

Original Article

Mosquito (Diptera: Culicidae) Fauna of Qom Province, Iran

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(Received 18 Sep 2010; accepted 8 Jun 2011)

Abstract

Background: There is very little information about the mosquito fauna of Qom Province, central Iran. By now only three species; *Anopheles claviger*, *An. multicolor*, and *An. superpictus* have been reported in the province. To study mosquito fauna and providing a primary checklist, an investigation was carried out on a collection of mosquitoes in this province.

Methods: To study the mosquito (Diptera: Culicidae) fauna, larval collections were carried out from different habitats on 19 occasions using the standard dipping technique during spring and summer 2008 and 2009.

Results: In total, 371 mosquito larvae were collected and morphologically identified including 14 species representing four genera: *Anopheles claviger*, *An. marteri*, *An. turkhudi*, *An. superpictus*, *Culex arbieeni*, *Cx. hortensis*, *Cx. mimeticus*, *Cx. modestus*, *Cx. pipiens*, *Cx. territans*, *Cx. theileri*, *Culiseta longiareolata*, *Cs. subochrea*, and *Ochlerotatus caspius s.l.* All species except for *An. claviger* and *An. superpictus* were collected for the first time in the province. All larvae were found in natural habitats. The association occasions and percentages of the mosquito larvae in Qom Province were discussed.

Conclusion: There are some potential or proven vectors of different human and domesticated animal pathogens in Qom Province. The ecology of these species and the unstudied areas of Qom Province need to be investigated extensively.

Keywords: *Anopheles*, *Culex*, *Culiseta*, *Ochlerotatus*, larvae, taxonomy

Introduction

According to the most recent classification of mosquitoes, the family Culicidae (Diptera) includes two subfamilies, 11 tribes, 111 genera, and 3523 species in the world fauna and the genus *Anopheles* Meigen includes seven subgenera and at least 464 species (Harbach 2007). The mosquito fauna of Iran includes seven genera, 64 species, and 3 subspecies and the records of 12 other species need to be verified (Azari-Hamidian 2007). Recently, Oshaghi et al. (2008) introduced *An. superpictus* Grassi as a species complex including three genotypes X, Y, and Z and Djadid et al. (2009) introduced a

new species of the Hyrcanus Group based on PCR techniques in the country. Malaria is the most important mosquito-borne disease in Iran and seven species of the genus *Anopheles*: *An. culicifacies* Giles s.l., *An. dthali* Patton, *An. fluviatilis* James s.l., *An. maculipennis* Meigen s.l., *An. sacharovi* Favre, *An. stephensi* Liston, and *An. superpictus* are known its proven vectors in Iran, also *An. pulcherrimus* Theobald is mentioned a suspected vector of malaria in southeastern Iran (Edrissian 2006). Eshghy (1977) observed *Plasmodium* oocysts in *An. multicolor* Cambouliu, but sporozoites have not been found

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in this species and it is not considered a vector in the country. Recently, Djadid et al. (2009) reported *An. hyrcanus* (Pallas) a potential vector of *P. falciparum* based on nested PCR in Guilan Province. West Nile and Sindbis viruses have been reported in Iran (Naficy and Saidi 1970). There is no information about their vectors in the country. The possibility of some mosquito-borne arboviral outbreaks like Japanese encephalitis and Rift Valley fever in the WHO Eastern Mediterranean Region, including Iran, is noteworthy (WHO 2004). There are some doubtful old records of Dengue fever in Iran (Foote and Cook 1959), however there is no formal recent record of this virus in the country. The mosquito-borne filariae: *Dirofilaria* (dirofilariasis) and *Setaria* (setariasis) (Spirurida: Onchocercidae) have been reported in Iran (Eslami 1997, Azari-Hamidian et al. 2007). *Anopheles maculipennis* and *Culex theileri* Theobald are known vectors of *Setaria labiatopapillosa* and *Dirofilaria immitis* respectively, in Ardebil Province, northwestern Iran (Azari-Hamidian et al. 2009).

In 1996, Qom Province was formally separated from Tehran Province. There is very little information about the mosquito fauna of Qom Province. Macan (1950) found *An. multicolor* larvae in “Darya-i-Namak” (Namak Lake, Salt Lake, or Qom Lake) (Fig. 1) and showed this species and *An. superpictus* around Qom in the distributional maps. In the document of the former Institute of Malariology and Parasitology (present National Institute of Health Research) (1953) *An. multicolor* was recorded around Qom. Saebi (1987) showed the occurrence of *An. superpictus* in Qom in the distributional map of the species. Recently, Farzinnia et al. (2010) reported *An. claviger* (Meigen) for the first time in the province. As the authors know there is no other documented information on the mosquitoes of Qom Province.

To study mosquito fauna and providing a primary checklist, an investigation was

carried out on a collection of mosquitoes in Qom Province.

Materials and Methods

Study area

Qom Province is bounded by Tehran Province in the north, Isfahan Province in the south, Semnan Province in the east, and Markazi Province in the west with an area of approximately 11240 square km (0.68% total area of Iran). The center of the province, Qom City, is almost 880 m above sea level. The province with arid climate has about 150 mm annual rainfall and is located between 34°09'–35°11' N latitude and 50°06'–51°58' E longitude and formally includes one county (Qom) and five districts: Jafarabad, Kahak, Khalajestan, Markazi (Qom), and Salafchegan (Fig. 1).

Specimen and data collection

In the present faunistic and cross-sectional investigation, larvae were collected from different habitats using the standard dipping technique (350 ml dipper) in nine stations (localities) of four districts; Kahak District (Emamzadeh Esmail and Dastgerd), Khalajestan District (Ahmadabad, Agholak, Dastjerd, and Ghahan), Markazi District (Ghomrood), and Salafchegan District (Ghal-e-cham and Rahjerd) on 19 occasions during spring and summer 2008 and 2009. The larvae were preserved in lactophenol and the microscope slides of the preserved larvae were prepared using de Faure's medium. The third- and fourth-instar larvae were identified using the keys of Shahgudian (1960), Zaim and Cranston (1986), Harbach (1988), and Azari-Hamidian and Harbach (2009). The mosquito name abbreviations follow Reinert (2009).

Results

In total, 371 mosquito larvae were periodically collected from four districts of Qom

Province during 2008–2009 and morphologically identified including 14 species representing four genera: *An. claviger*, *An. marteri* Senevet and Prunelle, *An. turkhudi* Liston, *An. superpictus*, *Culex arbieeni* Salem, *Cx. hortensis* Ficalbi, *Cx. mimeticus* Noe, *Cx. modestus* Ficalbi, *Cx. pipiens* Linnaeus, *Cx. territans* Walker, *Cx. theileri*, *Cu-*

liseta longiareolata (Macquart), *Cs. subochrea* (Edwards), and *Ochlerotatus caspius* (Pallas) s.l. (Table 1). The association occasions of the mosquito larvae in the province are shown in Table 2. The association percentages of the mosquito larvae in Qom Province are shown in Table 3. All larvae were collected from natural habitats.

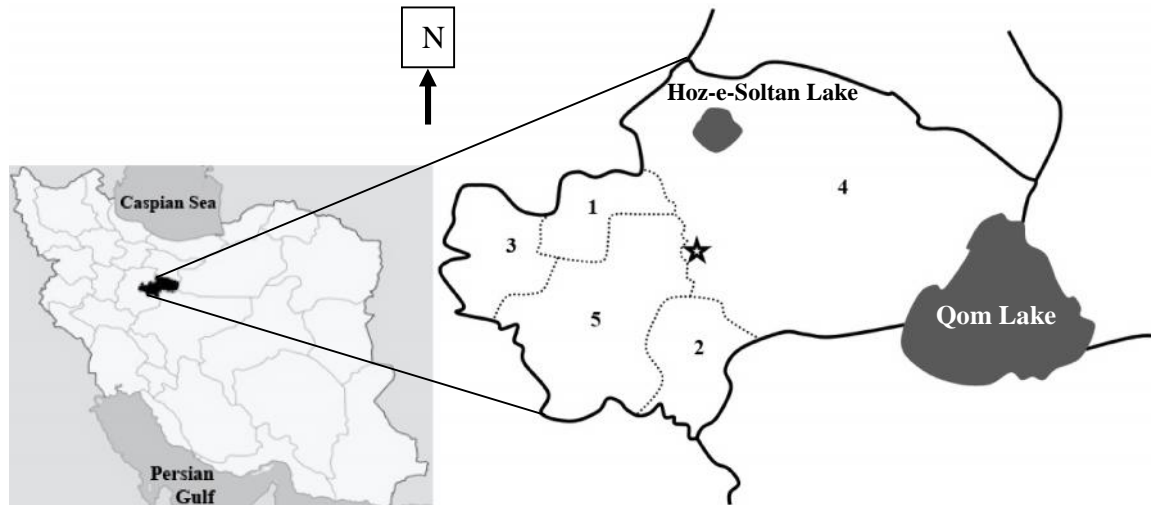


Fig. 1. Map of Iran, highlighting the position of Qom Province and its five districts: 1. Jafarabad, 2. Kahak, 3. Khalajestan, 4. Markazi, and 5. Salafchegan (★ Qom City)

Table 1. The distribution and composition of the mosquito larvae in nine localities of Qom Province, Iran, Spring–Summer 2008–2009

Species	Locality									n	%
	Agholak	Ahmadabad	Dastgerd	Dastjerd	Emanzadeh Esmail	Ghahan	Ghal-e- cham	Ghomrood	Rahjerd		
<i>An. claviger</i>	66	135	-	1	-	16	10	-	-	228	61.5
<i>An. marteri</i>	-	-	-	-	-	-	-	-	2	2	0.5
<i>An. superpictus</i>	-	-	12	-	20	-	-	-	-	32	8.6
<i>An. turkhudi</i>	-	-	7	-	-	-	-	-	-	7	1.9
<i>Cx. arbieeni</i>	-	-	1	-	-	-	-	-	-	1	0.3
<i>Cx. hortensis</i>	3	2	1	-	-	3	-	-	-	9	2.4
<i>Cx. mimeticus</i>	-	-	9	-	1	1	-	-	-	11	3.0
<i>Cx. modestus</i>	-	-	-	-	-	-	-	6	-	6	1.6
<i>Cx. pipiens</i>	-	-	-	-	-	-	-	13	-	13	3.5
<i>Cx. territans</i>	7	3	-	-	-	-	-	-	-	10	2.7
<i>Cx. theileri</i>	-	1	-	-	4	-	-	1	-	6	1.6
<i>Cs. longiareolata</i>	-	34	-	-	-	5	-	-	2	41	11.1
<i>Cs. subochrea</i>	1	-	-	-	-	-	-	1	-	2	0.5
<i>Oc. caspius s.l.</i>	-	-	-	-	-	-	-	3	-	3	0.8
Total	77	175	30	1	25	25	10	24	4	371	100

Table 2. The association occasions of the mosquito larvae in Qom Province, Iran, Spring–Summer 2008–2009

Species	Total occasions	<i>An. claviger</i>	<i>An. marteri</i>	<i>An. superpictus</i>	<i>An. turkhudi</i>	<i>Cx. arbieeni</i>	<i>Cx. hortensis</i>	<i>Cx. mimeticus</i>	<i>Cx. modestus</i>	<i>Cx. pipiens</i>	<i>Cx. territans</i>	<i>Cx. theileri</i>	<i>Cs. longiareolata</i>	<i>Cs. subochrea</i>	<i>Oc. caspius s.l.</i>
<i>An. claviger</i>	14	-	-	-	-	-	4	1	-	-	2	1	3	1	-
<i>An. marteri</i>	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
<i>An. superpictus</i>	2	-	-	-	1	1	1	2	-	-	-	1	-	-	-
<i>An. turkhudi</i>	1	-	-	1	-	1	1	1	-	-	-	-	-	-	-
<i>Cx. arbieeni</i>	1	-	-	1	1	-	1	1	-	-	-	-	-	-	-
<i>Cx. hortensis</i>	5	4	-	1	1	1	-	2	-	-	1	1	2	1	-
<i>Cx. mimeticus</i>	3	1	-	2	1	1	2	-	-	-	-	1	1	-	-
<i>Cx. modestus</i>	1	-	-	-	-	-	-	-	-	1	-	1	-	1	1
<i>Cx. pipiens</i>	1	-	-	-	-	-	-	-	1	-	-	1	-	1	1
<i>Cx. territans</i>	2	2	-	-	-	-	1	-	-	-	-	-	1	1	-
<i>Cx. theileri</i>	3	1	-	1	-	-	1	1	1	1	-	-	-	1	1
<i>Cs. longiareolata</i>	4	3	1	-	-	-	2	1	-	-	1	-	-	-	-
<i>Cs. subochrea</i>	2	1	-	-	-	-	1	-	1	1	1	1	-	-	1
<i>Oc. caspius s.l.</i>	1	-	-	-	-	-	-	-	1	1	-	1	-	1	-

Table 3. The association percentages of the mosquito larvae in Qom Province, Iran, Spring–Summer 2008–2009

Species association	Abundance n (%)
<i>An. claviger</i>	
<i>Cx. hortensis</i> , <i>Cx. theileri</i>	89 (39.0)
Alone	67 (29.4)
<i>Cx. hortensis</i> , <i>Cx. territans</i> , <i>Cs. subochrea</i>	59 (25.9)
<i>Cx. territans</i> , <i>Cs. longiareolata</i>	5 (2.2)
<i>Cx. hortensis</i> , <i>Cx. mimeticus</i> , <i>Cs. longiareolata</i>	5 (2.2)
<i>Cx. hortensis</i> , <i>Cs. longiareolata</i>	3 (1.3)
Total	228 (100)
<i>An. marteri</i>	
<i>Cs. longiareolata</i>	2 (100)
<i>An. superpictus</i>	
<i>Cx. mimeticus</i> , <i>Cx. theileri</i>	20 (62.5)
<i>An. turkhudi</i> , <i>Cx. arbieeni</i> , <i>Cx. hortensis</i> , <i>Cx. mimeticus</i>	12 (37.5)
Total	32 (100)
<i>An. turkhudi</i>	
<i>An. superpictus</i> , <i>Cx. arbieeni</i> , <i>Cx. hortensis</i> , <i>Cx. mimeticus</i>	7 (100)
<i>Cx. arbieeni</i>	
<i>An. superpictus</i> , <i>An. turkhudi</i> , <i>Cx. hortensis</i> , <i>Cx. mimeticus</i>	1 (100)
<i>Cx. hortensis</i>	
<i>An. claviger</i> , <i>Cx. territans</i> , <i>Cs. subochrea</i>	3 (33.4)
<i>An. claviger</i> , <i>Cx. mimeticus</i> , <i>Cs. longiareolata</i>	3 (33.3)
<i>An. superpictus</i> , <i>An. turkhudi</i> , <i>Cx. arbieeni</i> , <i>Cx. mimeticus</i>	1 (11.1)
<i>An. claviger</i> , <i>Cs. longiareolata</i>	1 (11.1)
<i>An. claviger</i> , <i>Cx. theileri</i>	1 (11.1)
Total	9 (100)

Table 3. Countinued...

<i>Cx. mimeticus</i>	
<i>An. superpictus</i> , <i>An. turkhudi</i> , <i>Cx. arbieeni</i> , <i>Cx. hortensis</i>	9 (81.8)
<i>An. claviger</i> , <i>Cx. hortensis</i> , <i>Cs. longiareolata</i>	1 (9.1)
<i>An. superpictus</i> , <i>Cx. theileri</i>	1 (9.1)
Total	11 (100)
<i>Cx. modestus</i>	
<i>Cx. pipiens</i> , <i>Cx. theileri</i> , <i>Cs. subochrea</i> , <i>Oc. caspius s.l.</i>	6 (100)
<i>Cx. pipiens</i>	
<i>Cx. modestus</i> , <i>Cx. theileri</i> , <i>Cs. subochrea</i> , <i>Oc. caspius s.l.</i>	13 (100)
<i>Cx. territans</i>	
<i>An. claviger</i> , <i>Cx. hortensis</i> , <i>Cs. subochrea</i>	7 (70)
<i>An. claviger</i> , <i>Cs. longiareolata</i>	3 (30)
Total	10 (100)
<i>Cx. theileri</i>	
<i>An. superpictus</i> , <i>Cx. mimeticus</i>	4 (66.6)
<i>Cx. modestus</i> , <i>Cx. pipiens</i> , <i>Cs. subochrea</i> , <i>Oc. caspius s.l.</i>	1 (16.7)
<i>An. claviger</i> , <i>Cx. hortensis</i>	1 (16.7)
Total	6 (100)
<i>Cs. longiareolata</i>	
<i>An. claviger</i> , <i>Cx. hortensis</i>	26 (63.4)
<i>An. claviger</i> , <i>Cx. territans</i>	8 (19.5)
<i>An. claviger</i> , <i>Cx. hortensis</i> , <i>Cx. mimeticus</i>	5 (12.2)
<i>An. marteri</i>	2 (4.9)
Total	41 (100)
<i>Cs. subochrea</i>	
<i>An. claviger</i> , <i>Cx. hortensis</i> , <i>Cx. territans</i>	1 (100)
<i>Cx. modestus</i> , <i>Cx. pipiens</i> , <i>Cx. theileri</i> , <i>Oc. caspius s.l.</i>	1 (100)
Total	2 (100)
<i>Oc. caspius s.l.</i>	
<i>Cx. modestus</i> , <i>Cx. pipiens</i> , <i>Cx. theileri</i> , <i>Cs. subochrea</i>	3 (100)

Discussion

In the present study, 371 mosquito larvae representing 14 species in four genera were collected from Qom Province. All species except for *An. claviger* and *An. superpictus* were collected for the first time in the province. *Anopheles multicolor*, which was recorded in Qom Province before (Macan 1950, Institute of Malariology and Parasitology 1953), was not found among the samples of this investigation.

Among the collected species, *An. superpictus*, *Cx. hortensis*, *Cx. mimeticus*, *Cx. pipiens*, *Cx. theileri*, *Cs. longiareolata*, *Cs. subochrea*, and *Oc. caspius s.l.* are widespread in Iran (Institute of Malariology and

Parasitology 1953, Gaffary 1954, Saebi 1987, Zaim 1987, Abai et al. 2007). *Anopheles claviger* was found almost everywhere in Iran, including 21 provinces (out of total 31), except for the eastern and southeastern areas of the country. *Anopheles marteri* was collected from 15 provinces other than those of eastern and southeastern Iran. *Anopheles turkhudi* is found in 15 provinces in central plateau, western, southwestern, eastern, southeastern, and southern Iran. *Anopheles multicolor*, which was not found in this investigation, however recorded around Qom before, was recorded in 14 provinces in central plateau, northeastern, eastern, southeastern,

and southern Iran (Institute of Malariology and Parasitology 1953, Gaffary 1954, Saebi 1987). *Culex arbieeni* was recorded in 9 provinces before: former Khorasan, Loristan, Chaharmahal and Bakhtiari, Yazd, Kerman, Sistan and Baluchistan, Hormozgan, Fars, and Bushehr (Zaim 1987). *Culex modestus* was collected from 6 provinces: Isfahan, East Azerbaijan, West Azerbaijan, Hormozgan (Zaim 1987), Ardebil (Azari-Hamidian et al. 2009), and North Khorasan (Azari-Hamidian et al. 2011). *Culex territans* was found in 6 provinces: Guilan, Kurdistan, former Khorasan, Isfahan, Hormozgan (Zaim 1987), and Sistan and Baluchistan (Lotfi 1973). Among the species, only *An. turkhudi* and *Cx. arbieeni* are not found in northern Iran including northwestern areas (West Azerbaijan, East Azerbaijan, and Ardebil Provinces), the Caspian Sea littoral (Guilan, Mazandaran, and Golestan Provinces), and northeastern areas (North Khorasan Province and northern Razavi Khorasan Province) (Institute of Malariology and Parasitology 1953, Gaffary 1954, Saebi 1987, Zaim 1987).

Oshaghi et al. (2008) reported three genotypes named X, Y, and Z within *An. superpictus* in Iran based on the second Internal Transcribed Spacer (ITS2) and Cytochrome c Oxidase subunit I (COI) sequence data. Genotype X was found in all parts of the country, including Qom Province, except for the southeastern areas. Genotypes Y and Z were only found in southeastern Iran including Kahnooj of southern Kerman Province and Sistan and Baluchistan Province.

Only two larvae, one the third instar, of *Cs. subochrea* were found in the present investigation (Table 1). Two close and rare species *Cs. subochrea* and *Cs. annulata* (Schrank) are very similar in larval stage; however they are easily distinguishable as adult. There is little information about taxonomy and distribution of three close species *Cs. alaskaensis* (Ludlow), *Cs. annulata*, and

Cs. subochrea in Iran (Azari-Hamidian and Harbach 2009).

Among the species which were found in the present study, *An. superpictus* is malaria vector in Iran (Edrissian 2006). *Culex theileri* is known vector of the canine heart worm nematode in Ardebil Province (Azari-Hamidian et al. 2009). In addition, *Cx. pipiens*, *Cx. theileri*, and *Oc. caspius s.l.* are known as the potential or proven vectors of different human and domesticated animal pathogens in different areas of the world (Gutsevich et al. 1974, Harbach 1988). The ecology of medically important species and the unstudied areas of Qom Province need to be investigated extensively.

Acknowledgements

The authors are grateful to Dr A Akbari, Dr A Abbasi, F Abedi-Astaneh, Qom Provincial Health Center, Qom University of Medical Sciences, Qom, for their kind collaborations. This study was financially supported by the Institute of Public Health Research, Academic Pivot for Education and Research, Tehran University of Medical Sciences: project No.: 241.83.77. The authors declare that they have no conflicts of interest.

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