

## LARVAL MOSQUITOES COLLECTED FROM NORTHERN JORDAN AND THE JORDAN VALLEY

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**ABSTRACT.** Nineteen species of anopheline and culicine mosquitoes are reported from larval collections made in northern Jordan and the Jordan Valley. *Culex judaicus*, *Culiseta annulata*, and *Uranotaenia unguiculata* are reported as new records for Jordan. The impact of agricultural development and man-made changes on the mosquito fauna of Jordan is discussed.

### INTRODUCTION

Lumsden and Yofe (1950) is the main reference on anopheline mosquitoes of Jordan. Barraud (1921), Buxton (1924), Lumsden (1944), Berberian (1946), and Farid (1954) included records of anophelines breeding in freshwater habitats of Jordan. Recently, Harbach (1988) presented a comprehensive study on the subgenus *Culex* in southwestern Asia. Very little information is available on the culicine mosquitoes of Jordan because they are no longer considered of medical importance.

For the past 40 years, Jordan has witnessed environmental changes, including habitat modification resulting from agricultural development in the Jordan Valley and the Eastern Desert, in the form of water extraction and changes in water courses, and construction of dams and irrigation canals. All these changes drastically affected the mosquito fauna and its distribution.

The Jordan Valley was known for its malaria hyperendemicity. Elsewhere in Jordan, the disease was in the meso-hyperendemic range. A malaria eradication program was launched in the late 1950s, and the country was declared malaria free in 1970 (De Zulueta and Mur 1972). Because of high receptivity and vulnerability, especially in the lowlands, a vertical malaria control program still exists despite the malaria-free status. Since 1970, most *Anopheles* breeding sites all over the country are still under weekly larviciding with temphos. In 1990, a malaria outbreak took place in the Karak lowlands, resulting in 33 *Plasmodium vivax* cases among the local people.

The present study reports on the anopheline and culicine mosquitoes that were collected from northern Jordan and the Jordan Valley during February–October 1996.

### MATERIALS AND METHODS

Larval mosquitoes were collected from various sites in northern Jordan and the Jordan Valley (JV). Northern Jordan includes Irbid, Ajloun, and Jarash Governorates (Govn.) which are influenced by the

Mediterranean biotope. The Jordan Valley is defined here as the area that extends from the northwestern part of Jordan along the Jordan River to the northern borders of the Dead Sea to the south. Sites were visited on a monthly basis, and some selected sites were studied more regularly. A total of 48 sites were sampled (11 in Jarash Govn., 10 in Irbid Govn., 1 in Ajloun Govn., and 26 in the Jordan Valley). Some sites were visited 4 times, as in Zarqa River and Ain Al-Moalaka. Vegetation type, a brief description, and other observations for each site were recorded. Specimens were collected by using a dipper and were preserved in 75% alcohol. Larvae were identified using Edwards (1921), Mattingly and Knight (1956), and Harbach (1988).

### RESULTS

Nineteen species (8 anophelines and 11 culicines), representing 5 genera were identified.

#### *Anopheles (Anopheles) algeriensis* Theobald 1903

Ten larvae were collected from Al-Mashreh (JV) in mid-April. No further specimens were obtained because of the continuous insecticide spraying for this particular site. Streams, springs, ponds, and wells are the preferred habitats (Pener and Kitron 1985). This species was collected from Rud el-Bassa in the Jordan Valley (Lumsden and Yofe 1950).

#### *Anopheles (Anopheles) claviger* (Meigen 1804)

This species was collected from stagnant and semistagnant water that formed around seepages and banks of small streams.

Larvae of this species were collected from 3 localities (Dair Al-Layat, Jarash Govn., Ain Al-Trab, Irbid Govn., and Al-Mashreh, JV). It was found in sites also containing *Anopheles sergentii* and *Culex perexiguus*. This is the most common species of *Anopheles* in the Middle East (Abdel-Malek 1956).

#### *Anopheles (Anopheles) marteri* Senevet and Prunelle 1927

Seven larvae were collected from Wadi Rajib (Ajloun Govn.) during early September. It seems

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that *An. marteri* prefers streams and springs, an observation shared by Pener and Kitron (1985). This rare species was found in the same habitats as *An. claviger* and was previously collected from the Jordan Valley, Wadi Shaib, and Wadi Sir (Lumsden and Yofe 1950).

#### ***Anopheles (Anopheles) sacharovi* Favre 1903**

Twelve larvae were collected from Ain Al-Moalaka (Irbid Govn.). They were found in sites that also contained *Anopheles superpictus*, *Culex pipiens*, *Culex theileri*, and *Cx. perexiguus*. Farid (1954) recorded a considerable number of adults in premises in the northern parts of the Jordan Valley.

#### ***Anopheles (Cellia) dthali* Patton 1905**

Five larvae were found in a water seepage near Sywmeh Dam, along with *Cx. perexiguus*. *Anopheles dthali* has been recorded from Jabel Usdum, Ein Hasb, and Wadi Hasa (Lumsden and Yofe 1950). This is a rare species, with a distribution that extends from India, across Arabia and the Middle East, Sudan, Ethiopia to Algeria (Stone et al. 1959).

#### ***Anopheles (Cellia) multicolor* Cambouliu 1902**

This is a rather common species that inhabits relatively saline bodies of water. It was collected from several localities in the Madi area (JV), where salt marshes are frequent. Lumsden and Yofe (1950) reported that salt-laden habitats formed by extensive evaporation are preferred by this species. Pener and Kitron (1985) found *An. multicolor* to be a rare species in northern Palestine.

#### ***Anopheles (Cellia) sergentii* (Theobald 1907)**

This species is widely distributed in North Africa and in the Middle East to Pakistan (Stone et al. 1959) and is the second most abundant anopheline in Jordan. Larvae collected from Dair Al-Layat (Jarash Govn.), Ain Badran, Ain Al-Minqatah, and Ain Aqeel (JV) were associated with *Cx. perexiguus*, *An. claviger*, *Anopheles superpictus*, *An. multicolor*, and *Uranotaenia unguiculata*. It was collected previously from Azraq, Es-Sukhne (Zarka River), Wadi Rum, and Wadi Musa (Lumsden and Yofe 1950).

#### ***Anopheles (Cellia) superpictus* Grassi 1899**

This is the most common anopheline in Jordan. Larvae were collected from 4 study sites: Ain Al-Moalaka (Irbid Govn.), Ain Badran, Tabaqat Fahal, and Ain Al-Minqatah (JV). It was collected from temporary irrigation ponds and side pools formed by springs. This species was found in sites containing *An. sacharovi*, *An. sergentii*, *Culex mimeticus*, *Ur. unguiculata*, and *Cx. perexiguus*.

Lumsden and Yofe (1950) reported this species from Ein Ghidyan in the Jordan Valley, Wadi Rum, and Kuweira upland. Pener and Kitron (1985) found that *An. superpictus* was the 2nd most common anopheline in northern Palestine.

#### ***Aedes (Ochlerotatus) caspius* (Pallas 1771)**

A larva was collected from the Swaymeh area in September. The site was a small, slow running stream under thick vegetation very close to the Dead Sea. This species is associated with saline habitats. It seems to be a rare species in northern Palestine and Jordan, and Kitron and Pener (1986) collected few larvae during 1974–1983. Margalit et al. (1973) reported *Ae. caspius* from the Dead Sea area.

#### ***Culex (Culex) antennatus* (Becker 1903)**

Eight larvae were collected from 2 localities: Ain Al-Moalaka and Saham (Irbid Govn.). It breeds in stagnant water, stream pools, and seepages as well as ditches (Harbach 1988). This species was found to breed along with several species of *Anopheles* and *Cx. pipiens*, *Cx. theileri*, and *Cx. perexiguus*.

The larvae of *Cx. antennatus* are extremely similar to *Cx. perexiguus* (= *univittatus*). However, live larvae of *Cx. antennatus* are readily distinguished from those of *Cx. perexiguus* by the 2-banded appearance of the abdomen and characteristics of setae 1-C, 1-M, and 1-S (Harbach 1988). However, specimens collected from Jordan did not have all of the characters described by Harbach (1988). In particular, seta 1-C was long and occasionally not located laterally, posteriorly, or intermediary. Furthermore, the siphon was equipped with 3 lateral pairs of 1-S seta. Samples that did not match 1 of the 3 characteristics given by Harbach (1988) were designated *Cx. perexiguus*.

#### ***Culex (Culex) mimeticus* Noe 1899**

Forty-one larvae were collected from Tabaqat Fahal and Wadi Nheer (JV) on various occasions. Larvae prefer habitats with dense aquatic vegetation and algal growth and were found along with *An. superpictus*. The distribution range of this mosquito extends from the southern Palaearctic into Oriental regions (Harbach 1988).

#### ***Culex (Culex) perexiguus* Theobald 1903**

This was the 2nd most abundant culicine collected in Jordan. A total of 255 larvae were collected from 11 sites covering the entire study area. It was found in a variety of habitats including stream pools, irrigation ponds, seepages, and ditches. Associated species were *Cx. pipiens*, *An. sacharovi*, *An. superpictus*, and *Culiseta longiareolata*.

In a comprehensive treatment for the subgenus

*Culex*, Harbach (1988) made a distinction between *Culex univittatus* Theobald and *Cx. perexiguus*, where *Cx. univittatus* is confined to the temperate highlands of southern and eastern Africa and the southwestern corner of Arabia, whereas *Cx. perexiguus* is distributed in northern Africa and southwestern Asia and into India. *Culex univittatus*, *Cx. perexiguus*, and *Culex neavei* are considered members of a sibling species group (Jupp 1971, 1972; Harbach 1985; Jupp and Harbach 1990).

The larvae of this species resemble those of *Cx. antennatus*; however, they are distinguished by the combination of shorter seta 1-C, a siphon with 2 lateral pairs of seta 1-S, seta 1-M is usually single, and the abdomen of live larvae is without the obvious 2-banded appearance.

#### *Culex (Culex) pipiens* L. 1758

This was the most common mosquito species collected during this study. It was collected from various localities representing all types of habitats in Jordan: Zarqa River, Dair Al-Layat, Roman pools and Soof area (Jarash Govn.), Dair Alla and Adasyeh (JV), and Ain Rahoob and Ain Al-Moalaka (Irbid Govn.). Other species that shared the same habitats include *Culex theileri*, *Cx. perexiguus*, *Culex judaicus*, *An. sacharovi*, *An. superpictus*, *Cs. longiareolata*, and *Ur. unguiculata*.

Adult activity of this species persists until the end of December in the Irbid area, where temperature drops to 11°C during winter.

#### *Culex (Culex) theileri* Theobald 1903

This was the 3rd most common culicine mosquito. Larvae were found in large numbers in Zarka River, Ain Al-Moalaka, associated with *Cx. perexiguus*, *Cx. pipiens*, *Cs. longiareolata*, *An. sacharovi*, and *An. superpictus*. It was previously collected from Zarka. This species is distributed throughout southern and eastern Africa, Mediterranean countries, and across southern states of the former Soviet Union to China (Harbach 1988).

#### *Culex (Culex) tritaeniorhynchus* Giles 1901

A single specimen was collected from an irrigation pool in Kraymeh. It was found along with *Cs. longiareolata*. This is a rare species in Palestine, where it represented 0.5% of the larvae collected during 1974–1983 (Kitron and Pener 1986). Harbach (1988) indicated specimens collected from Wadi Al-Yabis (JV).

This mosquito is distributed over southeastern and eastern Asia and east Africa (Harbach 1988).

#### *Culex (Neoculex) judaicus* Edwards 1926

Six larvae were collected from a pool in Ain Rahoob. This is the only member of the subgenus

*Neoculex* that occurs in Jordan. It was collected in sites with *Cx. perexiguus*, *Cx. pipiens*, and *Ur. unguiculata*.

#### *Culiseta (Allotheobaldia) longiareolata* (Macquart 1838)

This is one of the most common and abundant species. It was collected from irrigation pools in Al-Krymeh, Al-Qarn (JV), Ramtha area and Ain Al-Moalaka (Irbid Govn.), Slehi, Zarka River, Dair Al-Layat (Jarash Govn.). It was found in association with *Cx. theileri*, *Cx. perexiguus*, *Cx. pipiens*, *Cx. tritaeniorhynchus*, and *Ur. unguiculata*. Kitron and Pener (1986) reported a negative association of *Cs. longiareolata* and *Cx. perexiguus*. This species occurs in the southern Palaearctic region from North Africa to India (Margalit and Tahori 1973).

#### *Culiseta (Culiseta) annulata* (Schrank 1776)

Only a single specimen was collected from a small pool under a shady area in Ain Al-Moalaka.

#### *Uranotaenia (Pseudoficalbia) unguiculata* Edwards 1913

Twelve larvae were collected from Dair Al-Layat (Jarash Govn.) and Ain Rahoob and Ain Al-Minqatah (JV). It was found in the same habitat as *Cx. perexiguus*, *Cx. pipiens*, *Cx. judaicus*, *An. sergentii*, and *An. superpictus*. Similar observations on its association with *C. perexiguus* and *C. pipiens* were reported by Abdel-Malek (1956).

## DISCUSSION

The mosquito fauna of the study area consists of 19 species representing 5 genera (*Anopheles*, *Aedes*, *Culex*, *Culiseta*, and *Uranotaenia*). The genus *Anopheles* is represented by 8 species belonging to 2 subgenera: *Anopheles* and *Cellia*. Mosquitoes of the genus *Culex* are represented by 7 species in 2 subgenera: *Culex* and *Neoculex*. Two *Culiseta*, one *Aedes* and one *Uranotaenia* species are reported in this study.

Agriculture and other man-made changes have affected the spatial distribution and abundance of several anopheline species in the Jordan Valley. Also, the intensive use of insecticides for malaria eradication and changes of aquatic habitats are reflected in the mosquito assemblage in Jordan. Earlier reports indicated the presence of species such as *Anopheles hyrcanus* (Pallas), *Anopheles pharoensis* (Theobald), and *Anopheles cinereus* Theobald (= *Anopheles hispaniola* (Theobald)) that are not recorded in this study. Species that were not previously known to occur in Jordan were found in the present survey (*Cs. annulata*, *Cx. judaicus*, and *Ur. unguiculata*).

The role of culicine mosquitoes in disease trans-

mission in Jordan is unknown. Several studies implicated *Cx. pipiens*, *Cx. antennatus*, *Cx. tritaeniorhynchus*, and *Culiseta* in the transmission of Sindbis, West Nile, and the Rift Valley fever viruses (Nir et al. 1968, 1972; Meegan et al. 1980). The biology, biting habits, and vector competence for a variety of pathogens need to be assessed in the 11 culicine species reported here.

This preliminary study strongly suggests the urgent need for a countrywide survey of the mosquito fauna of Jordan because Jordan offers a variety of habitats and different biotopes (Mediterranean, Sahara-Sindian, and Irano-Turanian) and is located in a transitional zone influenced by African, Oriental, and Arabian elements.

Studies of the seasonal abundance, habitat preference, and biology are required for the anopheline mosquitoes in this study, particularly the primary vectors of malaria (e.g., *An. claviger*, *An. superpicus*, and *An. sergentii*). During the recent malaria outbreak in the Karak Govn., a man biting rate of 560 bites/man/night was recorded. Such outbreaks necessitate continuous follow-up and surveillance for possible breeding sites. Establishing a good entomological monitoring system is essential for predicting and preventing such outbreaks.

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