

Original Article

Culicinae (Diptera: Culicidae) Mosquitoes in Chabahar County, Sistan and Baluchistan Province, Southeastern Iran

*SH Moosa-Kazemi, H Vatandoost, H Nikookar, M Fathian

Department of Medical Entomology and Vector Control, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

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Abstract

Background: Mosquito-borne diseases are a major public health threat in Iran. The objective of this study was to determine the fauna of culicinae mosquitoes for future mosquito control programs.

Methods: Three genera and eleven species of the subfamily Culicinae (Diptera: Culicidae) were collected by dipping technique and identified in Chabahar County, Sistan and Baluchistan Province, southeastern Iran, during January, February, and March 2007.

Results: The collected species included: *Aedes vexans* (new occurrence record for the province), *Culex arbieeni*, *Cx. bitaeniorhynchus*, *Cx. deserticola*, *Cx. hortensis*, *Cx. perexiguus*, *Cx. pipiens*, *Cx. pseudovishnui*, *Cx. pusillus*, *Cx. quinquefasciatus*, *Cx. sinaiticus*, *Cx. theileri*, *Cx. tritaeniorhynchus*, *Culiseta longiareolata*, *Ochlerotatus caballus*, *Oc. caspius*, and *Uranotaenia unguiculata*.

Conclusion: Our observations indicate that, in South of Iran hot and wet climatic conditions support the persistence of culicinae mosquitoes. As our study, regular monitoring of culicinae mosquitoes in this area could be the most useful for mosquito control and mosquito-borne disease prevention.

Keywords: Culicinae, mosquito, fauna, Chabahar, Iran.

Introduction

Mosquito-borne diseases such as malaria, West Nile, Sindbis viruses, Japanese encephalitis, and Rift Valley fever are a major public health in some Asian countries (Yasoka and Levis 2007). Some of diseases such as malaria, West Nile, Sindbis as well as *Dirofilaria immitis* (dog heart worm) and *D. repens* (dirofilariasis) had been previously reported in Iran (Naficy and Saidi 1970, Saidi et al. 1976, Azari-Hamidian et al. 2007). Malaria transmission in Chabahar County occurs through the year, most of the malaria cases were observed from May to Nov almost in the age groups of 5-25 yr old (Moosa-Kazemi et al. 2006).

Malaria is transmitted by five species: *Anopheles culicifacies* Giles s.l., *An. dthali* Pat-

ton, *An. fluviatilis* James s.l., *An. stephensi* Liston and *An. superpictus* Grassi (Moosa-Kazemi et al. 2006). By now, 64 species, 3 subspecies, and 7 genera of mosquitoes have been reported in Iran (Azari-Hamidian 2007). Four genera of *Culex*, *Culiseta*, *Ochlerotatus*, *Uranotaenia* and 18 species of the subfamily Culicinae have been reported from Sistan and Baluchistan Province (Lotfi 1973, Zaim 1987). Zaim (1987) mentioned four genera and sixteen species of the subfamily Culicinae (Diptera: Culicidae) in Sistan and Baluchistan Province as follow: *Culex arbieeni* Salem, *Cx. bitaeniorhynchus* Giles, *Cx. deserticola* Kirkpatrick, *Cx. hortensis* Ficalbi, *Cx. perexiguus* Theobald, *Cx. pipiens* Linnaeus, *Cx. pusillus* Macquart, *Cx. pseudovishnui* Colless, *Cx. quinquefasciatus* Say, *Cx. sinaiticus* Kirkpatrick, *Cx. theil-*

eri Theobald, *Cx. tritaeniorhynchus* Giles, *Culiseta longiareolata* Macquart, *Ochlerotatus caballus* Theobald, *Oc. caspius* Pallas, and *Uranotaenia unguiculata* Edwards. It is noteworthy that *Culex mimeticus* and *Cx. territans* were found by Lotfi (1973) in this area.

There is only one recent study on the mosquitoes in the county in relation to malaria and anophelines (Moosa-Kazemi et al. 2006). While it is necessary to study mosquitoes in Chabahar, there are no more references on the culicine mosquitoes of the county. This paper presents the first report of the results of the recent surveys of the culicinae mosquitoes from samples taken from a range of larval breeding sites in which they occur in nature, and adult culicinae mosquitoes captured from various places.

The aim was to obtain new data, which would be valuable to develop programmes for future planning of mosquito control in this area of southeastern Iran.

Materials and Methods

To better understand the Culicinae fauna of Chabahar County and gather information on their distribution and the kinds of larval breeding sites in which they occur in nature, a field trial study was performed from Jan to Mar 2007 in Sistan and Baluchistan Province. This study took place in five randomly selected rural villages in Chabahar County (57°14'N, 26°19'E). The County is bounded by Pakistan in the east, Hormozgan Province in the west, Kerman Province in the north, and Oman Sea in the south (Fig. 1). In 2007, the max and min mean monthly temperature was 33 °C and 5.5 °C in July and Jan, respectively. The total annual rainfall was 221 mm, the min of 3.5 mm in July and max of 64 mm in Apr. The mean annual relative humidity was 75%. The main economic activity of the people is husbandry of cow, goats and fishing. Based on available epidemiological data from the Chabahar Health

Center, some villages were short-listed and entomological surveys were carried out.

On this basis, five villages with 1118 houses and 5513 population were selected. To study the mosquito fauna, sampling was carried out by dipping technique for collecting larvae and pyrethrum space spray collection (PSSC) for adult mosquitoes. The specimens were collected from five villages in the different topographical areas of the district including Baho-kalat, Beris, Dak-baho, Pollan, and Soldan. Pyrethrum space spray mosquitoes collection were conducted between 05.00 and 08.00 h monthly in eight fixed animal and human shelter randomly on each villages before spraying, all the eaves, windows, doors and other exit points were closed and cloth sheets were spread on the floor. Pyrethrum (0.2% in kerosene) was sprayed using a pressurized hand sprayer. After spraying, the room was kept closed for 15 min and the knocked-down mosquitoes were then collected from the floor sheet with forceps and placed in Petri-dishes lined with moist cotton. All collected mosquitoes were pinned and then were identified using the keys of Zaim and Cranston (1986), Harbach (1988), and Darsie and Samanidou-Voyadjoglou (1997). Mosquito name abbreviations were cited based on Reinert (2001).

Larval habitats present within 500 m around each village were studied for mosquito larvae two times per month. Five randomly selected larval breeding places located within a 500-m radius of the study site were also included and formed the sampling unit for mosquito larvae. 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. 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 paks and transported to the laboratory where they were sorted by ge-

nus and instar counted and recorded. The pupae were reared to adults in emergent cages and identified to species by morphological characters. Because we did not have enough emergent cages to separate the pupae from each habitat by date of collection, samples for each habitat type were pooled together in each site irrespective of date of collection. 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 School of Public Health, Tehran University of Medical Sciences, where the author identified using the aforementioned keys.

Results

The number of the culicine mosquito species at the various sites of Chabahar is shown in Table 1. A total of 3824 adults and 5031 larvae of the culicine mosquitoes were collected, and were recognized including; *Aedes vexans* Meigen (indicate new occurrence records for the province), *Culex arbieeni*, *Cx. bitaeniorhynchus*, *Cx. deserticola*, *Cx. hortensis*, *Cx. perexiguus*, *Cx. pipiens*, *Cx. pseudovishnui*, *Cx. pusillus*, *Cx. quinquefasciatus*, *Cx. sinaiticus*, *Cx. theileri*, *Cx. tritaeniorhynchus*, *Culiseta longiareolata*, *Ochlerotatus caballus*, *Oc. caspius s.l.*, and *Uranotaenia unguiculata*. In PSSC collection Overall, *Culiseta longiareolata* predominated (22.8%), followed by *Cx. perexiguus* (16.8%), *Cx. pipiens* (14.2 %), and *Cx. tritaeniorhynchus* (8.8%). In the larval collection, of 5031 culicinae larvae collected, *Culiseta longiareolata* predominated (19.5%), followed by *Cx. perexiguus* (16.9%), *Cx. pipiens* (13.6 %), and *Cx. tritaeniorhynchus* (9.1%) respectively (Table 1). Seven species including *Culiseta longiareolata*, *Ochlerotatus caspius s.l.*, *Cx. perexiguus*, *Cx. pipiens*, *Cx. sinaiticus*, *Cx. theileri*, and *Cx. tritaeniorhynchus* accounted for 85.1%, and 79.2% of the adult and larval collection respectively. The other species were less than 6% of the total.

Culiseta longiareolata was the most frequent culicine mosquito collected at Chabahar, with total of 982, and 875 specimens, by larval collection and PSSC, respectively. *Aedes vexans* is recorded for the first time in Chabahar County and Sistan and Baluchistan Province. Number and localities of the larvae of culicinae mosquitoes collected in this survey are shown in Table 2. *Uranotaenia unguiculata*, *Oc. caballus*, *Cx. quinquefasciatus*, and *Cx. arbieeni* were collected only in the larval stage. Number and localities of the adult of the culicine mosquitoes collected in this survey are shown in Table 3. *Culiseta longiareolata*, *Cx. perexiguus*, and *Cx. pipiens* were the most prevalent species respectively, and collected in almost all of the villages (Table 2 and 3). The highest numbers of culicines were collected in the Dak-Baho (1206 larvae and 717 adult specimens), and the lowest in the Beris (965 larvae and 627 adult specimens) (Table 2 and 3). *Ochlerotatus caballus*, *Cx. quinquefasciatus*, and *Cx. arbieeni* were collected from larval collection and other species from both SPSS and Larval (Table 2 and 3).

Discussion

Five genera and 17 species of culicine mosquitoes were collected and identified from Chabahar County in Sistan and Baluchistan Province, including the first record of *Ae. vexans* in the province.

From 18 species of culicinae mosquitoes in Sistan and Baluchistan Province (Lotfi 1973, Zaim 1987), 16 species, which had already been recorded, were also collected in this investigation. Two species *Culex mimeticus* and *Cx. territans* are not recorded in this study. However, the occurrence of *Aedes vexans* in the province was not mentioned before (Zaim 1987), although some references counted *Aedes vexans* as the more common species of Guilan and Isfahan Provinces (Azari-Hamidian et al. 2002, Mousa-kazemi et al. 2000).



Fig. 1. Map of Iran indicating the location of the study area in Chabahar County (Ch) situated in the south of Sistan and Baluchistan Province (S and B)

Table 1. Number and prevalence of adult and larvae culicinae mosquitoes collected by pyrethrum space spray and larval collections in Chabahar County, Sistan and Baluchistan Province during January, February, and March 2007

Species	Larvae		Adult	
	No	Percentage	No	Percentage
<i>Aedes vexans</i>	120	2.4	61	1.6
<i>Culex arbieeni</i>	15	0.36	-	-
<i>Cx. bitaeniorhynchus</i>	30	0.59	49	1.3
<i>Cx. deserticola</i>	120	2.4	137	3.6
<i>Cx. hortensis</i>	65	1.3	111	2.9
<i>Cx. perexiguus</i>	851	16.9	643	16.8
<i>Cx. pipiens</i>	685	13.6	543	14.2
<i>Cx. pseudovishnui</i>	120	2.4	5	0.13
<i>Cx. pusillus</i>	206	4.1	202	5.3
<i>Cx. quinquefasciatus</i>	146	2.9	-	-
<i>Cx. sinaiticus</i>	267	5.3	291	7.6
<i>Cx. theileri</i>	418	8.3	291	7.6
<i>Cx. tritaeniorhynchus</i>	458	9.1	337	8.8
<i>Culiseta longiareolata</i>	982	19.5	875	22.8
<i>Ochlerotatus caspius s.l.</i>	327	6.5	279	7.3
<i>Oc. caballus</i>	156	3.1	0	-
<i>Uranotaenia unguiculata</i>	65	1.3	-	-
Total	5031	100	3824	100

Table 2. Number and locality of the culicine mosquito larvae, Chabahar County, Sistan and Baluchistan Province, January–March 2007

Species	Villages						No	%
	Baho-Kalat	Beris	Dak-Baho	Pollan	Soldan			
<i>Aedes vexans</i>	40	-	51	29	-	120	2.4	
<i>Culex arbieeni</i>	-	1	9	-	5	15	0.36	
<i>Cx. bitaeniorhynchus</i>	6	8	7	4	5	30	0.59	
<i>Cx. deserticola</i>	29	24	36	31	-	120	2.4	
<i>Cx. hortensis</i>	14	13	15	11	12	65	1.3	
<i>Cx. perexiguus</i>	243	84	192	204	128	851	16.9	
<i>Cx. pipiens</i>	178	-	201	217	89	685	13.6	
<i>Cx. pseudovishnui</i>	29	14	28	32	17	120	2.4	
<i>Cx. pusillus</i>	40	37	39	51	39	206	4.1	
<i>Cx. quinquefasciatus</i>	29	68	-	49	-	146	2.9	
<i>Cx. sinaiticus</i>	-	94	-	-	173	267	5.3	
<i>Cx. theileri</i>	124	101	98	-	95	418	8.3	
<i>Cx. tritaeniorhynchus</i>	94	83	101	54	126	458	9.1	
<i>Culiseta longiareolata</i>	209	304	272	101	96	982	19.5	
<i>Ochlerotatus caspius s.l.</i>	69	71	78	63	46	327	6.5	
<i>Oc. caballus</i>	-	63	48	-	45	156	3.1	
<i>Uranotaenia unguiculata</i>	-	-	31	16	18	65	1.3	
Total	1104	965	1206	862	894	5031	100	

Table 3. Number and locality of the adult culicine mosquitoes collected by Pyrethrum space spray, Chabahar County, Sistan and Baluchistan Province, January–March 2007

Species	Villages						No	%
	Baho-Kalat	Beris	Dak-Baho	Pollan	Soldan			
<i>Aedes vexans</i>	-	16	21	11	13	61	1.6	
<i>Cx. bitaeniorhynchus</i>	13	8	-	19	9	49	1.3	
<i>Cx. deserticola</i>	45	48	44	-	-	137	3.6	
<i>Cx. hortensis</i>	-	-	63	34	14	111	2.9	
<i>Cx. perexiguus</i>	151	116	164	183	29	643	16.8	
<i>Cx. pipiens</i>	89	96	101	76	181	543	14.2	
<i>Cx. pseudovishnui</i>	-	-	5	-	-	5	0.13	
<i>Cx. pusillus</i>	69	-	-	121	12	202	5.3	
<i>Cx. sinaiticus</i>	81	94	-	46	70	291	7.6	
<i>Cx. theileri</i>	103	-	48	82	58	291	7.6	
<i>Cx. tritaeniorhynchus</i>	59	-	15	142	121	337	8.8	
<i>Culiseta longiareolata</i>	167	172	219	153	164	875	22.8	
<i>Ochlerotatus caspius s.l.</i>	38	77	37	70	57	279	7.3	
Total	815	627	717	937	728	3824	100	

In this study, two species of the tribe Aedini including; *Ochlerotatus caspius s.l.* and *Oc. caballus* were recorded in Chabahar County. These species were differentiated from each other in larval stage (Zaim and Cranston 1986). There is no information about the *Oc. caspius* sibling species (A or B) in the country (Azari-Hamidian 2007).

Culex mimeticus and *Cx. territans* had been previously reported by Lotfi (1973) in Sistan and Baluchistan, whereas in this study have not been found.

Culex pipiens was one of the most frequent culicine mosquitoes collected at Chabahar, with total of 573 and 685 specimens, by PSSC and larval collection respectively. *Culex*

pipiens can be separated from *Cx. torrentium*, and *Cx. vegans* by Harbach's (1988) key using seta 1-III-V, seta 1-M, seta 1-X, seta 1-C, and some other characters. Based on this key, only *Cx. pipiens* was identified.

One species of *Culiseta*, *Cs. longiareolata* was found in this investigation. Results of this survey are the same of finding by previous study in Sistan and Baluchistan Province (Zaim 1987).

In this study were collected other culicine mosquitoes such as, *Culex. theileri*, and *Cx. Tritaeniorhynchus*. This species are potential vectors of human and domesticated animal pathogens (Horsfall 1955, Harbach 1988).

The species *Cx. theileri* was one of the culicine mosquito collected at Chabahar, with total of 291, and 418 specimens by means of PSSC and larval collection, respectively. This species is the more prevalent species at higher altitudes and in rural areas of Isfahan (Mousakazemi et al. 2000), Zanzan (Ghavami and Ladonni 2005) and East Azerbaijan Provinces (Abai et al. 2007). Observations made during the present study agree with those of Simsek (2004) who noted that *Cx. theileri* in Turkey prefers large natural larval habitats that are generally present in rural areas.

In conclusion, regular monitoring of mosquitoes in this area could be the most timely and sustainable way to follow up mosquito ecology and raise awareness about mosquito control and mosquito-borne disease prevention.

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References

- Abai MR, Azari-Hamidian S, Ladonni H, Hakimi M, Mashhadi-Esmail K, Kousha A, Vatandoost H (2007) Fauna and checklist of mosquitoes (Diptera: Culicidae) of East Azerbaijan Province, northwestern Iran. *Iranian J Arthropod-Borne Dis*. 1: 27-33.
- Azari-Hamidian S, Joeafshani MA, Rassaei A, Mosslem M (2002) Mosquitoes of the genus *Aedes* (Diptera: Culicidae) in Guilan. *J Med Fac Guilan Univ Med Sci*. 11(43): 29-39 [in Persian with English abstract].
- Azari-Hamidian S (2007) Checklist of Iranian mosquitoes (Diptera: Culicidae). *J Vect Ecol*. 32: 235-242.
- Azari-Hamidian S, Yaghoobi-Ershadi MR, Javadian E, Mobedi I, Abai MR (2007) Review of dirofilariasis in Iran. *J Med Fac Guilan Univ Med Sci*. 15(60): 102-113 [in Persian with English abstract].
- Darsie RE, Samanidou-Voyadjoglou A (1997) Keys for the identification of the mosquitoes of Greece. *J Am Mosq Contr Assoc*. 13: 247-254.
- Ghavami MB, Ladonni H. (2005) The fauna and frequency of different mosquito species (Diptera: Culicidae) in Zanzan Province. *The Scientific Journal of Zanzan University of Medical Sciences*. 13: 46-54 [in Persian].
- Harbach RE (1988) The mosquitoes of the subgenus *Culex* in southwestern Asia and Egypt (Diptera: Culicidae). *Contrib Am Ent Inst*. 24: 1-240.

- Horsfall WR (1955) Mosquitoes. Their Biometrics and Relation to Disease. Hafner Publishing, New York.
- Lotfi, MD (1973) Iranian species of genus *Culex* (Culicinae: Diptera) II. – Report of four species of larvae (including three new records) and 14 adult species. Bull Soc Path Exot. 66: 204-207.
- Mousakazemi SH, Zaim M, Zahraii A (2000) Fauna and ecology of Culicidae of the Zarrin-Shahr and Mobarakeh area in Isfahan Province. Armaghan Danesh, Journal of Yasuj University of Medical Sciences. 5: 46-54 [in Persian].
- Moosa-Kazemi SH, Vatandoost H, Raeisi A, Akbarzadeh K (2006) Deltamethrin Impregnated Bed Nets in a Malaria Control Program in Chabahar, Southeast Baluchistan, I.R. Iran. Iranian J Arthropod-Borne Dis. 1: 27–33.
- Naficy K, Saidi S (1970) Serological survey on viral antibodies in Iran. Trop Geog Med. 2: 183–188.
- Reinert JF (2001) Revised list of abbreviation for genera and subgenera of Culicidae (Diptera) and the notes on generic and subgeneric changes. J Am Mosq Contr Assoc. 17: 51-55.
- Simsek FM (2004) Seasonal larval and adult population dynamics and breeding habitat diversity of *Culex theileri* Theobald, 1903 (Diptera: Culicidae) in the Golbasi District, Ankara, Turkey. Turk J Zool. 28: 337-44.
- Yasuoka J, Levins R (2007) Ecology of vector mosquitoes in Sri Lanka-suggestions for future mosquito control in rice ecosystems. Southeast Asian J Trop Med Public Health. 38(4): 646-57.
- Zaim M, Cranston PS (1986) Checklist and keys to the Culicinae of Iran (Diptera: Culicidae). Mosq Syst. 18: 233–245.
- Zaim M (1987) The distribution and larval habitat characteristics of Iranian Culicinae. J Am Mosq Contr Assoc. 3: 568-573.