Original Article

Fauna and Checklist of Mosquitoes (Diptera: Culicidae) of East Azerbaijan Province, Northwestern Iran

MR Abai[1], *S Azari-Hamidian[2], H Ladonni[1], M Hakimi[1], K Mashhadi-Esmail[1], K Sheikhzadeh[3], A Kousha[3], H Vatandoost[1]

[1] Department of Medical Entomology and Vector Control, School of Public Health, Medical Sciences/ University of Tehran, Iran
[2] School of Public Health, Guilan University of Medical Sciences, Rasht, Iran
[3] Tabriz Health Center, Tabriz University of Medical Sciences, Tabriz, Iran

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Abstract

In order to study the mosquito (Diptera: Culicidae) fauna of East Azerbaijan Province, some samplings were carried out by dipping method for the larvae and hand catch, night biting catch, total catch, and shelter pit collection as well as using window trap for the adults during June, July, and August 2004 plus July and August 2005. In total, 1305 adult mosquitoes and 603 larvae were collected. Seven genera and 15 species were identified in the province including; *Anopheles claviger*, *An. hyrcanus*, *An. maculipennis* s.l., *An. pseudopictus*, *An. sacharovi*, *An. superpictus*, *Aedes vexans*, *Coquillettidia richiardii*, *Cx. pipiens*, *Cx. theileri*, *Cx. tritaeniorhynchus*, *Culiseta longiareolata*, *Cs. subochrea*, *Ochlerotatus caspius* s.l., and *Uranotaenia unguiculata*. *An. maculipennis* complex, *Cx. pipiens*, and *Cx. theileri* were the most prevalent and widely distributed species. *An. pseudopictus*, *Ae. vexans*, and *Cq. richiardii* are reported for the first time in East Azerbaijan Province and a checklist for the mosquitoes of the province is also presented. Among the mosquitoes of the province, there are many potential vectors of human and domesticated animal pathogens that their ecology needs to be studied extensively.

Keywords: Fauna, Iran, Mosquito, Species checklist

Introduction

The mosquito fauna of Iran includes seven genera, 64 species, and 3 subspecies. The records of 12 other species need to be verified (Azari-Hamidian 2007).

By now, five genera and 19 species of mosquitoes have been recorded in East Azerbaijan Province by different investigators (Beklemishev and Gontaeva 1943, Zolotarev 1945, Kalandadze and Kaviladze 1947, Dow 1953, Minar 1974, Danilov 1975, Saebi 1987, Zaim 1987, Harbach 1988, Vatandoost et al. 2005). Six species of *Anopheles* Meigen have been recorded in the province (Beklemishev and Gontaeva 1943, Zolotarev 1945, Kalandadze and Kaviladze 1947, Dow 1953, Saebi 1987) including; *An. claviger* (Meigen), *An. hyrcanus* (Pallas), *An. maculipennis* Meigen, *An. pseudopictus* Grassi, *An. sacharovi* Favre, *An. superpictus* Grassi. Of the Maculipennis Group, *An. sacharovi* has been recorded in the province by Beklemishev and Gontaeva (1943) along with Dow (1953) and *An. maculipennis* by Zolotarev (1945) plus Dow (1953) based on egg pattern as well as by Djadid et al. (2007) using Polymerase Chain Reaction (PCR) technique. There is no published reference about the occurrence of *An. pseudopictus* in this province (Azari-Hamidian et al. 2006). Kalandadze and Kaviladze (1947) reported *Ochlerotatus caspius* (Pallas) s.l. and *Oc. dorsalis* (Meigen) in the province. *Oc. dorsalis* has not been found in Iran recently. Zaim and Cranston (1986) did not mention this spe-

*Corresponding author: S Azari-Hamidian, Tel/Fax: +98 131 3229599, E-mail: azari@gums.ac.ir

cies in their checklist of Iranian Culicinae. The occurrence of this species in Iran needs to be verified. Dow (1953) reported *Uranotaenia unguiculata* Edwards in this province. Zaim (1987) mentioned seven species of *Culex* L. and three species of *Culiseta* Felt in the province as follows: *Culex modestus* Ficalbi, *Cx. mimeticus* Noe, *Cx. perexiguus* Theobald, *Cx. theileri* Theobald, *Cx. tritaeniorhynchus* Giles, *Cx. hortensis* Ficalbi, *Cx. pipiens* L., *Culiseta longiareolata* (Macquart), *Cs. alaskaensis* Ludlow, and *Cs. subochrea* (Edwards). There is only one recent study on the mosquitoes in the province in relation to malaria and anophelines (Vatandoost et al. 2005).

As mentioned above, the data on the mosquitoes of East Azerbaijan Province are mostly old and scattered. In order to study the mosquito fauna and providing a primary checklist, an investigation was carried out in the province.

Materials and Methods

Study area

East Azerbaijan Province is located in northwestern Iran between 39º 26´- 36º 45´ N latitudes and 45º 5´- 48º 22´ E longitudes and has mostly foothill and mountainous areas with an area of approximately 45490 square kilometers. The province is bounded by the Republic of Azerbaijan and Armenia in the north, West Azerbaijan Province in the west and the south, Zanjan Province in the south, and Ardebil Province in the east. This province formally includes 19 counties. The center of the province, Tabriz City, is in almost 1360 m above sea level. The average annual rainfall is about 300 mm. The average relative humidity changes are from 44% (12:30 pm) to 67% (6:30 pm). The averages of the maximum and minimum temperatures are 17.7 °C and 6.8 °C, respectively, and the average temperature is 12.3 °C (these are 30 year data from Tabriz Synoptic Station). The province includes arid and semi-arid climates. The main occupations in rural areas are agriculture and husbandry and in urban, service, business, and industry.

Specimen and data collection

To study the mosquito fauna, sampling was carried out in East Azerbaijan Province by dipping method for collecting larvae and hand catch, night biting catch on human, cow, and donkey, total catch, and shelter pit collection and using window trap for the adults during June, July, as well as August 2004 and July plus August 2005. The specimens were collected from six counties in the different topographical and climatic areas of the province including: Ahar, Ajabshir, Jolfa, Kaleibar, Maragheh, and Tabriz Counties. In addition, some adult mosquitoes were reared from the pupae. The larvae were preserved in lactophenol and the microscopic slides of the preserved larvae were prepared using Berlese medium. The adult mosquitoes were pinned. The adult specimens and the third and fourth stage larvae were identified using the keys of Shahgudian (1960), Zaim and Cranston (1986), Harbach (1988), and Darsie and Samanidou-Voyadjoglou (1997). Mosquito name abbreviations are cited based on Reinert (2001).

Results

Totally 1305 adult mosquitoes and 603 larvae were collected and seven genera along with 15 species were identified, including; *An. claviger*, *An. hyrcanus*, *An. maculipennis* s.l., *An. pseudopictus*, *An. sacharovi*, *An. superpictus*, *Aedes vexans* (Meigen), *Coquillettidia richiardii* (Ficalbi), *Cx. pipiens*, *Cx. theileri*, *Cx. tritaeniorhynchus*, *Cs. longiareolata*, *Cs. subochrea*, *Oc. caspius* s.l., and *Ur. unguiculata*. These species were collected from the mountainous areas of the province on 12 occasions in June-August 2004 and on 11 occasions in July and August 2005. *Aedes vexans* and *Cq. richiardii* are recorded for the first time in East Azerbaijan Province and this is the first formal report of *An. pseudopictus* in the province. *Uranotaenia unguiculata*

was collected only in the larval stage and *Ae. vexans, Cq. richiardii, Cx. tritaeniorhynchus,* and *Cs. subochrea* only in the adult stage. *Anopheles maculipennis* complex, *Cx. pipiens,* and *Cx. theileri* were the most prevalent species and collected in almost all of the counties, but *An. claviger, An. hyrcanus, An. pseudopictus, Ae. vexans, Cq. richiardii, Cx. tritaeniorhynchus, Cs. subochrea,* and *Oc. caspius* s.l. were collected only in Kaleibar County (Table 1 and 2). *Anopheles maculipennis* s.l., *An. sacharovi, Cx. pipiens, Cx. theileri,* and *Oc. caspius* s.l. were collected by different methods, but *An. claviger, An. pseudopictus,* and *Ae. vexans* by hand catch plus night biting catch; *An. hyrcanus, An. superpictus, Cx. tritaeniorhynchus,* and *Cs. longiareolata* only by hand catch; and *Cq. richiardii* along with *Cs. subochrea* only by night biting catch. *Aedes vexans, Cq. richiardii,* and *Cs. subochrea* were collected from only outdoors and *An. hyrcanus, An. superpictus, Cx. tritaeniorhynchus,* and *Cs. longiareolata* from only indoors and other species from both indoors and outdoors (Table 3). Composition and localities of the adult mosquitoes collected in this survey are shown in Table 1. Composition and localities of the larvae of mosquitoes collected in this survey are shown in Table 2. The adult mosquitoes collected by different methods are shown in Table 3.

The checklist of mosquitoes of East Azerbaijan Province is given below. *Ochlerotatus dorsalis* is not mentioned here. As it was explained before the occurrence of this species in Iran needs to be verified (The first and new formal records are shown by*):

1- *Anopheles claviger* (Meigen, 1804)
2- *An. hyrcanus* (Pallas, 1771)
3- *An. maculipennis* Meigen, 1818
4- *An. pseudopictus* Grassi, 1899 *
5- *An. sacharovi* Favre, 1903
6- *An. superpictus* Grassi, 1899
7- *Aedes vexans* (Meigen, 1830) *
8- *Coquillettidia richiardii* (Ficalbi, 1889) *
9- *Culex hortensis* Ficalbi, 1889
10- *Cx. mimeticus* Noe, 1899
11- *Cx. modestus* Ficalbi, 1889
12- *Cx. perexiguus* Theobald, 1903
13- *Cx. pipiens* Linnaeus, 1758
14- *Cx. theileri* Theobald, 1903
15- *Cx. tritaeniorhynchus* Giles, 1901
16- *Culiseta alaskaensis* Ludlow, 1906
17- *Cs. longiareolata* (Macquart, 1838)
18- *Cs. subochrea* (Edwards, 1921)
19- *Ochlerotatus caspius* (Pallas, 1771) s.l.
20-*Uranotaenia unguiculata* Edwards, 1913

Table 1. Composition and localities of the adult mosquitoes collected in East Azerbaijan Province during June, July, and August 2004 and July and August 2005

Species	County					No.	%
	Ahar	Ajabshir	Kaleibar	Maragheh	Tabriz		
An. claviger	-	-	3	-	-	3	0.2
An. hyrcanus	-	-	1	-	-	1	0.1
An. maculipennis s.l.	20	-	266	-	4	290	22.2
An. pseudopictus	-	-	94	-	-	94	7.2
An. sacharovi	-	-	427	-	-	427	32.7
An. superpictus	-	-	70	-	20	90	6.9
Ae. vexans	-	-	16	-	-	16	1.2
Cq. richiardii	-	-	1	-	-	1	0.1
Cx. pipiens	-	23	31	16	12	82	6.3
Cx. theileri	4	48	126	10	5	193	14.8
Cx. tritaeniorhynchus	-	-	1	-	-	1	0.1
Cs. longiareolata	-	-	-	2	47	49	3.7
Cs. subochrea	-	-	1	-	-	1	0.1
Oc. caspius s.l.	-	-	57	-	-	57	4.4
Total	24	71	1094	28	88	1305	100

Table 2. Composition and localities of the larvae of mosquitoes collected in East Azerbaijan Province during June, July, and August 2004 and July and August 2005

Species	County						No.	%
	Ahar	Ajabshir	Jolfa	Kaleibar	Maragheh	Tabriz		
An. claviger	-	-	-	57	-	-	57	9.4
An. hyrcanus	-	-	-	1	-	-	1	0.2
An. maculipennis complex	17	-	1	49	20	-	87	14.4
An. pseudopictus	-	-	-	9	-	-	9	1.5
An. superpictus	-	-	-	-	-	28	28	4.7
Cx. pipiens	28	1	-	-	20	15	64	10.6
Cx. theileri	51	19	2	2	31	40	145	24.0
Cs. longiareolata	16	-	-	-	-	17	33	5.5
Oc. caspius s.l.	-	-	-	175	-	-	175	29.0
Ur. unguiculata	3	-	-	1	-	-	4	0.7
Total	115	20	3	294	71	100	603	100

Table 3. The adult mosquitoes collected by different methods in East Azerbaijan Province during June, July, and August 2004 and July and August 2005

Species	Collecting method							
					Night biting catch on			
	Hand catch	Total catch	Shelter pit collection	Window trap	Human	Cow	Donkey	Rearing pupa
An. claviger	2	-	-	-	1	-	-	-
An. hyrcanus	1	-	-	-	-	-	-	-
An. maculipennis s.l.	265	7	16	-	-	2	-	-
An. pseudopictus	8	-	-	-	84	2	-	-
An. sacharovi	403	2	12	-	6	4	-	-
An. superpictus	70	-	-	-	-	-	-	20
Ae. vexans	4	-	-	-	6	6	-	-
Cq. richiardii	-	-	-	-	1	-	-	-
Cx. pipiens	12	6	16	1	6	1	-	40
Cx. theileri	5	-	7	1	105	10	2	63
Cx. tritaeniorhynchus	1	-	-	-	-	-	-	-
Cs. longiareolata	1	-	-	-	-	-	-	48
Cs. subochrea	-	-	-	-	-	1	-	-
Oc. caspius s.l.	7	-	4	-	18	28	-	-
Total	779	15	55	2	227	54	2	171

Discussion

Seven genera and 15 species of mosquitoes were identified from East Azerbaijan Province, including the first record of *Ae. vexans*, and *Cq. richiardii* and the first formal report of *An. pseudopictus* in the province.

All six species of *Anopheles*, which had already been recorded in East Azerbaijan Province, were also collected in this investigation. However, the occurrence of *An. pseudopictus* in the province was mentioned only in the unpublished documents of the School of Public Health (SPH) and the Institute of Public Health Research (IPHR) as a variety or subspecies of *An. hyrcanus* (Azari-Hamidian et al. 2006). Some recent investigations mentioned only *An. hyrcanus* in northwestern Iran (Yaghoobi-Ershadi et al. 2001, Vatandoost et al. 2005), though many references counted *An. pseudopictus* as the more common species of the Hyrcanus Group in northern Iran (Dow 1953, Minar 1974, Azari-Hamidian et al. 2006). The present study confirms these observations. It seems that those investigations, mentioned *An. hyrcanus*, referred to the Hyrcanus Group indeed and did not differentiate *An. hyrcanus* from *An. pseudopictus*. These species can easily be separated using hindtarsomere 4 in the adult stage (Azari-Hamidian et al. 2006). In this study, these species were differentiated from each other in the larval stage based on seta 2-C using Darsie and Samanidou-Voyadjoglou's key (1997). This seta is simple in *An. pseudopictus*, but it has some short apical branches in *An. hyrcanus*. Recently, *An. superpictus* was mentioned as a complex in Iran (Oshaghi et al. 2004). The biosystematics of this species needs to be studied more in the country.

Two species of the tribe Aedini including; *Ochlerotatus caspius* s.l. and *Oc. dorsalis* (as a subspecies of *Oc. caspius*) were recorded in East Azerbaijan Province (Kalandadze and Kaviladze 1947). There is no information about the *Oc. caspius* sibling species (A or B) in the country (Azari-Hamidian 2007). In this study, *Ae. vexans*, for the first time, and *Oc. caspius* s.l. were found in the province.

The genus *Coquillettidia* Dyar, with its unique species *Cq. richiardii* in Iran, has been found in Mazandaran, Guilan, Ardebil, and probably Kurdistan Provinces (Azari-Hamidian 2007 and Azari-Hamidian, unpublished data). This is the first record of this species in East Azerbaijan Province.

Three species of *Culex* were found in this study (out of seven previously recorded species in the province). Based on Zaim and Cranston's (1986) key, the larval stages of *Cx. pipiens*, *Cx. torrentium*, and *Cx. vagans* are not distinguishable from each other, but they can be separated by Harbach's (1988) key using seta 1-III-V, seta 1-M, seta 1-X, seta 1-C, and some other characters. Among the available specimens from East Azerbaijan Province only *Cx. pipiens* was identified.

Two species of *Culiseta*, *Cs. longiareolata* and *Cs. subochrea*, were found in this investigation. Kalandadze and Kaviladze (1947) found both *Cs. annulata* and *Cs. subochrea* (as a subspecies of *Cs. annulata*) in West Azerbaijan Province and *Cs. subochrea* in East Azerbaijan Province. They mentioned that the record of *Cs. annulata* in Iran was the first one. Zaim and Cranston (1986) included *Cs. annulata* in their checklist and *Cs. subochrea* in their keys. The taxonomy and distribution of these two species need to be investigated more in Iran (Azari-Hamidian 2007).

Mosquitoes, especially *Anopheles*, have been studied in Iran and East Azerbaijan Province mostly in relation to malaria. There are many potential vectors of human and domesticated animal pathogens, such as *Ae. vexans*, *Cx. pipiens*, *Cx. theileri*, *Cx. tritaeniorhynchus*, and *Oc. caspius* s.l. (Horsfall 1955, Harbach 1988), among the mosquitoes of the province that their ecology need to be studied extensively. In this study several methods of collection were used in different areas of East Azerbaijan Province to show the diversity of the collected mosquito species. However, more mosquito surveillance

is needed in the province to interpret different aspects of their ecology such as composition, prevalence, active season, host preference, and larval habitat.

All specimens are deposited in the Medical Arthropod Museum at the School of Public Health, Tehran University of Medical Sciences, Iran.

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