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Spatial distribution and abundance of culicine mosquitoes in realtion to the risk of filariasis transmission in El Sharqiya Governorate, Egypt

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ABSTRACT

Culicine mosquito surveys were conducted in El Sharqiya Governorate (Nov. 2007 - May 2008) in some villages (cities) representing the different districts. Totally 6 species were reported: *Culex (Culex) pipiens* Linnaeus, *Cx. (Cx.) perexiguus* Theobald, *Cx. (Cx.) antennatus* (Becker), *Cx.* (*Barraudius*) *pusillus* Macquart, *Cx. (Cx.) sinaiticus* Kirkpatrick *and Ae. (Ochlerotatus) detritus* (Haliday). The last two were identified as newly distributed species. *Culex pipiens*, the main filariasis vector was the predominant or the most common species (ca.88% larvae and 47% adults, $p<0.01$). For the common species, the following were examined: (1) the type and characteristics (temperature and pH) of the breeding habitats and their relation to the larval density and (2) the relation of adult indoor density and indoor and outdoor temperature and RH. The AMRAD-ICT Filariasis card Test was used to detect the *Wuchereria bancrofti* antigen in the Finger prick blood samples. Filariasis cases (0.4%, 11/ 2504) were detected in six out of the fifteen districts. The highest infection rate (2.4%) was reported in the 10th of Ramadan, a new settlement area. The cases were associated with the abundance of *Cx. pipiens* adults (ca. 40- 60% of the collected adults). Digital maps showing the spatial distribution of mosquito species and filariasis cases were generated. Such maps will provide the authorities with more information about the disease risk areas that would assist in the control activities.

Keywords: Culicine mosquitoes-Spatial distribution-Abundance-Filariasis-El Sharqiya Governorate-Egypt.

INTRODUCTION

El Sharqiya is a Governorate (Fig. 1) situated in the eastern part of the Nile Delta. It is bordered from the north by El Manzlah Lake and from the east and south by the Eastern desert, so that it represents various topographic strata including agricultural, semi desert, and desert areas.

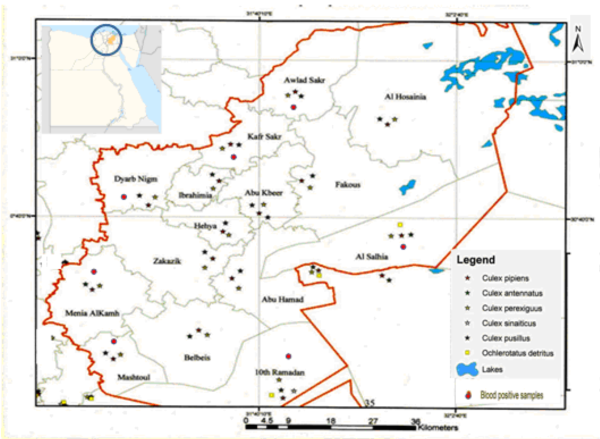

Fig. 1: Spatial distribution of culicine mosquitoes and filariasis cases in El Sharqiya Governorate

[1]Central Agency for Public Mobilisation and Statistics Egypt (web). THOMAS BRINKHOFF THOMAS BRINKHOFF, http://www.citypopulation.de/ 2009-02-22

It covers about 4911km² with a population of 5,354,041 (2006 public census)[1] and comprises of a large number of administrative centers, cities and towns.

There are fifteen districts in this Governorate. The Governorate with an agricultural area of 824,098 feddans. The most important crops are wheat, cotton, soybeans, maize, rice, several fruits (mango, lemon, citron, grabs and palm tree) and all kinds of vegetables. Its main economic resources are driven from agriculture, raising poultry and food industries. Additionally, Arab tribes of the Governorate are famous for raising best races of camels and horses.

Various water collections, extended irrigation water network and several wells are found in the Governorate. This has its impact on the occurrence and abundance of mosquitoes (Kenawy *et al.,* 1996). Totally 10 mosquito species are known to exist in the Governorate (Kaschef *et al*., 1982; El-Said and Kenawy, 1983 and El-Bashier *et al.*, 2006).

Several mosquito born diseases are known and fully documented in El Sharqiya Governorate. Filariasis is a widespread disease with an incidence of 4-6% (Shawarby *et al.*, 1965 and Rashed, 1981) and transmitted mainly by *Cx pipiens*. Malaria has an old history as the only outbreak of malignant (*falciparum*) malaria occurred in the Nile Delta was at Inshas (Farid, 1940). Between 1982 and 1991, malaria was reported in 7 Egyptian Governorates, including El Sharqiya (Hassan *et al*., 2003). Today, *Plasmodium vivax* may be present in some parts of the Governorate and is transmitted by *Anopheles pharoensis*. However, currently, no malaria is recorded in Egypt (Ministry of Health, Egypt, unpublished data). The Rift Valley fever outbreak (1977-1978) occurred also in El Sharqiya (Hoogstraal *et al.,* 1979).

The Geographic Information System (GIS) have been used widely to produce maps of disease distribution and for analyzing spatial patterns in diseases distribution. These maps have been used as tools for developing control and intervention strategies (Hassan and Onsi, 2004; Ceccato *et al.*, 2005 and Reiter and Lapoint, 2007). Mapping the breeding habitats of the mosquito species facilitate assessment of the risk of contracting the diseases and also assist in control of the vectors (Dale *et al.*, 1998; Thomson and Connor, 2000 and Vanwanbeke *et al.,* 2007).

The status of mosquito abundance and their associated diseases in El Sharqiya Governorate necessitates a wide vector control program based on solid biological and ecological information of mosquito vectors. Hence, the present study was planned to provide further observations on the mosquito fauna of the Governorate and to produce health maps for the governorate showing distribution of mosquito vectors of diseases to evaluate the risk of these disease transmission.

MATERIALS AND METHODS

The Study Sites:

The work was carried out during November 2007 to May 2008 in the different districts of the Governorate. Two to three villages were selected to represent the district except the 10th of Ramadan where the city was selected.

Entomological Surveys

Larval surveys were carried out on geographical/topographical sampling bases to determine the mosquito fauna, the species distribution, breeding habitats and factors affecting their proliferation. All water collections and sites were sampled. The temperature, and pH of the breeding water were recorded. Larvae were collected by netting using a round net (17 cm. dia.) fixed at the end of a long stick. After collection, larvae were kept in 70% ethyl alcohol in screw cap glass vials, labeled and transferred to the laboratory. Only 3rd and 4th larval instars were identified.

Adults were collected from inside houses (bed rooms and other places) by hand collection using mechanical aspirators for half an hour / room. Space spraying (0.2%% pyrethroid in kerosene) using total coverage (WHO, 1975) was also applied for estimation of the indoor resting densities of mosquito species per room. Samples collected were transferred to labeled boxes and taken to laboratory for counting and identification. Keys given by Kirkpatrick (1925) and Harbach (1988) were used for mosquito identification.

Filariasis Survey

In the field, the AMRAD-ICT Filariasis card Test (ICT-Fil) (Immunochromatographic Diagnostic Tests Company, Balgowlah, New South Wales, Australia) was used to detect the *Wuchereria bancrofti* antigen in the whole blood (Weil *et al.*, 1997; Ramzy *et al.*, 1999 and Weil and Ramzy, 2007). Finger prick blood samples were drawn onto the card (El-Setouhy *et al.*, 2007) and the results were read visually (negative/positive) after 15 minutes. The positive cases gave two lines on the card, while negative ones gave one line only.

GIS Mapping

Digital map for Egypt was obtained from the WHO Health Mapper computer data management system for public health, showing various administration divisions of Egypt along with different shape files feature classes for lakes, rivers, roads, and elevation.

Locations (longitude and latitude) of all potential breeding sites and detected filariasis case were recorded using a global positioning system (GPS) unit using coordinate system GCS_WGS_1984 and Datum D_WGS_1984. Arc view 8, computer program was used for producing maps showing spatial distribution of each mosquito species and filariasis case in the Governorate. Satellite images for El Sharqiya Governorate were obtained through the Internet showing the land use and nature, also distribution of vegetation, agricultural areas, desert areas and populated areas of the Governorate.

Statistical Analysis

Means and Standard Deviations were calculated for larval and adult densities of the reported mosquito species. Means were compared by the one-way ANOVA and if significantly different, they were exposed to pairwise comparison by Tukey test. Multiple Regression analysis was used to examine the relation of larval density (DL) to the temperature and pH of the breeding water and of the adult density (DA) to the indoor (In) and outdoor (Out) temperature and Relative Humidity (RH). The regression equations were in the form of DL=a+b_1 Temp. +b_2 pH (larvae) and DA= a+b_1 In Temp.+ b_2 Out Temp. + b_3 In RH + b_4 Out RH (adults) where a = constant (intercept), b_1-b_4 are the slopes (regression coefficients). The slopes were tested for deviation from 0 by t-test. The SSP (Smiths Statistical Package, version 2.75 by Gary Smith, 2004) computerized program was used for statistical analysis.

RESULTS

Composition and Relative Abundance of Mosquito Species

Six mosquito species were collected in the different districts (Table 1 and Fig. 1). These are *Culex (Culex) pipiens* Linnaeus, *Cx. (Cx.) perexiguus* Theobald, *Cx. (Cx.) antennatus* (Becker), *Cx.* (*Barraudius*) *pusillus* Macquart, *Cx. (Cx.) sinaiticus* Kirkpatrick *and Aedes* (*Ochlerotatus*) *detritus* (Haliday). In 67.5 collections (Survey unit; SU each of 10 net dips), a total of 29134 larvae were collected of which *Cx. pipiens* was the predominant species (ca. 88%, 503 larva/SU, p<0.01). A total of 9232 adults were collected (space spraying: 3507, 37.99% and hand collection: 5725, 62.01%) from 599 examined rooms of which *Cx. Pipiens* was the most common species (ca.47%, 7 adult/room, p<0.01).

Table 1: Species composition and relative abundance of the mosquito species in El Sharquiya Governorate

SPECIES	LARVAE (67.5 SU)[1]			ADULTS (599 rooms)		
	No	%	Mean± SD[2]	No	%	Mean ± SD[3]
Cx. pipiens	25661	88.11	502.50±516.70 A	4344	47.05	7.01±2.63 A
Cx. perexiguus	1373	4.71	42.75±108.90 C	2592	28.08	3.99±2.84 B
Cx. antennatus	2091	7.18	76.44±208.40 B	2291	24.82	3.77±1.79 B
Cx. pusillus	5	0.02	---	0	0.00	
Cx. sinaiticus	0	0.00	----	4	0.04	---
Ae. detritus	4	0.01	---	1	0.01	---
TOTAL	29134			9232		

1. SU= Survey Unit (10 net dips)
2. Mean density per district (Larvae/ SU), $F_{2,35}= 7.3$, , P<0.01, means with the different letters are significantly different, P<0.01 (Pairwise comparisons by Tukey test).
3. Mean density per district (Adults/ room), $F_{2,42}= 8.2$, P<0.01, means with the different letters are significantly different, P<0.01 (Pairwise comparisons by Tukey test).

Mosquitoes were more common in Hehia (2932 Larva /SU, 30 adult / room) than in the other districts (Table 2). In all districts, *Cx pipiens* adults (3.3- 13.6 adult/room) was the most common species as compared to *Cx antennatus* (1.5- 5.4), *Cx. perexiguus* (0.8-12.6), *Cx. sinaiticus* (0.08) or *Ae. detritus* (0.02) except at Ibrahimia where *Cx. antennatus was the most common species* (8 adult/room) as compared to *Cx. pipiens (*6.9) or *Cx. perexiguus (*2.8). As larvae, only *Cx. pipiens* was collected in Mashtoul Al Souk and Menia Al Kamh (100-116 larva/SU). In all districts, *Cx. pipiens* was the most common species *(*33.0-1342.4 larva/SU) as compared to *Cx. antennatus* (1-704), *Cx. perexiguus* (1.2-386.0), *Cx. pusillus* (collected only in Abu Kbeer, 0.3 larva/SU) and *Ae. detretus* (collected only in Al Salhya, 1.6 larva/SU).

Table 2: Relative abundance of mosquito larvae and adults in El Sharquiya districts

DISTRICT	SPECIES[1]						LARVAE		ADULTS	
	Cx. pipiens	*Cx. antennatus*	*Cx. perexiguus*	*Cx. sinaiticus*	*Cx. pusillus*	*Ae. derritus*	No. of SU[2]	No/SU	No. of rooms	Tot. No/ room
Mashtoul Al Souk	LA	A	A				2.0	116.0	23	6.2
Belbeis	LA	LA	LA				3.0	607.2	36	16.1
10th of Ramadan	LA	LA	LA	A		A	2.0	297.5	46	12.2
Menia Al Kamh	LA	A	A				1.0	100.0	31	10.3
Dyarb Negm	LA	LA	LA				8.0	270.7	38	18.3
Ibrahimia	LA	LA	LA				4.0	758.5	44	17.7
Hehya	LA	LA	LA				2.0	2932.0	58	30.0`
Al-Zakazik	LA	A	LA				5.0	43.4	38	10.8
Abu Hammad	LA	LA	LA				4.0	863.0	43	12.6
Abu Kbeer	LA	LA	LA		L		16.0	141.9	45	9.8
Fakous	LA	LA	A				2.5	284.8	34	21.8
Kafr Sakr	LA	LA	LA				5.0	54.4	46	13.9
Awlad Sakr	LA	LA	LA				7.5	407.5	42	14.3
Al Hosainia	LA	A	LA				3.0	668.6	44	9.3
Al Salhya	LA	LA	LA			L	2.5	1347.4	31	18.3

1. Collected as: LA = Larvae and Adults, A= Adults, L= Larvae
2. SU= Survey Unit (10 net dips)

Breeding Habitats

Mosquito larvae were found to have a variety of breeding habitats: Irrigation canals (ditches, drains, and misqas or narrow irrigation canals), Sewage water (Cesspits and cesspools), unused sakias pits (deep wells used for irrigation) Pools, surface water, seepage water and wells.

Effect of Water Temperature and pH on the Density of Mosquito Larvae

Multiple Regression analysis (Table 3) revealed that larval densities of the 3 common species increase as temperature increased within the range (18-30^{o}C). Larval density of *Cx. pipiens* increases (P>0.05) and densities of *Cx. antennatus and Cx perexiguus decrease* (P>0.05) as pH increased within the range (7.4-8.4). In general for all larvae, density increases as temperature increased (P<0.05) while it decreases (P>0.05) as pH increased.

Table 3: Multiple regression analysis for the effect of temperature, Relative humidity and pH on the density of mosquito larvae and adults

	SPECIES	COEFFICIENTS[a] *a*	b_1	b_2	b_3	b_4	R^{2b}
LARVAE[c]	*Cx. pipiens*	-2.7	+74.4[e]	+191.7			0.3
	Cx. antennatus	+396.5	+11.2	-76.2			0.1
	Cx.perexiguus	+208.1	+7.2	-43.3			0.1
	All	-1485.3	+102.1[e]	-34.3			0.2
ADULT[d]	*Cx. pipiens*	+1.0	-0.1	+0.2	+0.2	+0.2	0.2
	Cx. antennatus	+6. 5	+0.2	-0.2	+0.1	-0.1	0.2
	Cx. perexiguus	-0.5	-0.8	+0.8	-0.1	+0.1	0.2
	All	+5.6	-0.5	+0.8	-0.2	+0.2	0.1

a. a = constant (intercept), b1-b4 are the slopes (regression coefficients).
b. Coefficient of Determination.
c. Equation ($y=a+b_1x_1+b_2x_2$) where y= Density, x_1= Temperature and x_2= pH
d. Equation ($y=a+b_1x_1+b_2x_2+b_3x_3+b_4x_4$) where y= Density, x_1= Indoor temperature, x_2= Outdoor temperature, x_3= Indoor RH and x_4= Outdoor RH.
e. P<0.05, all others not significant, P>0.05

Effect of Temperature and Relative Humidity on the Density of Mosquito Adults

Multiple Regression analysis (Table 3) revealed the following;

1. *Cx. pipiens*: Density decreases as indoor temperature (range=16.5-27.9^{o}C) increased, while it increased as outdoor temperature (range= 17.5-29.0 ^{o}C), indoor RH (range=45.0-68.8) and outdoor RH (range=45.7-68.2) increased (P>0.05).
2. *Cx antennatus*: Density increases as indoor temp and RH increased, while it decreases as outdoor temp. and RH increased (P>0.05).
3. *Cx perexiguus*: Density decreases as indoor temp. and RH increased, while it increases as outdoor temp. and RH increased (P>0.05).
4. Generally, for all adults, Density increases as outdoor temp. and RH increased, while it decreases as indoor temp. and RH increased (P>0.05).

Parasitological Survey

Of the total 2504 collected blood samples, 11 (0.44%, range = 0.51-2.38%) were positive for microfilaria of lymphatic filariasis (Table 4 and Fig. 1). Cases were reported in 10th of Ramadan, Al Salhya, Menia Al-Kamh, Mashtoul Al Souk, Dyarb Negm, Kafr Sakr and Awlad Sakr. In addition, clinical examination showed only one elephantiasis case (0.61%) in Kafr Sakr district. The cases were associated with the abundance of *Cx. pipiens* adults (40.5-60.1% of the collected adults)

Table 4: Filariasis cases in El Sharquiya Governorate

District	No. blood samples			Mosquito adults (%)		
	Examined	Positive		*Cx. pipiens*	*Cx. antennatus*	*Cx. perexiguus*
		No.	%			
Mashtoul Al Souk	143	1.0	0.7	53.2	24.2	22.6
Belbeis	157	0.0		47.8	33.5	18.6
10th of Ramadan	168	4.0	2.4	40.5	30.6	28.9
Menia Al Kamh	142	1.0	0.7	55.3	36. 9	7.8
Dyarb Negm	195	1.0	0.5	50.3	28.4	21.3
Ibrahimia	155	0.0		39.0	45.2	15.8
Hehya	171	0.0		45.3	12.7	42.0
Al-Zakazik	183	0.0		51.9	18.5	29.6
Abu Hammad	175	0.0		47.6	23.0	29.4
Fakous	148	0.0		40.8	22.5	36. 7
Abu Kbeer	175	0.0		4 9	20.4	30.6
Kafr Sakr*	164	2.0	1.2	48.9	28.1	23.0
Awlad Sakr	173	1.0	0.6	60.1	14.0	25.9
Al Hosainia	183	0.0		43.0	21.5	35.5
Al Salhya	172	1.0	0.6	50.3	29.5	20.2
Total	2504	11.0	0.4			

***** One clinical case was detected (0.61%)

DISCUSSION

Totally, eight culicine mosquito species were previously reported from El Sharqiya governorate (Kaschef *et al.*, 1982; El-Said and Kenawy, 1983; Kenawy *et al.*, 1996 & 1998 and El-Bashier *et al.*, 2006): *Culex (Culex) pipiens* Linnaeus, *Cx. (Cx.) perexiguus* Theobald, *Cx. (Cx.) antennatus* (Becker), *Cx.* (*Barraudius*) *pusillus* Macquart, *Cx.* (*Cx.*) *poicilipes* (Theobald), *Aedes (Ochlerotatus) caspius (Pallas)*, *Culiseta* (*Allotheobaldia*) *longiareolata* (Macquart), *Uranotaenia* (*Pseudoficalbia*) *unguiculata* Edwards. During the present study, only the first four of these species were reported. In addition, two other species namely *Cx. (Cx.) sinaiticus* Kirkpatrick *and Ae. (Ochlerotatus) detritus* (Haliday) were identified as newly distributed species.

Culex. pipiens was the predominant or the most common species (ca.88%, larvae and 47% adults, p<0.01) similar to the previous observations (Gad *et al*., 1995; Kenawy *et al.*, 1996 and El-Bashier *et al.*, 2006). This indicate the prevalence of the main filariasis vector (Harb *et al.*, 1993) in all surveyed areas breeding mainly in drainage and irrigation canals, which are numerous in the Governorate through its fertile areas. The Governorate covers areas of fertile cultivated lands as well as newly reclaimed land (AL Salhya) and desert areas (10th of Ramadan) and as appears from satellite images (Fig. 2). The areas of Cities and villages appear in the images as many small grey spots areas in the majority of green fields covering most of the districts.

Breeding habitats were found to have alkaline water (pH 7.4-8.4) as previously reported by Kirkpatrick (1925). In El Sharqiya rice fields, Larvae of *Cx. antennatus* and *Cx. perexiguus* breeding water has pH of 6-8 (Kenawy *et al.*, 1998). The temperature range (18-30^{o}C) of the breeding water as observed in this study is comparable to 21-29 ^{o}C reported by Kenawy *et al.* (1998) in the rice fields. The difference in temp ranges for the different mosquito species could explain their breeding seasonalities.

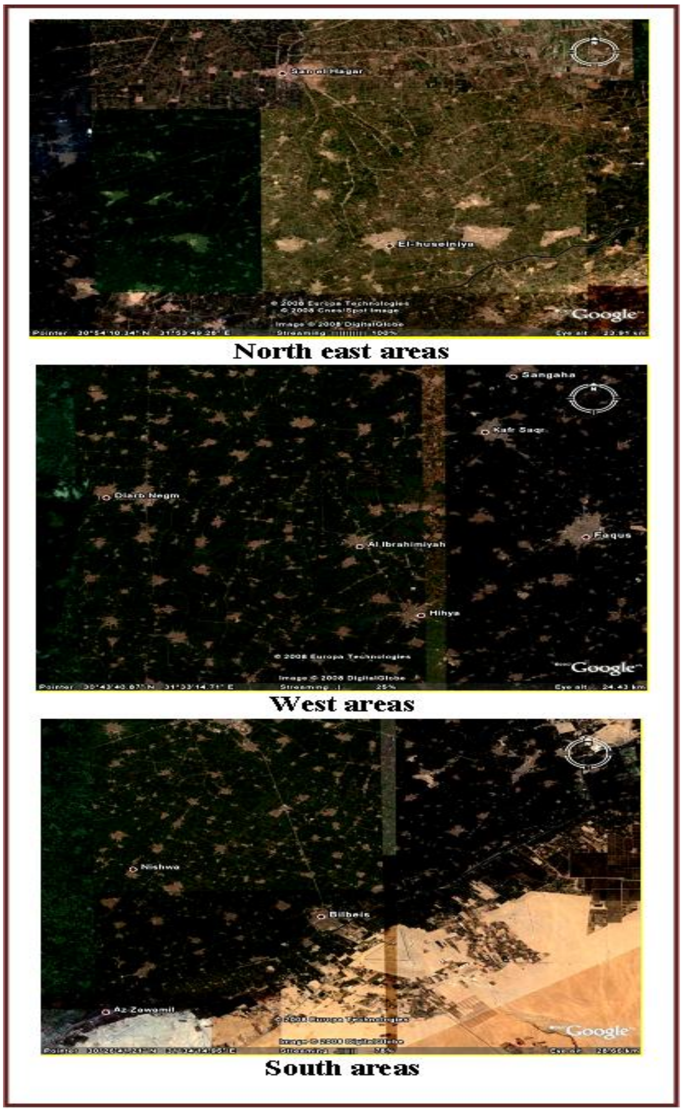

Fig. 2: Satellite images of El Sharqiya Governorate

Regression analysis revealed that larval densities of the 3 common species are directly related to water temperature. Larval density of *Cx pipiens* increases (P>0.05) while those of *Cx. antennatus and Cx. perexiguus* decrease (P>0.05) as pH increased (R^2=0.1-0.3). Studies on such relations in Egypt are few and included only 4 anopheline and 2 culicine species (El-Said and kenawy, 1982 and kenawy and El-Said, 1989 &1990). In El Sharquiya, Kenawy *et al.* (1996) reported that densities of *Cx. antennatus* and *Cx. perexiguus* increased as a linear function of pH and temperature of the breeding water with regression coefficients (b) significantly different from 0 (P<0.05). While in El Sharquiya rice fields (Kenawy *et al.*, 1998), the relation of larval densities of *Cx. antennatus* and *Cx. perexiguus* were positive with pH and negative with temperature. In the neighboring Ismailia governorate, Kenawy and El-Said (1990) reported that density of *Cx. antennatus* larvae was directly proportional with water temperature and pH (P>0.05). Several other physico-chemical factors, e.g. salinity are known to affect the survival of mosquito larvae and pupae (Sinha, 1976 and kenawy and El-Said, 1990). Indoor density of the common mosquito adults was found to increase as outdoor temperature and RH increased, while it decreases as indoor temperature and RH increased (P>0.05).

No comparable results however, are available.

Data indicates that filariasis cases (0.4%, 11/ 2504) are still to be found in this Governorate (in six out of the fifteen districts) despite the facts that our collected samples were limited and that the Governorate was covered by the Mass Drug Administration (MDA) national programme of Ministry of Health to eliminate lymphatic filariasis (Ramzy *et al.,* 2005 and El-Setouhy *et al.,* 2007). The highest infection rate (2.4%) was reported in the 10th of Ramadan, a new settlement area. The cases were associated with the abundance of *Cx. pipiens* adults which gives further indication that *Cx. pipiens* is the main filariasis vector in the Governorate. Moreover, *Cx. pipiens* was found (Gad et al., 1995) to be primarily anthropophilic (forage ratio = 2.7) at Abu Heif, a village in Sharqiya Governorate, the finding that support such conclusion.

The Geographic information systems have allowed researchers to visualize data distribution together with environmental parameters such as temperature and relative humidity on maps (Coetzee et al., 2000). The obtained results thus can provide a new basis for directing the control of mosquito vectors as they provide health authorities with precise maps of mosquito breeding habitats in a timely manner. Moreover, the generated map delineating risk areas could be used by project developers to either re-site the project, or invest in mosquito control activities in order to avoid health risks and ensure sustainability of their development (Hassan and Onsi, 2004).

In the present work GIS has been used to analyze the spatial distribution of vectors of diseases and disease risk in El Sharquiya Governorate. It was found that the breeding pattern of the vector species and the availability of its breeding sites are important variables in explaining the variability in disease transmission. Our results support findings of previous research (Bergquist, 2001) that environmental factors are important determinants of vector-born disease risk.

The distribution map of vectors and associated filariasis cases in the study areas that generated during the present investigation will provide the vector control authorities with more information that would assist in their control activities and prioritization.

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ARABIC SUMMARY

التوزيع المكانى وغَزَارَة بعوض الكيوليسينى فيما يتعلق بأختطار نقل مرض الفيلاريا
فى محافظة الشرقيه- جمهورية مصر العربيه

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اجرى مسح لبعوض الكيوليسينى (نوفمبر 2007 – مايو 2008) فى بعض القرى والمدن ممثلة للمراكز المختلفه فى محافظة الشرقيه وقد امكن حصر 6 انواع وهى: كيولكس ببيانز, كيولكس بيريكسيجس, كيولكس انتناتس وكيولكس بوسيلس بلأ ضافة الى كيولكس سيناتيكس وأيديس ديتريتس والذان اعتبرا كتسجيل جديد فى هذه المحافظه. وجد ان كيولكس ببيانز وهو الناقل الرئيسى للفيلاريا كان النوع الغالب او الأكثر شيوعا (88% من اليرقات و 47% من البعوض اليافع). بالنسبة للأنواع الشائعه, فقد تم دراسة التالى : (1) انواع وخصائص (درجات الحرارة وتركيز ايون الهيدروجين) اماكن التوالد وعلاقتها بكثافة اليرقات، (2) علاقة كثافة البعوض اليافع بكل من درجات الحراره والرطوبه النسبيه داخل وخارج المنازل. بالمسح الطفيلى اكتشفت 11 حاله لمرض الفيلاريا من بين 2504 عينه دم تم جمعها (0.4%) فى 6 مراكز وكانت اعلى نسبه للأصابه (2.4%) فى مدينة العاشر من رمضان وهى من المناطق السكانيه الجديده . وقد وجد ان الحالات الم سجله مصحوبه بغزارة من كيولكس ببيانز (40-60% من البعوض اليافع الذى تم اصطياده). تم عمل خرائط للتوزيع المكانى لأنواع البعوض وحالات الفيلاريا والتى قد تساهم فى امداد الجهات المعنيه بالمعلومات عن مناطق اختطار المرض والتى قد تساعد فى اعمال المكافحه التى تقوم بها.