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# STUDIES ON THE BIOLOGICAL CONTROL AND ECOLOGY OF MOSQUITOES IN ASWAN GOVERNORATE
## 2- ECOLOGICAL STUDIES OF MOSQUITO LARVAE

(With 4 Tables and One Figure)

By
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## دراسات على المكافحة الحيوية وبيئة البعوض بمحافظة أسوان
## ٢- دراسات بيئية على يرقات البعوض

***عبدالعال عبدالمجيد عبدالعال ، نورالدين فرغلي حمد ، صفوت أحمد عكاشة ، عصام عبدالسلام شعلان***

أوضحت هذه الدراسة تواجد عشرة أنواع من البعوض الكيوليسيني وثلاثة أنواع من البعوض الأنوفيليني في محافظة أسوان وهذه الأنواع هي : كيولكس يونيفيتاتس ، كيولكس بيبينز موليستس ، كيولكس أنتيناتس ، أيدس كاسبيس ، كيولكس بويسليس ، كيولبيسيتا لونجياريولاتا، كيولكس ثيليرى ، يرانوتينيا أنجيكيولاتا ، كيولكس بوسيلس وكيوليستيا سيبوكريا من البعوض الكيوليسينى وأنوفيليس فرعونسيس ، أنوفيليس تينيبروسيس وأنوفيليس ملتيكلر من البعوض الأنوفيليني. وتم جمع العديد من الفونا المائية المصاحبة ليرقات البعوض منها علق المياه العذبة ، قواقع المياه العذبة ، السيكلوبس ، الدافنيا (برغوث الماء) ، السيبريس (قشريات صدفية) وأطوار غير كاملة وأخرى كاملة لحشرات مائية تنتمي إلى رتب ذباب مايو ، الرعاشات ، نصفية الأجنحة ، غمدية الأجنحة وذات الجناحين ، وأغلب هذه الحشرات وسمك الجامبوزيا وأبو ذنيبة يفترس يرقات البعوض . كما لوحظ أن يرقات البعوض المجمعة من أماكن التوالد وجدت مصابة طبيعيا ببعض الميكروبات هي الأوليات السوطية (الفورتيسلا) ، الفطريات (فطر سيلوموميسيس) والطحالب الخضراء (طحلب أودوجونيم). كذلك كانت جميع اليرقات المجمعة مصابة ب فورتيسلا فيما عدا يرقات كيوليسيتا سيبوكريا وأنوفيليس فرعونسيس. أما بالنسبة لفطر سيلوموميسيس وجد أن يرقات كيولكس يونيفيتاتس والمجمعة من منطقة العقبة هي المصابة فقط بهذا الفطر. وأما طحلب أودوجونيم وهو من الطحالب الخضراء ذاتية التغذية فقد وجد ملتصقاً بأجسام يرقات كيولكس

بيبينز موليستس ، كيولكس أنتيناتس ، كيولكس يونيفيتاتس ، كيولكس تيلـيرى وأنوفيليس فرعونسيس.


## SUMMARY

The study of mosquito larvae in Aswan Governorate has revealed the presence of thirteen culicid mosquito species, ten species belonging to culicinae and three to anophelinae. *Culex univittatus* ((Theobald), *Culex pipiens molestus* (Forskal), *Culex antennatus* (Becker) and *Aedes caspius* (Pallas) were the most common culicine species respectively, while *Anopheles pharoensis* (Theobald) was the most common anopheline species. Many aquatic fauna associated with mosquito larvae were collected during the larval survey. This fauna includes fresh water leeches, fresh water snails, tadoples, *Gambusia* fish, fresh water prawn, copepods, branchiopods, ostracods and aquatic insects belonging to the orders Ephemeroptera, Odonata, Hemiptera, Coleoptera and Diptera. *Gambusia* fish, tadpoles and the majority of insects are predaceous on mosquito larvae. Mosquito larvae collected in the present study were infected by flagellated protozoa (*Vorticella sp.*), funig (*Coelomomyces sp.*) and algae (*Odogonium sp*). *Vorticella sp.* infect all mosquito larvae except larvae of *Culiseta subochrea* and *Anopheles pharoensis. Coelomomyces sp.* infecting larvae of *Culex univittatus* only, these infected larvae were collected from Al-Aqabah area only. *Odogonium sp.* is an autotrophic green algae attaching only with the larvae of *Culex pipiens molestus, Culex antennatus, Culex unitvittatus, Culex theileri* and *Anopheles pharoensis.*


***Key words:*** *Mosquito larvae,* Culicinae, Anophilinae, *Culex pipiens molestus, Culex antennatus, Culex univittatus, Aedes caspius, Anopheles pharoensis, Vorticella sp., Coelomomyces sp., Odogonium sp.*

## INTRODUCTION

Mosquitoes are the most important blood sucking arthropods that annoy man, owing to their role in transmission of many diseases such as malaria, filaria, yellow fever, dengue fever and encephalitis. Culicine mosquitoes in Egypt were incriminated as vectors of filariasis (Southgate, 1979) and various viral diseases including Rift Valley fever (Hoogstraal et

al., 1979), West Nile virus (Taylor et al., 1956) and several other viruses (Darwish and Hoogstraal, 1981). In case of anopheline mosquitoes, only *Anopheles pharoensis* and *Anopheles sergentii* are known to be the vectors of malaria in Egypt (Barber and Rice, 1937 and Farid, 1940). Therefore, it is important to control these vectors, in order to clarify annoyance to man and reduce the rate of transmission and incidence of these diseases.

Many authors carried out surveys for mosquito and their identification. Kirkpatrick (1925) carried out the first real attempt for surveying the Egyptian mosquitoes over a period of nine months. He recorded the following *Culex* species; *Culex pusillus* (Macquart); *Culex pluvialis* (Kirkpatrick); *Culex deserticola* (Kirkpatrick); *Culex quasigelidus* (Theobald); *Culex tritaeniorhynchus* (Giles); *Culex tipuliformis* (Theoblad); *Culex laticinctus* (Edwards); *Culex sinaiticus* (Kirkpatrick); *Culex perexiguus* (Theobald); *Culex laurenti* (Newstead) and *Culex pipiens* (Linnaeus). In case of genus *Aedes*, he recorded the presence of three species namely; *Aedes caspius* (pallas); *Aedes detritus* (Haliday) and *Aedes argenteus* (Poiret). He also recorded one species from each genus of *Uranotaenia* and *Theobaldia* (= *Culiseta*) namely *Uranotaenia unguiculata* (Edwards) and *Culiseta longiareolata* (Macquart). As for anopheline species he recorded *Anopheles mauriticins* (Grp.).; *Anopheles pharoensis* (Theobald); *Anopheles rhodesiensis* (Theobald); *Anopheles sergentii* (Theobald); *Anopheles superpictus* (Grassi) and *Anopheles multicolor* (Cambouliu). The seasonal prevalence of the recorded species was studied by the same author, some of these species were found to be hot weather species; as *Anopheles pharoensis.* The second type includes definitely cool weather species, as *Culiseta longiareolata.* The third type includes European species, more abundant in cool weather, as *Aedes caspius* and *Aedes detritus. Culex pipiens* is stated to be a cosmopolitan species, so numerous throughout the year that it is difficult to say when it attains its maximum.

Abdel-Aal (1983) collected eight culicid mosquitoes in his survey in Assiut Governorate. The collected mosquitoes included *Culex pipiens molestus, Culex antennatus, Culex univitatus, Culex theileri, Aedes caspius, Uranotaenia unguiculata, Theobaldia longiareolata* and *Anopheles pharoensis.* He also found that the density of *Culex pipiens molestus* larvae was much higher than that of any other species and is present throughout the whole year in all studied areas but with marked variations in the incidence percentage in different seasons. The highest larval density of *Aedes caspius* was in summer while the maximum population density of *Culex theileri*

larvae and *Uranotaenia unguiculata* larvae was in October. In case of larvae of *Culex antennatus; Culex univittatus* and *Theobaldia longiareolata* the maximum population density was in January, November and May respectively. The incidence of *Anopheles pharoensis* larvae was very low.

El-Said and Kenawy (1983) carried out a survey all over Egypt to determine the geographical distribution of mosquito species in the different Governorates. In Aswan Governorate they collected *Anopheles pharoensis, Anopheles multicolor, Culex pipiens, Culex antennatus, Culex univitatus, Culex poicilipes, Aedes caspius* and *Culiseta longiareolata.*

Pener and Kitron (1985) reported that larvae of *Anopheles coustani (=tenebrosus)* were most common in June and July in Israel.

Soliman (1985) encountered five culicine and two anopheline mosquito species in his study in El-Kashish village, Qalyobiya Governorate. The encountered species were *Culex pipiens, Culex antennatus, Culiseta longiareolata, Culex univitatus, Aedes caspius, Anopheles pharocensis and Anopheles tenebrous.*

Zimmeerman et al. (1985) studied the host feeding patterns of *Culex* mosquitoes in Gharbiya Governorate. They stated that engorged *Culex pipiens* have only one significant seasonal activity period, which occurred from April to July with a peak in May.

Kenawy et al. (1987) carried out an adult mosquito survey in Aswan Governorate to determine host feeding patterns of mosquitoes. The survey revealed the presence of the following mosquitoes, *Aedes caspius; Aedes detritus; Anopheles multicolor; Anopheles pharoensis; Anopheles tenebrosus; Culex antennatus; Culex pipiens; Culex poicilipes; Culex pusillus; Culex theileri; Culex univittatus; Culiseta longiareolata; Culiseta subochrea* and *Uranotaenia unguiculata.*

Zayed (1989) studied the mosquito fauna in an endemic and non-endemic areas in the Lower Egypt. He encountered the following species, *Culex pipiens Linnaeus, Culex antennatus* Becker, *Culex univittatus.* Theobald, *Culiseta longiareolata* Macquart, *Uranotaenia unguiculata* Edwards, *Aedes caspius* Pallas and *Anopheles pharoensis* Theobald. Larvae of *Culex pipiens* were found to be the main species collected and their population density was low in winter, increased during spring and reach its highest peak in June (early summer), another peak (lower than the summer one) appeared during autumn. The population density of *Culex antennatus* larvae was low during winter and spring; and reached its highst peak in August and November. The other species were found in very low densities.

Wasim (1993) encountered ten mosquito species prevalent in brackish and saline-water breeding habitats in Egypt. The collected species included *Aedes caspius, Anopheles multicolor, Culex pusillus, Culex theileri, Aedes detritus, Uranotaenia unguiculata, Culex antennatus, Culex perexiguus, Culex pipiens* and *Culiseta longiareolata*. The first three species were widely distributed throughout the different localities; while the other six species were limited in their geographical distribution to certain areas. Regarding the seasonal distribution, *Aedes caspius* with two peaks of larval densities during February and September. Larvae of *Anopheles multicolor* were found all over the year with highest density in August. *Culex pusillus* larvae were encountered during summer and autumn months with a peak in September. *Culex theileri* larvae were found during winter and early summer with maximum density during May.

Cope et al. (1995) collected twelve adult female *Anopheles sergentii* from two villages in the Nile River Valley in Aswan Governorate, from August 13 to 22, 1993, during an outbreak of Rift Valley Fever (RVF) in the region and no immature forms were found. This is the first record of this malaria vector in Aswan Governorate.

## MATERIAL and METHODS

**The study area:**

The present study was conducted in Aswan Governorate, which is situated in the southern Upper Egypt and bordering Sudan.

The study of the population dynamics of mosquito larvae was carried out in seven localities situated around Aswan city during March 1993 to February 1994. Selection of localities was made to represent various ecological conditions.

Monthly larval collections were made from different breeding places representing cesspits and pools in all the seven studied sites. Samples of three net dips were taken from the surface rapidly and gently, three dips represented one square foot in which the number of the larvae were estimated to determine the prevalence and density of larvae.

The handled larval net consists of an iron ring (20 cm in diameter) to which a musiline sleeve (30 cm long) was attached.

During collection, the larvae were washed into the musilines sleeve which was then inverted and washed out in a white enamel bowl containing clear water.

All larvae were collected with a pipette into a large glass container, about one half liter, full of clean breeding site water to transport the larvae alive from the field to the laboratory.

Identification of the larvae was carried out after they have been killed with alcohol 70%.

**Statistical Analysis:**

Correlation coefficinet (r) was calculated by using MINITAB.

(statistical package, IBM release 7.2). Correlation coefficient was carried out to determine the relation between the climatic conditions and the density of mosquito larvae.

## RESULTS

In the present study the prevalent mosquito species in Aswan Governorate were identified through carrying out a larval survey in seven localities. The aquatic fauna associated to mosquito larvae and the natural infection of larvae by microorganisms were also studied (Tables 1 & 2).

**Mosquito larvae and seasonal prevalence** (Fig. 1):

The present study revealed the occurrence of ten culicine and three anopheline mosquito species in Aswan Governorate. *Culex univittatus* (Theobald) was the most common culicine mosquito species (32.7% of the total culicine larvae) followed by *Culex pipiens molestus Forskal* (26.3%), *Culex antennatus Becker (25%), Aedes caspius* Pallas (13.4%), *Culex poicilipes* Theobald (0.8%), *Culiseta longiareolata* Macquart (0.7%), *Culex theileri* Theobald (0.5%), *Uranotaenia unguiculata* Edwards (0.4%), *Culex pusillus* Macquart (0.2%) and *Culiseta subochrea* Edwards (0.01) *Anopheles pharoensis* (Theobald) was the most common anopheline mosquito species (81.8% of the total anopheline larvae) followed by *Anopheles tenebrosus* Donitz (11.4%) and *Anopheles multicolor* Cambouliu (6.8%).

*Culex univittatus* larvae were collected from all localities and its incidence was higher in Al-Khazzan area than that in the other urban and cultivated rural areas. The larvae were distributed throughout the year but predominate during summer and autumn.

*Culex pipiens molestus* larvae were detected in all screened areas and larval collections from urban areas gave the maximum population density

compared to that in cultivated rural areas. The highest density of larvae was found in spring and winter.

*Culex antennatus* larvae were encountered in all localities and the incidence of larvae was high in cultivated rural areas and low in urban areas. The larvae showed high incidence in spring.

*Aedes caspius* larvae were collected from all studied areas. The incidence of larvae was high in cultivated rural areas and low in urban areas. The highest population density of larvae was recorded in winter.

Few numbers of *Culex poicilipes* larvae were detected in five localities and did not give a real idea about its seasonal distribution.

*Culiseta longiareolata* larvae were encountered in all screened localities in low densities and all the larvae were collected in spring and winter only.

Few numbers of *Culex theileri* were detected in five localities. All these larvae were collected in spring and no larvae were collected in the other seasons.

The few numbers of *Uranotaenia unguiculata* larvae collected from all localities except Aswan city gave no idea about its seasonal distribution.

Only 13 larvae of *Culex pusillus* were collected from four screened areas and did not give a clear idea about its seasonal abundance.

*Culiseta subochrea* larvae were very rare. Only 3 larvae were collected from Kema, Aswan city and Gharb Aswan.

The larvae of *Anopheles pharoensis* were detected in all screened areas. The larval collections from rural areas gave the maximum population densities while urban areas gave the minimum population densities, and the summer season gave the highest incidence of larvae.

*Anopheles tenebrosus* larvae were common in all localities and the maximum population density was recorded in cultivated rural areas. The larvae showed high incidence in winter.

*Anopheles multicolor* larvae were encountered in five localities and the maximum population density was found in Aswan city (urban area). The highest incidence of larvae was recorded in spring.

The correlation coefficient of both temperature and relative humidity (Table 4) revealed that they had a direct effect on the density of some mosquito species and converse effect on other species.

**Fauna associated to mosquito larvae:**

During the study of mosquito larvae many immature and mature animal stage were collected with the larvae. These fauna include annelids, arthropods, molluscas, amphibians and fish.

The annelids included fresh water leeches (class: Hirudinea).

The arthropods included fauna belong to classes Crustaceans and Insects. Curstaceans among the copepods (*cyclops sp.*), ostracods (*Cypris sp.*), branchiopods (*Daphnia sp*), and fresh water prawn were encountered. The Insects included members of the order Ephemeroptera (naids of family Baetidae); order Odonata (naids of families Aeschnidae Libellulidae and Coenagrionidae); order Hemiptera [adults and naids of *Sphodrodema sp.* (family: Belostomatidae); adults of *Ranatra sp.* (family: Nepidae) and adults and naids of *Anisops sp.* (family: Notonectidae)].; order Coleoptera (larvae and adults of family Dytiscidae, and larvae of family Hydrophilidae) and of the order Diptera (larvae and pupae of family Stratiomyiidae, larvae and pupae of family Rhagionidae; larvae of nonbiting midges, family Chironomidae and larvae of family Tabanidae).

The molluscs included fresh water snails (class: Gastropoda). The amphibians included the tadepoples. *Gambusia sp.* is the common fish.

**Natural infection of mosquito larvae by some micro-organisms:**

Data obtained during the present study (Table 3) revealed that mosquito larvae were infested with flagellated protozoa, Fungi and algae. In case of flagellated protozoa, only *Vorticella sp.* was found to infest all mosquito larvae except larvae of *Culiseta subochrea* and *Anopheles tenebrosus.* The infection with *Vorticella sp* greatly varied among the different species and also in the same species.

In case of fungi, *Coelomomyces sp.* was recorded to infect larvae of *Culex univittatus* only. The infected larvae were collected from Al-Aqabah area and no infection was recorded in the larvae collected from the other areas. In case of algae, *Odogonium sp.* (a green algae) was found attaching to the larvae of *Culex pipiens molestus, Culex antennatus, Culex univittatus, Culex theileri* and *Anopheles pharoensis.* It is worthy of mention that *Odogonium sp.* is an autotrophic algae but not parasitic, and use the body of mosquito larvae for attachment only.

## DISCUSSION

Results of the present study revealed the occurrence of 10 culicine and 3 anopheline mosquito species in Aswan Governorate. The cuilicine species were *Culex pipiens molestus* (Forskal), *Culex univittatus* (Theobald), *Culex antennatus* (Becker), *Culex theileri* (Theobald), *Culex pusillus* (Macquart), *Culex poicilipes* (Theobald), *Aedes caspius* (Pallas), *Uranotaenia unguiculata* (Edwards), *Culiseta longiareolata* (Macquart) and *Culiseta subochrea* (Edwards). The anopheline species were *Anopheles pharoensis* (Theobald), *Anopheles multicolor* (Cambouliu) and *Anopheles tenebrosus* (Donitz).

**The culicine species:**

Data obtained during the present study (Table 1 & 2) revealed that 7763 culicine larvae were collected and comprise 71% of the total culicid larvae.

***Culex pipiens molestus* (Forskal):**

The larvae represent 26.3% of the total culicine larvae (Table 1) and are the second common culicine species. Results indicated that this species was detected in all studied areas without exception. The larval collections from Kema, Aswan city and Al-Khazzan (urban areas) gave the maximum population density, while collections from Abu El-Rish (rural cultivated area) gave a moderate population density, on the other hand Al-Aqabah, Gharb Aswan and Al-Kubbaniyyah (rural cultivated areas) gave the minimum densities. The maximum population density of larvae found in urban areas is a result of the fact that these areas are rich with the breeding sites of *Culex pipiens molestus* larvae such as pools, ditches, puddles, slightly brackish water and human seepages.

Khalil (1980) and El-Said and Kenawy (1983) collected larvae of *Culex pipiens* from Aswan governorate. The former author also indicated that *Culex pipiens, Culex antennatus* and Culex univittatus were common culicines in Upper Egypt, these results run in agreement with our results. Wasim (1993) collected larvae of *Culex pipiens* in few numbers from Qaron and El-Natrun lake shores.

***Culex univittatus* (Theobald):**

The larvae of this species comprise 32.7% of the total culicine larvae collected (Table 1). The density of *Culex univittatus* larvae was much higher

than any other culicine species in the present study. The larvae were collected from all studied areas. The incidence of larvae was high in Al-Khazzan (urban area) and moderate in Al-Aqabah, Abu El-Rish, Gharb Aswan, Al-Kubbaniyyah (rural cultivated areas), Kema and Aswan city (urban areas). The larvae collected from Al-Khazzan were more or less twice in number those as in each studied area. The larvae were found to breed in fresh or slightly brackish, temporary and stagnant water with vegetation.

Kaschef et al. (1982) in Sharkyia Governorate, Ebraheem (1987) in Sohag Governorate and Zayed (1989) in Lower Egypt, mentioned that low incidence of *Culex univittatus* larvae could not give celar idea about its seasonal abundance. Beier et al. (1986) in Faiyum Governorate and Morsy (1987) in Sinai Peninsula concluded that *Culex univittatus* larvae breed all the year round, while Mohamed et al. (1981) in Giza Governorate collected 2 larvae only.

***Culex antennatus* (Becker):**

Results in Tables (1 & 2) showed that, *Culex antennatus* larvae represent 25% of the total culicine larvae. This species was the third common culicine species. The larvae were detected in all studied areas.

The incidence of larvae was high in Gharb Aswan, Al-Kubbaniyyah and Abu El-Rish (cultivated rural areas) while collections from Al-Aqabah (cultivated rural area) gave moderate densities. On the other hand, Kema, Aswan city and Al-Khazzan (urban areas) gave minimum densities if compared to the other areas. The larvae were found to breed in grassy ponds.

Khalil (1980) and El-Said and Kenawy (1983) colelcted larvae of *Culex antennatus* from Aswan Governorate. Wasim (1993) encountered *Culex antennatus* larvae in few numbers in El-Natrun lake shores and brackish pools during his survey of salt water mosquito in Egypt.

***Culex poicilipes* (Theobald):**

The larvae of this species comprise 0.8% of the total culicine larvae collected (Table 1). Results indicated that this species was detected in five studied areas, these are Al-Aqabah, Al-Kubbaniyyah, Abu El-Rish, Aswan city and Al-Khazzan.

Data in (Table 2) showed that 26 larvae (40%) were collected in winter, 25 larvae (38.5%) in autumn, 8 larvae (12.3%) in summer and 6 larvae (9.2%) in spring. This low incidence could not gives a real picture about its seasonal distribution.

*Culex poicilipes* that was mentioned by Kirkpatrick (1925) under the name *Culex quasigelidus* as a hot weather species reached its maximum density in July and very rarely in winter. Gad (1955) and Wassif (1969) recorded *Culex poicilipes* larvae in their surveys in the Nile-Delta, also El-Said and Kenawy (1983) recorded larvae of this species in Aswan Governorate. Howeer, Farghal (1979) in Assiut Governorate, Khalil (1980) in Aswan Governorate, Kaschef et al. (1982) in Sharkyia Governorate, Abdel-Aal (1983) in Assiut Governorate, Ibrahim (1986) in Qalyobiya Governorate, Ebraheem (1987) in Sohag Governorate and Morsy (1987) in Sinai Peninsula, did not record larvae of this species in their surveys.

***Culex theileri* (Theobald):**

Results in (Tables 1 & 2) showed that, larvae represent 0.5% of the total culicine larvae. The larvae were detected in 5 studied areas, 18 larvae were collected from Al-Kubbaniyyah, 8 from Garb Aswan, 7 from Abu El-Rish, 8 from Al-Aqabah and from Al-Khazzan.

All larvae of *Culex theileri* in the present study were collected in spirng and no larvae were collected in the other three seasons. These findings agree to some extent with those of Farghal (1979) in Assiut Governorate who recorded larvae of this species during April and May in low numbers, and with the results of Kitron and Pener (1986) in Israel, who showed that *Culex theileri* peaked in the late spring.

***Culex pusillus* (Macquart):**

From the results shown in (Tables 1 & 2), it is clear that *Culex pusillus* larvae represent 0.2% of the total culicine larvae. The larvae of this species were not common from all studied areas. Only 13 larvae were collected, 9 larvae from Al-Kubbaniyyah, 2 larvae from Aswan city and one larva from Abu El-Rish and Al-Khazzan.

Farghal (1979) in Assiut Governorate, Khalil (1980) in Aswan Governorate, Kaschef et al. (1982) in Sharkyia Governorate, Abdel-Aal (1983) in Assiut Governorate, El-Said and Kenawy (1983) in Aswan Governorate, Ibrahim (1986) in Qalyobiya Govenrorate and Ebraheem (1987) in Sohag Governorate did not collect larvae of this species in their surveys.

***Aedes caspius* (Pallas):**

The larvae of *Aedes caspius* comprise 13.4% of the total culicine larvae (Table 1). The larvae were detected in all studied areas. The incidence

of larvae was high in Abu El-Rish, Al-Kubbaniyyah and Gharb Aswan (rural cultivated areas), moderate in Al-Aqabah (rural cultivated area) and low in Al-Khazzan, Aswan city and Kema (urban areas). The highest population density of *Aedes caspius* larvae in rural cultivated areas was due to, the presence of permanent or temporary, slow running or standing water with or without vegetation such as stream bed pools, bogs, irrigation ditches and brackish pools which are the breeding sites of this species. The larvae of *Aedes caspius* were previously detected in Aswan Governorate by Khalil (1980) and El-Said and Kenawy (1983).

***Culiseta longiareolata* (Macquart):**

From the results shown in (Tables 1 & 2), it is clear that *Culiseta longiareolata* larvae represent 0.7% of the total culicine larvae. The larvae were detected in all studied areas but in a few numbers and found to breed in ponds with polluted water. Khalil (1980) and El-Said and Kenawy (1983) collected larvae of this species form Aswan Governorate. Mohamed et al. (1981) in Giza Governorate, Kenawy et al. (1986) in El-Gara Oasis and Zayed (1989) in Lower Egypt encountered larvae of *Culiseta longiareolata* in very low densities.

***Culiseta subochrea* (Edwards):**

Results in (Tables 1 & 2) showed that, larvae of this species were very rare. Only 3 larvae were collected from Kema (I larva), Aswan city (I larva) and Gharb Aswan (I larva). The larvae comprise 0.01% of the total culicine larvae and their very rare incidence could not give a real idea about its seasonal prevalence and distribution. Kenawy (1983) in Aswan Governorate, Ibrahim (1986) in Qalyobiya Governorate and Ebraheem (1987) in Skohag Governorate did not record this species in their surveys. However, Kenaway et al. (1986) were the first authors recorded this species in Egypt, in El-Gara oasis. Morsy (1987) was the second author who recorded this species in Egypt in Sinai Peninsula, he also, stated that larvae has a short season from December till April. Kenawy et al. (1987) recorded adults of this species in Aswan Governorate.

***Uranotaenia unguiculata* (Edwards):**

Results in (Tablees 1 & 2) indicated that, larvae represent 0.4% of the total culicine larvae. The larvae were collected in few numbers from all studied areas except Aswan city. This very low incidence agrees with that of Wassif (1969), Kaschef et al. (1982), and Zayed (1989). However, Farghal

(1979) in Assiut Governorate, Khalil (1980) in Aswan Governorate, El-Said and Kenawy (1983) in Aswan Governorate, Ibrahim (1986) in Qalyobiya Governorate, and Ebraheem (1987) in Sohag Governorate did not detect larvae of this species. Larvae of *Uranotaenia unguiculata* were found in Qaron lake shores and brackish pools.

**The anopheline species:**

Data obtained during the present study (Tables 1 & 2) revealed that 3172 anopheline larvae were collected and comprised 29% of the total culicid larvae.

***Anopheles pharoensis* (Theobald):**

The larvae of *Anopheles pharoensis* were the most common anopheline larvae encountered in the present study and represent 81.8% of the total anopheline larvae (Table 1). The larvae were detected in all studied areas without exception. Kaschef et al. (1982) in their survey in Sharkyia Governorate stated that larvae of *Anopheles pharoensis* were detected in all studied areas and were the predominant anopheline larvae (78%). In the present study it was found that larval collection from Abu El-Rish and Gharb Aswan (rural areas) gave the maximum population density, while collections from Al-Aqabah and Al-Kubbaniyyah (rural areas) gave moderate population densities. On the other hand, kema, Al-Khazzan and Aswan city (urban areas) gave the minimum densities. The high incidence of larvae in rural areas may be due to the presence of many breeding sites such as drainage ditches; irrigation channels and fresh water pools with or without vegetation. The larvae of this species were previously detected in Aswan Governorate by Khalil (1980) and El-Said and Kenawy (1983).

***Anopheles tenebrosus* (Donitz):**

Data obtained during the present study (Tables 1 & 2) showed that, larvae of this species comprise 11.4% of the total anopheline larvae. The larvae were common in all studied areas but in few numbers if compared to that of *Anopheles pharoensis*. The same results were obtained by Kaschef et al. (1982) in their study in Sharkyia Governorate. The population density of *Anopheles tenebrosus* larvae was high in Al-Khazzan (urban area), moderate in Abu El-Rish (rural area), Aswan city (urban area) and Al-Aqabah (rural area), while in Al-Kubbaniyyah, Gharb Aswan (rural area) and Kema (urban area) the population density was low.

***Anopheles multicolor* (Cambouliu):**

The larvae of this species represent 6.8% of the total anopheline larvae (Table 1). The larvae were detected in all studied areas except Al-Aqabah and Kema. The population density of larvae was high in Aswan city, very low in Al-Khazzan, Al-Kubbaniyyah and Abu El-Rish, and rare in Gharb Aswan (one larva only). The larvae were most often breeding in small pools with or without vegetation, ditches, and in drains either stagnant or floowing.

Kaschef et al. (1982), Abdel-Aal (1983), Ibrahim (1986) and Ebraheem (1987) did not record *Anopheles multicolor* larvae in their surveys in Sharkyia, Assiut, Qalyubiya and Sohag Governorates respectively. On the other hand, Khalil (1980), El-Said and Kenawy (1983) in Aswan Governorate and Kenawy et al. (1986) in el-Gara Oasis, recorded larvae of this species. Pener and Kitron (1986) in Israel, concluded that *Anopheles multicolor* larvae were not found in sufficient numbers to detect a seasonal pattern.

**Natural infection of mosquito larvae by some micro organisms:**

Mosquito larvae collected during the present study were infested with *Vorticella sp.*, *Coelomomyces sp.*, and *Odogonium sp.* (Table 3). *Odogonium sp.*, is an autotrophic green algae using the larval bodies for attachment only and not parasitic.

*Vorticella sp.* were infecting all mosquito larvae collected in the present study, except larvae of *Culiseta subochrea* and *Anopheles tenebrosus.* Krirkpatrick (1925) stated that *Vorticella* is frequently found on mosquito larvae; it did not cause any injury to them except, when it is so numerous as to impede their movements. Farghal (1979) in Assiut Governorate, observed *Vorticella sp.* parasitizing culicine larvae. He also studied its efficiency against culicine larvae and found that the percentage of mortality in parasitized larvae was 20% in *Culex univittatus*, 16.67% in *Culex antennatus*, 6.67% in *Aedes caspius* and 2% in *Culex pipiens molestus.*

*Coelomomyces* is one of the most effective pathogens of mosquito larvae. In the present study *Coelomomyces sp.* was found to infect *Culex univittatus* larvae. Weiser et al. (1991) discovered a new species of *Coelomomyces (Coelomomyces irani)* infecting *Anopheles maculipennis* larvae in Iran.

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Table ( ) culicid larvae collected from Aswan Governorate.

| Areas | Total culicine larvae | Culicines | | | | | | | | | | Total anopheline larvae | Anophelines | | | Total number of culicid larvae |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Culex pipiens molestus* | *Culex univittatus* | *Culex antennatus* | *Culex theileri* | *Culex Pusillus* | *Culex poicilipes* | *Uranotaenia unguiculata* | *Aedes caspius* | *Culiseta longiareolata* | *Culiseta subochrea* | | *Anopheles pharoensis* | *Anopheles multicolor* | *Anopheles tenebrosus* | |
| Al-Aqabah | 879 | 98 | 340 | 251 | 2 | 0 | 34 | 2 | 149 | 3 | 0 | 546 | 498 | 0 | 48 | 1425 |
| Abu ar-Rish | 1279 | 168 | 317 | 446 | 7 | 1 | 10 | 14 | 300 | 16 | 0 | 892 | 805 | 5 | 82 | 2171 |
| Al-Kubbaniyyah | 1012 | 23 | 235 | 479 | 18 | 9 | 12 | 2 | 231 | 3 | 0 | 530 | 493 | 10 | 27 | 1542 |
| Gharb Aswan | 1091 | 50 | 235 | 575 | 8 | 0 | 0 | 1 | 219 | 2 | 1 | 633 | 608 | 1 | 24 | 1724 |
| Aswan city | 963 | 430 | 390 | 71 | 0 | 2 | 5 | 0 | 57 | 7 | 1 | 294 | 41 | 189 | 64 | 1257 |
| Kema | 1149 | 682 | 383 | 42 | 0 | 0 | 0 | 2 | 17 | 22 | 1 | 106 | 102 | 0 | 4 | 1255 |
| Al-Khazzan | 1390 | 586 | 640 | 79 | 1 | 1 | 4 | 11 | 63 | 5 | 0 | 171 | 47 | 12 | 112 | 1561 |
| Total | 7763 | 2037 | 2540 | 1943 | 36 | 13 | 65 | 32 | 1036 | 58 | 3 | 3172 | 2594 | 217 | 361 | 10935 |
| Percentage | 71 | 26.3 | 32.7 | 25 | 0.5 | 0.2 | 0.8 | 0.4 | 13.4 | 0.7 | 0.01 | 29 | 81.8 | 6.8 | 11.4 | |

Table (2 ) Seasonal distribution of culicid larvae collected from Aswan Governorate.

| Seasons | | Total culicine larvae | Culicines | | | | | | | | | | Total anopheline larvae | Anophelines | | | Total number of culicid larvae |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *Culex pipiens molestus* | *Culex univittatus* | *Culex antennatus* | *Culex theileri* | *Culex Pusillus* | *Culex poicilipes* | *Uranotaenia unguiculata* | *Aedes caspius* | *Culiseta longiareolata* | *Culiseta subochrea* | | *Anopheles pharoensis* | *Anopheles multicolor* | *Anopheles tenebrosus* | |
| Spring | No | 2371.0 | 885.0 | 515.0 | 625.0 | 36.0 | 1.0 | 6.0 | 10.0 | 242.0 | 48.0 | 3.0 | 814.0 | 602.0 | 193.0 | 19.0 | 3185.0 |
| | % | 30.5 | 43.4 | 20.1 | 32.2 | 100.0 | 7.7 | 9.2 | 31.2 | 23.4 | 82.8 | 100.0 | 25.7 | 23.2 | 88.9 | 5.3 | 29.1 |
| Summer | No | 1821.0 | 169.0 | 876.0 | 511.0 | 0.0 | 10.0 | 8.0 | 7.0 | 240.0 | 0.0 | 0.0 | 878.0 | 819.0 | 6.0 | 53.0 | 2699.0 |
| | % | 23.4 | 8.3 | 34.2 | 26.3 | 0.0 | 76.9 | 12.3 | 21.9 | 23.2 | 0.0 | 0.0 | 27.7 | 31.6 | 2.8 | 14.7 | 24.8 |
| Autumn | No | 1620.0 | 315.0 | 722.0 | 359.0 | 0.0 | 2.0 | 25.0 | 7.0 | 190.0 | 0.0 | 0.0 | 758.0 | 664.0 | 12.0 | 82.0 | 2378.0 |
| | % | 20.8 | 15 | 28.2 | 18.5 | 0.0 | 15.4 | 38.5 | 21.9 | 18.3 | 0.0 | 0.0 | 23.9 | 25.6 | 5.5 | 22.7 | 21.8 |
| Winter | No | 1971.0 | 668.0 | 447.0 | 448.0 | 0.0 | 0.0 | 26.0 | 8.0 | 364.0 | 10.0 | 0.0 | 722.0 | 509.0 | 6.0 | 207.0 | 2673.0 |
| | % | 25.3 | 32.8 | 17.5 | 23.0 | 0.0 | 0.0 | 40.0 | 25.0 | 35.1 | 17.2 | 0.0 | 22.7 | 19.6 | 2.8 | 57.3 | 24.4 |
| Total | | 7763.0 | 2037.0 | 2560.0 | 1943.0 | 36.0 | 13.0 | 65.0 | 32.0 | 1036.0 | 58.0 | 3.0 | 3172.0 | 2594.0 | 217.0 | 361.0 | 10935.0 |

**Table ( 3 ): Natural infection of mosquito larvae by some micro organisms**

| mosquito larvae | micro organisms | | |
|---|---|---|---|
| | *Vorticella sp.* (protozoa) | *Coelomomyces sp.* (Fungi) | *Odogonium sp.* (Green algae) |
| *Culex antennatus* | + | - | + |
| *Culex pipiens molestus* | + | - | + |
| *Culex poicilipes* | + | - | - |
| *Culex pusillus* | + | - | - |
| *Culex theileri* | + | - | + |
| *Culex univittatus* | + | + | + |
| *Culiseta longiareolata* | + | - | - |
| *Culiseta subochrea* | - | - | - |
| *Uranotaenia unguiculata* | + | - | - |
| *Aedes caspius* | + | - | - |
| *Anopheles multicolor* | + | - | - |
| *Anopheles pharoensis* | + | - | + |
| *Anopheles tenebrosus* | - | - | - |

**Table ( 4 ) Mosquito larvae collected from Aswan Governorate and its relation to climatic conditions**

| Mosquito species | Correlation coefficient for temperature | | Correlation coefficient for relative humidity | |
|---|---|---|---|---|
| | value | class | value | class |
| *Culex pipiens molestus* | 0.723 | x x | 0.304 | x |
| *Culex univittatus* | 0.784 | x x | -0.377 | - |
| *Culex antennatus* | 0.082 | x | -0.349 | - |
| *Culex theileri* | 0.034 | x | -0.11 | - |
| *Culex pusillus* | 0.348 | x | -0.14 | - |
| *Culex poicilipes* | -0.348 | - | 0.801 | x x |
| *Uranotaenia unguiculata* | -0.332 | - | 0.179 | x |
| *Aedes caspius* | -0.454 | - | -0.108 | - |
| *Culiseta longiareolata* | -0.444 | - | -0.181 | - |
| *Culiseta subochrea* | 0.023 | x | -0.103 | - |
| *Anopheles pharoensis* | 0.637 | x x | -0.308 | - |
| *Anopheles multicolor* | -0.227 | - | -0.206 | - |
| *Anopheles tenebrosus* | -0.636 | -- | 0.506 | x x |

(x) Weak directly relationship (-) Weak conversely relationship

(xx) Strong directly relationship (--) Strong conversely relationship

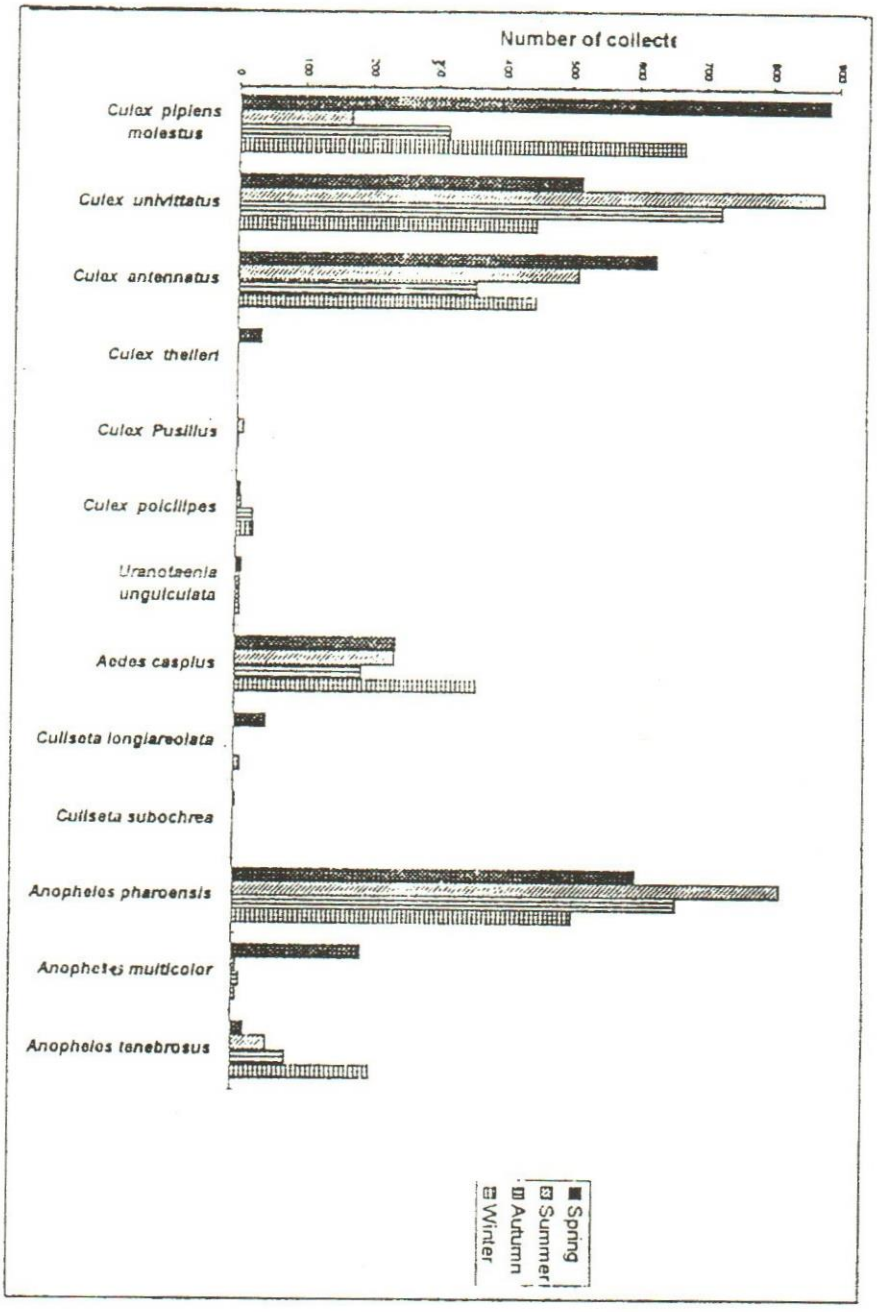


Figure 1: Seasonal distribution of culicid larvae collected from Aswan Governorate.