

# Culicinae mosquitoes in Sanandaj county, Kurdistan province, western Iran

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## Abstract

**Background & objectives:** This study aims at studying mosquito-borne diseases as the major public health threat in Iran. Sanandaj outskirts are considered suitable habitats for mosquito larvae. In view of scanty reports on mosquito-borne disease implementation in this area, a study was undertaken to determine the mosquito fauna and frequency of mosquito larvae at Sanandaj City.

**Methods:** In order to study the mosquito (Diptera: Culicidae) fauna, the samples were collected from May to July 2009 using dipping and night catch methods in Sanandaj district, Kurdistan province, western Iran.

**Results:** Three genera and 11 species of the Culicinae subfamily were identified—*Aedes vexans* Meigen, *Ochlerotatus caspius s.l.* Pallas (indicating new occurrence records for the province), *Culex hortensis* Ficalbi, *Cx. pipiens* Linnaeus, *Cx. mimeticus* Noe, *Cx. theileri* Theobald, *Culiseta longiareolata* Macquart, and *Cs. subochrea* Edwards.

**Interpretation & conclusion:** Present study revealed that *Ae. vexans* and *Ochlerotatus caspius s.l.* caught had not been previously recorded in Kurdistan province, highlighting the deficient knowledge of the fauna and distribution of Culicinae mosquitoes of this part of Iran.

**Key words** Culicinae; fauna; Iran; mosquito; Sanandaj

## Introduction

Mosquito-borne diseases such as malaria, West Nile and Sindbis viruses, Japanese encephalitis, Rift Valley fever as well as *Dirofilaria immitis* (dog heart worm) and *D. repens* (dirofilariasis) are a major public health threat in Asian countries, including Iran<sup>1–3</sup>. Malaria transmission in this area occurs in summer, most of the malaria cases were observed on borderline with Iraq<sup>4</sup>. Numerous semi-permanent and permanent aquatic habitats in irrigation and drainage systems offer excellent conditions for mosquito development. Consequently, the inhabitants of the surrounding villages suffer a periodical, but long-lasting mosquito nuisance from May to the end of July.

Seven species of *Anopheles* have been recorded in Kurdistan province, namely *An. algeriensis* Theobald, *An. claviger* Meigen, *An. maculipennis* Meigen *s.l.*, *An. marteri sogdianus* Keshishian, *An. sacharovi* Favre, *An. sergentii* Theobald, and *An. superpictus* Grassi<sup>4</sup>. About 64 species, three subspecies and seven genera of mosquitoes have been reported in Iran<sup>3</sup>. Two genera of *Culex*, and *Culiseta* and eight species of the Culicinae subfamily have been reported in Kurdistan province<sup>5</sup>. Three genera of *Aedes*, *Ochlerotatus* and *Uranotaenia* have not been found in Sanandaj previously<sup>5</sup>. Zaim and Cranston<sup>5</sup> did not mention this species in their checklist of Iranian Culicinae. Zaim<sup>6</sup> mentioned two genera and eight species of the subfamily Culicinae (Diptera: Culi-

cidae) in Kurdistan province, namely *Culex hortensis* Ficalbi, *Cx. perexiguus* Theobald, *Cx. pipiens* Linnaeus, *Cx. mimeticus* Noe, *Cx. theileri* Theobald, *Cx. tritaeniorhynchus* Giles, *Culiseta longiareolata* Macquart and *Cs. subochrea* Edwards. There is only one recent study on the mosquitoes in the county in relation to malaria and anophelines<sup>4</sup>. While it is necessary to study mosquitoes in Sanandaj, there are no more references on the Culicine mosquitoes of the district. This paper presents the first survey of larvae and adults of Culicinae mosquito samples captured from different sites in Sanandaj county, Kurdistan province, western Iran.

### Material & Methods

A field trial was conducted in four randomly selected rural villages in Sanandaj district (35°37'N, 36°16'E) in May, June and July 2009 in Kurdistan province. The district is bounded by the Iraq in the west, Hamedan province in the east, Kermansha province in the south, and western Azerbaijan province in the north. In 2009, the maximum and minimum mean monthly temperatures were 30°C and -1°C in July and February respectively. The total annual rainfall was 800 mm, the minimum of 3.9 mm in April and maximum of 126.2 mm in November. The mean annual relative humidity was 39%. The main economic activity of the people is agriculture and husbandry of cow and goats. On the basis of available epidemiological data from the Sanandaj Health Centre, four villages with 1118 houses and 5513 population were selected.

Sampling was carried out using dipping method for collecting larvae and night catch using suction tubes from animal baited traps for adult mosquitoes. The specimens were collected from three villages in different topographical areas of the district, including Hassan-Abad-e-Sofla, Hassan-Abad-e-Olia and Hossain-Abad. Night catch mosquito collection was conducted from 2000 to 0300 hrs monthly in fixed animal shelter randomly in each village. All collected mosquitoes were pinned and then identified using the keys of Zaim and Cranston<sup>5</sup>, Harbach<sup>7</sup>, and Darsie

and Samanidou-Voyadjoglou<sup>8</sup>. Mosquitoes name abbreviations are cited based on Reinert<sup>9</sup>.

Larval habitats present within 500 m radius of each village were identified and sampled for mosquito larvae twice a month. Three randomly selected breeding places located within a 500 m radius of the study site were also included. All larvae were collected from natural habitats, generally feeding with seepage water, such as swamps, seepages, streams, river banks, drying river beds, pools, and grasslands. Up to 20 dipper samples were taken at intervals along the edge of each larval breeding place using a standard mosquito dipper (350 ml) depending on the size of the habitat.

The larvae for each habitat were placed separately in whirl-pak bags and transported to the laboratory where they were sorted by genus and instar counted and recorded. All III and IV instars of Culicinae subfamily were preserved in 100% lactophenol solution and later identified morphologically into species<sup>5</sup>. Samples for each habitat type were pooled together in each site irrespective of the collection date. Physical characteristics of the larval habitats including habitat stability, water depth, turbidity, presence of other aquatic invertebrates, and presence of floating, emergent, and submerged vegetation were recorded. Water depth was measured using a metal ruler. The habitat was recorded as unstable if it did not contain water during the next weekly sampling visit. The larvae were preserved in lactophenol and the microscopic slides of the preserved larvae were prepared using Berlese medium. The Culicinae larvae along with the description of their breeding sites were sent to the Department of Medical Parasitology, School of Medicine, Kurdistan University of Medical Sciences. In order to reconfirm the species, specimens were also sent to the School of Public Health, Tehran University of Medical Sciences.

### Results

The number of Culicinae mosquito species at the ecological station of Sanandaj is shown in Table 1.

**Table 1. Number and prevalence of adult and larvae culicinae mosquitoes collected by night catch and larval collections in Sanandaj county, Kurdistan province from May–July 2009**

Species	Number collected (%)	
	Larvae	Adults
<i>Ae. vexans</i>	120 (3.17)	176 (9.5)
<i>Cx. hortensis</i>	65 (1.71)	21 (1.1)
<i>Cx. pipiens</i>	685 (18.09)	164 (8.8)
<i>Cx. mimeticus</i>	206 (5.44)	48 (2.6)
<i>Cx. theileri</i>	418 (11.04)	934 (50.5)
<i>Cs. longiareolata</i>	982 (25.95)	1 (0.07)
<i>Cs. subochrea</i>	982 (25.95)	86 (4.2)
<i>Oc. caspius s.l.</i>	327 (8.63)	432 (23.2)
Total	3785 (100)	1862 (100)

A total of 1862 adult and 3785 larvae of Culicinae mosquitoes were collected, of which four genera and eight species of Culicinae were recognized, namely *Aedes vexans*, *Ochlerotatus caspius s.l.* (indicating new occurrence records for the province), *Culex hortensis*, *Cx. pipiens*, *Cx. mimeticus*, *Cx. theileri*, *Culiseta longiareolata* and *Cs. subochrea*.

A total of 1862 adult Culicinae mosquitoes were collected using night catch from cow bait and bait net trap in living quarters and stables. Overall, *Culex theileri* predominated (50.5%), followed by *Oc. caspius s.l.* (23.2%), *Ae. vexans* (9.5%), *Cx. pipiens* (8.8%), *Cs. subochrea* (4.2%), *Cx. mimeticus* (2.6%), *Cx. hortensis* (1.1%), and *Cs. longiareolata* (0.07%).

In the larval collection, of 3785 Culicinae larvae collected, *Cs. longiareolata* and *Cs. subochrea* predominated (19.5%), followed by *Cx. pipiens* (13.6%), *Cx. theileri* (8.3%), *Oc. caspius s.l.* (6.5%), *Cx. mimeticus* (4.1%), *Ae. vexans* (2.4%) and *Cx. hortensis* (1.3%) (Table 1). Two species including *Cx. theileri*, and *Oc. caspius s.l.*, accounted for 50.5 and 23.2% of the adult collection respectively. The other species are less frequent, each accounting for less than 27% of the total (Table 1).

*Culex theileri* was the most frequent culicine mosquito collected at the Sanandaj, with total of 934, and 418 specimens, using night catch and larval collection, respectively. *Aedes vexans* and *Oc. caspius s.l.* are recorded for the first time in Sanandaj, Kurdistan province. The number and prevalence of Culicinae mosquito catches by animal bait trap through night are presented in Table 2. Feeding activity of *Oc. caspius s.l.* was increased from 2000 to 2300 hrs and decreased slowly from 2300 to 0200 hrs, whereas blood feeding activity of *Cs. subochrea* was increased from 2300 to 0200 hrs and then decreased from 0200 to 0500 hrs. *Culex theileri* was active throughout the night and other culicine mosquitoes species such as *Cx. pipiens*, *Cx. hortensis*, *Cx. mimeticus*, and *Ae. vexans* were active during 2300 to 0200 hrs. Two species including *Cx. theileri*, and *Oc. caspius s.l.* accounted for 83% of the adult collection after the sunset in the animal bait trap collection whereas during 2300 to 0200 hrs these spe-

**Table 2. Number and prevalence of culicinae mosquitoes catches by animal bait trap during the night at Sanandaj county, Kurdistan province from May–July 2009**

Species	Number of mosquitoes caught during the night (catch rate in %)			
	2000–2300 hrs	2300–0200 hrs	0200–0500 hrs	Total
<i>Ae. vexans</i>	41 (23.3)	88 (50)	47 (26.7)	176 (9.4)
<i>Cx. hortensis</i>	6 (28.6)	14 (66.6)	1 (4.76)	21 (1.12)
<i>Cx. pipiens</i>	29 (12.5)	134 (82)	1 (0.6)	164 (8.8)
<i>Cx. mimeticus</i>	6 (14)	25 (52)	17 (35)	48 (2.57)
<i>Cx. theileri</i>	292 (31)	361 (38.8)	281 (30.1)	934 (50.16)
<i>Cs. longiareolata</i>	1 (100)	–	–	1 (0.05)
<i>Cs. subochrea</i>	23 (26.7)	35 (40.7)	28 (32.55)	86 (4.61)
<i>Oc. caspius s.l.</i>	242 (56)	121 (28)	69 (16)	432 (23.2)
Total	640 (34.37)	778 (41.78)	444 (23.84)	1862 (100)

cies with *Cx. pipiens* were predominant and accounted for 79% of the adult collection. In this study, *Cx. theileri*, *Oc. caspius s.l.* and *Ae. vexans* were active during 0200 to 0500 hrs and formed about 89% of the total mosquito catches.

### Discussion

Four genera and eight species of Culicinae mosquitoes were identified from Sanandaj and Kurdistan province, including the first record of *Ae. vexans* and *Oc. caspius s.l.* in this area. Among eight species reported in this study, six species had previously been recorded<sup>5</sup>, and only two species are new. *Culex perexiguus* and *Cx. tritaeniorhynchus* have not been found throughout this investigation. The occurrence of *Ae. vexans* and *Oc. caspius s.l.*, in the province was not mentioned before<sup>5</sup>, although these were reported in many parts of Iran<sup>10</sup>. Two species of *Ae. vexans* and *Oc. caspius s.l.* were differentiated from each other in the larval stage<sup>8</sup>. There is no information about the *Oc. caspius* sibling species (A or B) in the country<sup>3</sup>.

The species of *Cs. longiareolata* was one of the most frequent culicine mosquito collected at the Sanandaj, with total number of 982 specimens, by larval collection, however, this species was collected in low numbers in adult collections. *Culex pipiens* can be separated from *Cx. torrentium* and *Cx. vegans* by Harbach's key using seta 1-III-V, seta 1-M, seta 1-X, seta 1-C, and some other characters<sup>11</sup>. Based on this key, in the current survey only *Cx. pipiens* was identified.

Results of this survey are almost the same as those of previous study in Kurdistan province<sup>5</sup>. It should be mentioned that in this study, other culicine mosquitoes were collected being potential vectors of human and domesticated animal pathogens, such as *Oc. caspius s.l.* and *Ae. vexans*<sup>7,11</sup>. *Culex theileri* was one of the culicinae mosquitoes collected and is the more prevalent species at higher altitudes and in rural areas of Isfahan<sup>12</sup>, Zanjan<sup>13</sup> and East Azerbaijan provinces<sup>14</sup>.

In this study, peak blood feeding activity of *Oc. caspius s.l.* was around 2000 to 2300 hrs. Our findings conform with those of a previous study in Zarrin-Shar and Mobarakeh areas in Isfahan province, in the central part of Iran<sup>12</sup>. Results of this research are in line with those of Mousa kazemi who reported that the *Cx. theileri* was active during the night, whereas *Ae. vexans* and *Cs. subochrea* were active from 0200 to 0500 hrs.

Observations made during the present study agree with those of Simsek who noted that *Cx. theileri* in Turkey prefers large natural larval habitats that are generally present in rural areas<sup>15</sup>. Presence of river can lead to explore new sites like pools, swamps and grasslands that permit the recognition of a large number of Culicinae mosquitoes. It is worth to note that another study also reported formation of pools, swamps and grasslands which can lead to proliferation of new species of culicinae<sup>16</sup>. Therefore, as environmental factors keep on changing, monitoring should be done constantly and their ecology needs to be studied extensively.

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