1925). In the Ethiopean 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 1). 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 (Kirkpatric 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 | C. molestus | C. univittatus | C. theileri | Culiseta longiareolata | Aedes caspius |
|---|---|---|---|---|---|---|
| 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 | | 5000 |
| 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'aqov) | 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 | 50 | 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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| | September | 2000 | 1200 | | | 7000 |
| | October | 400 | 200 | 1 | | |
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| | 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 $H_2O$ | Material not soluble after drying at 110°C for 1 h in ppm | Material not soluble after burning at 900°C in ppm | Material soluble after drying at 110°C for 1 h in ppm | Material soluble after burning at 900 °C in ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ashqelon | Swamp | Stagnant | Phragmites Typha | Average | Arthropod predators. (Odonata larvae. Dytiscid larvae) Copepoda, Ostracoda | 8.6 | 333.7 | 19.9 | 37.1 | 26.4 | 980 | 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'aqov) | Sewage | Stagnant | Phragmites Typha Polypodium | Average | Arthropod predators, (Odonata larvae, Dytiscid larvae), Copepoda, Ostracoda | 8.0 | 211.6 | 17.8 | 24.2 | 12.4 | 980 | 425 |
| Yarqon | Overflow from poultry shed | Stagnant | Typha Polypodium | Average | Straiomyid larvae. Syrphid larvae, Copepoda, Ostracoda, Tubifex, Dytiscid larvae | 8.0 | 49.0 | 9.1 | 11.2 | | 451 | 345 |
| Hulata | Nature Reserve area high sewage contents | Stagnant | Cyperus papyrus, Typha, Phragmites, Polypodium | Average | arthropod predators (Odonate larvae, Dytiscid larvae) Copepoda, Ostrapoda | 8.0 | 53.8 | 11.3 | 34.9 | 31.2 | 567 | 2-3 |

The chemical data are average of 3 - 4 tests.

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