

SPECIES DIVERSITY AND SEASONAL ABUNDANCE OF CERTAIN AQUATIC ARTHROPODS SURVEYED FROM SOME PONDS LOCATED AT THE EL-GHORIEB AREA ASSIUT, EGYPT.

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ABSTRACT

The current study focused on certain aquatic arthropods extracted from some ponds located at El-Ghorieb area during two years starting from March, 2011. In the present study, twenty species of aquatic arthropods pertaining to six orders (i.e., Diptera, Hemiptera, Coleoptera, Odonata, Cladocera and Acari) were recorded from some water pools. All the aquatic species increase to enumerate through the spring season and the least numbers were recorded during winter. Autumn and summer were in between. The occurrence percentage of each species inside its own order was also calculated. The study showed that the highest proportion of mosquito species with an average ratio of 62.29 and the least was with Odonata with an average of 3.6.

Keywords: Aquatic arthropods, species diversity, seasonal abundance, El-Ghorieb ponds.

INTRODUCTION

Aquatic arthropods play an important role in the food chain and public health in environment. This group of animals include at least 12 orders of insects and others (i.e., Araneae, Acari, Crustaceae). Yet, the large groups of water arthropods are the aquatic insects, of these, 12000 species were counted worldwide, the larval stages of these species are fully aquatic, while adults in many species are terrestrial, or at least air-breathing. The aquatic insects include: the dragonflies (Odonata); Caddisflies (Trichoptera); stoneflies (Plecoptera); beetles (Coleoptera); bugs (Hemiptera), flies and mosquitoes (Diptera) and mayflies (Ephemeroptera). The scarce numbers of mites and spiders are principally occurred on the water surface (Smith, B.P. 1983, Merritt and Cummins, 1996, and Richardson, 2008).

Aquatic insects are the most diverse arthropod groups occurred almost in every type of aquatic habitat throughout the world including, lakes, highly saline pools, phytotelmata, coastal waters and estuaries, acid peat swamps, groundwater, hot springs and even pools of crude oil seeping from the ground (Yule and Yong, 2004). On the other side, some of insect species, especially the adults of order Diptera are of medical importance such as: mosquitoes and houseflies are the major vectors of a wide range of diseases of human and other animals. Certain aquatic insects are predators either in their larval stages (some stone flies), larval and adult stages (some beetles and dragonflies) and in nymphal and adult stages (some bugs) (Adity *et al.*, 2005; Spangler and Steiner, 2005 and Richardson, 2008).

Mosquitoes are the most important participants in the aquatic arthropods complex in Assiut area (Farghal, 1974, 1979 and Abo El-Maged,

2009). The second, important participants in the aquatic arthropods complex is the aquatic natural enemies. The role in the ecological food chain is well recognized by certain aquatic ecologists (Rueda, 2008 and Scudder *et al.*, 2010).

The population density of aquatic mosquitoes are closely related to the numerical density of their natural enemies, but the intensity of predators and their significance are vary greatly among habitat types. The mosquito larvae are also habitats diverse (Su and Mulla, 2002).

Numerous species of mosquitoes predators were recorded from different pool habitats. Moreover, the aquatic arthropods play an important role not only in the trophic dynamic of ecosystem but also in the indication of the changes of the quality of water as a result of pollution or degradation because of their high sense ability to such changes (Deepa and Rao, 2007). This study was carried out with the following topics firstly to survey and identify diversity of aquatic arthropods in some pools of El-Ghorieb area, secondly to study the population density of those species during the two years of study, and thirdly to estimate the percentage of occurrence of each species inside its own order.

MATERIALS AND METHODS

The present work was carried out to study the species composition of some aquatic arthropods (i.e., Mosquitoes, beetles, bugs, dragon flies, water fleas and water mites), in addition to study of the population density of the aquatic arthropod species in El-Ghorieb area during two years starting from March, 2011. The experimental sites chosen for the present study are rather mosaic agro-ecosystem that have been planted with vegetables, field crops and orchards. The selected 12 ponds for the present study are completely free of aquatic plants and algae and far from and organic materials. Samples of ten dips were taken fortnightly through two years starting from March, 2011.

The collected materials were taken from the water pool by using enamel ladle (10 cm in diameter), wide enamel plate, labeled bottle and jar containing normal water in addition to test tubes (containing formalin) and small droppers in accordance with the known method previously recommended by WHO (1975).

Samples were transferred to the laboratory to for identification using certain taxonomical keys illustrated by Mogi *et al.* (1999); Impoinvil *et al.* (2007) and Saba (2008). The number of each species of the aquatic arthropods was recorded in each sample.

The monthly of seasonal abundance of each species during the two studied years was also possible.

Statistical analysis: Data obtained were statistically analyses by using applying linear model (F-test) of MSTATC statistical package software (Anonymous, 1988). Means were compared according to the least significant difference (LSD) with 5% probability (Steel and Torrie, 1984). Figures were illustrated by using the graphic prism software 5 Microsoft Office Excel 2007 programs.

RESULTS AND DISCUSSION

Monthly and seasonal abundance of some aquatic arthropod species inhabiting water pools, El-Ghorieb area, Assiut Governorate during the two studied years starting in March 2011:

Data in Table (1, 2) show the monthly and seasonal abundance of aquatic mosquitoes and their predators (Avg. no. individuals/10 dips) throughout two years. The highest densities of aquatic mosquitoes were recorded in April of both years (1291 and 1505 individuals/10 dips) and the lowest ones were recorded in January of the first year (105 individuals) and in February of the second year (103 individuals). It might be observed that spring season exhibited the highest population of aquatic mosquitoes, while winter season seemed to be unfavorable as recorded the lowest population. On the other side, all aquatic predator species gave the same trends as recorded more numbers in the spring season, whereas winter season seemed to be less suitable for these predators' activities except for water mites, where scored less census during the summer season of both years.

Table (1): Seasonal abundance of certain aquatic arthropods (Avg. no. ind./10 dips), in El-Ghorieb area during the period starting from March, 2011 to February, 2012 .

Season	Month	Aquatic arthropods (Avg. no. ind./10 dips)					
		Aquatic Mosq.	Aquatic bug.	Aquatic beetles	Dragon-flies	Water fleas	Aquatic mites
Spring	March	1199	246	132	42	90	125
	April	1291	189	169	45	370	350
	May	1485	230	158	30	292	210
	Mean	1325	222	153	39	251	228
Summer	June	1016	169	183	49	180	13
	July	910	85	35	11	81	7
	August	215	102	177	28	3	2
	Mean	547	119	98	29	88	7
Autumn	Sept.	945	84	74	6	106	23
	Oct.	1115	109	74	23	150	51
	Nov.	127	165	148	41	80	51
	Mean	729	119	98	23	112	42
Winter	Dec.	420	103	53	34	36	69
	Jan.	105	79	28	8	30	58
	Feb.	289	86	30	3	16	93
	Mean	271	89	37	15	27	73
L.S.D 0.05 for seasons		22.39	19.39	23.08	2.02	1.97	0.99
L.S.D 0.05 for month		19.38	16.79	19.99	1.74	1.71	0.85
L.S.D 0.05for interaction		38.77	33.58	39.97	3.49	3.42	1.71

Table (2): Seasonal abundance of certain aquatic arthropods (Avg. no. ind./10 dips), in El-Ghorieb area during the period from March, 2012 to February, 2013 .

Season	Month	Aquatic arthropods (Avg. no. ind./10 dips)					
		Aquatic Mosq.	Aquatic bug.	Aquatic beetles	Dragon-flies	Water fleas	Aquatic mites
Spring	March	1319	265	152	36	166	195
	April	1501	275	186	19	321	294
	May	1346	193	154	25	579	122
	Mean	1390	244	164	27	355	204
Summer	June	1089	166	199	55	102	13
	July	375	115	98	34	107	22
	August	310	99	43	7	24	56
	Mean	691	126	113	32	68	30
Autumn	Sept.	792	101	53	15	119	106
	Oct.	986	116	89	11	98	72
	Nov.	1353	235	101	21	112	89
	Mean	1044	150	81	16	110	89
Winter	Dec.	927	68	26	4	80	43
	Jan.	743	73	31	3	15	86
	Feb.	778	32	28	6	15	81
	Mean	816	57	281	4	37	7
L.S.D 0.05for seasons		15.412	9.87	9.87	1.97	9.87	4.83
L.S.D 0.05for month		13.347	8.54	8.54	1.07	8.54	4.19
L.S.D 0.05f or interaction		26.695	17.09	17.09	3.41	17.09	8.37

Occurrence percentages of aquatic insect predators, crustacean and mite species:

Data in Table (3) represent the result of identified aquatic arthropods extracted from water pools, in El-Ghorieb village, Assiut Governorate, during 2011 to 2013. Five species of mosquitoes pertaining to three genera of a single family (Culicidae) (viz., *Culex pipiens*, *C. antennatus*, *C. univittatus*, *Culiseta* sp. and *Aedes* sp.), ten species of aquatic insect predators belonging to four orders and 9 genera were recorded. Order Coleoptera was represented by three species (*Cybister fimbriolatus*, *Cybister* sp. and *Dytiscus* sp.); Hemiptera (*Abedus ovatus*, *Belostoma* sp., *Lethocems* sp., *Sigara* sp. and *Gerris* sp.) and Odonata (*Agrion* sp. and *Cordulia* sp.). In addition, to three species of water fleas (*Bosmina* sp., *Acroperus* sp. and *Alona* sp.) and two species of water mites (*Arrenaras* sp. and *Hydrzetes* sp.).

The percentages of occurrence of each species within its own order showed that, the individuals of *Culex pipiens* represented 63.94% and 61.09%, respectively of the total of individuals of the other species occurred in water ponds of El-Ghorieb village during 2011 and 2013 seasons.

Most of the forementioned mosquitoes and aquatic arthropod predators were also surveyed by certain authors (Farghal, 1974 and 1979 and Abo El-Maged, 2009) in Assiut area, recorded six species of the *Culicine mosquitoes*

(*C. pipiens*, *C. antennatus*, *C. univittatus*, *C. theleri*, *A. caspius* and *Culisetae longiareolate*); three species of aquatic beetles (*Cybister fimbriolatus*, *Cybister* sp. and *Dytiscus onrinalis*); two dragonflies and damselflies (*Agrion* sp. and *Godulia* sp.); five species of aquatic bugs (*Abedus ovatus*, *Betostoma* sp., *Lethems* sp., *Sigara* sp. and *Gerris* sp.); two species of water mites, (*Arena* sp. and *Hydrozetes* sp.); three species of water fleas (*Bormia* sp., *aceopetes* sp. and *Alona* sp.), in addition to species of aquatic arthropods. While, Morsy *et al.* (2003) surveyed 5 species of mosquitoes in Greater Cairo, Egypt (*C. pipiens*, *C. pusillus*, *C. perexigus*, *Culiseta longiareolata* and *Aedes capsius*).

The study of mosquito species and associated aquatic predators were received the collectable of many authors around the world.

Simth and Cook (1991), in North American, Fisher and Schweigmann(2004,2008) in Argentina, Spangler and Steiner (2005) in Venezuela, Deepa and Roa (2007) in India, Braford *et al.* (2008) in USA and Others.

Table (3): Occurrence percentages (%) for each surveyed species of aquatic arthropod in relation to its own order during the two year of study.

Order	Species	Occurrence (%)		Total(%)		Means
		2011/2012	2012/2013	2011/2012	2012/2013	
Diptera	<i>Culex pipiens</i>	63.94	79.77			62.29
	<i>C. antennatus</i>	12.45	8.2			
	<i>C. univittatus</i>	9.96	8.98	63.49	61.09	
	<i>Culiseta</i> sp.	8.36	5.48			
	<i>Aedes</i> sp.	5.29	2.57			
Hemiptera	<i>Abedus oratus</i>	25.38	35.73			10.95
	<i>Belostoma</i> sp.	18.82	20.25			
	<i>Lethocerus</i> sp.	13.66	14.10	10.72	11.18	
	<i>Sigara</i> sp.	23.44	17.55			
	<i>Gerris</i> sp.	18.70	12.37			
Coeloptera	<i>Cybister fimbriolatus</i>	62.21	69.05			7.50
	<i>Cybister</i> sp.	10.61	12.16	7.54	7.46	
	<i>Dytiscum originalis</i>	27.81	18.79			
Odonata	<i>Agrion</i> sp.	66.56	58.74			3.60
	<i>Cordulia</i> sp.	33.44	41.53	2.08	1.52	
Crustacea	<i>Bosmino</i> sp.	41.28	39.65			10.25
	<i>Acroperus</i> sp.	36.06	33.14	9.33	11.17	
	<i>Alona</i> sp.	22.66	27.21			
Acari	<i>Arrenurus</i> sp.	66.08	74.64			7.21
	<i>Hydrozetes</i> sp.	33.94	25.36	6.84	7.58	

The correlation coefficient (r) between aquatic stages of mosquitoes versus their aquatic predators are summarized in Table (4).

Statistical analysis of data showed no significant correlations (0.013, 0.0231, 0.262, 0.321, 0.081) between the average numbers of aquatic mosquitoes versus the mean numbers of their aquatic arthropods (bugs, beetles, dragonflies, waterfleas and water mites) in the first year. In the second year, highly significant correlation with aquatic bug (0.968), positive significant was recorded with aquatic beetles, aquatic fleas, aquatic mites (0.870, 0.721 and 0.846) respectively. While no significant correlation was recorded with Odonata.

Table (4): Simple correlation coefficient (r) between aquatic stages of mosquitoes versus their aquatic arthropods (insects, crustaceae and mites).

No.	Species	1	2	3	4	5	6
2011/2012							
1	Aquatic mosquito	-	-	-	-	-	-
2	Aquatic bugs	0.013	-	-	-	-	-
3	Aquatic beetles	0.0231	0.9774**	-	-	-	-
4	Odonata	0.262	0.905*	0.923*	-	-	-
5	Aquatic flies	0.321	0.805	0.875*	0.636	-	-
6	Aquatic mites	0.081	0.998**	0.868**	0.924*	0.820	-
2012/2013							
1	Aquatic mosquito	-	-	-	-	-	-
2	Aquatic bugs	0.968**	-	-	-	-	-
3	Aquatic beetles	0.870*	0.931*	-	-	-	-
4	Odonata	0.623	0.642	0.858*	-	-	-
5	Aquatic fleas	0.721*	0.820	0.633	0.147	-	-
6	Aquatic mites	0.846*	0.946**	0.858*	0.474	0.940**	-

In general, mosquito populations are regulated by certain factors including adverse conditions, shortage of food supply, aquatic parasites, and predators (Service, 1973 and Shaalan et.al.2006). However, interaction of factors such as nutrition habitat dehydration, physical features and social interactions influence the distribution and aggregation patterns of mosquito habitats (Impoinvil *et al.*, 2007).

The most aquatic insects associated with immature stages of mosquito are belonged to the orders: Coleoptera, Hemiptera, Odonata and Diptera in addition to Crustacea and Acari. Fisher and Schweigmann (2008) found six mosquito species associated with 23 insect predators in temporary rain pools in Argentina. Similar investigation was recorded by many authors in Egypt (Morsy *et al.*, 2003 and Abo El-Maged, 2009) who recorded that the most aquatic insects associated with immature stages of mosquito are belong

to orders: Odonata, Hemiptera, Coleoptera and Diptera. Generalist predators that feed on a broad range of prey species are polyphagous, while specialists predatory are oligophagous. Although most predators of mosquitoes tend to be generalists. In the present study the most important aquatic predators recorded in association with mosquito immature stages were aquatic beetles (Dytiscidae), aquatic bugs (Belostomatidae, Corixidae and Gerridae), dragonflies and mayflies (Coenagriidae and Cordulifidae) wholly in agreement with data obtained by certain authors (i.e., Das *et al.*, 2005; Dehghani *et al.*, 2007; Deepa and Roa, 2007 and Caillouët *et al.*, 2008).

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الوفرة الموسمية لبعض مفصليات الأرجل المائية وحصر أنواعها في بعض البرك المتواجدة في منطقة الغريب بأسبوط مصر.
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أجريت الدراسة على بعض مفصليات الأرجل المائية الموجودة في بعض البرك في منطقة الغريب بأسبوط خلال عامين بدءاً من مارس ٢٠١١ إلى فبراير ٢٠١٣ وتم حصر ٢٠ نوع من مفصليات الأرجل المائية تتبع ٦ رتب منها ذات الجناحين وغمدية الأجنحة ونصفية الأرجل والرعاشات والقشريات والأكاروسات وكشفت الدراسة أن أكبر تعداد لمفصليات الأرجل المائية خلال موسم الربيع وأقل تعداد خلال موسم الشتاء ووضحت الدراسة نسبة الأنواع المختلفة من الرتب التابعة لمفصليات الأرجل المائية وتعدادها خلال الدراسة وأظهرت الدراسة أن أنواع البعوض أعلى نسبة بمتوسط ٦٢.٢٩ وأقل نسبة أنواع الرعاشات بمتوسط ٣.٦٠ أثناء الدراسة .