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THE DENSITY OF *ANOPHELES ARABIENSIS* (DIPTERA: CULICIDAE) IN CORRELATION TO MALARIA CASES AND SOME ENVIRONMENTAL FACTORS IN THREE VILLAGES AROUND WAD MEDANI TOWN

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ABSTRACT

This work aimed at studying the population density of Anopheles *arabiensis* and the incidence of malaria, during July–December 2001 and 2002. The study was conducted in three villages, namely Kereba, Barakat and Hantoub. The mean temperature and amount of rain fall were also recorded during this study.

The results showed that the species of *Anopheles arabiensis* (Larvae and Adults) were recorded in all villages. The numbers recorded for this vector species were higher during September, in Kereba and Hantoub villages and during August in Barakat village than during the other months, during 2001. In 2002, the means recorded for this species were higher during September and October in Kereba and during August and September in Barakat and Hantoub than during other months. The species were not recorded during November and December 2002 in all villages. The overall mean number of the vector recorded in all villages was higher in 2001 than in 2002.

The number of malaria cases recorded in all villages was highly correlated with the number of vectors recorded and with the environmental factors (means temperature and the amount of rain fall), during 2001, the amount of rainfall was high and this may have led to the increase of the breeding sites, and hence, the malaria cases recorded.

During both years the numbers of vectors and of the resulting malaria cases were higher in Kereba and Barakat villages, than in Hantoub village.

العلاقة بين كثافة الأنوفلس العربي وعدد حالات الملا ريا
وبعض العوامل البيئية في مدينة ودمدني

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المخلص

هدف هذا البحث إلى دراسة كثافة أعداد الأنوفلس العربي الناقل للملاريا وعلاقة ذلك بحالات الملاريا الناتجة وكذلك بمتوسط درجات الحرارة وكميات الأمطار في تلك الفترة. وقد أجريت الدراسة فى ثلاث قرى حول مدينة ودمدنى وهى قرية الكريبة، بركات وحنتوب وذلك خلال الفترة من يوليو – ديسمبر من عامى 2001م و 2002م.

أظهرت النتائج أن الأنوفلس العربي *A. Arabiensis* (الأطوار اليرقية والبالغة) قد سجل فى المناطق الثلاث خلال العامين 2001م و 2002م.

هذا وقد كانت الكثافة العددية للناقل فى عام 2001م عالية فى شهر سبتمبر فى قريتي الكريبة وحنتوب وفى شهر أغسطس فى قرية بركات مقارنة بالشهور الأخرى. فى عام 2002م كانت الكثافة العددية لهذا النوع عالية نسبياً خلال شهري سبتمبر وأكتوبر في قرية الكريبة وخلال شهري أغسطس وسبتمبر في قريتي بركات وحنتوب مقارنة بالشهور الأخرى, ولم تظهر هذه الآفة فى المواقع الثلاثة خلال شهرى نوفمبر وديسمبر. وقد كان متوسط أعداد الباعوض التى سجلت فى المناطق الثلاث خلال عام 2001م أعلى من التى سجلت عام 2002م.

وجد أن هنالك ارتباط كبير جداً عند مقارنة أعداد البعوض مع أعداد المصابين بالملاريا فى القرى الثلاثة وكذلك مع عوامل الحرارة وكمية الأمطار في تلك الفترة. وإتضح كذلك أن حالات الملاريا كانت مرتفعة فى عام 2001م وذلك لارتفاع كمية الأمطار وعدد أماكن التوالد وبالتالي أعداد البعوض مقارنة مع عام 2002م. هذا وقد كانت أعداد الباعوض والمصابين بالملاريا عالية فى الكريبة وبركات خلال العامين وذلك لموقعها داخل المشروع حيث القنوات وفرص التوالد أكبر مقارنة بحنتوب.

INTRODUCTION

Mosquitoes are important vectors of several tropical diseases, and about 100 species act as vectors of human diseases (Burgess and Coman, 1993). Example of such diseases is malaria; filariasis, Japanese encephalitis and yellow fever (Muirhear, 1951) and some species may transmit a few arboviruses. Few anopheles species, besides transmitting malaria, they also transmit filariasis (Lacey and Oidacre, 1983).

The most important man-biting mosquitoes belong to the genera *Anopheles, Culex, Aedes, Mansonia, Haemagogus* and *Sabethes* (Hawking, 1973). The genus *Aedes* includes important vectors of yellow fever, dengue fever and encephalitis, viruses, while the genus *Mansonia* transmits *Brugia malyi* (Buttiker, 1979). However, several other genera are vectors of various arboviruses in central and south America (White, 1989). Other biting species of *Anopheles* mosquito are nuisance to man (Clements, 1992).

Malaria is a wide spread disease and about 200,000,000 persons in different parts of the World are affected and as a result high mortalities occurred (BNHP, 1989). In the Sudan, malaria is recorded in several areas especially the southern and central States (Haridi, 1994). In the Gezira, malaria is prevalent all the year round and increases during autumn and winter because of the increase of the vector population (White, 1989).

The present study aimed at determining the density of *Anopheles arabiensis* mosquito which prevails in three locations in Wad Medani (Viz. Kereba, Barakat and Hantoub) in relation to the number of persons who acquire malaria, and mean temperature and the amount of rain fall during autumn months (July-December) of the year 2001 and 2002.

MATERIALS AND METHODS

The study area: Three locations were selected for conducting this study, viz. kereba, Barakat, and Hantoub village. Sampling of larvae and adult mosquitoes was carried out in these three locations at 14 days interval during July – December, 2001 and 2002.

Sampling of the larvae: Sampling of the larvae was carried out at all three locations every 14 days, during July – December, 2001 and 2002.

In each location, the mosquito larvae were collected from 4 ponds by means of small metal dishes (20 cm. diam.). *Anopheles* larvae were transferred to glass tubes (10 x 10 x 10 cm) containing 70% ethanol alcohol and were kept for identification by using the key for identification of common anophelines in Sudan described by Medical Entomology Section (1960). The number of *A. arabiensis* larvae collected in both years were recorded for each site.

Sampling of the adults: Sampling of the adults was carried out in all locations at 14 days interval during July – December, 2001 and 2002.

Ten houses were randomly selected in each location, and one room was selected from each house. The floor in each room was covered with a white cloth sheet (4 x 4m). The cloth was provided by the Malaria Control Management (MCM). The rooms were sprayed with Malathion 75% and the knocked down adult mosquitoes were collected, the numbers of adults/room collected during 2001 and 2002 were recorded. The adults were put in a glass jar containing 70% ethanol alcohol and were kept for identification. The identification was conferred by the Blue Nile Training and Research Institute, Wad Medani.

The number of adult *A. arabiensis* collected from the three villages was recorded there.

Number of malaria cases: The data concerning the number of persons who acquired malaria in the three locations was obtained from Kereba, Barakat and Hantoub health centers. These data were confirmed by the Malaria Control Administration, Gezira State.

Meteorological data: The meteorological data was obtained from the meteorological station, Agricultural Research Corporation (ARC) at Wad Medani and also from the Gezira State Vaccination Administration.

Statistical analysis: Analysis for descriptive statistics, presentation of data and correlation analysis were obtained by using Microsoft Excel program so as to conduct the conclusions.

RESULTS AND DISCUSSION

During 2001: The total number of A. arabiensis collected was low at Kereba, Barakat and Hantoub villages during July (43, 44 and 31, respectively), then gradually increased during August (50, 49 and 42, respectively), and deceased again during September (31, 43 and 29, respectively). The numbers were low during October (47, 31 and 50, respectively), November (39, 31 and 33, respectively) and December (54,

44 and 56, respectively). The densities of the Anopheles population were coincided with the recorded number of malaria cases during these months, as was shown in Table (1 and 2) and Figure (1).
The total number of the vector during the respective months at Kereba was 264 and the total number of malaria cases was 771, at Barakat the total number during the respective months was 242 and the total number of malaria cases was 441, at Hantoub the total number during the respective months was 241 and the total number of malaria cases was 347.

Table (1): No. of A. arabiensis , No. of Malaria Cases, Temperature (Co) and Rain Fall (mm) From Three Sites Around Wad Medani During July to December 2001.

		No. of *A. arabiensis*			**No. Malaria cases**	**Environmental Factors (means)**	
Area	**Months**	**Larvae**	**Adults**	**Total**		**Temp. (C°)**	**Rain Fall (mm)**
Kereba	July	29	14	43	**19**	39	133.7
	August	36	14	50	**73**	37	33.3
	Sept.	21	10	31	**116**	36	50.1
	October	30	17	47	**206**	35	5.7
	Nov.	28	11	39	**187**	28	0.4
	Dec.	34	20	54	**170**	26	0
	Total	**178**	**87**	**264**	**771**	**191**	**223.2**
Barakat	July	28	16	44	**20**	39	129
	August	38	11	49	**31**	37	120.1
	Sept.	26	17	43	**41**	36	81.3
	October	18	13	31	**159**	35	7
	Nov.	20	13	31	**97**	28	0
	Dec.	30	14	44	**93**	25	0
	Total	**160**	**84**	**242**	**441**	**191**	**337.4**
Hantoub	July	31	0	31	**20**	39	133.7
	August	23	19	42	**51**	37	33.3
	Sept.	26	13	29	**61**	36	50.1
	October	36	14	50	**82**	35	5.7
	Nov.	20	13	33	**73**	28	0.4
	Dec.	37	19	56	**60**	26	0
	Total	**173**	**78**	**241**	**347**	**191**	**223.2**

Table (2): Correlation Coefficient Analysis for the No. of *A. arabiensis*, No. of Malaria Cases, Temperature (C^{o}) and Rain Fall (mm) From Three Sites around Wad Medani during July to December 2001.

(A)Kereba

VS.	Larvae	Adults	Total	Malaria cases	Temp. (C^{o})
Adults	0.9959	-			
Total	0.9995	0.9982	-		
Malaria cases	0.9605	0.9659	0.9631	-	
Temp. C^{o})	0.9919	0.9858	0.9907	0.9467	-
Rain Fall (mm)	0.8177	0.8069	0.8148	0.6719	0.8614

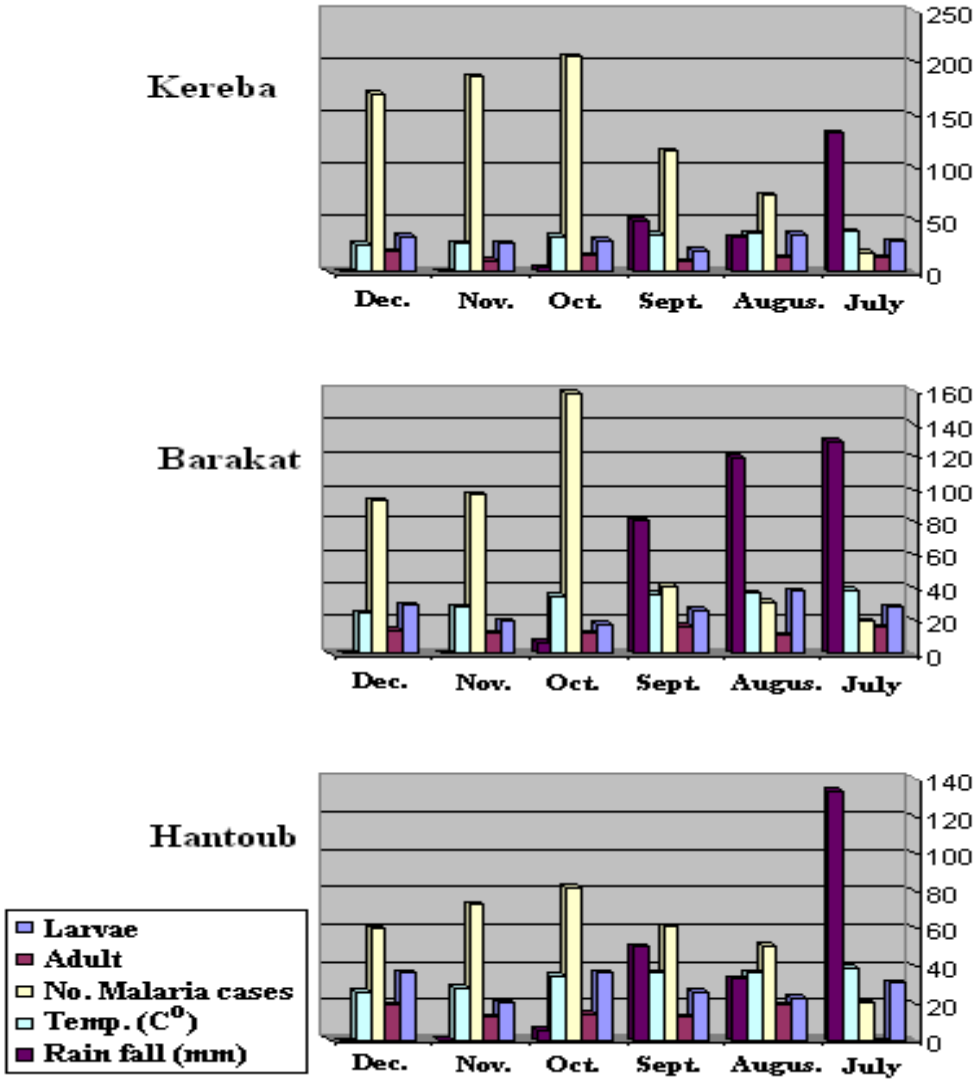
(B) Barakat

VS.	Larvae	Adults	Total	Malaria cases	Temp. (C^{o})
Adults	0.9865	-			
Total	0.9985	0.9938	-		
Malaria cases	0.9062	0.9340	0.9172	-	
Temp. C^{o})	0.9902	0.9948	0.9947	0.9282	-
Rain Fall (mm)	0.9163	0.8895	0.9116	0.7034	0.9143

(C) Hantoub:

VS.	Larvae	Adults	Total	Malaria cases	Temp. (C^{o})
Adults	0.9608	-			
Total	0.9951	0.9799	-		
Malaria cases	0.9778	0.9818	0.9848	-	
Temp. C^{o})	0.9892	0.9547	0.9831	0.9739	-
Rain Fall (mm)	0.8257	0.6861	0.7813	0.7301	0.8614

Figure (1) No. of A. arabiensis (Larvae and Adults), No. of Malaria Cases, Temperature (Co) and Rain Fall (mm) From Three Sites Around Wad Medani During July to December 2001.


Kereba
250
200
150
100
50
0
Dec.
Nov.
Oct.
Sept.
Augus.
July
Barakat
160
140
120
100
80
60
40
20
0
Dec.
Nov.
Oct.
Sept.
Augus.
July
Hantoub
140
120
100
80
60
40
20
0
Dec.
Nov.
Oct.
Sept.
Augus.
July
Larvae
Adult
No. Malaria cases
Temp. (C0)
Rain fall (mm)

The highest records of total number of mosquitoes recorded were during Aug. in Barakat (49) and during Dec. in Kereba (54) and Hantoub (56). The highest records of the malaria cases recorded were during Oct. at all sites (Kereba (206), Barakat (159) and Hantoub (82). Although this month was of low rainfall, but the temperature was of 35^{o}C at all sites, and the previous months had a higher amount of rainfall. The total records of malaria cases were higher at Kereba (771 cases) and Barakat (441 cases) compared to Hantoub village (347 cases). This may be related to the fact that the former two sites are located in the middle of the Gezira scheme, surrounded by canals and probably breeding sites compared to Hantoub village, in addition to the flowing systems of the rainfall water. As was shown in Table (2), the density of mosquitoes did not correlated strictly to the malaria cases (R^2= 0.67 at Kereba, 0.70 at Barakat and 0.73 at Hantoub), and this finding can be due to other factors that might had contributed to the malaria cases. The results also showed that, there were a high correlation between the mean temperature and the density of mosquitoes ($R^2 > 0.98$).
During 2002: As was shown in Table (3 and 4) and Figure (2), the total number of mosquitoes or malaria cases recorded in the study areas during July, August, September and October, 2002 were remarkably lower compared to those recorded on the same months during 2001. At all sites, there was no abundance of mosquitoes during November and December at all, although that there were some malaria cases. In both years the number of adults and malaria cases coincided with the amount of rainfall which prevailed during these months. The lowest records of adult mosquito or malaria cases recorded were at Hantoub and this was attributed to the fact that this village lies out of Gezira Scheme i.e. a long distance from fields and canals compared to Kereba and Barakat villages.

Table (3): No. of A. arabiensis, No. of Malaria Cases, Temperature (Co) and Rain Fall (mm) From Three Sites around Wad Medani during July to December 2002.

		No. of *A. arabiensis*			**No. Malaria cases**	**Environmental Factors (means)**	
Area	**Months**	**Larvae**	**Adults**	**Total**		**Temp. (Cº)**	**Rain Fall (mm)**
Kereba	July	29	16	45	**12**	33	53.4
	August	40	19	59	**36**	38	84.3
	Sept.	45	17	62	**67**	36	52.1
	October	41	20	61	**33**	31	16.1
	Nov.	0	0	0	**25**	29	0
	Dec.	0	0	0	**10**	30	0
	Total	155	72	227	**183**	197	205.9
Barakat	July	37	17	54	**13**	33	90
	August	45	21	66	**18**	38	78.1
	Sept.	40	19	59	**37**	36	16.2
	October	33	13	46	**22**	31	8
	Nov.	0	0	0	**20**	29	0
	Dec.	0	0	0	**16**	30	0
	Total	155	70	225	**126**	197	193.3
Hantoub	July	29	15	44	0	33	53.4
	August	44	24	68	6	38	84.3
	Sept.	49	22	71	21	36	52.1
	October	40	16	56	30	31	16.1
	Nov.	0	0	0	17	29	0
	Dec.	0	0	0	19	30	0
	Total	162	77	239	93	197	205.9

Figure (2) No. of A. arabiensis (Larvae and Adults), No. of Malaria Cases, Temperature (Co) and Rain Fall (mm) From Three Sites Around Wad Medani During July to December 2002.

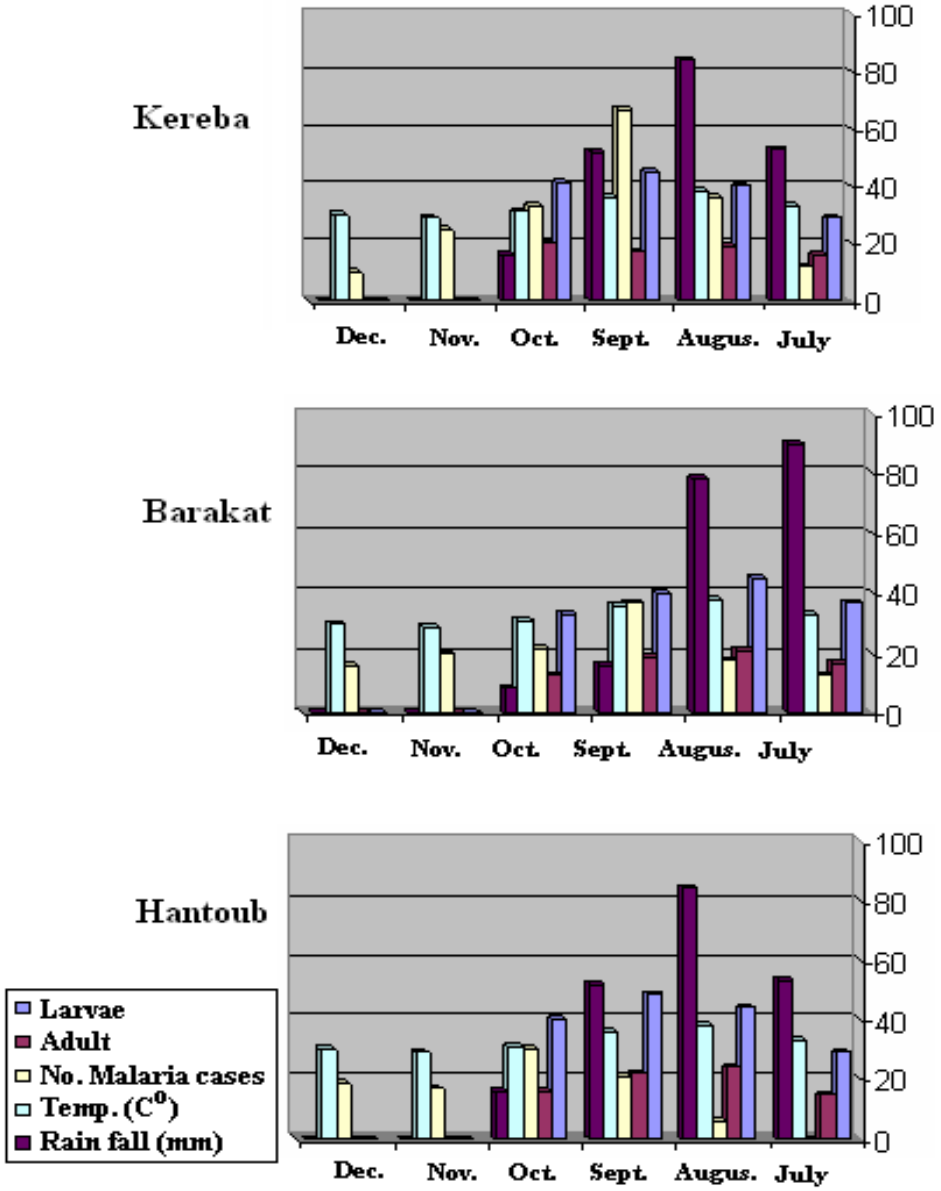


Table (4): Correlation Coefficient Analysis For The No. of A. arabiensis, No. of Malaria Cases, Temperature (Co) and Rain Fall (mm) From Three Sites Around Wad Medani During July to December 2002

(A) Kereba

VS.	Larvae	Adults	Total	Malaria cases	Temp. (C⁰)
Adults	0.9968	-			
Total	0.9997	0.9985	-		
Malaria cases	0.9607	0.9426	0.9556	-	
Temp. C⁰)	0.9456	0.9470	0.9467	0.9581	-
Rain Fall (mm)	0.9553	0.956	0.9563	0.9097	0.9212

(B) Barakat:

VS.	Larvae	Adults	Total	Malaria cases	Temp. (Cº)
Adults	0.9993	-			
Total	0.9999	0.9996	-		
Malaria cases	0.9364	0.9352	0.9361	-	
Temp. Cº)	0.9488	0.9472	0.9484	0.9837	-
Rain Fall (mm)	0.9212	0.9264	0.9230	0.7975	0.8687

C) Hantoub:

VS.	Larvae	Adults	Total	Malaria cases	Temp. (Cº)
Adults	0.9973	-			
Total	0.9997	0.9988	-		
Malaria cases	0.8804	0.8588	0.8739	-	
Temp. Cº)	0.9450	0.9457	0.9458	0.9396	-
Rain Fall (mm)	0.9608	0.9783	0.9670	0.7705	0.9212

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