

Original Article

The species composition of mosquitoes (Diptera: Culicidae) in the Mahshahr district, Khuzestan province, southwest of Iran

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Received 29 Jun 2013; accepted 01 Jul 2014

ABSTRACT

There is very little information about the mosquito fauna of Mahshahr district. The present study gives an overview of data on the species composition and distribution of mosquitoes in the Mahshahr district, Khuzestan province, southwest of Iran. In order to study the mosquito fauna, the samples were collected from May to November 2012 using dipping and total catch methods from seven villages (Soveireh, Hadid, Seraimeh, Meksar, Hashtcheh, Seyed Yahya and Maghtoo Sofla) and two towns (Shahrake Meghdad and Shahrake Dastgheib) in the Mahshahr district. Totally 1023 adult mosquitoes and 1618 larvae were collected and four genera along with eleven species of Culicidae were identified, including; *Anopheles stephensi* Liston, *An. superpictus* Grassi, *An. dthali* Patton, *An. pulcherrimus* Theobald, *Culex pusillus* Macquart, *Cx. quinquefasciatus* Say, *Cx. sitaiticus* Kirkpatrick, *Cx. theileri* Theobald, *Cx. perexiguus* Theobald, *Ochlerotatus caspius* Pallas and *Culiseta longiareolata* Macquart. There are some potential or proven vectors of different human and domesticated animal pathogens in Mahshahr district. The ecology of these species of Mahshahr district need to be investigated extensively.

Keywords: Species composition, Mosquito, *Anopheles*, *Culex*, *Culiseta*, *Ochlerotatus*, Mahshahr

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 (Saghafipour *et al* 2012). The mosquito fauna of Iran includes seven genera, 64 species, and 3 subspecies (Azari-Hamidian 2007a).

Oshaghi *et al.* (2008) recently identified *Anopheles superpictus* Grassi as a complex of 3 genotypes (X, Y, and Z), and Dinparast-Djadid *et al.* (2009) proposed a new species of the Hyrcanus group based on DNA sequence data. Naddaf *et al* (2010) reported *An. fluviatilis* James s.l. species U from Fars Province and were in doubt about the occurrence of the species (form) V in Iran (Azari-Hamidian 2007a), Mehravaran *et al.* (2011) also recorded species U in southeastern Iran. Malaria is the most important mosquito-borne

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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* Grassi are known its proven vectors in Iran (Edrissian 2006). Zaim et al. (1993) mentioned *An. pulcherrimus* Theobald as a potential vector of malaria in southeastern Iran. Eshghy (1977) observed *Plasmodium* oocysts in *An. multicolor* Comboulieu, but sporozoites have not been found in this species and it is not considered a vector in Iran. Recently, Dinparast-Djadid et al. (2009) reported *An. hyrcanus* Pallas a potential vector of *P. falciparum* based on Nested PCR in Guilan Province. Sindbis and West Nile viruses have been reported in Iran (Naficy & Saidi 1970, Saidi et al 1976, Sharifi et al 2010, Ahmadnejad et al 2011, Chinikar et al 2011, Fereidouni et al 2011). The mosquito borne filariae, *Dirofilaria* (dirofilariasis) (*Dirofilaria immitis* and *D. repens*), *Setaria* (setariasis) (*Setaria labiatopapillosa*, *S. digitata*, and *S. equina*), and *Diptaltonema evansi* (Camel filariasis) (Spirurida: Onchocercidae) are found in Iran (Eslami 1997, Azari-Hamidian et al 2007b, Maraghi et al 2006, Oryan et al 2008). *Anopheles maculipennis* Meigen s.l. and *Culex theileri* Theobald are known vectors of *Setaria labiatopapillosa* and *D. immitis* respectively, in Ardebil Province, northwestern Iran (Azari-Hamidian et al 2009). The possibility of some mosquito-borne arboviral outbreaks like Japanese encephalitis (JE) and Rift Valley Fever in the WHO Eastern Mediterranean Region, including Iran, is noteworthy (World Health Organization 2004). There are some doubtful old records of dengue fever in Iran (Foote & Cook 1959), Chinikar et al (2010) recently reported a case of Dengue Fever in Tehran, which had been imported from Malaysia (Kuala Lumpur). Apart from mosquito borne diseases, mosquitoes cause nuisances for both humans and animals when they are abundant. The data on the mosquitoes of Khuzestan province are mostly old and scattered, for example, the studies of Zaim & Cranston (1986) were conducted during a time of war between Iran and Iraq. Since then, the mosquito fauna

of much of the southwest of Iran has received little attention. Navidpour et al. (2012), identified five species of the subfamily culicinae from Shadegan wetland, south of Khuzestan province: *Cx. pipiens* Linnaeus, *Cx. tritaeniorhynchus* Giles, *Cx. sinaiticus* Kirkpatrick, *Cx. modestus* Ficalbi and *Oc. caspius* Pallas. There is no data available about the mosquito fauna of Mahshahr district. The present study gives an overview of data on the species composition and distribution of mosquitoes in the Mahshahr district, Khuzestan province, southwest of Iran.

MATERIALS AND METHODS

Study area. The Mahshahr district (30° 33' 32" N, 49° 11' 53" E at an altitude of about 3 m above sea level) with 7304 square kilometers and a population of approximately 289,785 people lies in the south of Khuzestan province; it is situated in the North of Ahvaz and Ramhormoz districts, in the eastern of Omidieh and Hendijan districts; in the west ends in the Shadegan district, and in the south ends in the Persian gulf. The weather is hot in the summer and moderate in the winter.

Specimen and data collection. To study the mosquito fauna, sampling was carried out by dipping technique for collecting larvae and pyrethrum space spray collection (PSSC) or total catch for adult mosquitoes during May, June, July, September, October and November 2012. The specimens were collected from seven villages (Soveireh, Hadid, Seraimeh, Meksar, Hashcheh, Seyed Yahya and Maghtoo Sofla) and two towns (Shahrake Meghdad and Shahrake Dastgheib) in the different topographical areas of the district. The larvae were preserved in Lactophenol and the microscopic slides of the preserved larvae were prepared using Liquid de Faure. 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), Azari-Hamidian and Harbach (2009). Mosquito name abbreviations were cited based on Reinert (2009).

RESULTS

A total of 1023 adult and 1618 larvae of Culicidae mosquitoes were collected, of which four genera and eleven species of Culicidae were recognized, namely *An. stephensi* Liston, *An. superpictus* Grassi, *An. dthali* Patton, *An. pulcherrimus* Theobald, *Cx. pusillus* Macquart, *Cx. quinquefasciatus* Say, *Cx. sitaiticus* Kirkpatrick, *Cx. theileri* Theobald, *Cx. perexiguus* Theobald, *Ochlerotatus caspius* Pallas and *Culiseta longiareolata* Macquart. Composition and localities of the larvae mosquitoes collected in this survey are shown in Table 1. Composition and localities of the adult of mosquitoes collected in this survey are shown in Table 2. *Anopheles stephensi* Liston (31.08%), *Cx. quinquefasciatus* Say (25.96%), and *Oc. caspius* Pallas (11.68%) were the most abundant species of the larval stage, and *An. stephensi* Liston (62.95%), *An. superpictus* Grassi (16.34%), and *Cx. pusillus* Macquart (10.26%) were the most abundant species of the adult stage. *Culex quinquefasciatus* Say and *Oc. caspius* Pallas were collected only in the larval stage, *Cx. theileri* Theobald, and *Cx. perexiguus* Theobald were collected only in the adult stage.

DISCUSSION

Eleven species representing 4 genera were collected and identified in Mahshahr district. *Anopheles (Cellia) stephensi* Liston is the main malaria vector in southern coastal areas of Iran (Edrissian 2006, Manouchehri et al 1992, Vatandoost et al 2006). The species includes three egg phenotypes: mysorensis, typical and intermediate, all exist in Iran (Oshaghi et al 2006). These egg phenotypes are natural variations and systematically considered inferasubspecific forms of the species (Azari-Hamidian 2007a, Azari-Hamidian et al 2010). The previous investigations have shown it to be the most prevalent anophelinae species in the malarious area of southern Iran. This species is reported from Bushehr, Fars, Hormozgan, Ilam, Kerman, Kermanshah, Khuzestan, Kohgiluyeh and Boyer-Ahmad, Lorestan, Sistan and Baluchestan provinces (Hanafi-

Bojd et al 2011). *Anopheles stephensi* Liston was the most frequent culicidae mosquito collected at Mahshahr, with total of 644 and 503 specimens, using PSSC and larval collection, respectively. *Anopheles (Cellia) superpictus* Grassi is considered as a major malaria vector in central plateau, and the secondary vector in the southern areas of the country (Edrissian 2006, Manouchehri et al 1992). Oshaghi et al (2007) reported two distinct morphological forms (A and B) of this species from Iran. While molecular analysis of mitochondrial DNA COI-COII region separated this *anopheles* into at least three genotypes X, Y and Z (Oshaghi et al 2008). *Anopheles superpictus* Grassi has a widespread distribution in Iran. The species is recorded in all provinces of the country, however there is no formal report of it from Qazvin province (Hanafi-Bojd et al 2011). The species *An. superpictus* Grassi was one of the anophelinae mosquitoes collected at Mahshahr, with total of 167 and 142 specimens by means of PSSC and larval collection, respectively. *Anopheles (Cellia) dthali* Patton is a secondary vector of malaria in southern Iran especially in mountainous areas of Hormozgan province (Vatandoost et al 2006, Manouchehri et al 1972, Manouchehri & Rohani 1975). It has been found in southern part of the Zagros chain and coastal area of the Persian Gulf (Vatandoost et al 2006, Manouchehri & Rohani 1975). This species is widespread throughout the coastal and mountainous areas with high density in mountain area. It is reported from Bushehr, Ilam, Isfahan, Kerman, Kermanshah, Khuzestan, Kohgiluyeh and Boyer-Ahmad, Lorestan, Sistan and Baluchestan and Yazd provinces (Hanafi-Bojd et al 2011). The species *An. dthali* Patton was one of the anophelinae mosquitoes collected at Mahshahr, with total of 16 and 70 specimens by means of PSSC and larval collection, respectively. *Anopheles (Cellia) pulcherrimus* Theobald is reported serologically positive to *Plasmodium falciparum* and *P. vivax* in Sistan and Baluchestan province and introduced as a suspected vector in that area (Zaim et al 2003, Ghavami et al 1997). This species is reported from Chaharmahal and Bakhtiari, Fars, Golestan,

Table1. Composition and localities of the larvae mosquitoes collected in Mahshahr district

Species	Location									NO	%
	Soveireh	Hadid	Seraimeh	Meksar	Hashcheh	Seyed Yahya	Maghtoo Sofla	Shahrake Meghdad	Shahrake Dastgheib		
<i>An. stephensi</i>	141	218	68	42	34	0	0	0	0	503	31.08
<i>An. superpictus</i>	20	109	5	8	0	0	0	0	0	142	8.78
<i>An. dthali</i>	33	16	0	21	0	0	0	0	0	70	4.33
<i>An. pulcherrimus</i>	4	9	2	0	0	0	0	0	0	15	0.93
<i>Cx. pusillus</i>	93	0	0	3	0	0	0	0	0	96	5.93
<i>Cx. quinquefasciatus</i>	0	0	0	0	0	0	0	242	178	420	25.96
<i>Cx. sinaiticus</i>	0	0	0	0	0	0	0	1	0	1	0.06
<i>Cs. longiareolata</i>	0	16	127	0	26	0	13	0	0	182	11.25
<i>Oc. caspius</i>	21	3	6	19	0	89	51	0	0	189	11.68
Total	312	371	208	93	60	89	64	243	178	1618	100

Table2. Composition and localities of the adult mosquitoes collected in Mahshahr district

Species	Location									NO	%
	Soveireh	Hadid	Seraimeh	Meksar	Hashcheh	Seyed Yahya	Maghtoo Sofla	Shahrake Meghdad	Shahrake Dastgheib		
<i>An. stephensi</i>	203	259	14	86	73	0	9	0	0	644	62.95
<i>An. superpictus</i>	42	70	19	33	3	0	0	0	0	167	16.34
<i>An. dthali</i>	4	9	2	0	1	0	0	0	0	16	1.56
<i>An. pulcherrimus</i>	0	16	0	0	3	0	0	0	0	19	1.86
<i>Cx. pusillus</i>	18	0	0	0	0	31	56	0	0	105	10.26
<i>Cx. sinaiticus</i>	2	0	0	0	0	0	0	0	0	2	0.19
<i>Cx. theileri</i>	19	0	0	0	0	11	2	0	0	32	3.13
<i>Cx. perexiguus</i>	16	0	7	0	0	0	0	0	0	23	2.25
<i>Cs. longiareolata</i>	0	0	15	0	0	0	0	0	0	15	1.46
Total	304	354	57	119	80	42	67	0	0	1023	100

Hormozgan, Ilam, Kermanshah, Khuzestan, Kohgiluyeh and Boyer-Ahmad, Mazandaran, North Khorasan and Sistan and Baluchistan provinces (Hanafi-Bojd *et al* 2011). The species *An. pulcherrimus* Theobald was one of the anophelinae mosquitoes collected at Mahshahr, with total of 19 and 15 specimens by means of PSSC and larval collection, respectively. *Culex (Barraudius) pusillus* Macquart reported from Bushehr, Khuzestan, Sistan and Baluchistan, Kerman and Hormozgan provinces (Zaim *et al* 1985). The species *Cx. pusillus* Macquart was one of the culicinae mosquitoes collected at Mahshahr, with total of 105 and 96 specimens by means of PSSC and larval collection, respectively. *Culex (Culex) quinquefasciatus* Say breeds in sewage system of the houses. This species is considered as a main nuisance mosquito in the country.

There are reports of disease transmission by *Cx. quinquefasciatus* Say in Iran (Vatandoost *et al* 2004). Saidi *et al* (1976) reported the transmission of sindbis virus by *Cx. quinquefasciatus* Say, subsequently Mobedi *et al* (1990) postulated that *Cx. quinquefasciatus* Say could be as a vector of microfilaria, *D. immitis*. This species is reported from Bushehr, Fars, Hormozgan, Kerman, Khuzestan, Sistan and Baluchistan (Zaim *et al* 1985) and Tehran provinces (Vatandoost *et al* 2004). The species *Cx. quinquefasciatus* Say was one of the most frequent culicinae mosquito collected at Mahshahr, with total number of 420 specimens by larval collection, however, this species was not collected in adult collection. *Culex quinquefasciatus* Say larvae were collected from two towns, but were not collected from

none villages. In other hand, this species was sampled abundantly in urban and suburban habitats. *Culex (Culex) sinaiticus* Kirkpatrick reported from Bushehr, Khuzestan, Sistan and Bluchestan, Fars, Kerman and Hormozgan provinces (Zaim et al 1985). The species *Cx. sinaiticus* Kirkpatrick was one of the culicinae mosquitoes collected at Mahshahr, with total of 2 and 1 specimen by means of PSSC and larval collection, respectively. *Culex (Culex) theileri* Theobald has been collected in all provinces of Iran (Zaim et al 1985). This species is known vector of the canine heart worm nematode (*D. immitis*), in Ardebil Province, northwestern Iran (Azari-Hamidian et al 2009). The species *Cx. theileri* Theobald was one of the culicinae mosquitoes collected at Mahshahr, with total number of 32 specimens by adult collection, however, this species was not collected in larval collection. *Culex (Culex) perexiguus* Theobald is recorded in majority of provinces of Iran, including Khuzestan province (Zaim et al 1985). The species *Cx. perexiguus* Theobald was one of the culicinae mosquitoes collected at Mahshahr, with total number of 23 specimens by adult collection, however, this species was not collected in larval collection. *Ochlerotatus (Ochlerotatus) caspius* Pallas has been collected in many provinces of Iran (Zaim et al 1984), but not in the southern province of Kerman (Azari-Hamidian et al 2005). This species are capable of transmitting West Nile Fever and other arboviruses. It is an anthropophilic mosquito that bites during the day and is capable of flying long distances (Navidpour et al 2012). The species *Oc. caspius* Pallas was one of the culicinae mosquitoes collected at Mahshahr, with total number of 189 specimens by larval collection, however, this species was not collected in adult collection. *Culiseta (Allotheobaldia) longiareolata* Macquart is recorded in all provinces of the country (Zaim et al 1986). Adults of this species never enter houses and rarely bite Man, so this species appears to be of no medical importance (Salit et al 1994). The species *Cs. longiareolata* Macquart was one of the culicinae mosquitoes collected at Mahshahr, with total of 15 and 182 specimens by means of PSSC and larval

collection, respectively. *Culex pipiens* Linnaeus, *Cx. tritaeniorhynchus* Giles and *Cx. modestus* Ficalbi had been previously reported by Navidpour et al (2012) in Shadegan wetland, whereas in this study have not been found in Mahshahr district. This investigation reveals certain aspects of the species composition and locality distribution of mosquitoes in the Mahshahr district. *Anopheles stephensi* Liston is most abundant and constant species. Among the species which were found in the present study, *An. stephensi* Liston, *An. superpictus* Grassi and *An. dthali* Patton are malaria vector in Iran, also *An. pulcherrimus* Theobald is probable vector of malaria in Iran (Edrissian 2006). In addition, *Cx. quinquefasciatus* Say, *Cx. theileri* Theobald, and *Oc. caspius* Pallas are known as the potential or proven vectors of different human and domesticated animal pathogens in different areas of the world (Moosa-Kazemi et al 2009, Saghafipour et al 2012, Vatandoost et al 2004), but *Cx. pusillus* Macquart, *Cx. sinaiticus* Kirkpatrick and *Cx. perexiguus* Theobald are of little medical importance, given the fact that they were not reported to transmit any pathogen (Harbach 1985, Harbach 1988). However, more mosquito surveillance is needed in the Mahshahr district to interpret different aspects of their ecology such as seasonal activity, host preference, and larval habitat. All specimens are deposited in the museum of the department of medical entomology and vector control, School of Health, Ahvaz Jundishapur University of Medical Sciences.

Ethics

I hereby declare all ethical standards have been respected in preparation of the submitted review article.

Conflict of Interest

The authors declare that they have no conflict of interest.

Grant Support

This study was financially supported by Student Research Committee, Ahvaz Jundishapur University of Medical Sciences (Project No.: 91s.35).

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