J. Agric. Sci. Mansoura Univ., 34 (1): 553 - 568, 2009

PREDATORY INSECTS ASSOCIATED WITH MOSQUITOES AND THEIR RELATIVE ABUNDANCE AT DAKAHLIA GOVERNORATE.

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ABSTRACT

Ten species of predatory insects were found associated with mosquitoes larvae and pupae in three districts (Mansoura, Talkha, and Miniet El-Nasr) from January 2005 till December 2007 at Dakahlia governorate in the present study. These predatory insects are belonging to three different orders (Heteroptera, Coleoptera, and Odonata) as the following: Order Heteroptera: *Micronecta plicata* (Costa) (Corixidae), *Diplonychus urinator* (Durfour) (Belostomatidae), *Lethocerus niloticus* (Stal) (Belostomatidae), and *Anisops* sp. (Notonectidae), Order Coleoptera: *Rhantus elevatus* Sharp (Dytiscidae), and *Stemolophus soleiri* Laporte de Castelnau (Hydrophilidae), and Order Odonata: *Anax imperator* Leach (Aeshnidae), *Trithemis annulata* Pale (Aeshnidae). *Pantala flavescens* Fabricius (Aeshnidae), and *Ishnura senegalensis* Rambur (Agrionidae).

During season of 2005, the more abundant species was *Anisops* sp. In addition, it listed the highest percentage in Talkha district (48.43%). But *R. elevatus* was the next highest predator and it approximately similar in the three districts. Moreover, *M. plicata* was the next one in Meniet El-Nasr district (12.91%). Meanwhile, *L. niloticus* represented the lowest percentage to the total predatory insects in Mansoura and Talkha districts but in Meniet El-Nasr district, *D. urinator* was the lowest percentage.

In season 2006, *Anisops* sp. was the most abundant predator species (53.80%, 46.90 and 47.65% in Mansoura, Talkha, and Meniet El-Nasr, respectively). The second one was *R. elevatus* (19.88, 16.29 and 21.04% in the three districts, respectively). In addition , *L. niloticus* represented the lowest percentage of the total predatory insects in Mansoura and Talkha districts. Whereas in Meniet El-Nasr district, *D. urinator* was the lowest percentage.

During season of 2007, *Anisops* sp. was the most numerous species (44.02, 47.36, and 49.73%) followed by *R. elevatus* (19.55, 18.39, and 17.86%), *M. plicata* (14.35, 12.89, and 10.99%),and *S. soleiri* (5.77, 5.24, and 5.77%) in Mansoura, Talkha and Meniet El-Nasr districts, respectively. Whereas in Mansoura and Talkha districts, *L. niloticus* was the lowest predator species.

Keywords: Mosquitoes predators, survey, seasonal abundance, Dakahlia Governorate.

INTRODUCTION

Mosquitoes (Diptera, Culicidae) are the most prominent of the numerous species of blood sucking arthropods that annoy man and other warm-blooded animals. Their attacks on farm animals can cause loss of weight and decreased milk production. Some mosquitoes are capable of transmitting disease organisms that cause malaria, lymphatic filariasis, yellow fever, and dengue to man, encephalitis to man and horses, and heartworm to dogs (Kline, 2006).

Over the last 45 years, the use of chemical pesticides has been the method of choice for mosquito control (Porter *et al.*, 1993).

Environmental methods and biological control are alternatives to chemical control and are key components of the integrated strategy. The use of vertebrate and invertebrate predators and entomopathogens as biological control agents and their role in integrated control programs is reviewed with emphasis on fish, *Toxorhynchites* mosquitoes, *Notonecta* species, predatory copepods, entomopathogenic bacteria, and the fungus *Lagenidium giganteum* (Lacey and Orr, 1994).

A variety of aquatic insects in the orders Odonata, Hemiptera, Coleoptera, and Diptera are will known to prey upon mosquito larvae. Generalist predators that feed on a broad range of prey species are polyphagous, while specialist predators with a restricted range of prey can be oligophagous or monophagous with a limited range or single species of prey. Although most predators of mosquitoes tend to be generalists (Collins and Washino, 1985).

In Egypt, some authors studied the biological control agents of mosquitoes, (Tawfik *et al.,* 1986a and 1990; Abdel-Aal *et al.,* 1998; Abdel-Aal, 2000). These studies still very limited, therefore, the present work is devoted to study: 1- Survey the aquatic predaceous insects upon mosquito larvae and pupae. 2- Seasonal abundance and the role of these predators as natural enemies of mosquitoes in three different distrcts at Dakahlia Governorate (Mansoura, Talkha and Miniet El-Nasr).

MATERIALS AND METHODS

A survey of predatory insects attacking mosquitoes was conducted at three different districts in Dakahlia governorate (Mansoura, Talkha and Miniet El-Nasr) in Dakahlia governorate during three successive years. Biweekly trips were done to the natural breeding sites of mosquitoes in the different above mentioned districts. The specimens were taken using a metalic strainer (15 cm in diameter) from water static or from water consequential agricultural soils to sweep most of these insects, each specimen was taken randomizely from nearly centare area. The collected mosquitoes larvae and pupae and their associated predators were kept in plastic pots (10 cm in diameter and 20 cm height) half full of water from swimming pool to still alive, after that, the specimens were transported to the laboratory for identification, counting and recording. The correlation coefficients between the mosquitoes and its predators were run (Costat, 2004).

RESULTS AND DISCUSSION

1-Field survey:

Ten species of predatory insects were found associated with mosquitoes larvae and pupae in three districts (Mansoura, Talkha, and Miniet El-Nasr) from January 2005 till December 2007 at Dakahlia governorate in the present study. As indicated in Table (1), these predatory insects are belonging to three different orders, four species from order Heteroptera, two species from order Coleoptera, and four species from order Odonata.

Similar results were reported by Tawfik *et al.* (1986b) in Egypt, who mentioned that aquatic insects attacking mosquitoes included the notonectid, *Anisops sardea* Herrich-Schaeffer, the belostomatid, *Sphaerodema urinator*,

the corixid, *Corixa hierogliphica*, the dytiscids, *Rhantus pulverosus* Stephens, and the agrionid, *Ischnura senegalensis.*

Table 1: Predatory insects associated with mosquitoes at Dakahlia Governorate.

Order	Family	Species
Heteroptera	Corixidae	*Micronecta plicata* (Costa)
	Belostomatidae	*Diplonychus urinator* (Durfour)
		Lethocerus niloticus (Stal)
	Notonectidae	*Anisops* sp
Coleoptera	Dytiscidae	*Rhantus elevatus* Sharp
	Hydrophilidae	*Stemolophus soleiri* Laporte de Castelnau
Odonata	Aeshnidae	*Anax imperator* Leach
		Trithemis annulata Pale
		Pantala flavescens Fabricius
	Agrionidae	*Ishnura senegalensis* Rambur

From the data in Table (2), it can be mentioned that the more dominant species was *Anisops* sp. in Mansoura, Talkha, and Miniet El-Nasr districts. Similar results were also reported by Tawfik *et al.* (1986a) in Egypt, who recorded the notonectid, *Anisops sardea* H.S. as an active mosquito predator.

The more abundant species during season of 2005 was *Anisops* sp. In addition, it listed the highest percentage in Talkha district (48.43%). On the other hand, *R. elevatus* was the next highest predator and it approximately similar in the three districts. Moreover, *M. plicata* was the next one in Meniet El-Nasr district (12.91%). Meanwhile, *L. niloticus* represented the lowest percentage to the total predatory insects in Mansoura and Talkha districts but in Meniet El-Nasr district, *D. urinator* was the lowest percentage.

During season of 2006, *Anisops* sp. was the most abundant predator species in Mansoura, Talkha, and Miniet El-Nasr districts (53.80%, 46.90 and 47.65%, respectively). The second one was *R. elevatus* (19.88, 16.29 and 21.04% in Mansoura, Talkha and Meniet El-Nasr districts, respectively). In addition , *L. niloticus* represented the lowest percentage to the total predatory insects in Mansoura and Talkha districts. Whereas in Meniet El-Nasr district, *D. urinator* was the lowest percentage.

During season of 2007, *Anisops* sp. was the most numerous species (44.02, 47.36, and 49.73%) followed by *R. elevatus* (19.55, 18.39, and 17.86%) followed by *M. plicata* (14.35, 12.89, and 10.99%) followed by *S. soleiri* (5.77, 5.24, and 5.77%) in Mansoura, Talkha and Meniet El-Nasr districts, respectively. Whereas, in Mansoura and Talkha districts *L. niloticus* was the lowest predator species.

2- Seasonal abundance of predators and their relationship with mosquitoes.

2.1. Heteropterous species:

A. *Micronecta plicata.*

Figure (1) revealed that *M. plicata* had two peaks in the fourth weeks of August and September during season of 2005 in Mansoura district. Whereas, in Talkha district, this predator listed four peaks in the first week of May, first week of June, second week of July and fourth week of August

(Figure 4). In Miniet El-Nasr district, the predator had also four peaks (Figure 7). Figures (2 and 5) show the seasonal abundance of *M. plicata* during season of 2006 in Mansoura and Talkha districts. The population of this predator was initially present in low numbers in the first week of May in Mansoura and Talkha districts, then the population increased gradually till the fourth week of June in Mansoura district and the second week of August in Talkha district. The population peaked again in the second week of August in Mansoura, third week of September in Talkha district. In Miniet El-Nasr district, this predator had three peaks in the third week of May, second week of July and second week of August (Figure 8). Figure (3) revealed that *M. plicata* had two peaks in the second week of August and first week of September during season of 2007 in Mansoura district. In Talkha district, *M. plicata* had four peaks in the third week of April, fourth weeks of May, July and August (Figure 6), but in Miniet El-Nasr district, the predator listed two peaks in the second week of July and second week of August (Figure 9). In Mansoura district, this predator showed a highly significant relationship with mosquito larvae and pupae ("r" = 0.9248, 0.9101, and 0.8867 durjng seasons of 2005, 2006, and 2007, respectively). In Talkha district, the predator showed a highly significant relationship with mosquito larvae and pupae in the three studied years ("r" = 0.8664, 0.7968, and 0.9267 during seasons of 2005, 2006, and 2007, respectively). In Miniet El-Nasr district, *M. plicata* showed also a highly significant relationship with mosquito larvae and pupae. (Tables 3, 4, and 5).

B. *Diplonychus urinator.*

During season of 2005, there were three peaks in Mansoura district (Figure 1). These peaks were recorded in the fourth week of June, fourth week of August and first week of November. In Talkha district, the populations listed also three peaks (Figure 4). In Miniet El-Nasr district, this predator had two peaks in the third week of April and fourth week of August (Figure 7). Data illustrated in Figure (2) in Mansoura district indicated that there were considerable changes in the average number of *D. urinator* populations. It could be noticed that the peak of this predator occurred during the first week of September during season of 2006. In Talkha district, the predator had four peaks in the second week of June, fourth week of July, fourth week of August and first week of November (Figure 5). Meanwhile in Miniet El-Nasr district, this predator listed five peaks as shown in Figure (8). During season of 2007, there were two peaks in Mansoura district (Figure 3). In Talkha district, the predator listed four peaks as shown in Figure (6). In Miniet El-Nasr district, *D. urinator* had four peaks in the third week of April, fourth week of June, second week of August and third week of October (Figure 9). This predator shows a highly significant positive correlation with mosquitoes in the first and second studied seasons in Mansoura district ("r" = 0.6083 and 0.6414) (Table 3). These findings generally are in agreement with those of Venkatesan and Jeyachandra (1985) in India, who mentioned that *Diplonychus indicus* Venkatesan & Rao. had potential as a control agent of larval populations of *Anopheles stephensi*. In addition, Das *et al.* (2006) reported that there was a highly significant correlation between *Culex vishnui* and the predator *Diplonychus indicus*.

Table 4: Correlation coefficient between mosquitoes and their predators during seasons of 2005, 2006 and 2007 in Talkha district.

Predators species	2005				2006				2007			
	r ± S.E	Slope (b) ± S.E	Y Int (a)	P	r ± S.E	Slope (b) ± S.E	Y Int (a)	P	r ± S.E	Slope (b) ± S.E	Y Int (a)	P
M. plicata	0.8664 ± 0.1019	0.0166 ± 0.0019	0.2588	0.0000 ***	0.7968 ± 0.1233	0.0132 ± 0.0020	0.5587	0.0000 ***	0.9267 ± 0.0767	0.0172 ± 0.0014	0.5594	0.0000 ***
D. urinator	0.8371 ± 0.1117	0.0049 ± 6.5427	0.2717	0.0000 ***	0.7347 ± 0.1385	0.0042 ± 7.9163	0.4013	0.0000 ***	0.8844 ± 0.0953	0.0050 ± 5.3860	0.3032	0.0000 ***
R. elevatus	0.8413 ± 0.1104	0.0255 ± 0.0033	0.8145	0.0000 ***	0.7666 ± 0.1311	0.0277 ± 0.0047	0.5069	0.0000 ***	0.8543 ± 0.1062	0.0318 ± 0.0039	0.0894	0.0000 ***
S. solieri	0.7723 ± 0.1297	0.0069 ± 0.0012	0.0445	0.0000 ***	0.5236 ± 0.1739	0.0047 ± 0.0016	0.5758	0.0060 **	0.8590 ± 0.1045	0.0081 ± 9.9133	0.0025	0.0000 ***
Anisops sp.	0.9289 ± 0.0756	0.0812 ± 0.0066	-2.3034	0.0000 ***	0.9747 ± 0.0456	0.0869 ± 0.0041	-0.0654	0.0000 ***	0.9777 ± 0.0429	0.0788 ± 0.0035	-0.9549	0.0000 ***
L. niloticus	0.8090 ± 0.1199	0.0042 ± 6.2550	-0.0445	0.0000 ***	0.7330 ± 0.1388	0.0042 ± 8.0323	0.0480	0.0000 ***	0.8703 ± 0.1005	0.0055 ± 6.3644	-0.0645	0.0000 ***
Odonata species	0.6481 ± 0.1554	0.0093 ± 0.0022	0.1197	0.0003 ***	0.7762 ± 0.1287	0.0106 ± 0.0018	0.4494	0.0000 ***	0.7104 ± 0.1437	0.0097 ± 0.0019	0.6627	0.0000 ***

Table 5. Correlation coefficient between mosquitoes and their predators during seasons of 2005, 2006 and 2007 in Miniet El-Nasr district.

Predators species	2005				2006				2007			
	r ± S.E	Slope (b) ± S.E	Y Int (a)	P	r ± S.E	Slope (b) ± S.E	Y Int (a)	P	r ± S.E	Slope (b) ± S.E	Y Int (a)	P
M. plicata	0.9156 ± 0.0821	0.0181 ± 0.0016	0.4014	0.0000 ***	0.9171 ± 0.0814	0.0183 ± 0.0016	0.0678	0.0000 ***	0.9219 ± 0.0791	0.0161 ± 0.0014	-0.1311	0.0000 ***
D. urinator	0.6455 ± 0.1559	0.0031 ± 7.4949	0.2472	0.0004 ***	0.6655 ± 0.1524	0.0039 ± 9.1463	0.1262	0.0002 ***	0.5358 ± 0.1724	0.0025 ± 7.9158	0.4113	0.0048 **
R. elevatus	0.8107 ± 0.1195	0.02935 ± 0.0043	0.8149	0.0000 ***	0.8268 ± 0.1148	0.0389 ± 0.00541	-0.0286	0.0000 ***	0.7661 ± 0.1312	0.0251 ± 0.0043	0.1808	0.0000 ***
S. solieri	0.7429 ± 0.1366	0.0082 ± 0.0015	0.2919	0.0000 ***	0.5815 ± 0.1661	0.0076 ± 0.0022	0.4277	0.0018 **	0.5348 ± 0.1725	0.0184 ± 0.0059	-0.7761	0.0049 **
Anisops sp.	0.9756 ± 0.0448	0.0777 ± 0.0036	-1.1527	0.0000 ***	0.9392 ± 0.0701	0.0883 ± 0.0066	-0.2605	0.0000 ***	0.9626 ± 0.0553	0.0717 ± 0.0041	0.1269	0.0000 ***
L. niloticus	0.8855 ± 0.0948	0.0060 ± 6.4269	-0.0070	0.0000 ***	0.8589 0.1045	0.0070 ± 8.5491	0.0325	0.0000 ***	0.6877 ± 0.1482	0.0043 ± 9.2766	0.0566	0.0001 ***
Odonata species	0.5647 ± 0.1685	0.0079 ± 0.0023	0.5002	0.0026 **	0.8292 ± 0.1141	0.0143 ± 0.0019	0.1378	0.0000 ***	0.7595 ± 0.1328	0.0113 ± 0.0019	0.4397	0.0000 ***

Table 2. Numbers and percentages of mosquito predators in Mansoura, Talkha, and Miniet El-Nasr districts during seasons of 2005, 2006 and 2007.

Districts / Insect predators	Mansoura						Talkha						Miniet El-Nasr					
	2005		2006		2007		2005		2006		2007		2005		2006		2007	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
A- Odonata species	51	7.10	62	9.27	66	9.28	54	6.78	61	8.14	65	8.30	51	6.93	70	8.66	68	9.34
B-Order: Heteroptera																		
1- *M. plicata*	85	11.84	71	10.61	102	14.35	98	12.29	76	10.15	101	12.89	95	12.91	83	10.27	80	10.99
2- *D. urinator*	34	4.74	32	4.78	29	4.08	37	4.64	30	4.01	33	4.21	21	2.85	21	2.59	23	3.16
3- *L. Niloticus*	28	3.89	22	3.29	21	2.95	22	2.46	20	2.67	28	3.58	29	3.94	32	3.96	23	3.16
4- Anisops sp	329	45.82	311	46.49	313	44.02	386	48.43	403	53.81	371	47.38	335	45.52	385	47.65	362	49.73
C- Order: Coleoptera																		
1- *R. elevatus*	153	21.31	133	19.88	139	19.55	161	20.20	122	16.29	144	18.39	159	21.60	170	21.04	130	17.86
2- *S. solieri*	38	5.29	38	5.68	41	5.77	39	4.89	37	4.94	41	5.24	46	6.25	47	5.82	42	5.77
Total	718	100	669	100	711	100	797	100	749	100	783	100	736	100	808	100	728	100

Table 3. Correlation coefficient between mosquitoes and their predators during seasons of 2005, 2006 and 2007 in Mansoura district.

Predators species	2005				2006				2007			
	r ± S.E	Slope (b) ± S.E	Y Int (a)	P	r ± S.E	Slope (b) ± S.E	Y Int (a)	P	r ± S.E	Slope (b) ± S.E	Y Int (a)	P
M. plicata	0.9248 ± 0.0777	0.0153 ± 0.0012	-0.1419	0.0000 ***	0.9101 ± 0.0846	0.0143 ± 0.0013	-0.1148	0.0000 ***	0.8867 ± 0.0944	0.0182 ± 0.0019	0.1298	0.0000 ***
D. urinator	0.6083 ± 0.1620	0.0032 ± 8.4405	0.6004	0.0010 ***	0.6414 ± 0.1566	0.0037 ± 8.9675	0.4976	0.0004 ***	0.5678 ± 0.1680	0.0033 ± 9.8759	0.4209	0.0025 **
R. elevatus	0.9425 ± 0.06824	0.0283 ± 0.0020	-0.4309	0.0000 ***	0.9078 ± 0.0856	0.0313 ± 0.0029	-1.1256	0.0000 ***	0.9302 ± 0.0749	0.0254 ± 0.0020	0.0534	0.0000 ***
S. solieri	0.8108 ± 0.1195	0.0068 ± 9.956	-0.0465	0.0000 ***	0.7964 ± 0.1234	0.0082 ± 0.0013	-0.1793	0.0000 ***	0.9327 ± 0.0736	0.0093 ± 7.3616	-0.3645	0.0000 ***
Anisops sp.	0.8933 ± 0.0918	0.0715 ± 0.0073	-3.2932	0.0000 ***	0.9190 ± 0.0805	0.0776 ± 0.0068	-3.5236	0.0000 ***	0.9394 ± 0.0699	0.0685 ± 0.0051	-2.2276	0.0000 ***
L. niloticus	0.5572 ± 0.1695	0.0031 ± 9.4956	0.3801	0.0031 **	0.6062 ± 0.1623	0.0031 ± 8.3331	0.2250	0.0010 **	0.8548 ± 0.1059	0.0038 ± 4.7344	0.0126	0.0000 ***
Odonata species	0.7379 ± 0.1378	0.0092 ± 0.0017	-0.0998	0.0000 ***	0.8215 ± 0.1164	0.0112 ± 0.0016	0.1395	0.0000 ***	0.8418 ± 0.1102	0.0112 ± 0.0015	0.1632	0.0000 ***

These findings generally are in agreement with the findings of Shaalan *et al.* (2007) in Australia, who pointed out that adult of *Diplonychus* sp. preyed upon both larval and pupal stages of *Culex annulirostris* quite successfully. Nymphs of *Diplonychus* sp. proved to be more successful with smaller prey immatures. The predator showed a significant correlation with the mosquitoes during season of 2007. In Talkha district, the predator shows a highly significant relationship with mosquitoes larvae and pupae in the first, second, and third of studied years (Table 4). In Miniet El-Nasr district, the predator showed a highly significant relationship in seasons of 2005 and 2006 ("r" = 0.6455 and 0.6655). In addition in season of 2007, the predator showed a significant relationship with mosquitoes ("r" = 0.5358) (Table 5).

C. *Anisops* sp.

Regarding to the population density of *Anisops* sp. in season of 2005, the population of the predator peaked at the fourth week of July and fourth week of August in Mansoura district (Figure 1), then the population decreased gradually until the end of the season. But in Talkha district, the predator populations had three peaks in the fourth week of March, second week of July and second week of August (Figure 4). But in Miniet El-Nasr district, the populations increased gradually till the second week of July to reach its peak (Figure 7). Figure (2) shows the seasonal abundance of *Anisops* sp in Mansoura district during season of 2006. The population of this predator was initially present in low numbers in the second week of May, then the population increased gradually till the second week of August. The predator listed one peak in the second week of July in Talkha district (Figure 5), but in Miniet El-Nasr district, *Anisops* sp had two peaks in the first week of May and second week of July (Figure 8). Data in Figure (3) indicated that *Anisops* sp had one peak in the second week of August in Mansoura district during season of 2007. In addition, this predator had one peak in the fourth week of July in Talkha district (Figure 6), but in Miniet El-Nasr, this peak listed in the second week of July (Figure 9). Similar results were reported by Tawfik *et al.* (1986a) in Egypt, who mentioned that the notonectid, *Anisops sardea* H.S. an active mosquito predator. Data in Tables (3, 4, and 5) indicate that the correlation between *Anisops* sp. and mosquitoes was a highly significant positive effect on the preys during the studied seasons in Mansoura, Talkha, and Miniet El-Nasr districts. These results are in agreement with the findings of Ouda *et al.* (1986) in Iraq, who revealed that the notonectid, *Anisops sardea* was the most effective predator because of its long active period, field population density and feeding habits (largely on mosquitoes) and therefore appeared most promising as a possible biological control agent. Dhiman *et al.* (2004) in India, also found that the number of larvae consumed (*Anopheles stephensi* Liston and *Culex quinquefasciatus* Say) was positively correlated with the developmental stage of the bug, *Anisops sardae*.

D. *Lethocerus niloticus*.

In season of 2005, *L. niloticus* had two peaks in the third week of June and fourth week of July in Mansoura district (Figure 1). In Talkha district, the predator had three peaks in the third week of June, fourth week of July and fourth week of August (Figure 4). In Miniet El-Nasr district, *L. niloticus* listed three peaks as shown in Figure (7). Figure (2) shows the

population of *L. niloticus* during season of 2006 in Mansoura district. *Lethocerus niloticus* was initially present in the beginning of study (third week of April) in a low numbers, then the population increased gradually till the second week of June. In Talkha district, the predator listed three peaks in the fourth week of May, second week of July and fourth week of August (Figure 5). In Miniet El-Nasr district, this predator recorded three peaks as shown in Figure (8). During season of 2007, there were three peaks in Mansoura district (Figure 3). These peaks were recorded in the fourth week of May, second week of July and first week of September. In Talkha and Miniet El-Nasr districts, *L. niloticus* recorded three peaks (Figures 6 and 9). As shown in Table (3), *L. niloticus*, showed a significant relationship with the population of mosquitoes in the first and second studied years. But in the third studied year, the predator showed a highly significant relationship with the population of mosquito larvae and pupae in Mansoura district. In Talkha district, the predator showed a highly positive correlation with the population of mosquitoes ("r" = 0.8090, 0.7330) (Table 4). Whereas in Miniet El-Nasr district, *L. niloticus* showed a highly positive significant relationship with mosquitoes in the first, second, and third studied years (Table 5)

2.2. Coleopterous species:

A. Rhantus elevatus.

In the year of 2005, *R. elevatus* began to appear in small numbers in the beginning of study in the three studied districts, then the population increased gradually until the fourth week of July to reach its first peak in Mansoura and Miniet El-Nasr districts. The second peak was in the fourth week of August in Mansoura district (Figures 1 and 7). But in Talkha district, the predator showed three peaks in the first week of June, fourth week of July and fourth week of August (Figure 4). The relative abundance of *R. elevatus* listed one peak during season of 2006 in Mansoura district (Figure 2). This peak showed during the second week of August. This predator also listed one peak in the fourth week of July in Miniet El-Nasr district (Figure 8), but in Talkha district, it had two peaks in the fourth week of June and the great peak in the second week of August (Figure 5). *Rhantus elevatus* began to appear in a small numbers in the beginning of season of 2007, and then increased gradually until the fourth week of July. The population decreased gradually till the end of season in Mansoura district (Figure 3). In Talkha and Miniet El-Nasr districts, the predator listed three peaks as shown in Figures (6 and 9). Data presented in Tables (3, 4, and 5) indicated that the relationship between the predator population and the mosquito larvae and pupae was a highly positive correlation in all districts in the studied years. These results agree with the works of Valentyuk and Kovalyukh (1977) in USSR, who found that *Rhantus pulverosus* (Steph.) as a biological control agent against larvae of blood-sucking mosquitoes *Aedes cantans* (Mg.), *A. vexans* (Mg.), *Culex pipiens* L. and *C. territans* Wlk. Ouda *et al.* (1986) in Iraq, also recorded that adults of dytiscid, *Rhantus suturellus* Harris had the highest daily mosquito killing rate. Moreover, Campos *et al.* (2004) in Argentina, noted that *R. signatus signatus* Fabricius, *Lancetes marginatus* (Steinheil) (Coleoptera: Dytiscidae) were more associated with the pupal stage of mosquitoes.

B. Sternolophus solieri.

There were three peaks for this predator during season of 2005 in Mansoura district (Figure 1). The first peak occurred during the first week of June, then the second peak occurred in the second week of July and the third peak in the second week of August. In Talkha district, this predator had three peaks as shown in Figure (4). In Miniet El-Nasr district, the predator recorded two peaks in the fourth week of August and first week of May (Figure 7). In season of 2006, *S. solieri* had four peaks in the second week of July, second week of August, first week of September and first week of November in Mansoura district (Figure 2). In Talkha district, the predator listed two peaks as shown in Figure (5). But in Miniet El-Nasr district, the predator had three peaks in the fourth week of June, second week of August and first week of October (Figure 8). Figure (3) shows the counts of *S. solieri* during season of 2007 in Mansoura district. *Sternolophus solieri* was initially present in the beginning of study (the second week of June) in low numbers, then the population increased gradually till the second week of July to reach the first peak but the second peak listed in the first week of September. In Talkha district, the predator peaked in the fourth week of July, first week of September and third week of October (Figure 6). In Miniet El-Nasr district, the predator listed one peak as shown in Figure (9). In Mansoura district, the predator shows a highly significant positive relationship with mosquitoes in the first, second and third studied years (Table 3). However, in Talkha district, this predator showed a highly positive significant relationship in the first and third studied years.But in the second season, the predator showed a significant relationship with mosquitoes larvae and pupae (Table 4). In Miniet El-Nasr district, the predator showed a highly significant relationship only in the first year. But in the second and third years, the predator showed a significant relationship with mosquitoes ("r" = 0.5815 and 0.5348 in seasons of 2006 and 2007, respectively) (Table 5).

2.3. Odonata species:

From the data in season of 2005, the population of Odonata species listed three peaks in the first week of June, reached their maximum numbers in the second week of August and peaked in the first week of October in Mansoura district (Figure 1). In Talkha district, the predators listed four peaks as shown in Figure (4). But in Miniet El-Nasr district, Odonata species peaked in the second week of August, first week of September and third week of October (Figure 7). In season of 2006, Odonata species began to appear in the third week of May then peaked in the fourth week of May. In addition, this predator had another three peaks in the second week of July, fourth week of August and third week of September in Mansoura district. After that, the population decreased gradually till the end of the season (Figure 2). In Talkha district, the predators listed four peaks in the fourth week of May, July, August and third week of September (Figure 5). These predators listed two peaks as shown in Figure (8) in Miniet El-Nasr district. From Figure (3), it can be noticed that the population of Odonata species increased gradually and reached first peak in the second week of August. The maximum peak was occurred in the third week of September in season of 2007 in Mansoura district. Moreover, in Talkha district, the predators had two peaks (Figure 6).

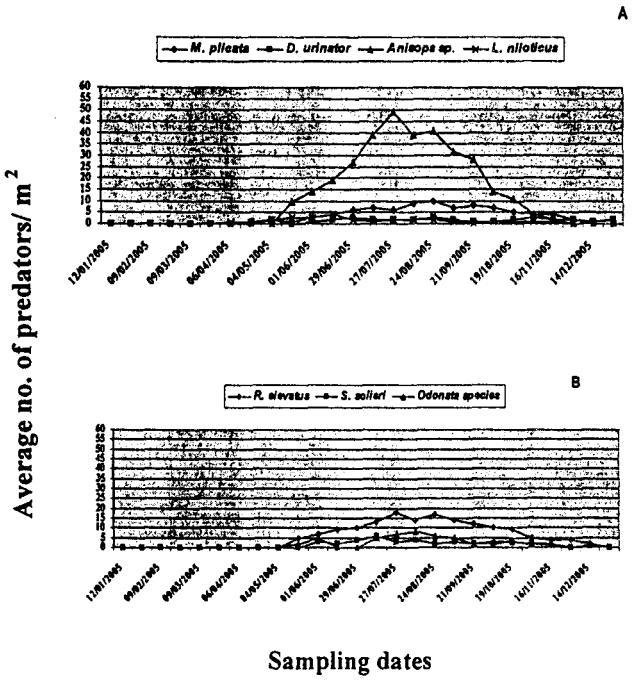

Fig. 1: The relative abundance of mosquito predators in Mansoura district during season of 2005 (A- Heteropterous predators, B- Coleopterous and Odonata predators).

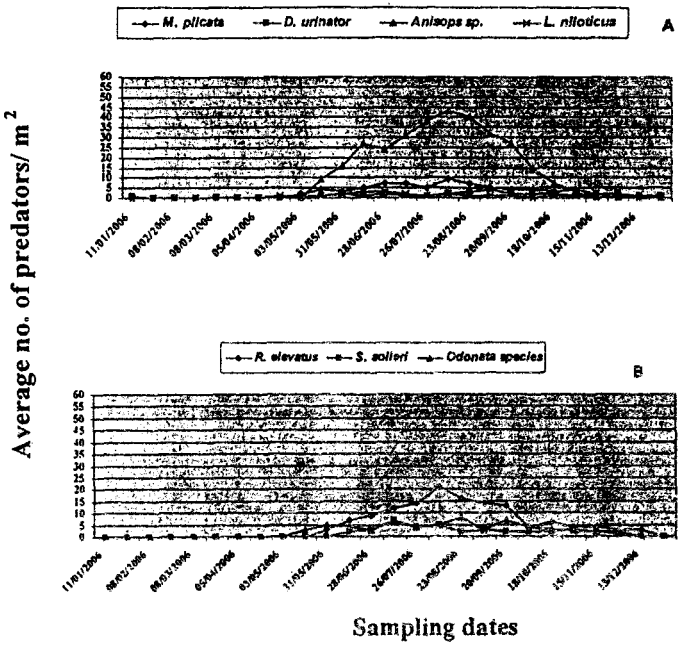

Fig. 2: The relative abundance of mosquito predators in Mansoura district during season of 2006 (A- Heteropterous predators, B- Coleopterous and Odonata predators).

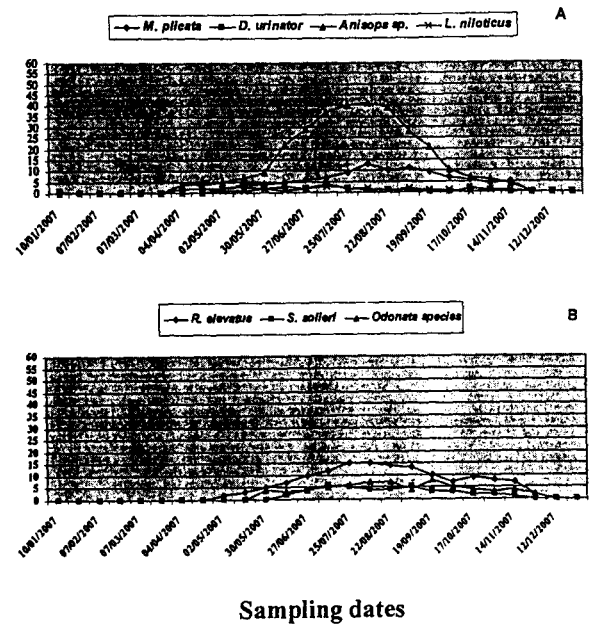

Fig. 3: The relative abundance of mosquito predators in Mansoura district during season of 2007 (A- Heteropterous predators, B- Coleopterous and Odonata predators).

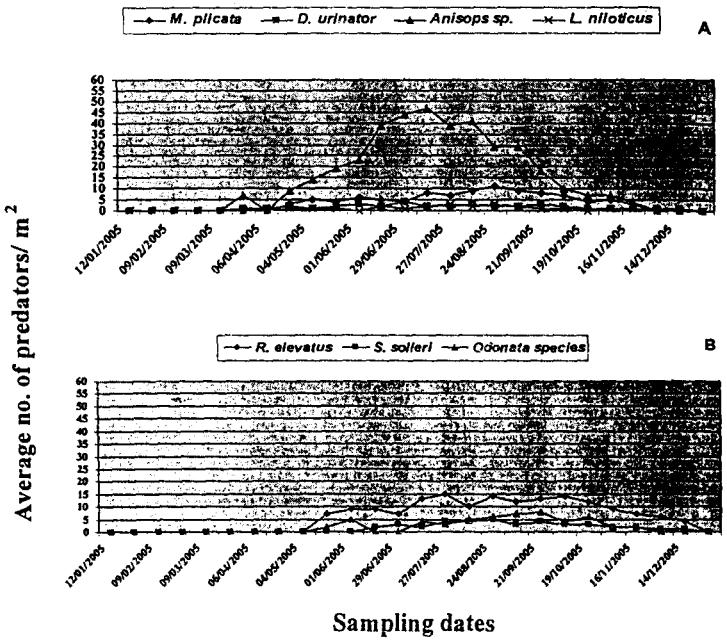

Fig. 4: The relative abundance of mosquito predators in Talkha district during season of 2005 (A- Heteropterous predators, B- Coleopterous and Odonata predators).

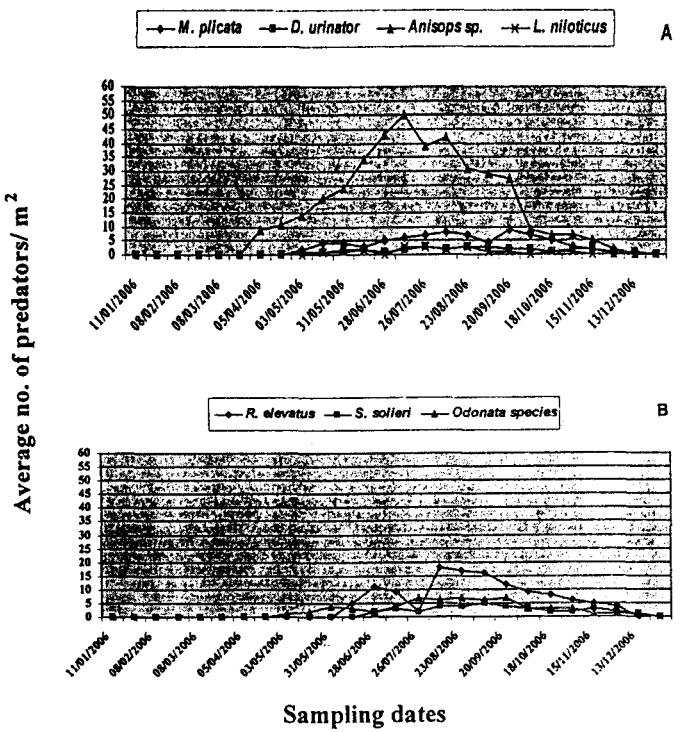

Fig. 5: The relative abundance of mosquito predators in Talkha district during season of 2006 (A- Heteropterous predators, B- Coleopterous and Odonata predators).

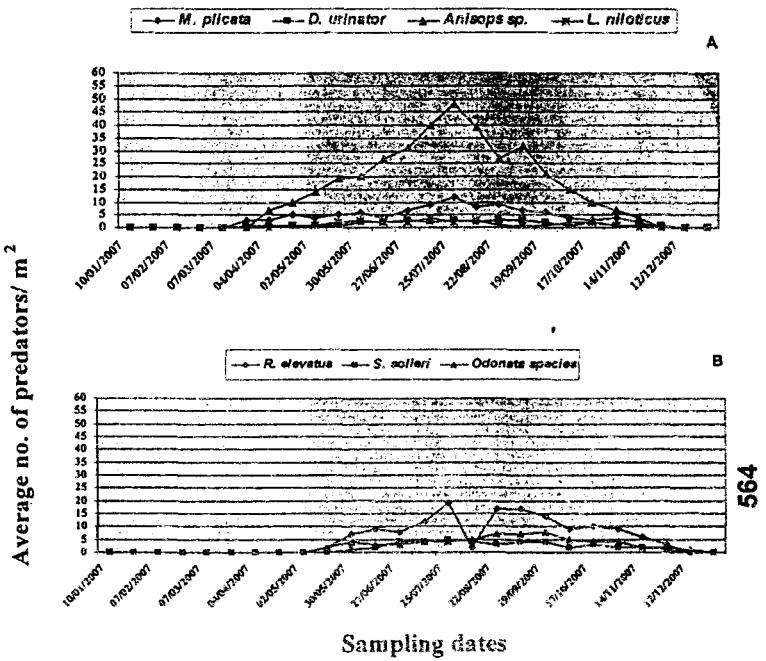

Fig. 6: The relative abundance of mosquito predators in Talkha district during season of 2007 (A- Heteropterous predators, B- Coleopterous and Odonata predators).

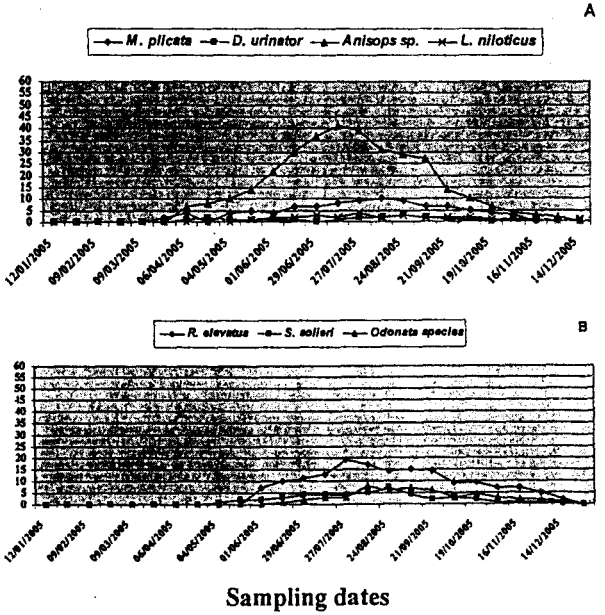

Fig. 7: The relative abundance of mosquito predators in Miniet El-Nasr district during season of 2005 (A-Heteropterous predators, B- Coleopterous and Odonata predators).

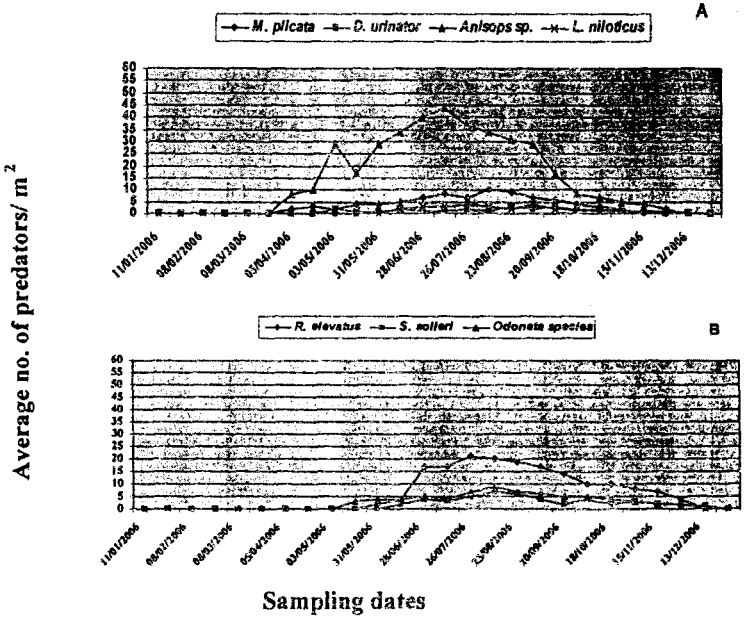

Fig. 8: The relative abundance of mosquito predators in Miniet El-Nasr district during season of 2006 (A-Heteropterous predators, B- Coleopterous and Odonata predators).

In Miniet El-Nasr district, Odonata species listed three peaks (Figure 9). Data in Table (3) showed a positive highly significant relationship between the population of predators and the mosquitoes in all studied years in Mansoura district. In Talkha district, these predators showed also a highly significant relationship with mosquito larvae and pupae in years of 2005, 2006, and 2007 (Table 4). In Miniet El-Nasr district, the predators showed a highly significant relationship in years of 2006 and 2007. Meanwhile in year of 2005, the predator showed a significant relationship with mosquito larvae and pupae (Table 5). These results are in agreement with the findings of Medrano (1993) in the USA, who revealed that *Anax junius* (Aeshnidae) is a predator of freshwater mosquitoes. In addition, Singh *et al.* (2003) in India, found that dragonfly nymphs have good predatory potential and can be used as a biological control agent for control of mosquito breeding. Mandal *et al.* (2008) in India, evaluated predatory efficiency of the nymphs of five coexisting Odonata species *Aeshna flavifrons* Lichtenstein (Aeshnidae), *Coenagrion kashmirum* Chowdhary & Das (Coenagrionidae), *Ischnura forcipata* Morton (Coenagrionidae), *Rhinocypha ignipennis* Selys (Chlorocyphidae) and *Sympetrum durum* Bartenef (Libelluloidea) using the fourth instar larvae of *Culex quinquefasciatus* as a prey. The results suggested the use of Odonata nymphs in temporary pools or larger habitats where they can be a potential biological resource in regulating the larval population of the vector and pest mosquitoes.

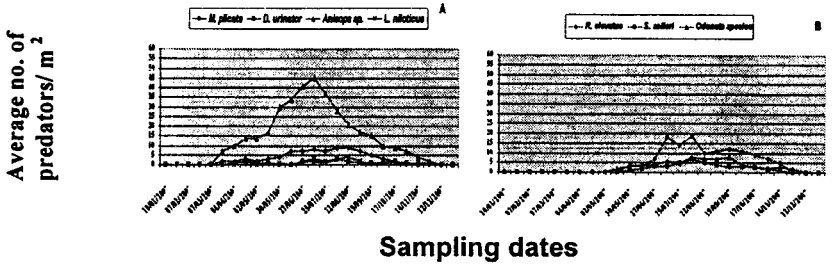

Fig. 9: The relative abundance of mosquito predators in Miniet El-Nasr district during season of 2007 (A- Heteropterous predators, B- Coleopterous and Odonata predators).

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المفترسات الحشرية المرتبطة بالبعوض ووفرتها الموسمية بمحافظة الدقهلية.

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تم عمل حصر للمفترسات المرتبطة بالبعوض فى محافظة الدقهلية بثلاث مناطق هى المنصورة ، طلخا و منية النصر خلال الفترة من يناير ٢٠٠٥ وحتى ديسمبر ٢٠٠٧. أوضحت النتائج أن المفترسات المرتبطة بالبعوض تنتمى الى ١٠ أنواع تتبع ثلاث رتب مختلفة هى رتبة الرعاشات ونصفية الأجنحة وغمدية الأجنحة.

كما أظهرت النتائج أن أكثر المفترسات تواجدا خلال عام ٢٠٠٥ هو المفترس *Anisops* sp حيث سجل أعلى تعداد له فى منطقة طلخا (٤٨,٤٣%) ، ثم المفترس *Rhantus elevaus* وكانت نسب تواجده متشابهة تقريبا فى مناطق الدراسة الثلاثة ، أما المفترس *Micronecta plicata* كان هو التالى فى التعداد حيث سجل أعلى تعداد له فى منطقة منية النصر (١٢,٩١%) . المفترس *Lethocerus niloticus* كان أقل المفترسات توجدا فى منطقتى المنصورة وطلخا ، أما فى منطقة منية النصر فكان أقل المفترسات توجدا هو *Diplonychs urinator*..

أما فى عام ٢٠٠٦ كذلك كان المفترس .*Anisops* sp أكثر المفترسات تواجدا فى مناطق الدراسة الثلاث ثم يليه المفترس *R. elevatus* أما البقة النيلية الكبيرة فكانت أقل المفترسات تواجدا فى منطقتى المنصورة وطلخا ، أما فى منية النصر فكان المفترس *D. urinator* هو الأقل تواجدا.

خلال عام ٢٠٠٧ كان المفترس .*Anisops* sp هو الأكثر تعدادا ثم يليه *R. elevatus* ثم يليه *M. plicata* ثم يليه المفترس *Sternolophus soleiri* فى مناطق المنصورة وطلخا ومنية النصر وكان أقل المفترسات تواجدا فى المنصورة وطلخا هو البقة النيلية الكبيرة أما فى منطقة منية النصر فتساوى كلا من البقة النيلية الكبيرة و *D. urinator* فى التعداد.