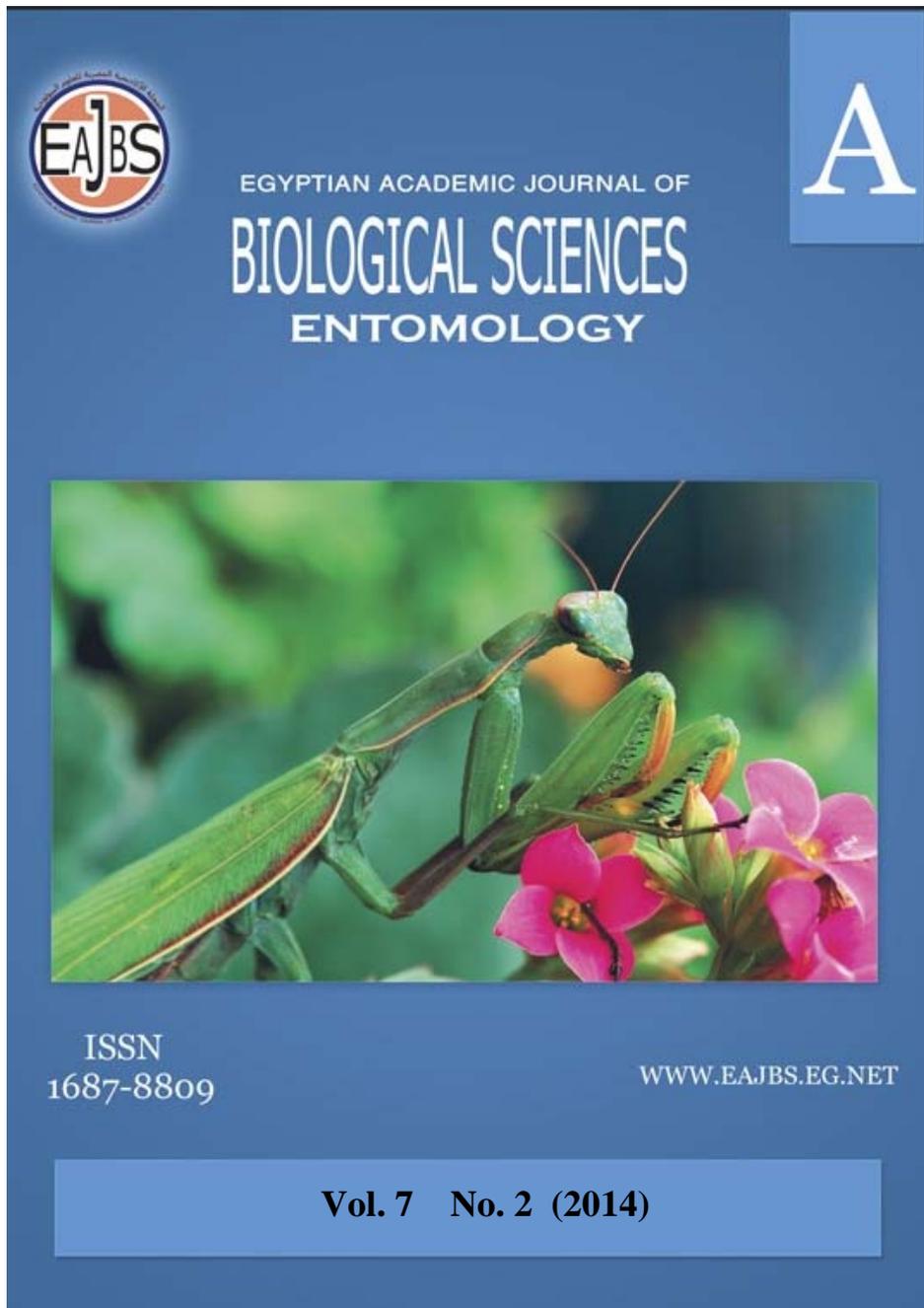


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Prevalence of mosquitoes in Jazan Province, Saudi Arabia

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ABSTRACT

During the period from February 2009 to September 2010, a mosquito (Diptera: Culicidae) survey was conducted in Jazan province the southwestern Region of Saudi Arabia,. A total of 29414 larval and 484 adult mosquitoes were collected from 41 sites, resembling 10 governorates. The collected mosquitoes related to 7 genera and 16 species. The genera were *Aedes* (A.) (1 species), *Stegomyia* (St.) (1 species), *Aedimorphus* (Am.) (1 species), *Anopheles* (An.) (4 species), *Lutzia* (L.) (1 species), *Culex* (Cx.) (7 species), and *Culiseta* (Cs.) (1 species) and the mosquitoes species encountered were *A. caspius* Pallas, *St. aegypti* Linnaeus, *Am. vexans arabiensis* Patton, *An. d'thali* Patton, *An. pretoriensis* Theobald, *An. Arabiensis* Patton, *An. turkhudi* Liston, *L. (Metalutzia) tigripes* de Grandpre & de Charmoy, *Cx. sitiens* Wiedmann, *Cx. decens* Theobald, *Cx. bitaeniorhynchus* Giles, *Cx. pipiens* Linnaeus, *Cx. quinquefasciatus* Say, *Cx. sinaiticus* Kirkpatrick, *Cx. tritaeniorhynchus* Giles, and *Cs. longiareolata* Macquart. *Cx. pipiens* is the most prevalent species in Jazan region. It was encountered in 90 % of total collection sites. *Cx. tritaeniorhynchus* is less prevalent encountering in 80 % of total collection sites but *An. Arabiensis* was encountered in 70 % of total collection sites. *St. aegypti*, *L. (Metalutzia) tigripes* and *Cx. sitiens* were encountered in 50% of total collection sites. *Cx. quinquefasciatus*, *Am. vexans* and *Cs. longiareolata* were encountered in 40 %, 30% and 20% of total collection, sites respectively. *An. pretariensis*, *An. d'thuli*, *An. turkdi*, *Cx. decens*, *A. caspius* and *Cx. bitaeniorhynchus* were the least prevalent mosquitoes in Jazan region encountered in only 10% of total collection sites. *Am. vexans* was the most abundant 57 % (17121), *Culicine spp.* 38.2 % (11416) , *Anopheline spp.* 1.5 % (433), *St. aegypti* 3 % (749) and each of *Aedine*, *Lutzia* and *Culleseta* were encountered less than 1%.

Keywords: mosquitoes -Jazan Province,- kSA

INTRODUCTION

Mosquitoes are notoriously undesirable arthropods and are well-known vector-borne diseases (e.g. Dengue, Filariasis, Malaria and Rift Valley fever): In Saudi Arabia, the most common mosquito-borne diseases include dengue (Fakeeh and Zaki 2001, 2003; Ayyub *et al.*, 2006; Khan *et al.*, 2008), filarial (Hawking 1973), malaria (Warrel 1993; Abdoon and Alsharani 2003), and Rift valley fever (Jupp *et al.*, 2002; Miller *et al.*, 2002; Al-Hazmi *et al.*, 2003; Balkhy and Memish 2003; Madani *et al.*, 2003): Recently, 76 people have died from an outbreak of Rift Valley fever and 408 people had contracted the disease (Ahmad 2000). Distribution of mosquitoes (Diptera: Culicidae) in Saudi Arabia has been investigated by many workers. Mattingly and Knight (1956) studied the distribution of mosquito larvae in the Arabian Peninsula and recorded 46 species and subspecies. In Saudi Arabia they recorded *Aedes* (*A.*) *aegypti*, *A. arabiensis*, *A. caspius*, *Anopheles* (*An.*) *cinereus*, *An. multicolor*, *An. stephensi*, *An. coustani*, *An. turkhudi*, *An. gambiae*, *An. sergenti*, *Culex* (*Cx.*) *laticinctus*, *Cx. tritaeniorhynchus*, *Cx. sitiens*, *Cx. sinaiticus*, *Cx. pusillus*, *Cx. tigripes*, *Cx. pipiens* and *Culiseta* (*Cs.*) *longiareolata*. In the Eastern Region of Saudi Arabia, Wills *et al.* (1985) recorded *A. caspius*, *An. fluviatilis*, *An. sergenti*, *An. tenebrosus*, *Cx. pipiens*, *Cx. quinquefasciatus*, *Cx. tritaeniorhynchus*, *Cx. univittatus*, *Uranotaenia unguiculata* and *Cs. longiareolata*. In the Southwestern of Saudi Arabia Abdullah and Merdan (1995), Bakr and Ghrama (2014) recorded *A. caspius*, *An. arabiensis*, *An. multicolor*, *An. sergenti*, *An. tenebrosus*, *Cx. pipiens*, *Cx. quinquefasciatus*, *Cx. theileri* and *Cs. Subochrea*. *Cx. pipiens* was the most dominant one in this region. Abdoon and Alshahrani (2003) reported *An. arabiensis* as the more abundant in the southern part of the region also reported other six species of anopheline mosquitoes in this Region, these were: *An. d'thali*, *An. rupicolus*, *An. sergenti*, *An. multicolor*, *An. turkhudi* and *An. pretoriensis*. In the ewgion of Riyadh, Al Kuriji *et al.* (2007) reported 15 species which included *A. caspius*, *An. stephensi*, *An. coustani*, *An. d'thali*, *An. pretoriensis*, *Cx. laticinctus*, *Culex perexiguus*, *Cx. pipiens*, *Cx. quinquefasciatus*, *Culex simpsoni*, *Cx. sinaiticus*, *Cx. theileri*, *Cx. tritaeniorhynchus*, *Cx. univittatus* and *Cs. longiareolata* and the abundance on the level of Genera collected was *Culex* (96.99%), 147 *Aedes* (2.21%), 39 *Anopheles* (0.59%) and 14 *Culiseta* (0.21%). Al-Ali *et al.* (2008) studied the mosquitoes in El Madina region reporting 7 species including *Culex duttoni*, *Cx. decens*, *Cx. Pipiens*, *Cx. quinquefasciatus*, *Cx. univittatus*, *Cx. sinaiticu*, *Cx. laticinctus* from them *Cx. Pipiens* and *Cx. quinquefasciatus* were the most abundant; 59.3% of collected adults. In the Western Region, Al Ghamdi *et al.* (2008) reported 11 species which included *An. d'thali*, *An. culicifacies*, *An. gambiae*, *An. turkhudi*, *An. pharoensis*, *An. sergenti*, *An. multicolor*, *An. fluviatilis*, *Anopheles subpictus*, *An. stephensi* and *An. rhodesiensis*. During the 2000 epidemic of Rift Valley fever in the southern region of Saudi Arabia, Jupp *et al.* (2002) and Miller *et al.* (2002) collected 7 species of mosquitoes: *A. vexans arabiensis*, *Cx. tritaeniorhynchus*, *Aedes vittatus*, *An. azaniae*, *Cx. pipiens*, *Ochlerotatus caballus* and *Ochlerotatus caspius*. In another study in the southwestern region of Saudi Arabia, Abdullah and Merdan (1995) recorded the following 9 species of mosquitoes: *Ae. caspius*, *An. arabiensis*, *An. multicolor*, *An. sergenti*, *An. tenebrosus*, *Cx. pipiens*, *Cx. quinquefasciatus*, *Cx. theileri* and *Cs. subochrea*. The distribution of mosquitoes in Mekkah Region was studied by Alahmed *et al.* (2009) recorded the following species: *A. caspius*, *A. aegypti*, *An. d'thali*, *An. gambiae*, *An. multicolor*, *An. rhodesiensis*, *An. sergenti*, *An. stephensi*, *An. subpictus*, *An. turkhudi*, *Cx. arbieeni*, *Cx. laticinctus*, *Cx. pipiens*, *Cx. quinquefasciatus*, *Cx. sinaiticus*, *Cx. tigripes*, *Cx. tritaeniorhynchus*, *Cx. univittatus* and *Cs. longiareolata*. *Cx. arbieeni*. In 2009 AL-Ghamdi and Al-Qahtani studied the mosquitoes of Jeddah city

showing that the genus of *Culex* mosquitoes were the dominant form has a very high proportion of presence as represented by 99.95% followed by the second genus *Aedes* by 0.0315% and genus *Anopheles* and *Ochlerotatus* the same relative density by 0.0066% and the recorded species were *A. caspius*, *A. aegypti*, *Cx. pipiens*, *Cx. quinquefasciatus*, *Cx. tritaeniorhynchus*, *Cx. perexiguus*, *Cx. torrentium*, *An. subpictus*, *An. stephensi*, *An. rohdesiensis*, *An. culicifacies*, *An. thurkhudi*, *An. pharoensis*, *An. gambiae*, *An. multicolor*, *An. fluviatilis*, *An. d'thali*, and *An. Sergenti* also in the Eastern region, Ahsaa, El Dammam and Hafr El Batin, of Saudi Arabia, *A. caspius*, *An. cinereus*, *An. coustani*, *An.d'thali*, *An. fluviatilis*, *An. gambiae*, *An. multicolor*, *An. pretoriensis*, *An. rhodesiensis*, *An. sergentii*, *An. stephensi*, *An. Subpictus*, *An. superpictus*, *An. tenebrosus*, *Cx. laticinctus*, *Cx. perexiguus*, *Cx. pipiens*, *Cx. pusillus*, *Cx. quinquefasciatus*, *Cx. simpsoni*, *Cx. torrentium*, *Cx. tritaeniorhynchus*, *Cx. univittatus*, *Cs. longiareolata* and *Uranotaenia unguiculata*, were recorded by Alahmed (2010) who reported also that *Culex spp.* were the most abundant (66.41%), followed by *A. caspius* (17.64%), *Anopheles spp.* (14.91%), *U. unguiculata* (1.03%) and *Cs. longiareolata*. Other survey and abundance as well as prevalences of the mosquitoes were done in Ahsaa city by Ahmed *et al.* (2011) recording the following species *A. caspius*, *An. multicolor*, *Cx. perexiguus*, *Cx. pipien*, and *Cx. pusillus*. They reported *Ae. caspius* was the most abundant mosquito followed by *Cx. pipiens*.

For the past few decades, Jazan region has witnessed big efforts in social development and urbanization, which have affected insect fauna, particularly the mosquitoes which have proved basic vectors for many of arboviral diseases as mentioned before. The present study was carried out to morphologically identify mosquito species and their prevalence in Jazan province, in the southwestern region of the Kingdom of Saudi Arabia.

MATERIAL AND METHODS

Study Area

Jazan Province lies in the southwest of Kingdom of Saudi Arabia (KSA) (N17.31 E42.71): It occupies an area of 13,000 km². It includes 455 villages. The topography of the area varies and consists of: (a) Sarawat Mountain ranges to the east with elevation up to 2500 m above sea level (A. S. L.), (b) Hilly middle sector with elevation ranges 300-600 m a.s.l. (c) Western coastal sector with elevation up to 30 m A. S. L. The climate is subtropical; with annual temperature 30°C Relative humidity is relatively high and usually between 50 and 70%, sometimes reaching 90%. Annual Precipitation is 165 mm in the coastal sector, while in the Sarawat mountain ranges it ranges 300-500 mm.

During this study, Jazan province was divided into

- a. Frequently visited sites, Gizan, Arda, Baish and Ahad El Masarha, resembling the west, East, North and South of the Jazan Province respectively (Figure 1) and spatial Coordinates were recorded using GPS (Garmin, USA) for each collection site. These sites were visited twice per month from February 2009 to September 2010 but collection visits did not take place in the following months March, September, and October 2009 in Gizan; September 2009, October 2009 and March 2010 in Arda; March, September, and October 2009 in Baish; and March, September, October, November, December 2009 and July 2010 in Ahad El masarha.
- b. Occasionally visited sites, Haroob; WadiGizan, Samta, El Darb, Dayer Bany Malek, and Farasan, which visited once per season summer and winter (Fig.1) and spatial Coordinates were recorded using GPS (Garmin, USA) for each collection site.

The Surveys were carried out including wadis at previously mentioned study sites as well as Natural collections of water in temporary pools that formed at the edge of the wadis as a result of overflow, seepage and receding water, water containers in or outside the houses, and wells were checked for the presence of mosquito larvae also.

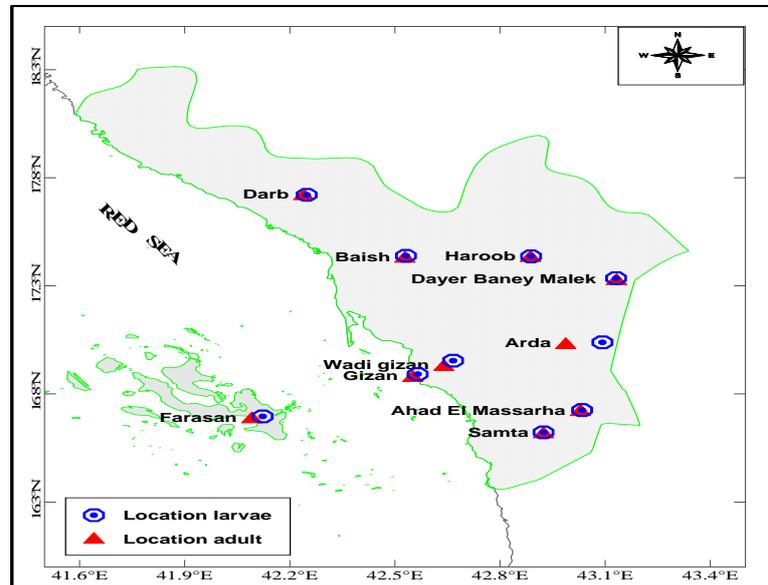


Fig. 1: Map of Jazan region showing collection sites of mosquitoes

Larval Collection

A standard mosquito larval dipper with extendable handle was used to collect larval specimens. Almost three -five scoops were taken from each breeding site (350 ml each): Larvae were preserved in 80% ethyl alcohol in glass vials and labeled for transfer to the laboratory to be identified using identification keys based on morphology (Mattingly and Knight, 1956; Harbach, 1988, Al Ahmad *et al.* 2011).

Adult Collection

Adult mosquitoes were collected using CDC light traps (Bioquip Company, Gardena, CA 90248-3602, USA): Each CDC light traps were operated once monthly and operated from sunset to sunrise of the following day throughout the study period. The collected mosquitoes were packed, labeled and transported to the Laboratory then counted and identified using identification keys of Mattingly and Knight (1956), Harbach (1988) and Glick (1992).

RESULTS

A total of 41 collection sites (Fig. 1) were visited during the period of the study revealing a total of 29414 larval and 484 adult mosquitos' specimens. In general, the number of mosquito specimens collected was rather low over the period of study. This is due to the effective regular and extensive larvicide operations that take place in the region. In addition, occasional use of space and residual sprays assists in reducing the density of flying mosquitoes in the area. The present study revealing that the presence of seven genera one *Aedes* (*A.*) Meigen, one *Stegomyia* (*St.*), one *Aedimorphus* (*Am.*) Theobald, four *Anopheles* (*An.*) Meigen, one *Lutzia* (*L.*), seven *Culex* (*Cx.*) Linnaeus and one *Culliseta* (*Cs.*) Felt. Sixteen species were concluded as the following *A. caspius* Pallas, *St. aegypti* Linnaeus, *Am. vexans arabiensis* Patton, *An. d'thali* Patton, *An.*

pretoriensis Theobald, *An. arabiensis* Patton, *An. turkhudi* Liston, *L. (Metalutzia) tigripes* de Grandpre & de Charmoy, *Cx. sitiens* Wiedmann, *Cx. decens* Theobald, *Cx. bitaeniorhynchus* Giles, *Cx. pipiens* Linnaeus, *Cx. quinquefasciatus* Say, *Cx. sinaiticus* Kirkpatrick, *Cx. tritaeniorhynchus* Giles, and *Cs. longiareolata* Macquart.

Prevalence of Mosquitoes in Jazan Province

Cx. Pipiens is the most prevalent species in Jazan province. It was encountered in 9 collection sites, Gizan, Arda, Baish, Ahad El Masarha, samta, Haroob, El Darb, Bany Malek and Farasan,. It was only recorded as larvae in Samta, Bany Malek and Farasan while as adult in Haroob. *Cx. tritaeniorhynchus* is less prevalent than the previous species and encountered in 8 collection sites, Gizan, Arda, Baish, samta, Haroob and Bany Malek,. It was only encountered as larvae in Ahad El Masarha, El Darb and Bany Malek. *An. Arabinesis* was encountered in 6 collection sites, Gizan, Arda (as larvae), Baish (as larvae), samta, Haroob(as larvae),and Bany Malek (as adults),. *L. tigripis* was collected from 5 collection sites, Arda, Ahad El Masarha, El Darb (as larvae), Haroob (as adults), Farasan (as larvae) and so *Cx. sitiens* was collected from 5 collection sites, Gizan (as larvae), Arda, Baish (as larvae), Ahad El Masarha (as larvae) and Wadi Gizan (as larvae): *Cx. quinquefascitus* also recorded in different 5 collection sites, Gizan (as larvae), Arda, Baish, Ahad El Masarha (as adults) and Farasan (as larvae): *St. aegypti* was collected from Gizan, Arda (as larvae), Haroob (as larvae) and Bany Malek (as adults): *An. d'thuli* was collected from 3 collection sites, Arda, Ahad El Masarha (as larvae) and Haroob (as larvae): *Am. Vexans* was collected from 2 collection sites Gizan (as larvae) and Ahad

Table 1: Prevalence of mosquitoes in jazan province

Sr.	Locality Species	Gizan	Arda	Baish	A_Elm asarha	Samta	W. Gizan	E Darb	Haroob	B Malek	Farasan	Positive localities
1	<i>An. Arabinesis</i>	+ ve	+ ve*	+ ve*	- ve	+ ve	- ve	- ve	+ ve*	+ ve**	- ve	6
2	<i>An. Pretariensis</i>	- ve	- ve	- ve	+ ve*	- ve	- ve	- ve	- ve	- ve	- ve	1
3	<i>An. d'thuli</i>	- ve	+ ve	- ve	+ ve*	- ve	- ve	- ve	+ ve*	- ve	- ve	3
4	<i>An. Turkdi</i>	- ve	- ve	- ve	- ve	+ ve*	- ve	- ve	- ve	- ve	- ve	1
5	<i>St. aegypti</i>	+ ve	+ ve*	- ve	- ve	- ve	- ve	- ve	+ ve*	+ ve**	- ve	4
6	<i>Am. Vexans</i>	+ ve*	- ve	- ve	+ ve*	- ve	- ve	- ve	- ve	- ve	- ve	2
7	<i>L. tigripis</i>	- ve	+ ve	- ve	+ ve	- ve	- ve	+ ve*	+ ve**	- ve	+ ve*	5
8	<i>A. caspius</i>	- ve	- ve	- ve	+ ve*	- ve	- ve	- ve	- ve	- ve	- ve	1
9	<i>Cx. pipiens</i>	+ ve	+ ve	+ ve	+ ve	+ ve*	- ve	+ ve	+ ve**	+ ve*	+ ve*	9
10	<i>Cx. tritaeniorhynchus</i>	+ ve	+ ve	+ ve	+ ve*	+ ve	- ve	+ ve*	+ ve	+ ve*	- ve	8
11	<i>Cx. sinaiticus</i>	+ ve*	+ ve*	- ve	- ve	- ve	- ve	- ve	- ve	- ve	- ve	2
12	<i>Cx. sitiens</i>	+ ve*	+ ve	+ ve*	+ ve*	- ve	+ ve*	- ve	- ve	- ve	- ve	5
13	<i>Cx. quinquefascitus</i>	+ ve*	+ ve	+ ve	+ ve**	- ve	- ve	- ve	- ve	- ve	+ ve*	5
14	<i>Cx. decens</i>	- ve	+ ve*	- ve	- ve	- ve	- ve	- ve	- ve	- ve	- ve	1
15	<i>Cx. bitaeniorhynchus</i>	- ve	- ve	- ve	- ve	- ve	- ve	- ve	+ ve*	- ve	- ve	1
16	<i>Cs. longiareolata</i>	- ve	+ v**	- ve	- ve	- ve	- ve	- ve	- ve	- ve	- ve	1
No of species/ locality		8	11	5	9	4	1	3	7	4	3	

+ ve : present, - ve : absent, + ve * : only collected as adult, + ve** : only collected as larvae

El Masarha (as larvae): And so *Cx. sinaiticus* was collected from 2 collection sites Gizan (as larvae) and Arda (as larvae): *An. pretariensis*, *An. turkdi*, *A. caspius*, *Cx. decens*, *Cx. bitaeniorhynchus* and *Cs. Longiareolata* were collected from only one collection sites, Ahad El Masarha (as larvae), Ahad El Masarha (as larvae), Arda (as larvae), Haroob (as larvae) and Baish (as adults) respectively (Table 1) and (Fig. 2):

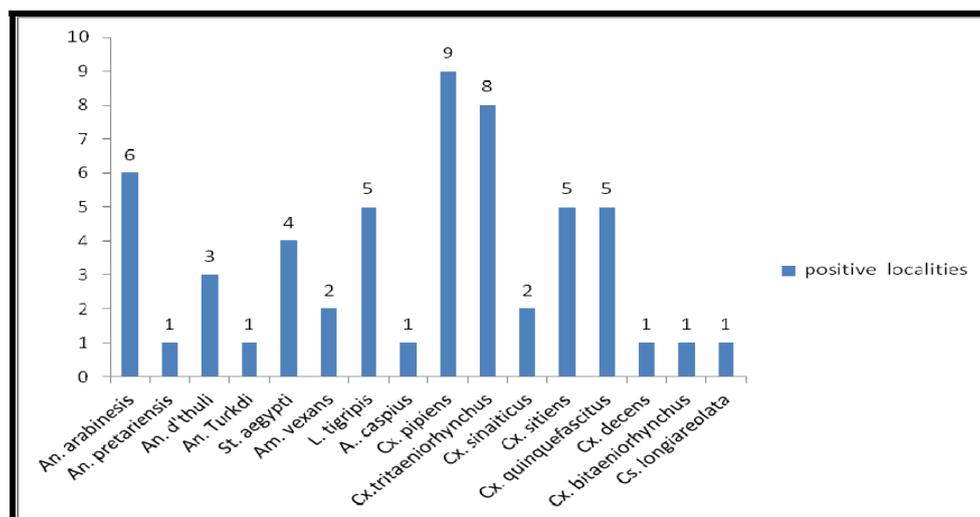


Fig. 2: prevalence of mosquitoes in Jazan province

Abundance of mosquitoes in jazan province

The most abundant mosquito species in Jazan province is *Am. vexans* recording 56.9 % (17150) of the total collected mosquitoes. *Cx. pipiens* and *Cx. tritaeniorhynchus* were less abundant recording 15.2 % (4573) and 14.9 % (4490) of the total collected mosquitoes in Jazan province. *Cx. sitiens*, *St. aegypti*, *An. Arabinesis*, *Cx. quinquefascitus* and *Cx. sinaiticus* were recording 6.4 % (1924), 2.6 % (780), 1 % (314), 1.1 % (332) and 0.6 % (191) respectively. The rest of collected mosquitoes were less than 0.6 % of the total collected mosquitoes (Table 2) and (Fig. 3).

Table 2: Abundance of mosquitoes in Jazan province

Sr	Mosquito species	Larvae	Adults	total	%
1	<i>An. Arabinesis</i>	300	14	314	1.0
2	<i>An. pretariensis</i>	5	0	5	<0.1
3	<i>An. d'thuli</i>	100	2	102	0.3
4	<i>An. turkdi</i>	18	0	18	0.1
5	<i>St. aegypti</i>	665	115	780	2.6
6	<i>Am. vexans</i>	17121	29	17150	56.9
7	<i>L. tigripis</i>	68	18	86	0.3
8	<i>A. caspius</i>	74	0	74	0.2
9	<i>Cx. pipiens</i>	4463	110	4573	15.2
10	<i>Cx. tritaeniorhynchus</i>	4239	251	4490	14.9
11	<i>Cx. sinaiticus</i>	191	0	191	0.6
12	<i>Cx. sitiens</i>	1911	13	1924	6.4
13	<i>Cx. quinquefascitus</i>	226	106	332	1.1
14	<i>Cx. decens</i>	22	0	22	0.1
15	<i>Cx. bitaeniorhynchus</i>	11	61	72	0.2
16	<i>Cs. longiareolata</i>	0	19	19	0.1
Total		29414	738	30152	100

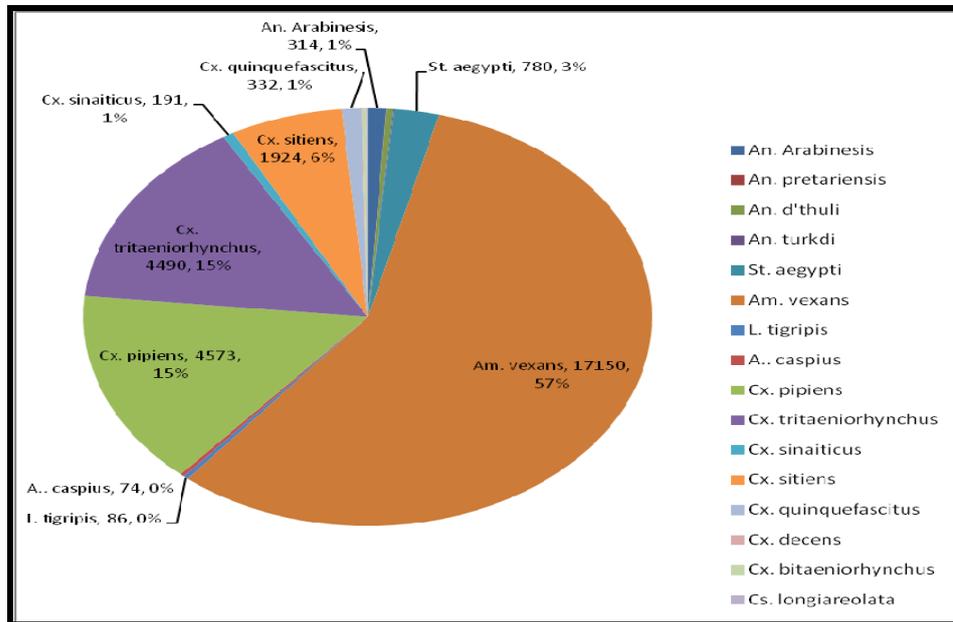


Fig. 3: Abundance of mosquitoes in Jazan province

DISCUSSION

Mosquitoes of Jazan

The results of the present study reveal the presence of seven genera one *Aedes* (*A.*) Meigen, one *Stegomyia* (*St.*), one *Aedimorphus* (*Am.*) Theobald, four *Anopheles* (*An.*) Meigen, one *Lutzia* (*L.*), seven *Culex* (*Cx.*) Linnaeus and one *Culiseta* (*Cs.*) Felt. Sixteen species were concluded as the following *A. caspius* Pallas, *St. aegypti* Linnaeus, *Am. vexans arabiensis* Patton, *An. d'thali* Patton, *An. pretoriensis* Theobald, *An. arabiensis* Patton, *An. turkhudi* Liston, *L. (Metalutzia) tigripes* de Grandpre & de Charmoy, *Cx. sitiens* Wiedmann, *Cx. decens* Theobald, *Cx. bitaeniorhynchus* Giles, *Cx. pipiens* Linnaeus, *Cx. quinquefasciatus* Say, *Cx. sinaiticus* Kirkpatrick, *Cx. tritaeniorhynchus* Giles, and *Cs. longiareolata* Macquart. These sixteen species were previously recorded in many parts of KSA by many authors [Mattingly and Knight (1956); Buttiker (1981); Harbach (1985); Wills *et al.* (1985); Harbach (1988); Abdullah and Merdan (1995); Al Zahrani (2001); Miller *et al.* (2002); Miller *et al.* (2002); Jupp *et al.* (2002); Abdoon and Alshahrani (2003); Abdoon (2004); Abdoon and Ibrahim (2005); Al Kuriji (2005); Al Kuriji *et al.* (2007); Al Kuriji *et al.* (2007); Al-Ali *et al.* (2008); Al-Ali *et al.* (2008); Al Ghamdi *et al.* (2008); Alahmed *et al.* (2009); AL-Ghamdi and Al-Qahtani (2009); Kheir *et al.* (2010); Alahmed (2010); Kheir *et al.* (2010) and Ahmed *et al.* (2011)]. Out of them only four species were newly recorded in Jazan province and twelve species were previously recorded in different regions in KSA. The newly recorded species in Jazan were *An. arabiensis* Patton which was recorded in Southwestern of Saudi Arabia by Abdullah and Merdan (1995), in Asir region by Abdoon and Alshahrani (2003), and in Southwestern of Saudi Arabia Tihama region by Abdoon and Ibrahim (2005).

An. turkhudi Liston was recorded in Eastern, Western and Southern regions in KSA by Mattingly and Knight (1956), in Asir region by Abdoon and Alshahrani (2003), in Southwestern of Saudi Arabia (Tihama lowland and Asir region) by Abdoon and Ibrahim (2005), in Riyadh by Al Kuriiji (2005), in Jeddah by Al Ghamdi *et al.* (2008) and AL-Ghamdi and Al-Qahtani (2009), in Mekkah by Alahmed *et al.* (2009), in Al Madinah Al Munwwrah by Kheir *et al.* (2010), in Abha and Najran, by Al Ahmed *et al.* (2011)

Cx. decens Theobald was recorded in the Tihama region of Southwestern of Saudi Arabia by Al Zahrani (2001), in Asir region by Abdoon (2004) and in Al-Madina by Al-Ali *et al.* (2008).

Cx. bitaeniorhynchus Giles was recorded in Asir region by Abdoon (2004) and in Tihama lowland and Asir region of Southwestern of Saudi Arabia by Abdoon and Ibrahim (2005): Some of recorded mosquito species have medical importance such as *An. arabiensis* and *An. sergentii* that known as a vectors of malaria in Asir region (Abdoon and Alshahrani 2003). *Culex* mosquitoes, especially *C. pipiens* and *C. quinquefasciatus*, are the chief vectors of bancroftian filariasis caused by *Wuchereria bancrofti* in many regions of the world including the Middle East and Eastern Mediterranean countries This disease has also been reported from the southwestern districts of the Kingdom of Saudi Arabia (KSA) where expatriates constitute the majority of cases (Chandran *et al.*, 2004) and (Pichon 2002):, In Abha, KSA, *Culex pipiens* is a potential vector of introduced bancroftian filariasis. *Culex* is also responsible for transmission of several serious viral diseases as Rift valley fever (RVF) (Balkhy and Memish 2003), and *Culex tritaeniorhynchus* Giles and *Aedimorphus vexans arabiensis* Patton, were the responsible of transmitting the Rift Valley Fever Virus in southwestern and Jazan in Saudi Arabia (Jupp *et al.*, 2002).

Prevalence and Abundance of Mosquitoes in Jazan Province

Cx. pipiens is the most prevalent species in Jazan region. It was encountered in 90 % of total collection sites and it is also prevalent in Jeddah governorate (AL-Ghamdi and Al-Qahtani (2009)) and Al-Ali *et al.* (2008) who reported *Cx. Pipiens* and *Cx. quinquefasciatus* were the most abundant mosquitoes in El Madina region. Also our results agree with Abdullah and Merdan (1995) who reported that *Cx. pipiens* was the most dominant one in Asir region. It was recorded also in eastern, western and southern region in KSA by Mattingly and Knight (1956), Eastern Region of Saudi Arabia by Wills *et al.*, (1985), Southwestern of Saudi Arabia by Abdullah and Merdan (1995), southern region of Saudi Arabia (Asir, jazan and Mekkah regions) by Miller *et al.*, (2002), southern region of Saudi Arabia (jazan region) by Jupp *et al.*, (2002), Southwestern of Saudi Arabia (Tihama lowland and Asir region) by Abdoon and Ibrahim (2005), Moreover Riyadh, Saudi arabia by Al Kuriiji (2005), Al-Madina by Al-Ali *et al.*, (2008) Mekkah by Alahmed *et al.*, (2009), Jeddah by Al-Ghamdi and Al-Qahtani (2009), Eastern region of Saudi Arabia by Alahmed (2010), Al Madinah Al Munwwrah by Kheir *et al.*, (2010), Al Ahsaa by Ahmed *et al.* (2011) and Jazan by Alahmed (2010):This prevalence may be due to its wide range suitability of breeding sites, variable extremes of temperature and different altitudes that is in agreement with Abdullah and Merdan (1995).

Cx. tritaeniorhynchus is less prevalent encountering in 80 % of total collection sites. It was from the first two dominant species in Jazan province during the surveys done by Alahmed *et al.*, 2010 and Sallam *et al.*, 2013. *Cx. tritaeniorhynchus* also recorded in eastern, western and southern region in KSA by Mattingly and Knight (1956), Eastern Region of Saudi Arabia by Wills *et al.*, (1985), southern region of Saudi Arabia (Asir, jazan and Mekkah regions) by Miller *et al.*, (2002), southern region of Saudi Arabia (jazan region) by Jupp *et al.*, (2002), Southwestern of Saudi Arabia (Tihama lowland and

Asir region) by Abdoon and Ibrahim (2005), Riyadh, Saudi Arabia by Al Kuriji (2005), Makkah by Alahmed *et al.*, (2009), Jeddah by AL-Ghamdi and Al-Qahtani (2009) and Eastern region of Saudi Arabia by Alahmed (2010), and Al Madinah Al Munwurah by Kheir *et al.* (2010).

An. Arabinesis was encountered in 70 % of total collection sites resembling the most abundant Anopheline mosquitoes in Jazan province, comprising 1% of total collected larval mosquitoes. It was recorded in Southwestern of Saudi Arabia by Abdullah and Merdan (1995) and by Abdoon and Alshahrani (2003) in Asir region and in Southwestern of Saudi Arabia Tihama region by Abdoon and Ibrahim (2005) but not recorded in Jazan before Alahmed *et al.*, 2010.

St. aegypti, *L. (Metalutzia) tigripes* and *Cx. sitiens* were encountered in 50% of total collection sites. *Stegomyia aegypti* (= *Aedes aegypti*) larvae recorded in many parts of KSA by many authors as Alahmed *et al.*, 2010 in Jazan region and some parts of KSA as in southern region of Saudi Arabia (Asir, Jazan and Makkah regions) by Miller *et al.*, 2002, in Southwestern of Saudi Arabia (Tihama lowland and Asir region) by Abdoon and Ibrahim (2005), Makkah by Alahmed *et al.*, 2009, in Jeddah by Al-Ghamdi and Al-Qahtani (2009), and in Al Madinah Al Munwurah by Kheir *et al.*, 2010. *Lutzia tigripis* (= *Culex lutzia*) larvae were previously recorded in Arabian Peninsula (eastern, western and southern region in KSA by Mattingly and Knight (1956), in Southwestern of Saudi Arabia (Tihama lowland and Asir region) by Abdoon and Ibrahim (2005), in Abha, Al Baha, Jizan, Najran, Jeddah and Taif by Al Ahmed *et al.*, 2011 and in Jizan by Alahmed (2010): *Cx. sitiens* it also recorded in eastern, western and southern region in KSA by Mattingly and Knight (1956), Eastern Region of Saudi Arabia by Wills *et al.*, 1985, Southwestern of Saudi Arabia by Abdullah and Merdan (1995), southern region of Saudi Arabia (Asir, Jazan and Makkah regions) by Miller *et al.*, (2002), southern region of Saudi Arabia (Jazan region) by Jupp *et al.*, (2002), Southwestern of Saudi Arabia (Tihama lowland and Asir region) by Abdoon and Ibrahim (2005), Riyadh, Saudi Arabia by Al Kuriji (2005), Makkah by Alahmed *et al.*, (2009), Jeddah by AL-Ghamdi and Al-Qahtani (2009), Eastern region of Saudi Arabia by Alahmed (2010), Al Madinah Al Munwurah by Kheir *et al.*, (2010), Al Ahsaa by Ahmed *et al.*, (2011) and Abha, Al Baha, Jizan, Najran, Al Dammam, Al Hassa, Al Madinah, Bureidah, Dwadmi, Jeddah, Makkah, Riyadh, Tabouk, Taif, and Wadi Al Dawasir by Al Ahmed *et al.*, (2011) and Jazan by Alahmed (2010) comprised 1.8 % of T C M A in the study area.

Cx. quinquefasciatus was resembled in 40 % of total collection sites. It is also recorded in Eastern Region of Saudi Arabia by Wills *et al.*, (1985), Southwestern of Saudi Arabia by Abdullah and Merdan (1995), Riyadh, Saudi Arabia by Al Kuriji (2005), Al-Madina Al-Ali *et al.*, (2008) Makkah by Alahmed *et al.*, (2009), Jeddah by AL-Ghamdi and Al-Qahtani (2009), Eastern region of Saudi Arabia by Alahmed (2010), Al Madinah Al Munwurah by Kheir *et al.*, (2010), Al Ahsaa by Ahmed *et al.*, (2011) and Jazan by Alahmed (2010).

Am. vexans was resembled in 30 % of total collection sites acting as a vector of Rift Valley fever in Jazan, Jupp *et al.*, 2002 and Miller *et al.*, 2002. It resembled the most abundant species in Jazan province recording 58.2 % of the total collected mosquitoes larvae in Jazan province which agree with Alahmed *et al.*, 2010 who reported it as 52.42% of total collected mosquito larvae in Jazan, it was recorded in southern region of Saudi Arabia (Asir, Jazan and Makkah regions) by Miller *et al.*, 2002, in Jazan region by Jupp *et al.*, 2002, and in Southwestern of Saudi Arabia (Tihama lowland and Asir region) by Abdoon and Ibrahim (2005).

Cs. longiareolata were encountered in 20% of total collection sites. *Cs. Longiareolata* was only recorded in our study as adult recording 19 adult mosquitoes, 2.6

% of T C M A, in Jazan province (Table 1): It was recorded also in eastern, western and southern region in KSA by Mattingly and Knight (1956), Eastern Region of Saudi Arabia by Wills *et al.*, (1985), Riyadh, Saudi Arabia by Al Kuriji (2005), Makkah by Alahmed *et al.*, (2009), Eastern region of Saudi Arabia by Alahmed (2010), Al Madinah Al Munwwrah by Kheir *et al.*, (2010) and Abha, Al Baha, Jizan, Najran, Al Dammam, Al Hassa, Al Madinah, Bureidah, Dwadmi, Jeddah, Makkah, Riyadh, Tabouk, Taif, and Wadi Al Dawasir by Al Ahmed *et al.*, (2011). *An. pretariensis*, *An. d'thuli*, *An. turkdi*, *Cx. decens*, *A. caspius* and *Cx. bitaeniorhynchus* were the least prevalent mosquitoes in Jazan region encountered in only 10% of total collection sites. *An. pretariensis* was represented in many parts of KSA as Alahmed *et al.*, 2010 in Jazan region and some parts of KSA as southern region by Miller *et al.*, 2002, in Asir region 2003 by Abdoon and Alshahrani, in 2005 by Abdoon and Ibrahim and Riyadh by Al Kuriji *et al.*, 2007 in Jeddah by Al Ghamdi *et al.*, 2008 and AL-Ghamdi and Al-Qahtani (2009) and in eastern region by Alahmed (2010) in Makkah by Alahmed *et al.*, 2009.

An. d'thuli is not prevalent in Jazan but Abdoon and Alshahrani (2003) reported it as a prevalent Anophline mosquito in Asir region. It was also reported by Alahmed *et al.*, 2010 in Jazan region and some parts of KSA as southern region by Miller *et al.*, (2002), in Asir region by Abdoon and Alshahrani (2003), by Abdoon and Ibrahim (2005) and in Riyadh by Al Kuriji *et al.*, 2007 in Jeddah by Al Ghamdi *et al.*, 2008 and AL-Ghamdi and Al-Qahtani (2009) and in eastern region by Alahmed (2010) in Makkah by Alahmed *et al.*, (2009).

An. turkhudi was newly recorded in Jazan but was recorded before in Eastern, Western and Southern regions in KSA by Mattingly and Knight (1956), in Asir region by Abdoon and Alshahrani (2003), in Southwestern of Saudi Arabia (Tihama lowland and Asir region) by Abdoon and Ibrahim (2005), in Riyadh by Al Kuriji (2005), in Jeddah by Al Ghamdi *et al.*, (2008) and AL-Ghamdi and Al-Qahtani (2009), in Makkah by Alahmed *et al.*, (2009), in Al Madinah Al Munwwrah by Kheir *et al.*, (2010), in Abha and Najran, by Al Ahmed *et al.*, (2011).

Cx. decens was recorded in Southwestern of Saudi Arabia by Abdullah and Merdan (1995), southern region of Saudi Arabia (Asir, Jazan and Makkah regions) by Miller *et al.* (2002), southern region of Saudi Arabia (Jazan region) by Jupp *et al.* (2002), Makkah by Alahmed *et al.* (2009).

A. caspius was recorded from only one collection site, Ahad El Masarha, resembling 0.3 % of total collected mosquitoes in Jazan province in the other hand Ahmed *et al.*, 2011 stated it in Alahsaa as the most abundant species recording 65.66% of the total larval collection. It is widely distributed in different regions of Saudi Arabia such as Riyadh district (Al-Khrejji 2005), as well as in the eastern (Mattingly and Knight 1956; Büttiker 1981; Wills *et al.*, 1985 and southwestern regions (Abdullah and Merdan (1995).

Cx. bitaeniorhynchus was concluded in Southwestern of Saudi Arabia (Asir region) by Abdoon (2004) Southwestern of Saudi Arabia (Tihama lowland and Asir region) Abdoon and Ibrahim (2005): *Am. vexans* was the most abundant 57 % (17121) which agree with Alahmed *et al.*, 2010 who reported it as 52.42% of total collected mosquito larvae in the same region, *Culicine spp.* 38.2 % (11416), *Anopheline spp.* 1.5 % (433), *St. aegypti* 3 % (749) and each of *Aedine*, *Lutzia* and *Culleseta* were encountered less than 1%.

Finally it is very obvious that *Culex* is the most prevalent genus in Jazan region which agree with Alahmed (2010) and AL-Ghamdi and Al-Qahtani (2009) who proving that in Eastern region and Jeddah city respectively.

The 16 species reported in this study is update to the last report (Alahmed *et al.* (2011) of the total mosquito species from KSA and that of Jazan done by Al Ahmed

2010. This number is subject to increasing or decreasing due to the confusions and lack of accurate identification (mis-identification or missed-identification) of samples. To avoid such confusions, molecular approaches must be developed for accurate identification and establish their true species status and identify new species. This is particularly important as not all members of species complexes are vectors of diseases and such information is lacking in the Arabian Peninsula.

Five of the mosquito species recorded in this paper is considered important dominant vector species according to the description of Sinka *et al.* (2010). These include *An. arabiensis*, *An. sergenti*, *Cx. quinquefasciatus*, *Cx. pipiens*, *Cx. tritaeniorhynchus* and *St. aegypti*. The mosquito dominant vector species are characterized by their well-adaptation to a broad range of habitats and climatic conditions, highly anthropophilic, variable adult behaviour of resting and propensity capacity (Sinka *et al.*, 2010). Full characterization of the bionomics of these dominant vector species under local eco-demographic conditions for example in the Arabian Peninsula, will add important information to the global disease maps established like those for malaria (Hay *et al.*, 2010). This will help to minimize the risk of disease transmission and outbreaks in Jizan due to changing human activities or climate change. This is also especially important for control strategies that aim at reducing vector-human contacts like indoor residual spraying and insecticide-treated nets; monitor the spread of insecticide resistance and development of innovative integrated vector management strategies (Hemingway *et al.*, 2006).

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