

**Seasonal distribution study of mosquito species
(Culicidae: Diptera) in Al- Naamania salt Basin north western
Al Kut city / Iraq**

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**التوزيع الموسمي لأنواع البعوض (Diptera: Culicidae) في حوض مملح النعمانية
شمال غرب مدينة - الكوت**

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المستخلص

درس تأثير العوامل الفيزيائية والكيميائية على توزيع ووفرة اجناس وانواع البعوض في حوض مملح النعمانية شمال غرب مدينة الكوت خلال فترة سبعة اشهر من (تشرين الاول 2012- نيسان 2013). شخّصت ثلاثة انواع تعود الى ثلاثة اجناس خلال فترة الدراسة من مجموع (339) يرقة هي :
Aedes caspius (Pallas) الأكثر وفرة ويليها النوع *Culex pipiens* (Linnaeus) واخيرا النوع *Culiseta longiareolata* (Macquarrrt) وينسب 66.07%, 18.58% و 10.02% على التوالي
قيست بعض العوامل الفيزيائية والكيميائية للعينات مثل الملوحة, التوصيلية الكهربائية, الرقم الهيدروجيني, المواد الذائبة الكلية وأخيرا درجة الحرارة. اظهرت نتائج التحليل الاحصائي ان النوع *Aedes caspius* يملك علاقة معنوية موجبة مع التوصيلية الكهربائية (0,001) وعلاقة موجبة ولكن ليست معنوية مع الملوحة, المواد الذائبة الكلية, الرقم الهيدروجيني والحرارة. اما النوع *Culex pipiens* فيملك علاقة سالبة ليست معنوية مع جميع العوامل المقاسة.
يملك النوع الاخير *Culiseta longiareolata* علاقة معنوية سالبة مع التوصيلية الكهربائية والاس الهيدروجيني بمستوى (0.05) وعلاقة معنوية سالبة قوية مع درجة الحرارة بمستوى (0.01) وعلاقة سالبة غير معنوية مع الملوحة والتوصيلية الكهربائية. هذا وبيّنت نتائج الدراسة بانه لا توجد علاقة ارتباط بين الانواع نفسها.

Abstract

The influence of physical and chemical parameters on the abundance and diversity of Mosquito Species were studied in Al- Naamania Salt Basin North Western Al-kut City during a period of seven months (October 2012- April 2013). Three species belong to three genera of Culicidae were identified from a total of (339) larvae :

Aedes caspius (Pallas) (66.07%) was the most abundant during the period of the study, *Culex pipiens* (Linnaeus) (18.58%) and *Culiseta longiareolata* (Macquarrrt) (10.02%). During this study, some of Physicochemicals parameters, such as water pH, Total Dissolved Solids (TDS), water temperature, water salinity (NaCl), Electrical conductivity (EC) were measured.

The results from Statistical analysis showed that *Aedes caspius* has significant positive correlation with EC ($P < 0.001$) and positive correlation but not significant with NaCl, TDS, PH and temperature. *Culex pipiens* has negative correlation not significant with EC, NaCl, TDS, PH and temperature. Finally *Culiseta longiareolata* has negative significant correlation with EC, PH ($p < 0.05$) and temperature ($p < 0.01$) also it has negative correlation but not significant with NaCl and TDS. According to principal component analysis (PCA) there are no relationships between the species themselves.

Introduction

Mosquitoes belong to order Diptera and family Culicidae. According to the most recent classification of mosquitoes this family divided into two subfamilies, 11 tribes, 113 genera, and 3526 species in the world fauna (1). Also, it represents the most important families of Diptera, their species live and spread in different thermal zones in various parts of the world (2). Mosquitoes are considered the first enemy within the insects to human and animals because their bites and blood sucking leave severe impact due to salivary injection (3).

Mosquitoes are spread in all tropical and temperate regions and extend range within the Southern Antarctic Circle and reach to higher (5500 meters) and in mining at a depth (1250 meters) below sea level, and some species have limited distribution only to certain areas of the world (4). Culicidae mosquitoes are the most public health important vectors of arthropods due to malaria transmission and vector of various types of filariasis, and arboviruses (5).

In Southeast Asia, *Aedes albopictus* (Skuse) has been incriminated as a secondary vector of dengue fever and *A. aegypti* (Linn.) as the principal vector of dengue viruses (6). The genus *Culex* L. includes 25 subgenera and at least 751 species in the world fauna (7). Certain species of the genus *Culex* are involved in the transmission of various arboviral and filarial diseases to humans and domesticated animals and/or are important for their biting nuisance in different parts of the world (8). The species *C. pipiens* has importance in the transfer of viruses that cause Dengue fever which is spread in the tropics and subtropics regions while *C. univittatus* and *C. antennatus* transfer viruses that cause West Nile Fever (9).

The Water is an essential factor for the development of the first stages of mosquitoes to reach to adult mosquitoes and that the quantity and quality of water are important for some species, since each species prefers a particular aquatic environment for its reproduction and presence (10).

The aims of this study

- Identification the species of mosquitoes and know the activity of each species in Al Naamania salt basin.
- Select the ecological factors that associated with its activity.

1. Materials and Methods

1.1. Study area: Al Naamania Salt Basin

This study was conducted in Al Naamania Salt Basin which is located in North West of Al-Kut City/Iraq. This Basin is lowered area which look like U-letters in the shape resulting from collection of the rains water and irrigation of many agricultural area. The Basin has about 5 kilometers length and 300-600 m in width and maximum 1.5m depth divided into three stations for study purpose. It is far about 330 m from Baghdad Street, 220 m from Al Naamania Street and about 1 kilometer from Tigris River Figure [1 (A –B)].

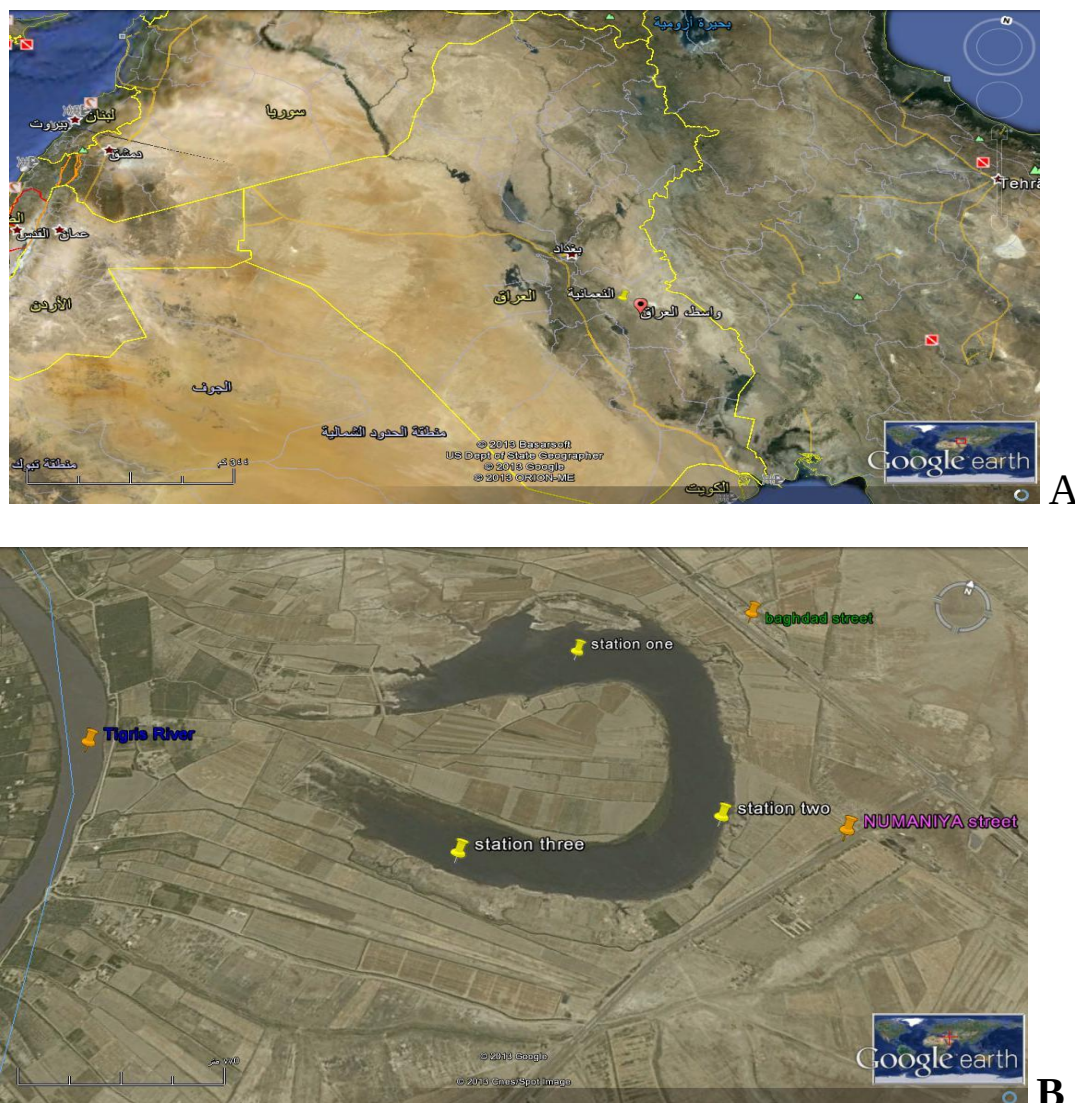


Figure [1 (A-B)] : Map of Al Naamania Salt Basin/ kut /Iraq showing approximate locations sites.

1.1.1. Sampling procedure

Quantitative samples of Mosquito larvae were randomly collected every month from three stations and ten samples for each station (total 30 samples) by using Standard Metal Dipper capacity 350 ml which universally agreed (11) equipped with a 1.2m long handle was used for collecting the larval samples and measure the ecological factors by ecological parameters, the samples were transferred into a labeled plastic bags with size (13×18cm) in ice box. The collected samples were transferred to the laboratory immediately preserved in 70% ethanol for subsequent identification and counting.

1.1.2. Environmental parameters

During sampling, measurement of physicochemical parameters, such as water pH, water temperature, water salinity, Electrical conductivity and total dissolved solid were made in situation at three randomly selected locations at each sampling site. At each site, water pH, Electrical conductivity, Total Dissolved Solids and Salinity were measured with a multi parameters (Martini instrument) model 180 after equilibration with standard buffer solutions (pH4, pH7, pH10).

1.1.3. Preparation of slides

The slides were prepared according to (12) method.

1.1.4. Identification of species

The larvae of mosquito that collected during the study period, identified according to the following key:

- Harbach, 1988 for *Culex* larvae in West- South Asia and Egypt (13).
- Ibrahim *et al.*, 1983 for culicinae larvae in Iraq (14).

The identification of larvae was vitrified in the Natural History Museum, university of Baghdad /Iraq.

1.1.5. Statistical analysis

The Mean of mosquito larvae numbers and environmental factors were analyzed by using statistical software Gretl (15) to analyze the relationship between environmental factors and abundance of the species of mosquitoes by extracting the P-value and to explain the relationship type whether negative or positive. Principal Component Analysis (PCA) of SPSS program (16) used to select the combination between the species.

2. Results

A total of (339) larvae were collected during the period of study (October 2012- April 2013). Three species belong to three genera of Culicidae mosquitoes were identified: *Aedes caspius* (Pallas)

(66.07%) was the most abundant, *Culex pipiens* (Linnaeus) (18.58%) and *Culiseta longiareolata* (Macquart) (10.02%).

As shown in figure [2] larval density of mosquitoes species sampled monthly. The highest density was reported in April with low density in January. The larval numbers of *Aedes caspius* were reported in all months during the study except in November and December, where begin to increase from January to reach to their peak in April. *Culex pipiens* appeared only in January and February. *Culiseta longiareolata* appeared from January to March.

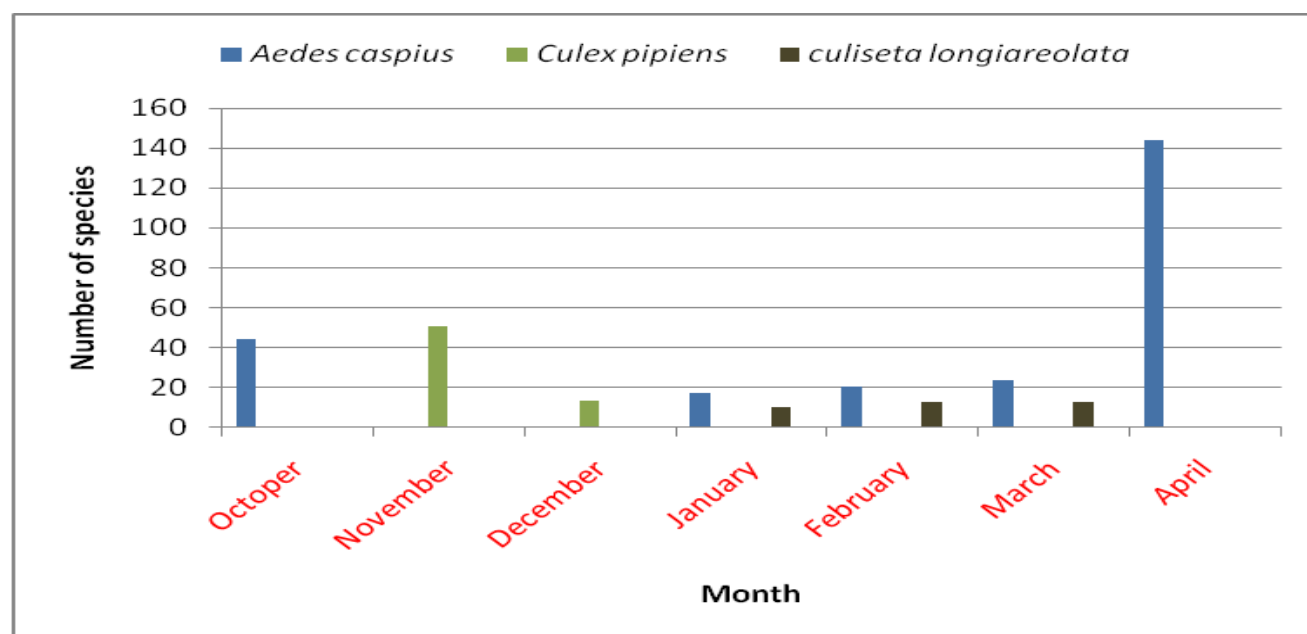


Figure [2]: Larval density of mosquitos' species sampled monthly during the period of study in Al- Naamania Salt Basin

The following Physicochemical parameters of water were measured monthly: water pH, total dissolved solids (TDS), water temperature, water salinity (NaCl), Electrical conductivity (EC), their ranges: (8.14-11.79), (17.79g/L-78.8g/L), (17 °C-25 °C), (67.73%-308.83%), (34.59 µs-422.88 µs) respectively.

Table (1) showed the correlation between the physicochemical parameters and Mosquito Species abundance. *Aedes caspius* has significant positive correlation with EC ($p < 0.001$) and positive correlation but not significant with NaCl, TDS, PH and temperature, *Culex pipiens* showed negative correlation with all environmental parameters but not in significant values. Finally *Culiseta longiareolata* has negative significant correlation with EC, PH ($p < 0.05$) and temperature ($p < 0.01$) also its has negative correlation but not significant with TDS and NaCl.

Table (1): Results of statistical analysis (Gretl) for correlation among Mosquito species and physicochemical parameters

Mosquitoes Species	Salinity (NaCl)%	Electrical Conductivity μs	Total dissolved solids (g/L)	PH	Temperature °C
<i>Aedes caspius</i>	0.17433	0.0001***	0.16260	0.72040	0.14122
<i>Culex pipiens</i>	-0.15185	-0.28321	-0.11799	-0.44924	-0.84039
<i>Culiseta longiareolata</i>	-0.15035	-0.06935*	-0.21927	-0.06646*	-0.01649**

*P<0.05; **P<0.01; ***p< 0.01, 0.05

3. Discussion

3.1. Larval density and distribution

The study showed that the mosquito larvae were present throughout the period of study, but at different densities depending on the prevailing climatic condition, *Aedes caspius* disappeared in November and December as a result of inadequate breeding places where (17) noted that mosquito activity decreases in Winter Season (December –February) and this results agree with (18), then its number increased gradually from January until it reaches to their peak in April due to the heavy rains followed by higher temperature. This view shared with (12) which explained the variance in the numbers of this species belonged to a difference in temperature with a range from (16-27 °C) and to another environmental factors.

The numbers of *Culex pipiens* was higher in November and started to decline in December because of temperature decreased; this is agreement with (19). This species appeared in the salts conditions where (20) mentioned that some species of *Culex* can lives in salty environments and their larvae can tolerances the differences of PH this is belong to the diversity of breeding citizen which they can lives in specially places resulting from rain full (21). *Culiseta longiareolata* showed that it prefers to live in environments with specific ecological conditions, and this explains its appearance with smaller numbers in certain months (January –March) similar findings were reported by (22) who found that this species appeared with (0.32%) in Guilan province /Northern Iran and in Riyadh City /Saudi Arabia appeared with (0.21%) according to (23) .

3.2. The effect of environment factors

Many Studies suggest that relative abundance of various mosquito species varies with the change in many factors. *Aedes caspius* has positive correlation but not significant with NaCl, TDS, PH and temperature, this shows it is salts tolerance therefore appear in a months with increases of salts due to a rising of temperature and evaporation. (24) referred to this species prefers permanent, temporary and few salinity water and has large adaptations while (5) showed that *Aedes caspius* can lives in environments with different salinity. Some of the larvae have adapted in salty environments through anal papilla that be short In salty environments and appear largest in a salt less and fresh aquatic environments, especially larvae of *Culex* (25).

There is a clear influence of the electrical conductivity in increase of the larval density of *Aedes caspius* according to statistical analysis figure [3] that mean this species prefers lives in a contaminated environments where the electrical conductivity affected by pollution, water flow and presence of nutrient and this is agree with (26).

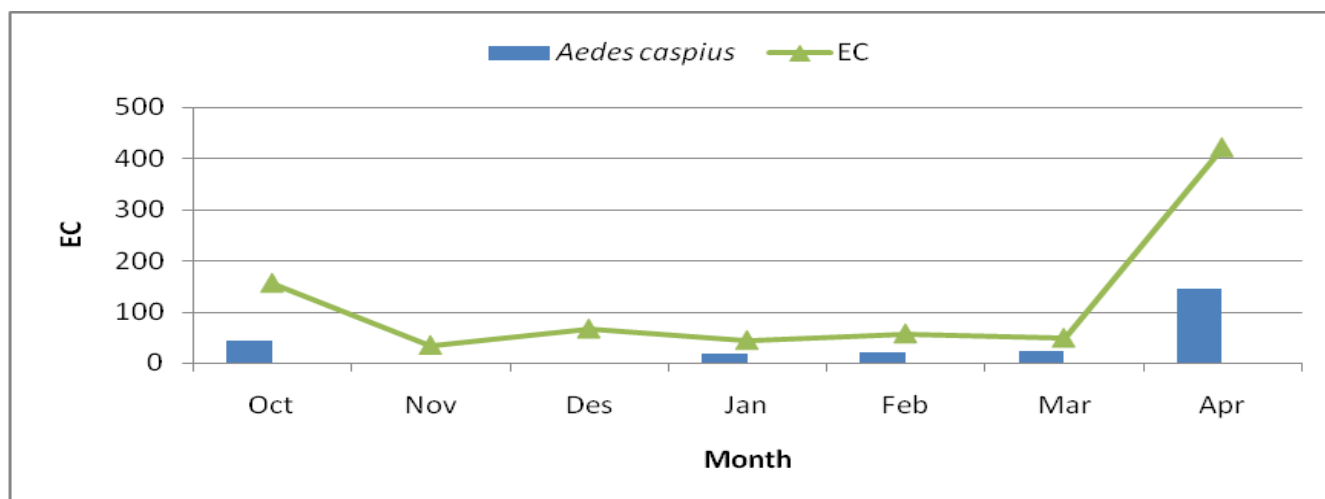


Figure [3]: The effect of electrical conductivity on species *Aedes caspius*

Aedes caspius has positive correlation but not significant with PH. The pH range between (8.14-11.79) is an indicator that mosquitoes can be found in alkaline environments. (12) Showed that there is a clear effect of PH which played a great role in spread of this species. Extremes of temperatures and pH are however lethal to aquatic stages (27).

Culex pipiens showed negative correlation with salinity so this study find this species in the months where increasing of rainfall, which reduces the concentration of salts, therefore the occurrence of *Culex pipiens* in this area shows that it is a highly adapted to all the different types of environments this result agree with (23).

Culiseta longiareolata has significant negative correlation with EC, PH ($p < 0.05$) show figure [4] and [5] respectively and temperature ($p < 0.01$) figure [6], this explains the strong appearance in the moderate months with low salts, moderate temperature and rain full, which reduces the concentration of salts (23).

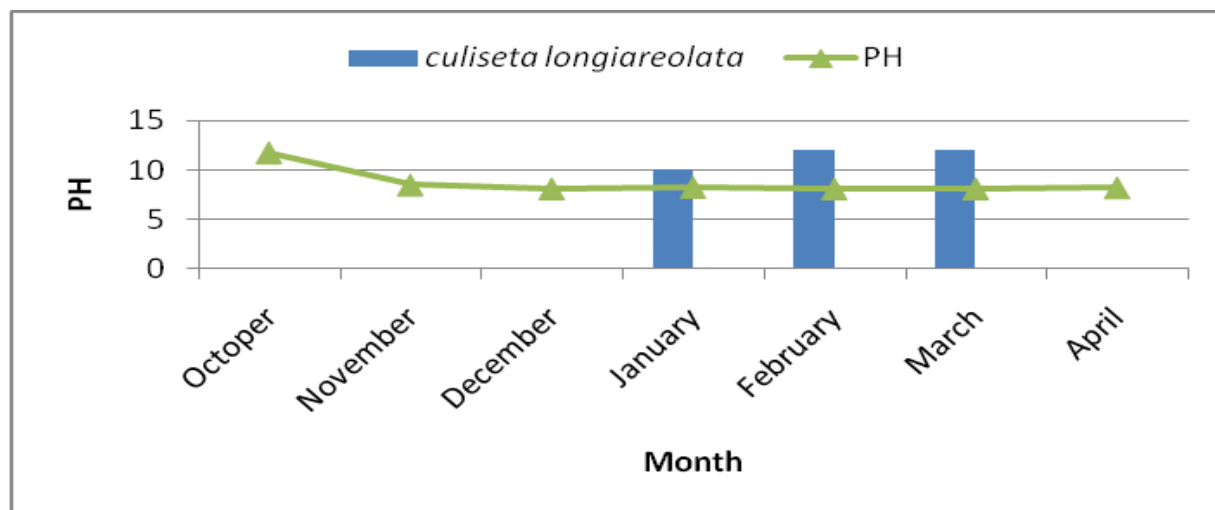


Figure [4] :The effect of PH on species *Culiseta longiareolata*

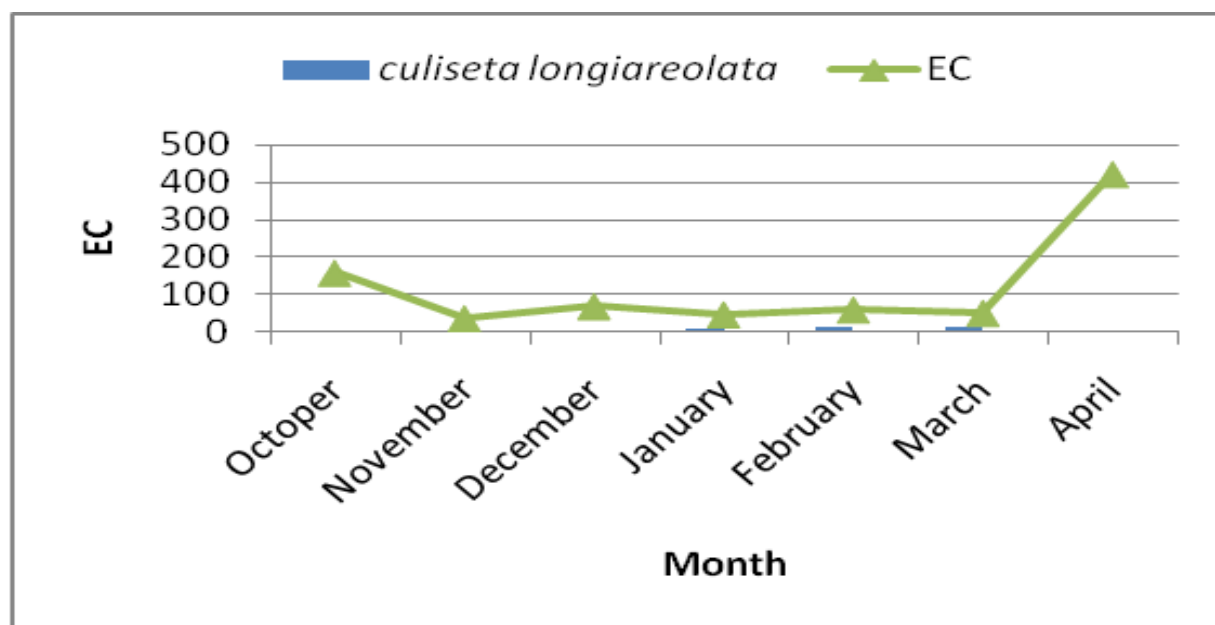


Figure [5] :The effect of EC on species *Culiseta longiareolata*

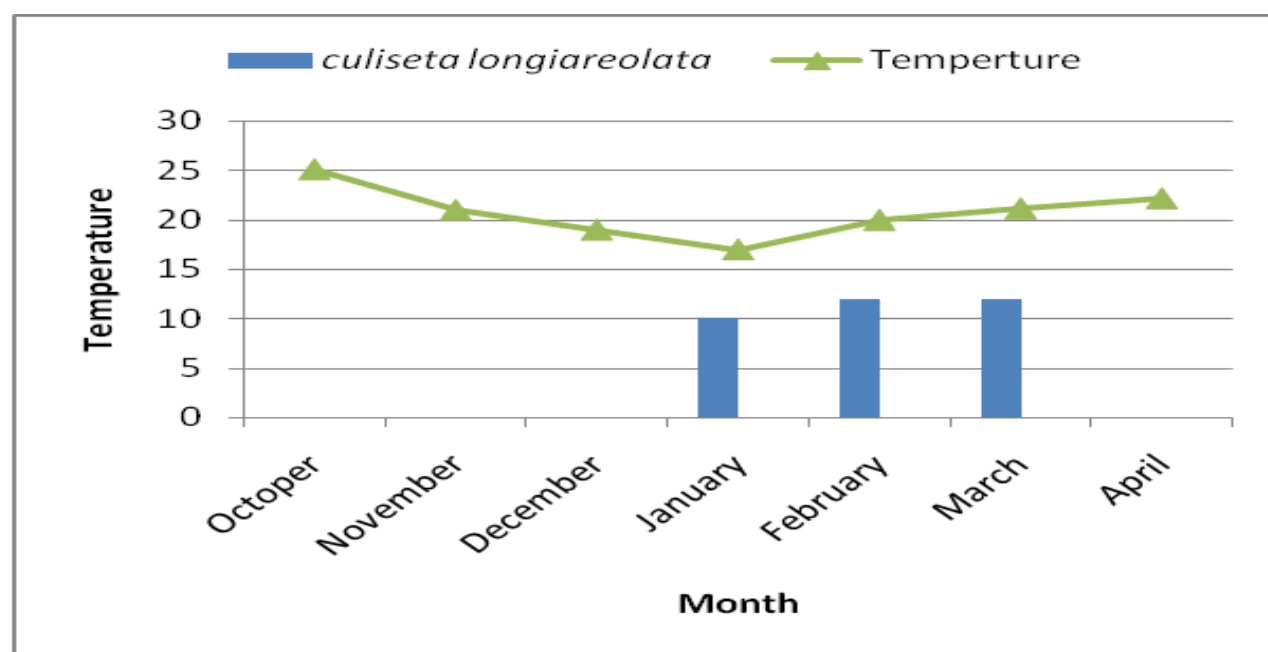


Figure [6]: The effect of Temperature on species *Culiseta longiareolata*

This study showed that the salinity has a negative impact on the spread of species and larval density, with the exception of *Aedes caspius*, which showed a high adaptation in the study area with increasing of salinities.

Response of individual species

PCA of statistical analysis showed that there is no correlation between the species themselves in this study because of the different response of each species to environmental factors and influence of environmental factors seem to be different between species.

This study found three parameters such as (EC, PH and temperature) have significant positive and negative correlation. As shown in figure (7), mosquitos' species in Al- Naamania Salt Basin were divided in to three groups:

1-First group: included *Aedes caspius* this species has significant positive correlation with EC only ($p < 0.001$) and positive correlation but not significant with NaCl, TDS, PH and temperature.

2-Second group: included *Culex pipiens* this species has negative correlation not significant with EC, NaCl, TDS, PH and temperature.

3-Third group: included *Culiseta longiareolata* this species has significant negative correlation with EC and PH ($p < 0.05$) and temperature only ($p < 0.01$) also its has negative correlation but not significant with TDS and NaCl.

Component Matrix(a)

Extraction Method: Principal Component Analysis.

a. 2 components extracted

	Component	
	1	2
x1	.401	.876
x2	-.945	-.114
x3	.650	-.706

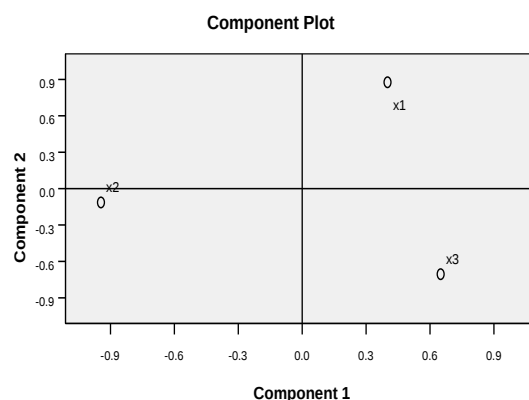


Figure [7]: principal component analysis (PCA) in dependent of distribution to three species of mosquitoes.

X1= *Aedes caspius* X2= *Culex pipiens* X3= *Culiseta longiareolata*

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