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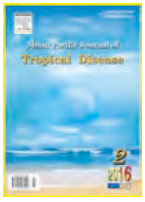

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First report of some adult mosquitoes captured by CDC gravid traps from North-Eastern Qatar

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ABSTRACT

Objective: To report six species of female mosquitoes caught in CDC gravid traps for the first time in Qatar.
Methods: Five traps were installed in Al-Khor community, north-eastern Qatar during the outbreak season between October-November, 2010 and February-March, 2011.
Results: The collection revealed that the adult female mosquitoes encountered in the gravid traps were: *Ochlerotatus caspius* (Pallas 1771), *Anopheles stephensi* (Liston 1901), *Culex quinquefasciatus* (Say 1823), *Culex pipiens* biotype *molestus* (Forskal 1775) (*Cx. pipiens molestus*), *Culex tritaeniorhynchus* (Giles 1901) and *Ochlerotatus dorsalis* (Meigen 1830). Except *Cx. pipiens molestus*, which was previously recorded, the other five species are reported for the first time in Qatar. Among the collected adult females, *Cx. pipiens molestus* was the most abundant (67.2%), followed by *Culex quinquefasciatus* (30.2%). The other species were present in small numbers. All of the recorded species have been collected as larval stages in the previous studies except for *Ochlerotatus dorsalis* which is collected as adult stage for the first time in the current study.
Conclusions: The collected species are of potential medical importance that threaten the north-eastern area of Qatar. A surveillance program is urgently required to generate a database of mosquito species in the area.

1. Introduction

Knowledge of mosquito fauna of Qatar is extremely missed until 2009, a literature review revealed only two entomological surveys. The first was conducted in the context of a normal collection of insect fauna across three years from 1982 up to 1985 and the second was carried out in Doha city through one-year observation of night flying insects[1,2]. Unfortunately, the two surveys did not focus on mosquito population despite the fact that four different species were recorded, three of them were identified only to genus level. In 2006, the first survey of mosquitoes at larval stages was conducted as a routine collection of municipal activities. In this survey five of the eight Qatari districts were scanned and larvae were collected from a wide range of natural breeding sites[3]. Recently, another mosquito larval survey was conducted in the north-western area which reported some additional records to the diversity of mosquitoes in Qatar[4].

Currently, the situation of vectors and vector borne-diseases is still highly vulnerable in Qatar. In fact, different mosquito-transmitted diseases have been established in adjacent countries. The arbo-virus diseases, filariasis and malaria have been reported from Saudi Arabia, Bahrain, Emirates and Iran[5-9]. Although Qatar has been early declared as a malaria-free country[10], little effort has been invested in keeping track the mosquito diversity. Furthermore, no surveillance programs or vector studies have been conducted in recent years. It is worth noting that the public health authorities have been rigorous about monitoring the imported malaria[11,12]. The aim of this study is to raise concern and draw attention to the urgent need for a surveillance program that keeps track for adult mosquitoes and updates records in term of mosquito diversity in Qatar.

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2. Materials and methods

2.1. Study area

The present study was carried out as a part of general survey which was conducted in Al-Khor District, north-eastern of Qatar (Figure 1). Five CDC traps (designed by Centers of Disease Control and prevention, USA) were installed in Al-Khor community campus which is considered as the largest housing community within the State of Qatar. It is currently houses over 12500 residents from nearly 45 different nationalities. It is a fast growing community which offers excellent facilities to employees of Qatar Gas and Ras Gas companies[13]. The community has nearby wastewater treatment plant (Al-Dhakhira treatment plant) which provides the community with high quality treated wastewater that is used mainly for landscaping activities. The community is also located 1 km from the coastal area of Al-Khor district, which enriched by mangrove swamps.

2.2. Installation of the CDC gravid traps

During an intensive larval survey from September 2009 up to June 2011 in Al-Khor District, five CDC gravid traps were installed on the premises of Al-Khor community for selective capture of gravid females of culicine mosquitoes. The traps were distributed in different locations inside the community including residences, main rounds (Figure 2) and in areas known to have mosquito outbreaks which are situated close to the sewage treatment plant. The pan of each trap was filled with treated wastewater baited by some camel debris. Traps were cycled at the same time during the outbreak season of October-November, 2010 and February-March, 2011. Each trap was operated over two nights at weekly intervals during the season. Mosquitoes were kept under 40 ℃ refrigerating and identified under a stereomicroscope using the conventional identification keys.

Figure 2. A photograph showing one location of installed CDC gravid trap inside Al-Khor community.

3. Results

Six species of adult females were encountered in the gravid traps:

Figure 1. A map showing the location of Al-Khor community in north-eastern Qatar.

Ochlerotatus caspius (Pallas 1771) (*Oc. caspius*), *Anopheles stephensi* (Liston 1901) (*An. stephensi*), *Culex quinquefasciatus* (Say 1823) (*Cx. quinquefasciatus*), *Culex pipiens* biotype *molestus* (Forskal 1775) (*Cx. pipiens* biotype *molestus*), *Culex tritaeniorhynchus* (Giles 1901) (*Cx. tritaeniorhynchus*) and *Ochlerotatus dorsalis* (Meigen 1830) (*Oc. dorsalis*). Among the collected adult females, *Cx. pipiens* biotype *molestus* was the most abundant species (67.20%), followed by *Cx. quinquefasciatus* (30.20%). The other species were present by lower numbers (Table 1).

Table 1

Abundance of adult female mosquitoesthat encountered in CDC gravid traps in Al-Khor community, north-eastern Qatar.

Adult female species	No. of female mosquitoes		Total [*n* (%)]
	Oct-Nov 2010	Feb-Mar 2011	
Oc. caspius	2	1	3 (0.17)
An. stephensi	3	2	5 (0.30)
Cx. pipiens molestus	715	433	1 148 (67.20)
Cx. quinquefasciatus	310	206	516 (30.20)
Cx. tritaeniorhynchus	15	9	24 (1.40)
Oc. dorsalis[*]	8	4	12 (0.70)
Total	1 053	655	1 708

[*]: New records in Qatar.

3.1. Encountered adult females in the CDC gravid traps

Cx. pipiens biotype *molestus* and *Cx. quinquefasciatus* females (Figures 3, 4 and 5) were the most abundant species, because they were present in all traps (67.20%) and (30.20%), respectively. *Cx. tritaeniorhynchus* (Figures 6 and 7) was encountered with lower frequency in the gravid traps (Table 1). *Oc. caspius* (Figure 8) was encountered in the gravid traps in limited numbers (0.17%). They were detected in lower numbers due to the low salinity of water used in trap pans. Table 1 indicated that this species hatches with one generation in the winter season. *An. stephensi* (Figures 9 and 10) was encountered in the gravid trap collection in low numbers (0.3%). The captured females had incomplete bodies with missing abdominal parts. *Oc. dorsalis* (Figures 11 and 12) is reported for the first time in this study and considered as a new additional record to the mosquito population of Qatar. Few numbers of females were encountered with gravid traps (Table 1).

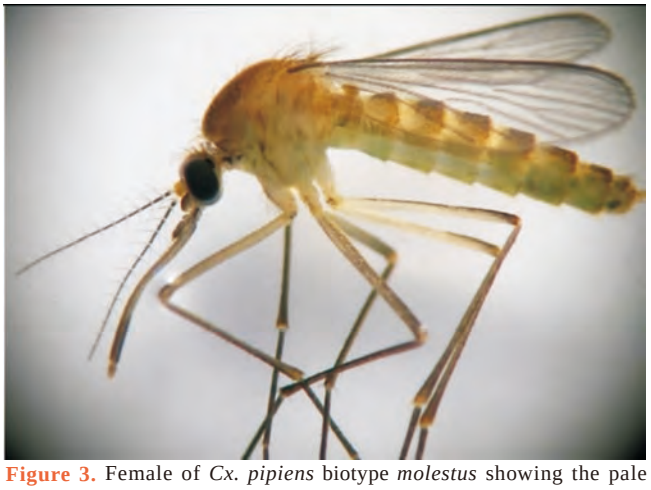

Figure 3. Female of *Cx. pipiens* biotype *molestus* showing the pale proboscis with dark apical third, abdominal tergites with pale basal bands straight that unconstructed laterally.

Figure 4. Female of *Cx. quinquefasciatus* seen from ventral view, the basal pale bands of abdominal terga which constricted laterally forming distinct pale lateral patches.

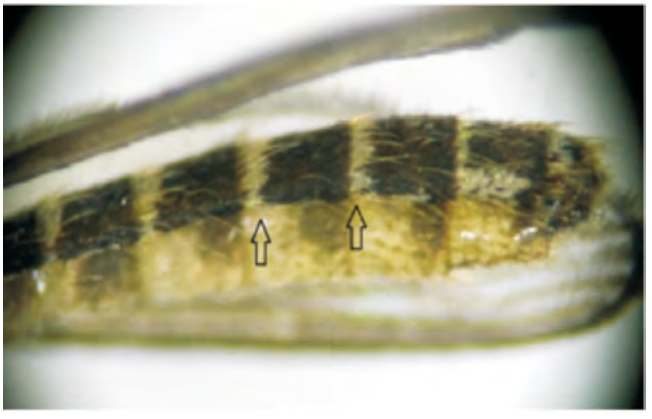

Figure 5. The abdomen of female *Cx. quinquefasciatus* showing dark scaled tergites with characteristic pale basal bands which constricted laterally.
The pale bands are of M-shaped which mostly prominent on segments IV and V.

Figure 6. *Cx. tritaeniorhynchus* female (lateral view) showing dark scaled proboscis with narrow median pale ring, short palps and pleurites with reddish brown patches.
Tarsi are dark scaled with narrow basal and apical pale rings on tarsomeres I-IV which more distinct on fore legs.

Figure 7. *Cx. tritaeniorhynchus* female (dorsal view) illustrating the scutum with narrow dark brown scales and terga with narrow, slightly convex basal pale bands.

Figure 8. Dorsal view of *Oc. caspius* female showing the scutum with 2 dorsocentral white stripes and wing veins covered with mixed dark and pale scales.

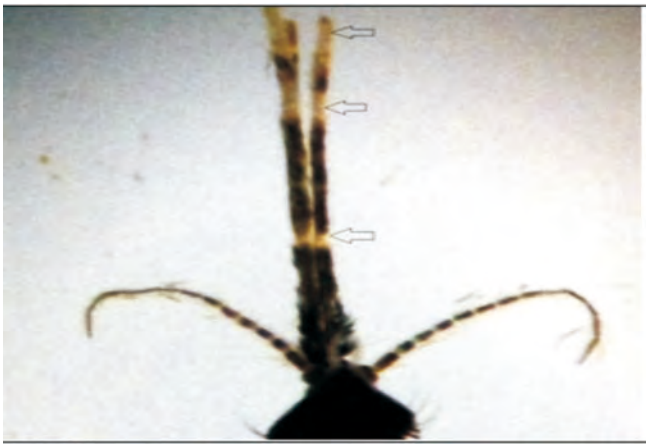

Figure 9. *An. stephensi*, palps with a broad pale ring at the apex and broad pale ring at the joint of palpomeres III and IV, the dark area in between is distinctly narrower than either ring.

Figure 10. *An. stephensi*, anterior part, wings with 4 large dark spots at anterior margin.

Figure 11. Dorsal view of *Oc. dorsalis* female showing dark scaled proboscis with pale scales intermixed especially on basal portion.
The abdominal terga mostly pale-scaled with pair of sub-median dark spots; last 2 terga entirely pale-scaled.

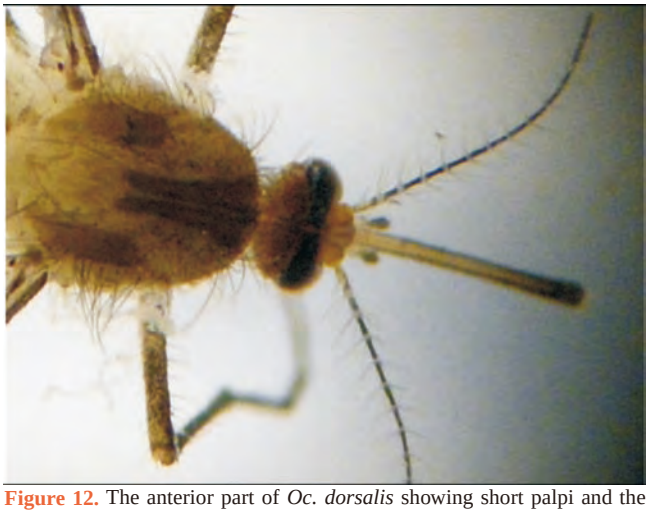

Figure 12. The anterior part of *Oc. dorsalis* showing short palpi and the characteristic ornaments of the scutum of the species.

4. Discussion

4.1. The available records of mosquito larvae in Qatar

The available literature revealed two larval surveys that reported eleven species of mosquito larvae: *Oc. caspius*, *Anopheles multicolor*, *An. stephensi*, *Culex univittatus*, *Culex pusillus*, *Cx. quinquefasciatus*, *Cx. pipiens* biotype *molestus*, *Cx. tritaeniorhynchus*, *Culex laticinctus*, *Culex sitiens* and *Culex perexiguus*[3,4]. It is obvious that all the collected adult mosquitoes that were encountered in the gravid traps have been recorded in the larval surveys in the north-eastern area except *Oc. dorsalis* which is recorded for the first time among the mosquito population in Qatar.

4.2. The encountered adult females in the CDC gravid traps

Cx. pipiens biotype *molestus* and *Cx. quinquefasciatus* females were the most abundant species, (67.20%) and (30.20%), respectively. This agrees with a previous study that showed that these two species are the most prevalent among Qatari mosquitoes[3,4]. This finding was expected due to the egg-laying behavior of females that usually prefer to laying their eggs on water surfaces[14]. Also, the abundance of man-made wetlands of treated wastewater is providing a favorable habitat for mosquito breeding[4]. It seemed that the camel manure was an excellent bait for attracting gravid females of the two types[15]. It is worth mentioning that *Cx. quinquefasciatus* is recorded for the first time as adult stage among Qatari mosquitoes.

Identification of *Culex pipiens* (*Cx. pipiens*) complex related species is still highly controversial. Recently, *Cx. pipiens* and *Cx. quinquefasciatus* have been established as separate species, in addition, *Culex molestus* as a biotype of *Cx. pipiens*[16]. Furthermore, many attempts have been done to study the morphological variations among southwestern Asian species and supported the same conclusion[17].

Cx. tritaeniorhynchus was found in larval stages in Al-Khor District as shown by the most recent study[4]. It was encountered with lower frequency because it is a halophilic species, commonly found in in coastal habitats and rarely near residences. Females feed mainly on domestic animals[18]. The presence of such coastal habitats raise the need to establish a surveillance program focused on investigating the different halophilic species, which are endemic to the areas.

Oc. caspius was highly abundant in the study area in larval stages as shown in the previous study which was carried out in the coastal areas of the north-eastern region[4]. It is a halophilic species despite the fact that it was encountered in the gravid traps in limited numbers. Although, *Ochlerotatus* females can be encountered in gravid traps as shown by Dugassa *et al.*[19], they were detected in lower numbers due to the low salinity of water used in trap pans.

An. stephensi was encountered in the gravid trap collection in low numbers. It appears that females of this species prefer clean water rather than treated wastewater. It is not clear that the captured females had incomplete bodies with missing abdominal parts. An. stephensi was recorded in larval stages in the area[4], but adults are reported for the first time in the current study.

Oc. dorsalis is reported for the first time in this study and considered as a new additional record to the mosquito population of Qatar. Few numbers of females were encountered with gravid traps. This species is halophilic which can tolerate up to 12% of salt contents[20]. It is likely that the nearby mangrove swamps are the main source of this mosquito species which also necessities a surveillance program. The larval stages have not been reported from the area during the previous larval surveys[3,4]. We assume that due to *Oc. dorsalis* is an endemic breeder species in the mangrove swamps[20], it hasn't been targeted by the previous surveys that have been conducted in the area.

4.3. The potential medical importance of the collected females

This study reveals that all the collected species are of potential medical importance. *An. stephensi* is the main vector of malaria disease in Iran[8], and Saudi Arabia[21]. *Cx. pipiens* biotype *molestus* and *Cx. quinquefasciatus*, both are vectors of various encephalitis viruses such as West Nile fever[22] and Sindbis virus[23]. *Cx. tritaeniorhynchus* was established as the main vector of Rift Valley fever in Saudi Arabia[5], and West Nile fever in Iran[24]. *Oc. caspius* was also capable of transmitting West Nile fever and other arboviruses in Iran[24]. It is also established as an efficient factor of Rift Valley fever in Saudi Arabia[5]. *Oc. dorsalis* is considered as a vector of many arbo-viruses[25].

No doubt that these species are of potential medical importance that threaten the north-eastern area of Qatar. A surveillance program is urgently required to generate a database of mosquito species in the area. This database will inform future studies of vectors and vector borne diseases and will also help in monitoring the exotic mosquito species in the future.

Conflict of interest statement

We declare that we have no conflict of interest.

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