

AN ANNOTATED LIST OF MOSQUITOES IN ISRAEL¹

J. Margalit² and A. S. Tahorl

Department of Parasitology, The Hebrew University, Jerusalem and
Israel Institute for Biological Research,
Ness-Ziona, Israel

A B S T R A C T

The paper gives a list of 42 species of Culicidae recorded in Israel. It is based to a large extent on the collection of Prof. Theodor, Department of Parasitology, The Hebrew University, Jerusalem, and other collections.

INTRODUCTION

42 species of Culicidae have been recorded in Israel. Some of these have become extinct in the area due mainly to control measures and changes in their environment resulting from drainage or water pollution. It is therefore of interest to summarize the species of mosquitoes recorded in Israel.

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2. Present address: Department of Biological Science, Southern Illinois University, Edwardsville, Illinois, USA..

Mosquito surveys of Israel were made by Austen (1919), Barraud (1921), Buxton (1924), Saliternik (1958), Saliternik and Barkai (1963), Margalit and Tahori (1970b) and Margalit, Tahori and Nir (1971). The present paper is based mainly on the collection of Prof. O. Theodor, The Hebrew University which he began in 1922 (T.H.U. in the text).

The following table summarises the occurrence of the various species in Israel, (1) indicates common occurrence; (2) occasional; (3) rare; (4) only record; (5) disappeared (common in the past); (6) restricted distribution.

<i>Anopheles algeriensis</i> Theobald	3
<i>A. claviger</i> (Meigen)	2
<i>A. coustani tenebrosus</i> Dönitz	1 and 6
<i>A. hyrcanus</i> (Pallas)	5 and 1
<i>A. marteri</i> Senevet & Prunelle	3 and 6
<i>A. sacharovi</i> Favre	5
<i>A. dthali</i> Patton	3 and 6
<i>A. hispaniola</i> (Theobald)	6
<i>A. multicolor</i> Cambouliu	2
<i>A. pharoensis</i> Theobald	3
<i>A. pulcherrimus</i> Theobald	4
<i>A. rhodesiensis rupicolus</i> Lewis	4
<i>A. sergentii</i> (Theobald)	1
<i>A. superpictus</i> Grassi	2
<i>A. turkhudi telamali</i> Saliternik & Theodor	3 and 6
<i>Mansonia buxtoni</i> (Edwards)	5 and 6
<i>M. richiardi</i> (Ficalbi)	6
<i>Uranotaenia unguiculata</i> Edwards	1
<i>Aedes caspius</i> (Pallas)	1
<i>Ae. detritus</i> (Haliday)	1
<i>Ae. mariae</i> (Sergent & Sergent)	6
<i>Ae. pulchritarsis</i> (Rondani)	6
<i>Ae. geniculatus</i> (Olivier)	4
<i>Ae. aegypti</i> (Linnaeus)	5
<i>Culiseta annulata</i> (Schrank)	3
<i>C. subochrea</i> (Edwards)	3
<i>C. morsitans</i> (Theobald)	4
<i>C. longiareolata</i> (Macquart)	1
<i>Culex adairi</i> Kirkpatrick	6
<i>C. modestus</i> Ficalbi	3 and 5

<i>C. pusillus</i> Macquart	6
<i>C. apicalis judaicus</i> Edwards	3
<i>C. hortensis</i> Ficalbi	3
<i>C. deserticola</i> Kirkpatrick	6
<i>C. antennatus</i> (Becker)	6
<i>C. laticinctus</i> Edwards	1
<i>C. mimeticus</i> Noe	3
<i>C. pipiens</i> complex	1
<i>C. sinaiticus</i> Kirkpatrick	4
<i>C. theileri</i> Theobald	1
<i>C. tritaeniorhynchus</i> Giles	1
<i>C. univittatus</i> Theobald	1

SPECIAL PART

Genus *Anopheles* Meigen

Subgenus *Anopheles* Meigen

Anopheles algeriensis Theobald

This is a marsh breeding mosquito. It was recorded by Austen (1919) from the Yarkon River area. Barraud (1921) collected one female in Akko and 50 specimens in Jenin. Buxton (1923) collected it in Akko, and Theodor in Binyamina. This species is to-day restricted mainly to the Akko Bay area, the Jordan valley and the Coastal Plain.

Anopheles claviger (Meigen)

A. claviger was reported as an important vector of malaria by Mühlens (1913) who found large numbers of larvae in cisterns in Jerusalem. It was later also recorded from Haifa, Jaffa, Akko and Nazareth (Barraud, 1921) and from Aqua Bella, Akko and Zefat (T.H.U.). This is mainly a northern species breeding in Europe in open water (Marshall, 1938). It adapted itself to the southern climate by breeding in cisterns and wells where temperatures are consistently lower than outside. Due to control measures, *A. claviger* is now mainly restricted to the northern hill areas. However, we found it also in wells in Azarya near Jerusalem on the eastern slopes of the Judean hills in 1968 and in 1969.

Anopheles coustani tenebrosus Dönitz

The record "Israel" under *A. coustani* in Stone, Knight and Starke (1959) refers to *coustani* as species in general, in this case to var. *tenebrosus*.

A. coustani was recorded in Israel from the Yarkon river region by Austen (1919) as *A. mauritianus* (Grandpré), and collected in Atlit and from the Kishon river area by Barraud (1921) who stated that it occurs regularly in Palestine, and in the Kishon area by Saliternik (1933). It was collected in the Hule area by Theodor in 1952 and in Zikhron Ya'aqov by Gratz in 1955 (T.H.U.). It was very rare in the past, but it now occupies the ecological niche made vacant by the disappearance of *A. hyrcanus*. *A. coustani* is now found mainly in the Hule area where it is a dominant species (Margalit, Tahori and Nir 1971).

Anopheles hyrcanus (Pallas)

This species was recorded from Rosh Ha'ayin in the Yarkon area by Austen (1919), and from Atlit, Jenin and the Kishon area by Barraud (1921). Buxton (1924) recorded 70 specimens from Bet She'an and Caesarea (T.H.U.). *A. hyrcanus* was again collected in Rosh Ha'ayin by Shapiro in 1931, and found in the Hule area by Theodor in 1952 and by Margalit in 1956 (T.H.U.).

A. hyrcanus disappeared in Israel after the large swamps had been drained in the late 1950's, and has not been found since. Records after 1956 are probably due to incorrect identification, since larvae of *A. hyrcanus* are indistinguishable from those of *A. coustani* and the identification was based only on larvae.

Anopheles marteri Senevet and Prunelle

A. marteri is a Mediterranean species recorded from Syria (Leeson, 1942); its southern zoogeographical border is northern Israel. It is restricted to the hill regions (Theodor, 1952). It has been found in pools in stream beds in northern Israel, e.g. Wadi Limon and Bezet (Barkai, 1965) and also at Wadi Karkara.

Anopheles sacharovi Favre

Barraud (1921) recorded this species from Jaffa, Atlit, Akko, Afula and Jenin in his survey in 1919 - 1920. It was the major vector of malaria in Israel (Saliternik, 1964). *A. sacharovi* disappeared because of control measures and environmental changes in the 1950's; it was recorded from the Betecha valley (north-east of the Sea of Galilee) in 1969 (Ben-Dov, 1971).

Subgenus *Cellia* Theobald

Anopheles dthali Patton

A. dthali is an East African species extending into the Dead Sea area. Numerous larvae were found by Theodor in Safieh in the southern Dead Sea area in 1946 and in En Gedi in 1952 (T.H.U.). Larvae of *A. dthali* were again found in the Dead Sea area in 1970 (Margalit, Avrahami and Tahori, 1973).

Anopheles hispaniola (Theobald)

This species is rare in Israel. Lumsden (1944) found *A. hispaniola* generally distributed in south-western Trans-jordan but not in Palestine. Theodor recorded it from Zakharia south of Bet Shemesh in July 1949 (T.H.U.). It has not been recorded again in Israel. It is common in the southern mountains of Sinai (Margalit and Tahori, 1973).

Anopheles multicolor Cambouliu

A. multicolor is a typical poikilohalinic species; it was found breeding in Sinai in water with a wide range of chlorine content 600 - 14400 mg/l (Margalit and Tahori, 1973). It was recorded from Wadi Ghuzze near Gaza and Wadi Mellahah in the Jordan valley (Austen, 1919). Theodor collected *A. multicolor* in Atlit, in the En Fashkha springs and two females in Jerusalem (probably carried by wind from the Dead Sea area) (T.H.U.). 17 specimens were collected in Neot HaKikar in the Dead Sea area (Nir et al., 1968) and numerous larvae in the En Qalya spring (Margalit et al., 1973).

Anopheles pharoensis Theobald

This is an Ethiopian species, common in Egypt. It was recorded from the river Auja (Yarkon) region (Austen, 1919) and from Tabcha (Lake Tiberias) (Barraud, 1921). Theodor collected it in Kabara, Binyamina, Wadi Hadera and Tel Yosef

(T.H.U.). After the drainage of marshes in the coastal plain it practically disappeared. Only 11 breeding places of *A. pharoensis*, mainly in the coastal plain, were found in 1948-56, 2 in 1957, 26 in 1959 and only 7 in 1960 - 64 (Saliternik, 1966).

Anopheles pulcherrimus Theobald

A single specimen of *A. pulcherrimus* was collected in Nir David in the Eastern Plain of Emeq Yizreel by Saliternik in 1950 (T.H.U.). This is the only record of this species from Israel and is apparently the most southern record of *A. pulcherrimus*.

Anopheles rhodesiensis rupicolus Lewis

Recorded from Sinai (Salem, 1938) and Wadi Ram (east of Elat) (Lumsden, 1950), but the first record of this species from Israel is from the Dead Sea area in 1970 (Margalit et al., 1973).

Anopheles sergentii (Theobald)

Barraud (1921) found a few females at Tabcha and some larvae in pools near Haifa. Theodor collected it in Nahalal, Hule, Dead Sea area and near Jerusalem (T.H.U.). This species is common in Israel, particularly in the Bet She'an area and in the Hule area. It is a potential vector of malaria (Saliternik, 1955).

Anopheles superpictus Grassi

This species was recorded by Austen (1919) from the Yarkon River area, Latrun, Wadi Kelt and En es Sultan near Jericho, and by Barraud (1921) from Jaffa, Lydda, Ramallah, Bet She'an, Tabcha and along the Jordan river. *A. superpictus* is now less common than *A. sergentii*, but it is still a potential vector of malaria in Israel mainly in running water (Saliternik, 1966).

Anopheles turkhudi telamali Saliternik and Theodor

A. turkhudi is very rare in Israel. It was described from Tel Amal in the eastern Plain of Emeq Yizreel (Saliternik and Theodor, 1942) in 1940. It was collected in Sede Eliyyahu in the Bet She'an valley in 1947 (T.H.U.) and was recorded from the Dead Sea area in 1970 (Margalit et al., 1973).

Genus *Mansonia* Blanchard

Subgenus *Coquillettidia* Dyar

Mansonia buxtoni (Edwards)

M. buxtoni was described by Edwards (1923) from specimens collected by P.A. Buxton in the Hule on 3 September 1922. It was collected by Theodor in Nahal Zerka, Binyamina, Kefar Gil'adi and Hule (T.H.U.). Its last record in Israel is from Hulata in May 1956 (Margalit & Tahori, 1970b). It has disappeared since the drainage of the Hule lake.

Mansonia richiardii (Ficalbi)

M. richiardii was collected by J. Cropper in the Hule region (Barraud, 1921). Buxton (1924) did not record it in his survey. It was again collected in Mellaha by Theodor, and in Nebi Yusha and Yahula by Gratz (T.H.U.). These localities are in the Hule region to which this species is restricted (Margalit & Tahori, 1970b).

Genus *Uranotaenia* Lynch Arribalzaga

Uranotaenia unguiculata Edwards

This is a common species in Israel, mainly from the end of August to the winter (Margalit & Tahori, 1907b). It usually breeds together with *A. sergentii*.

Genus *Aedes* Meigen

Subgenus *Ochlerotatus* Lynch Arribalzaga

Aedes caspius (Pallas)

Ae. caspius breeds in brackish or highly saline water (to 13% salinity in Atlit). It is very common along the Jordan, Dead Sea valley and on the Mediterranean coast.

Aedes detritus (Haliday)

Ae. detritus is also common. The larvae are found mainly in brackish or fresh water near the coast (Barraud, 1921). It was also collected in the Dead Sea area (En Fashkha) by Theodor in 1940 (T.H.U.). Its geographical distribution in Israel coincides with that of *Ae. caspius*, however, it is common only in winter.

Aedes mariaae (Sergent and Sergent)

Ae. mariaae is a hyperhalinic species, it was collected in Atlit by Barraud (1921) and by Theodor in 1923 (T.H.U.). It is still found there in rock pools (Margalit & Tahori, 1970b).

Aedes pulchritarsis (Rondani)

Ae. pulchritarsis is a tree breeder. It was collected by Theodor in Upper Galilee in 1942 and was found breeding in a tree hole in an *Ailanthus altissima* Swingle (Simarubaceae) in Jerusalem in 1958 (T.H.U.).

Subgenus *Finlaya* Theobald

Aedes geniculatus (Olivier)

Two females of *Ae. geniculatus* were collected in Aqua Bella near Jerusalem by Margalit on 23.4.1954 (T.H.U.). It was identified by Prof. O. Theodor. This is the only record from Israel. It usually breeds in tree-holes.

Subgenus *Stegomyia* Theobald

Aedes aegypti (Linnaeus)

Barraud (1921) collected *Ae. aegypti* in Jaffa, Jerusalem, Haifa, Jenin and Tiberias; Theodor collected it in Jericho, Jerusalem, Tiberias and Haifa, and Shapiro recorded it from Jerusalem, Wadi Rubin and the Dead Sea area (T.H.U.). The last record of *Ae. aegypti* in Israel is from Jerusalem in 1949, but this may have been an escaped specimen of a laboratory reared foreign strain. It has not been found again in Israel. It has also almost completely disappeared in the Mediterranean area.

Genus *Culiseta* Felt

Subgenus *Culiseta* Felt

Culiseta annulata (Schrank)

C. annulata was recorded by Barraud (1921) from Ramla and from the Jordan valley. It was later recorded from Caesarea and Afula, and by Gratz from the Hule (T.H.U.). *C. annulata* was found in the Bet She'an valley, Akko Bay, in the coastal area and the Jordan river valley by J. Margalit in 1956-7 (T.H.U.). Since the drainage of swamps it has been found only sporadically.

Culiseta subochrea (Edwards)

C. subochrea was collected by Theodor in the former Akko marshes in 1927 and later by Margalit in Kefar Ruppim (Beisan area) in 1955 (T.H.U.). Both *C. annulata* and *C. subochrea* breed in swamps and are thus not common at present.

Subgenus *Culisella* Felt

Culiseta morsitans (Theobald)

Barraud (1921) collected some larvae of *C. morsitans* in a pool in a small quarry in Haifa in April 1920. Theodor collected two males, four females and larvae of this species in Caesarea on 22.3.1924 (T.H.U.). It has not been found again.

Subgenus *Allotheobaldia* Broleman

Culiseta longiareolata (Macquart)

C. longiareolata is common in Israel (Margalit & Tahori, 1970b). It was first recorded by Barraud (1921) who stated that it was one of the commonest species in Palestine. It often breeds in association with *C. laticinctus* and *A. claviger* in cisterns and wells.

Genus *Culex* Linnaeus

Subgenus *Lasiosiphon* Kirkpatrick

Culex adairi Kirkpatrick

The first record of *C. adairi* in Israel is by Dimantman and Margalit (1974). Dimantman found it breeding in a temporary pool in the Wadi Zin area in the northern Negev in March 1968. This is the only record of this species outside Africa.

Subgenus *Barraudius* Edwards

Culex modestus Ficalbi

C. modestus was recorded from Jaffa by Austen (1921). Theodor found it in the Bet She'an valley and in Kefar Gil'adi (T.H.U.), and Gratz collected it in the Hule area (Mosquito collection, Department of Health, Jerusalem) in the early 1950's.

Culex pusillus Macquart

This species breeds in brackish or saline water. It is common in Egypt, Sinai and the Sudan. Larvae were collected in the En Turabe springs in the Dead Sea area (Margalit et al., 1973).

Subgenus *Neoculex* Dyar

Culex apicalis judaicus Edwards

Culex apicalis was collected by Theodor in Aqua Bella near Jerusalem (T.H.U.). It is rare in Israel and was found only in colder regions near springs and wells. According to Stone, Knight and Starke (1959) *C. apicalis* occurs only in North America, Europe and the Mediterranean area. Dr. S. Sirivanakarn (personal communication to Dr. Bruce Harrison) believes that *C. territans* is probably the species in Israel. On the other hand, *Culex apicalis* var. *judaicus* Edwards was described in 1926 with the type locality Palestine (Edwards, 1926). Mattingly (1953) raised *C. judaicus* to species rank.

Culex hortensis Ficalbi

C. hortensis was recorded by Barraud (1921) from Haifa, and collected by Theodor in Jenin, Aqua Bella near Jerusalem, Na'aman, Zefat and Tiberias (T.H.U.). During the 1955-58 survey (Margalit & Tahori, 1970b), a few specimens were collected throughout Israel. *C. hortensis* breeds usually together with *C. apicalis*, but is more common.

Culex deserticola Kirkpatrick

C. deserticola was collected by Theodor in the En Fashkha springs in the Dead Sea area in January 1946 (T.H.U.). It was found again in this area in 1965-6 (Nir et al., 1968) and in the spring in En Tzeelim in 1969 (Margalit et al., 1973).

Subgenus *Culex* Linnaeus

Culex antennatus (Becker)

C. antennatus was first recorded from Mellaha, Hule in 1940 and from Wadi Shaib, east of the Jordan in 1942 by Theodor (T.H.U.). Saliternik and Barkai (1963) found it in Megiddo, in the Zebulun valley and in the Hule area. Since then it has only been collected in the Hule area (Margalit & Tahori, 1970b). *C. antennatus* is an important vector of West Nile virus in Egypt (Taylor et al., 1956).

Culex laticinctus Edwards

C. laticinctus was recorded by Barraud (1921) from Jerusalem and Haifa. Buxton (1924) collected it in Tiberias (type locality), Jericho, Jerusalem, Haifa, Nablus and Hartuv. *C. laticinctus* is now found practically everywhere in Israel (Margalit and Tahori, 1970b), often breeding together with *A. claviger* and *C. longiareolata* in cisterns.

Culex mimeticus Noe

C. mimeticus was recorded from Wadi Hamish by Barraud (1921). Theodor collected it in Jericho, Aqua Bella and Wadi Kelt (T.H.U.). *C. mimeticus* usually breeds in springs. Since most open springs have been piped at present, it has become rare. Saliternik & Barkai (1963) found it only north of Haifa. Larvae of *C. mimeticus* were collected in large numbers in springs in En Turabe and Nahal Arugot in the Dead Sea area in 1969 (Margalit et al., 1973).

Culex pipiens complex

This house-entering mosquito is the most common species in Israel. Austen (1919) recorded large numbers of larvae and adults breeding together with *A. claviger* in cisterns in Shafat 2 miles north of Jerusalem. Data on the population dynamics of *C. pipiens* in various regions in Israel have been given by Margalit & Tahori (1970a).

Culex sinaiticus Kirkpatrick

C. sinaiticus is closely related to *Culex simpsoni* Theobald. These two species could not be separated in the Arabian area on the basis of key characters (Mattingly and Knight, 1956). The first record of *C. sinaiticus* from Israel, based on the identification of hundreds of larvae, is from the Dead Sea area in 1970 where the larvae were very common (Margalit et al., 1973).

Culex theileri Theobald

Barraud (1921) collected it in Akko and Haifa. Buxton (1924) collected it also in Hadera and Kantara and stated that *C. theileri* was not common. However, it is now quite common (Margalit & Tahori, 1970b).

Culex tritaeniorhynchus Giles

C. tritaeniorhynchus was recorded by Austen (1921) from near Jaffa, and by Barraud (1921) from Tiberias and Bet She'an. It is now common in Israel, especially in the Jordan valley (Margalit & Tahori, 1970b). Margalit collected it also in the Akko Bay and in Nahal Soreq in the Coastal Plain.

Culex univittatus Theobald

C. univittatus is common in Israel, especially in the warmer regions in late summer and autumn (Margalit & Tahori, 1970a). It is considered a major vector of West Nile Virus in Israel (Nir et al., 1968), Egypt (Taylor et al., 1956) and South Africa (Jupp and McIntosh, 1967).

Jupp (1971) claimed that there is a "short spined" Egyptian form of *C. univittatus* in the eastern Mediterranean which is neither *C. univittatus* nor *C. neavei* Edwards. He believes that the new species, which can be recognized only by characters of the male genitalia, is probably a distinct species and is the "*C. univittatus*" considered in Egypt and Israel as the vector of West Nile Virus.

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