

## Adult Mosquitoes Entomological Survey (Diptera: Culicidae) in Aseer Region, Kingdom of Saudi Arabia

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### ABSTRACT

**Background:** Mosquito borne diseases are a major public health problem threat in KSA. Therefore, mosquito entomological survey may directly contribute to the prevention of mosquito vector borne diseases.

**Aim:** Classification and identification for the different genus of mosquitoes in Aseer.

**Methods:** The study of entomological survey of adult mosquitoes (Diptera: Culicidae) was carried out in 4 sites (Mahayil, Rejalalmaa, Alfarsha and Maraba) in Aseer region. Two entomological surveys were conducted per month in each study site. Entomological survey was undertaken from 1<sup>st</sup> December 2017 to end January 2018, the adult mosquitoes were collected from the study areas and carried out to the laboratory for classification and identification for the different genus of mosquitoes using the morphological characteristics and standard identification keys, in addition to insectaries microscope.

**Results:** A total of 846 female mosquitoes include three genera of mosquito (Anopheles, Culicinae (Culex and Aedes)) were found in four sites and the adult mosquito distribution rate 0.906, 34.321, 3.013 and 3.994 in Mahayil, Rejalalmaa, Alfarsha and Maraba, respectively and the Culicinae (Culex and Aedes) were the most abundant, distribution rate 41,524. The genus Anopheles was the least abundant, distribution rate 0.71. In the study area Mahayil, no genus of the Anopheles mosquito identified, the most rate of mosquito distribution was found in Rejalalmaa area (18.5 and 34.321), respectively, while the least rate of mosquito's distribution found in Mahayil area (1.479 and 0.906), respectively.

**Keywords:** Mosquito, Anopheles, Survey, Culex, Aedes, Breeding site, Aseer region

### INTRODUCTION

According to the mechanism of lipid loss in our previous Mosquitoes are important vectors of several tropical diseases, including malaria, filariasis and numerous viral diseases, such as dengue Japanese encephalitis and yellow fever [1].

Mosquito-borne diseases not only cause high levels of morbidity and mortality but also have economic impacts, including loss in commercial labor outputs and social disruption, particularly in countries with tropical and sub-tropical climates. However, no part of the world is free from vector borne disease [1].

There are over 3,000 species of mosquito of which, approximately 100 are vectors of human malaria. Different species such as Culex and Aedes mosquitoes transmit other diseases such as filariasis, yellow fever and many others [2].

Female mosquitoes require a blood meal for egg production and they produce painful bite as they feed. While feeding they can also transmit number of disease causing organism to the human and animals and these might include: Encephalitis, dengue fever, filariasis, yellow fever and malaria [3]. Since 2007, four countries have eliminated

malaria and been certified by the World Health Organization (WHO) as malaria free countries [4]. Today, 34 countries, including the Kingdom of Saudi Arabia, are actively attempting to eliminate malaria [5].

The distribution of mosquitoes in several regions of Saudi Arabia has been reported [6]. Moreover, mosquitoes were surveyed in Aseer Region or generally in the south western area by some workers [7] carried out a survey following the outbreak of RVF in Aseer to assess the potential mosquito vectors in the region and get virus isolate from *Ae. Vexans arabiensis* females collected near the city of Muhajir.

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In addition, the authors collected 5 *Aedes*, 2 *Anopheles* and 4 *Culex* species.

In Saudi Arabia, malaria persists in the southwest provinces of Aseer and Jazan, which bordering the Republic of Yemen [8]. In Saudi Arabia, the most common mosquito-borne diseases include malaria [9,10]. Although malaria is endemic to southwestern Saudi Arabia, the number of indigenous malaria cases fell from 467 in 2006 to 58 cases in 2009, with a reduction of 88% [11].

Seven species of anopheline mosquitoes has been reported in the Aseer Region, these were: *Anopheles d'thali*, *Anopheles rupicolus*, *Anopheles sergenti*, *Anopheles arabiensis*, *Anopheles multicolor*, *Anopheles turkhudi* and *Anopheles pretoriensis* [10].

Many *Culex* species transmit viruses that cause encephalitis, *Culex pilosus* is currently not considered to be an important vector of human pathogens. However, as *Culex pilosus* feeds on various hosts, it may prove to play a secondary role in the transmission of some pathogens [12].

The *Aedes aegypti* mosquito is the main vector that transmits the viruses that cause dengue. The viruses are passed on to humans through the bites of an infective female *Aedes* mosquito, which mainly acquires the virus while feeding on the blood of an infected person [13].

Adult mosquito is entirely terrestrial and can fly long distances. Both females and males feed on nectars which they use for energy. Males and females mate during the first 3 to 5 days after they have emerged [14]. The male emerges first, from crepuscular swarms waiting the appearance of the females. Female mosquito mates only once. Males generally live for only a week. Only the female feed on blood meals [14], to obtain necessary nutrients for the development of eggs in ovaries.

The present work was undertaken to update and study the distribution and some ecological aspects of mosquitoes in Aseer Region.

## MATERIALS AND METHODS

### Study design

Cross section entomological survey was carried out in four sentinel sites in Aseer region, KSA. Mosquitoes from the selected sentinel sites were collected 2 times per month from each site for 2 months period from 1<sup>st</sup> December, 2017 to 31<sup>st</sup> January, 2018 using specific collection methods (the spray sheet collection technique and black hole trap

collection). This part was done by technicians and one supervisor from vector-borne diseases control department in Abha and then mosquitoes were transferred to the laboratory to identify.

### Study period

The field work was extending from 1<sup>st</sup> December, 2017 to 31<sup>st</sup> January, 2018.

### Study population

Adult mosquitoes (*Anopheles*, *Culicinae* (*Culex*, *Aedes*)).

### Study sites

The southern region of Saudi Arabia, the main criteria of selecting studies sites is based on the differences in the topographical settings and due mosquito's densities. Four study sites were selected (Alfarsha, Rejal Allmaa, Maraba and Mahayil).

### Collection of adult mosquitoes

A well-trained team consisting of technicians and a supervisor was implemented for the monthly field trips in accordance to the WHO manual collection methods as follows [15]. Principle method of mosquito collection:

1. **The spray sheet collection technique:** This method consists of the collection of indoor resting mosquitoes on white cotton sheets after knock-down by spraying of a pyrethrum solution, the aim of this method is to collect indoor resting mosquitoes for quantitative and qualitative studies. The materials that will be using area white sheet, hand atomizers (spray cans), pyrethrum solution (pyrethrin 0.1-0.2% in kerosene). Small plastic boxes, entomological forceps and hand lend petri dishes, cotton and filter paper. Time of application of this method will be during day time, usually early in the morning between 6.30 h and 10.00 h, depending on the situation and objective.
2. **Black hole trap collection:** Black hole trap (Figure 1) will be used to lure nocturnally active mosquitoes and other flying insects using these 2 materials CO<sub>2</sub> and UV light. They will be captured by the suction fan. Black hole trap miniature connected to 220 V and mosquito's cages. Four traps will be used. The traps will be hanged at 75-100 cm level above the ground at outdoor sites, between 18:00-06:00 h. Captured mosquitoes will be separated from other insects and preserved in silica Gail for identification.



**Figure 1.** The black hole.

### Adult mosquito identification

There are three genera with medical importance *Anopheles*, *Aedes* and *Culex*, all the adult mosquitoes collected from the study sites (Latarsha, reaj allmaa, Marba and Mahail) were transferred to the laboratory (insects). They were placed in a petri dish (**Figure 2**) where they were identified in the genus of different mosquitoes using the following morphological keys and the insect microscope.

1. Adults can distinguish *Anopheles* and mosquito *Culicinae* by observing their resting conditions.

*Anopheles* is located at an angle of 50-90°C to the surface while the coasts remain parallel to the surface.

*Anopheline* mosquitoes can also be distinguished from *Culicinae* by the length and shape of the panels:

- In female parasites, shorter is much shorter than a hose.
- In female *Anopheles*, palp if the hose.
- In male grafts, the fiber is longer than the hose, with tapered tips.
- In male *Anopheles*, the medulla if the hose and club shape at the tip.



**Figure 2.** The petri dish.

Distinguish between female and male *Anopheles*, on female antennae there are relatively few hairs and these are short (pilose). In contrast, male has a very long hair on the antennae and therefore has plumose.

The *Anopheles* wings have several veins. Each number of veins is given a number, dark ranks and pale scales arranged in.

### Sample size

Twice survey per month were carried out in each study site and 846 genera of female mosquitoes included in classification.

### Study variables

Include many environmental factors such as heat, breeding sites, water, climate and humidity.

### Ethical considerations

Permission was obtained from entomological laboratory of the vector-borne diseases control department in Abha. Following collection of samples from the targeted sites the health administration was informed about the presence of breeding areas for the mosquitoes to take the suitable vector control action.

### Data entry and statistical analysis

All entomological data was entered in form vector-borne diseases control center, Microsoft word and Microsoft Excel for statistical analysis.

### RESULTS

In the present study, adult mosquito survey was carried out in four sites in Asser region (Mahaila, Rejalalmaa, Alfarsha and Maraba), Southern of Saudi Arabia, survey was

undertaken from 1<sup>st</sup> December to 31<sup>st</sup> January, three genera of mosquito were (Anopheles, Culicinae (Culex and Aedes)) identified.

**Table 1** showed adult Anopheles mosquito distribution rate 0.0, 0.059, 0.031 and 0.62 in Mahaila, Rejalalmaa, Alfarsha and Maraba respectively and the Culicinae (Culex and Aedes) mosquito distribution rate were 0.906, 34.262, 2.982 and 3.374 in Mahayil, Rejalalmaa, Alfarsha and Maraba (**Table 2**), respectively.

**Table 1.** Distribution of adult Anopheles mosquitoes in Aseer regions 1/12/2017 to 31/1/2018.

| Study site | Anopheles<br>Mosquitoes distribution<br>1/12/2017 | Anopheles<br>Mosquitoes distribution<br>31/1/2018 | Total |
|------------|---------------------------------------------------|---------------------------------------------------|-------|
| Mahayil    | 0                                                 | 0                                                 | 0     |
| Rejalalmaa | 0                                                 | 0.059                                             | 0.059 |
| Alfarsha   | 0.031                                             | 0                                                 | 0.031 |
| Maraba     | 0.137                                             | 0.483                                             | 0.62  |
| Total      | 0.168                                             | 0.542                                             | 0.71  |

**Table 2.** Distribution of adult Culicinae mosquitoes in Aseer regions from 1/12/2017 to 31/1/2018.

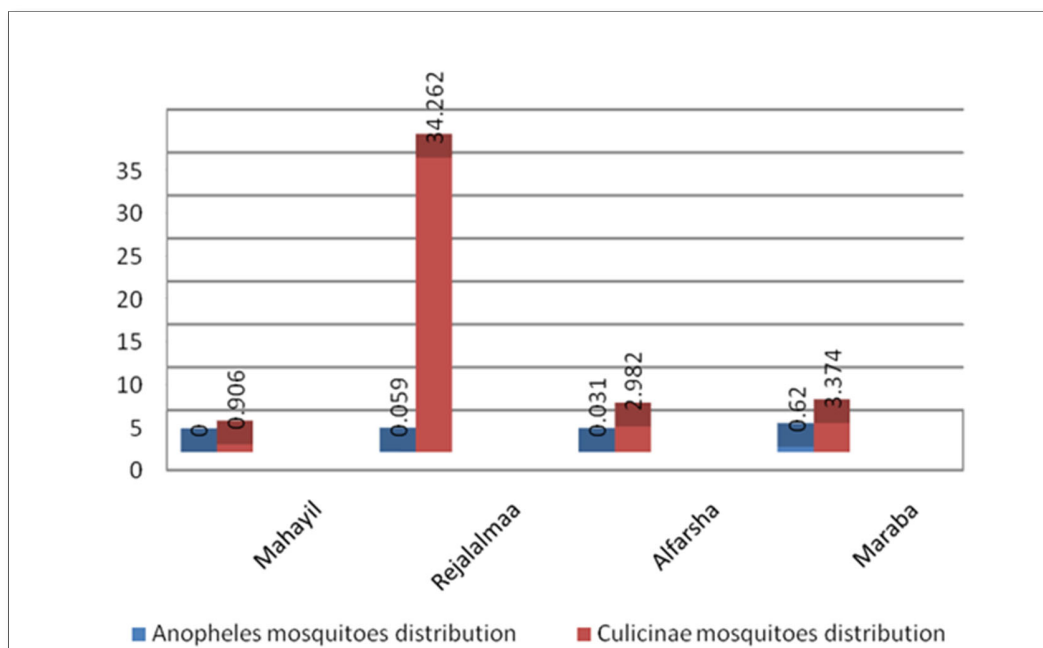
| Study site | Culicinae<br>Mosquitoes distribution<br>1/12/2017 | Culicinae<br>Mosquitoes distribution<br>31/1/2018 | Total  |
|------------|---------------------------------------------------|---------------------------------------------------|--------|
| Mahayil    | 0.266                                             | 0.640                                             | 0.906  |
| Rejalalmaa | 9.556                                             | 24.706                                            | 34.262 |
| Alfarsha   | 1.062                                             | 1.92                                              | 2.982  |
| Maraba     | 0.314                                             | 3.06                                              | 3.374  |
| Total      | 11.198                                            | 30.326                                            | 41.524 |

**Table 3** showed adult mosquito distribution rate were 0.906, 34.321, 3.013 and 3.994 in Mahayil, Rejalalmaa, Alfarsha and Maraba respectively, the Culicinae (Culex and Aedes)

were the most abundant and the distribution rate was 41,524 while the genus Anopheles were the less abundant, the distribution rate was 0.71 were identified (**Figure 3**).

**Table 3.** Distribution rate of genus mosquitoes during the study period in Aseer regions.

| Study site | Anopheles<br>Mosquitoes distribution | Culicinae<br>Mosquitoes distribution | Total  |
|------------|--------------------------------------|--------------------------------------|--------|
| Mahayil    | 0                                    | 0.906                                | 0.906  |
| Rejalalmaa | 0.059                                | 34.262                               | 34.321 |
| Alfarsha   | 0.031                                | 2.982                                | 3.013  |
| Maraba     | 0.62                                 | 3.374                                | 3.994  |
| Total      | 0.71                                 | 41.524                               | 42.234 |



**Figure 3.** Distribution rate of genus mosquitoes during the study period in Aseer regions.

**Table 3** and **Figure 3** showed that in the study area Mahayil, no genus of the Anopheles mosquito was identified.

In the study area Rejalalmaa, less rate genus of the Anopheles mosquito distribution (0.059) but the most abundant the Culicinae (Culex and Aedes) mosquito distribution (34.262).

The survey found in the study area Alfarsha on the January month, no genus of Anopheles mosquito was identified but were the most abundant of the Culicinae (Culex and Aedes) mosquito distribution rate was 2.982. In the study area Maraba on the January month, less genus of Anopheles mosquito distribution rate was (0.483) but was the most abundant the Culicinae (Culex and Aedes) distribution rate was 3.374 (**Figure 3**).

The adult mosquito survey of vector-borne disease center in Aseer regions the survey was carried out in four sites in

Aseer region (Mahayil, Rejalalmaa, Alfarsha and Maraba), Southern of Saudi Arabia, survey was undertaken from December 2016 to January 2017 and three genera of mosquito Anopheles, Culex and Aedes were identified.

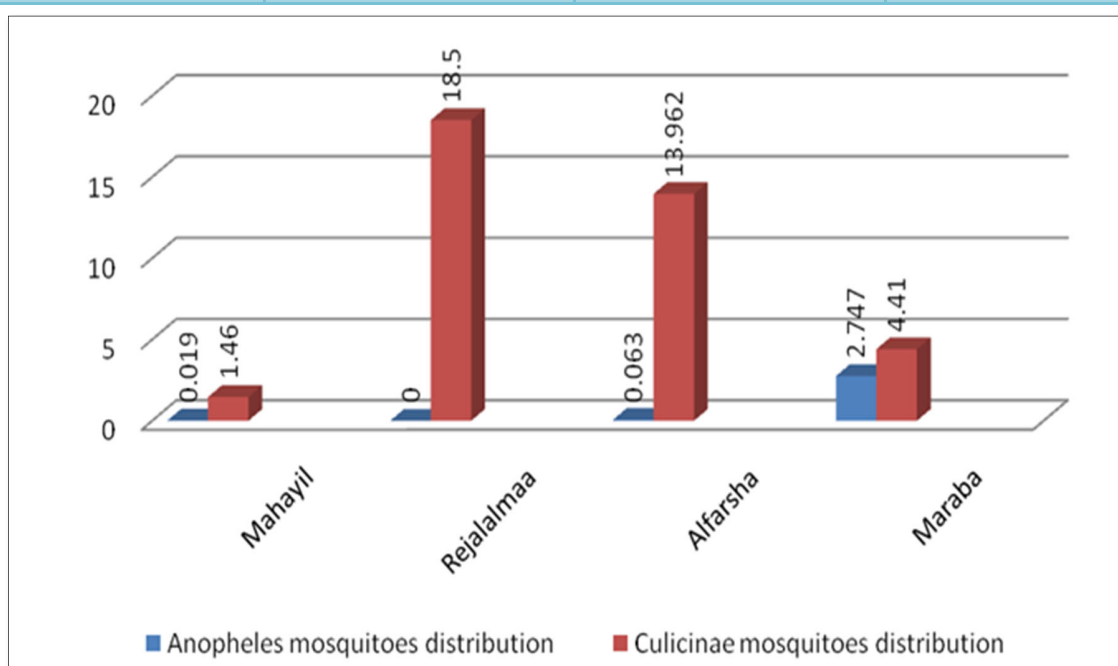
The survey found the Anopheles mosquito distribution rate 0.019, 0.0, 0.063 and 2.747 in Mahayil, Rejalalmaa, Alfarsha and Maraba respectively, while the Culicinae (Culex and Aedes) distribution rate were 1.46, 18.5, 13.962 and 4.41 in Mahayil, Rejalalmaa, Alfarsha and Maraba (**Tables 4 and 5 and Figure 4**). **Table 6** showed the adult mosquito distribution rate were 1.479, 18.5, 14.025 and 7.157 in Mahayil, Rejalalmaa, Alfarsha and Maraba respectively and the Culicinae (Culex and Aedes) were the most abundant the distribution rate was 38.332 and the genus Anopheles were the less abundant and the distribution rate was 2.829 were identified.

**Table 4.** Distribution of adult Anopheles mosquitoes of vector-borne disease center in Aseer regions 1/12/2016 to 31/1/2017.

| Study site | Anopheles mosquitoes distribution<br>1/12/2016 | Anopheles mosquitoes distribution<br>31/1/2017 | Total |
|------------|------------------------------------------------|------------------------------------------------|-------|
| Mahayil    | 0.019                                          | 0                                              | 0.019 |
| Rejalalmaa | 0                                              | 0                                              | 0     |
| Alfarsha   | 0.031                                          | 0.032                                          | 0.063 |
| Maraba     | 1.016                                          | 1.731                                          | 2.747 |
| Total      | 1.066                                          | 1.763                                          | 2.829 |

**Table 5.** Distribution of adult Culicinae mosquitoes of vector-borne disease center in Aseer regions 1/12/2016 to 31/1/2017.

| Study site | Culicinae<br>Mosquitoes distribution<br>1/12/2016 | Culicinae<br>Mosquitoes distribution<br>31/1/2017 | Total  |
|------------|---------------------------------------------------|---------------------------------------------------|--------|
| Mahayil    | 1.426                                             | 0.034                                             | 1.46   |
| Rejalalmaa | 11                                                | 7.5                                               | 18.5   |
| Alfarsha   | 7.156                                             | 6.806                                             | 13.962 |
| Maraba     | 1.968                                             | 2.442                                             | 4.41   |
| Total      | 21.55                                             | 16.782                                            | 38.332 |

**Figure 4.** Distribution of genus mosquitoes of vector-borne disease center in Aseer regions.**Table 6.** Distribution rate of genus mosquitoes of vector-borne disease center in Aseer regions.

| Study site | Anopheles<br>mosquitoes distribution | Culicinae<br>mosquitoes distribution | Total  |
|------------|--------------------------------------|--------------------------------------|--------|
| Mahayil    | 0.019                                | 1.46                                 | 1.479  |
| Rejalalmaa | 0                                    | 18.5                                 | 18.5   |
| Alfarsha   | 0.063                                | 13.962                               | 14.025 |
| Maraba     | 2.747                                | 4.41                                 | 7.157  |
| Total      | 2.829                                | 38.332                               | 41.161 |

In the study area Rejalalmaa no genus of *Anopheles* mosquito was identified (Table 4) and (Figure 4) but were

the most abundant of the *Culicinae* (*Culex* and *Aedes*) mosquito distribution rate was 18.5 (Table 5 and Figure 4).

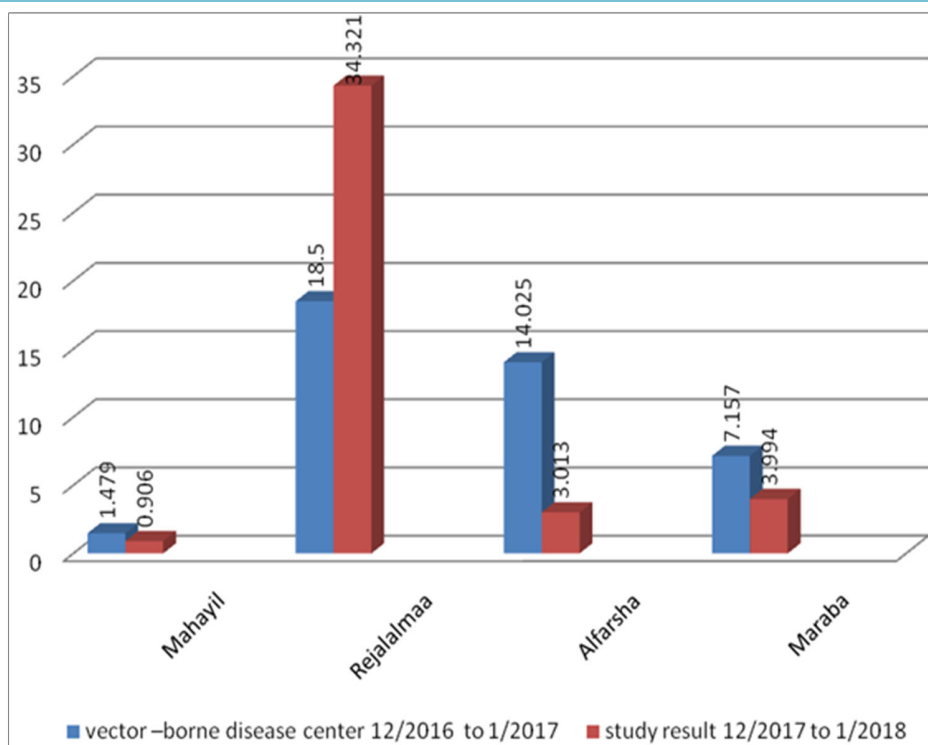


**Table 7** and **Figure 5** showed comparisons of mosquito's distribution (12/2016 to 1/2017) and (12/2017 to 1/2018), the most rate of mosquito distribution was found in

Rejalalmaa area (18.5 and 34.321) respectively, while the less rate of mosquito's distribution was found in Mahayil area (1.479 and 0.906), respectively.

**Table 7.** Comparison between the mosquitoes distribution 1/12/2016 to 31/ 1/2017 and 1/12/2017 to 31/ 1/2018.

| Study site | Vector-borne disease center<br>1/12/2016 to 31/1/2017 | Study results<br>1/12/2017 to 31/1/2018 |
|------------|-------------------------------------------------------|-----------------------------------------|
| Mahayil    | 1.479                                                 | 0.906                                   |
| Rejalalmaa | 18.5                                                  | 34.321                                  |
| Alfarsha   | 14.025                                                | 3.013                                   |
| Maraba     | 7.157                                                 | 3.994                                   |
| Total      | 41.161                                                | 42.234                                  |



**Figure 5.** Comparison between the mosquitoes distribution 1/12/2016 to 31/1/2017 and 1/12/2017 to 31/1/2018.

## DISCUSSION

Mosquito borne diseases are a major public threat in KSA. Therefore, mosquito entomological survey may directly contribute to the prevention of mosquito vector borne diseases. In the present study adult mosquito survey was carried out in four sites in Aseer region (Mahayil, Rejalalmaa, Alfarsha and Maraba), Southern of Saudi Arabia, survey was undertaken from December 2017 to January 2018; three genera of mosquito were identified (Anopheles, Culex and Aedes).

Mosquito distribution rates were 0.906, 34.321, 3.013 and 3.994 in Mahayil, Rejalalmaa, Alfarsha and Maraba

respectively and the Culicinae (Culex and Aedes) were the most abundant, the distribution rate was 41.524 while the genus Anopheles were the least abundant with distribution rate 0.71. Alahmed [6] obtained similar results during the period from March 2004 to February 2006, a mosquito (Diptera: Culicidae) survey was conducted in the Eastern Region of Saudi Arabia, and 25 species which belong to 5 genera: Aedes (1 species), Anopheles (13 species), Culex (9 species). Adult mosquito's light traps collected 5809 adult mosquitoes and Culex mosquitoes were the most abundant where 4086 were attracted to the light traps, followed by 879 (15.13%) Anopheles, 838 (14.42%) Aedes, 4 (0.07%) Uranotaenia and only 2 (0.04%) Culiseta.

Anopheles mosquito distribution rates were 0.0, 0.059, 0.031 and 0.62 in Mahayil, Rejalalmaa, Alfarsha and Maraba respectively, while the Culicinae (Culex and Aedes) mosquito distribution rates were 0.906, 34.262, 2.982 and 3.374 in Mahayil, Rejalalmaa, Alfarsha and Maraba. Similar results were obtained [16] in an entomological survey which was undertaken for one year to update the mosquito fauna of Aseer region, Kingdom of Saudi Arabia. A total of 31 species of 8 genera were reported of which genus Culex (55%) was the most common.

Examining the distribution of the different genus of mosquito revealed that Culicinae (Culex and Aedes) were more common in study areas. Similar result was obtained [17] which said that *Aedes caspius* was the most abundant species in the district, comprising 65.66% (6230 larvae) of the total larval collection (**Figure 4**). It was encountered in all localities (**Table 2**), including localities with highly saline water (**Table 3**).

*Culex pipiens* larvae represent 12.83% (1217 larvae) of the total larvae and were the second most common species collected in this study.

## CONCLUSION

This entomological survey showed 864 genera of female mesquites were surveyed and 3 genres (Anopheles, Culex and Aedes) of adult mosquitoes were found in four sites. The Culicinae rate were the most abundant, the distribution rate was 41.524 while the genus Anopheles were the least abundant, the distribution rate 0.71. The majority prevalence of Anopheles mosquitoes were identified in the Maraba area (0.62) while the Culicinae mosquitoes were identified in the Rejalalmaa area (34.262). The least prevalence of Anopheles mosquitoes were identified in the Mahayil area (0) while the Culicinae mosquitoes were identified in the Mahayil area (0.906).

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