STUDIES ON THE DISTRIBUTION, DIVERSITY, AND ACTIVITY PERIODS OF SPECIES BELONGING TO SUBFAMILIES GYMNOMYZINAE AND EPHYDRINAE (DIPTERA: EPHYDRIDAE) FROM EGYPT

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INTRODUCTION

Species of the family Ephydridae are often prominent members of aquatic and semi-aquatic environments. This family attracted great interest of workers because of the extreme abundance of certain species in marginal habitats including highly saline and alkaline lakes and pools, and crude oil pools. The fresh water species have elicited more attention in recent years, but most studies have been concerned primarily with elucidation life histories (Eastin & Foot, 1971; Deonier, 1972; Busacca & Foot, 1978; Deonier & Regensburg, 1978).

Many species are well known for their ability to endure extreme habitat conditions. As salt-influenced biotopes, larvae of some *Ephydra* spp. are found in water basins near the red sea beach where the water has a concentration salinity reaching 38% NaCl; on the other hand, adults were found resting on the water surface.

Lindroth (1931) reported that the shore fly larvae could be found in water with temperature of 53°C-55°C. Other shore fly species were known from Hot Springs (Tuxen, 1936).

Some shore fly species are adapted also to low temperatures as *Scatella stagnalis*, which is known from Alaska, Northwest Territory of Canada, northern Greenland and the arctic parts of Europe.

Most ephydrid species show a distinct tendency in their reaction to the hygric factor. The great majorities are hygrophilous, needing a moist substrate for their development; some develop in moist soil or need vegetation for their mining

larvae. But other species are distinctly xerophilous. Latreille (1804) and Schiner (1863) described how the European species *Mosillus subsultans* is dependent on dry, sandy substrate, in which this sun-loving species rapidly digs down when being shaded.

Still more peculiar biotopes with a strange medium, occupied by shore fly species, are sulphurous springs, from which *Scatella* specimens were recorded (Brauns, 1939), and oil pools, in which the larvae of a species originally described as *Psilopa petroleii* (Coquillett, 1899) achieves its development.

Country background:

Egypt forms the northeastern corner of Africa beside the Sinai Peninsula in Asia. It measures 1073 km in its greatest length from west to east and covers a land area of about one million square kilometers.

Situated between latitude 22° and 32° north, Egypt lies for the most part in the Temperate Zone. The whole country forms a part of the Great Desert Belt, and it is characterized by a warm and almost rainless climate. Air temperature in Egypt frequently rises to over 40°C in the daytime during the summer and seldom falls as low as 0°C even during the coldest nights of winter. The average rainfall over the country as a whole is only about one centimeter a year. Only the coastal strip from Salloum to Alexandria, Gebel Elba and the higher parts of Southern Sinai mountains receive higher rainfall. This is reflected on the floral and faunal composition.

The river Nile and its delta are the most prominent geographical features of Egypt, through which a regular and voluminous supply of water, coming from the east African mountains, is secured. This water is channeled by artificial canals over the narrow strip of alluvial lands on both sides of the river, the Fayum depression and the Delta expanse. These tracts of fertile land cover less than 3% of the total area of Egypt.

The position of Egypt among the faunal regions of the world is a rather anomalous one, since it combines the characteristics of both Palaearctic and Ethiopian regions. Egypt has generally been considered to belong to Palaearctic, but there is evidence that the Ethiopian element is much greater than usually thought (Steyskal, and El-Bialy, 1967).

Some biogeographical considerations:

Larsen (1990) divided Egypt into 7 ecological zones which are: The Coastal Strip, the Western Desert, the Lower Nile Valley and Delta, the Upper Nile

valley, the Eastern Desert, Gebel Elba and Sinai. Many Egyptian ecologists consider the Fayoum Basin as a separate zone in addition to the former 7 zones (Fig. 1). He stated also that upper Nile valley is taken to begin south of Giza and not at Asyut. Each zone has its own characteristics: The Coastal Strip mainly covered with sand dunes and salt-marshes near the sea shore and the rainfall in this zone is more consistent than the rest of Egypt, supporting a strip of vegetation. The Western Desert has a very arid climate and scattered vegetation occurring only on the border of the Nile Valley and in the oases, and includes many grasses and many crops with their associated weeds. The Lower Nile Valley and Delta has only traces of the original natural vegetation because of the recent plans of agriculture in the Delta, and the greatest part of its biomass consists of crops, introduced weeds, planted trees and many vegetables. The Upper Nile Valley is very similar to the Delta and Lower Nile Valley in most characteristics but its climate becomes progressively hotter and harbors more of the remaining vegetation. Fayoum Basin with the type of vegetation, the type of cultivated crops and the weather may differ from those of the Nile Valley and Western Desert regions. Many trees, shrubs, bushes and many herbaceous plants grow in Fayoum, which is also cultivated with olives, fruits and different kinds of crops. The Eastern Desert with more diverse vegetation than is seen in the Western Desert. Further south, between the Nile and Red Sea, rainfall appears to decline and the plant associations become more impoverished. Gebel Elba has much more profuse and much more tropical vegetation than the region north of it. This region represents the northern most extension of the dry savannas of Sudan. Sinai contains numerous wadies with a large number of Mediterranean plants and the vegetation is much richer than elsewhere in Egypt.

The present work aims at studying the geographical distribution diversity, and activity periods of the ephydrid subfamilies Gymnomyzinae and Ephydrinae in Egypt; however the detailed distribution and abundance of each species within each zone is planned to be studied later.

MATERIAL AND METHODS

A survey of adult shore-flies was carried out for three successive years from January 2000 to December 2003. The survey covered seventy six of different localities representing the eight Egyptian ecological zones in different seasons.

The adult shore-flies were collected either by sweeping using a conventional and standardized sweep-net, or by a light trap. Specimens collected

were killed and pinned directly in the field so as to maintain their color and texture; then they were identified using taxonomic keys. Some identification was confirmed by Prof. Dr. Tadeusz Zatwarnicki, specialist on Ephydridae (Poland).

A good deal of information about distribution and periods of activity were also gathered from museum specimens kept in two of the main Egyptian collections, namely: i) Collection of the Ministry of Agriculture, Plant Protection Research Institute, section of identification. ii) Collection of Cairo University, Faculty of Science, Entomology Department (Efflatoun's collection).

RESULTS AND DISCUSSION

Distribution and diversity:

A total of 47 shore fly species belonging to the subfamilies Ephydrinae and Gymnomyzinae are studied. They are arranged in 21 genera. The manner of distribution and diversity of these species show considerable differences within the eight Egyptian ecological zones.

The diversity of species within the zones was in the following descending order (Fig: 1): Eastern Desert (27 species), Western Desert (26 species), Delta and Lower Nile Valley (19 species), Sinai (12 species), Fayoum (11 species), Coastal Strip (8 species), Gebel Elba (6 species), and Upper Nile Valley (3 species). Within the 47 recorded species, five species were very common and highly abundant in Egypt, namely: *Chlorichaeta albipennis* (Loew), *Ephydra macellaria* Egger, *Mosillus subsultans* (Fabricius), *Scatella stagnalis* (Fallen), and *Hecamed albicans* (Meigen); whereas 21 species were very rare, represented only by few individuals as *Halmopota kozlovi* Becker, *Haloscatella dichaeta* (Loew), *Eremotrichoma simplicior* (Collin), *Allotrichoma (Allotrichoma) augierasi* Seguy, *Polytrichophora mira* n.sp. and *Scatophila farinae* Becker and others; likewise, 21 species are represented by moderate numbers and moderately distributed in the ecological zones as *Brachydeutera ibari* Ninomyia, *Ochthera (Ochthera) schembrii* Rondani and *Scatella (Neoscatella) subguttata* (Meigen) . The distribution of each species in the eight ecological zones is summarized in table 1.

The factors determining the ecological distribution constitute a complex, where the special factors are related to each other and to the common factor formed by these. The proper understanding of the interrelationship of organism and its surroundings necessitates isolation and an individual study of the ecological factors

(Dahl, 1959). This author also emphasized that the excellent conformity of temperature properties in species and environment, observed in some species, is not necessarily the principal cause of the ecological distribution of shore fly species. There might be other factors, directly or indirectly of greater significance, for instance humidity, salinity of substrate, grain size, substrate color ...etc. Some authors referred also to food and feeding behavior as a significant factor for the ecological distribution of shore-flies. For instance, Ardo (1957) reported *Hecamede albicans*, normally living on micro-algae, being collected on decaying herring fish. For an ecological-systematic arrangement of the genera, Dahl (1959) divided the shore flies with regard to the physiognomical structure of their habitats in accordance with their morphological adaptations to those habitats. He listed the most common physiognomical types of habitats and how the genera (*i.e.* their most abundant species) may be grouped in relation to these. His list was as follows: (sign * referes to genera represented in Egypt)

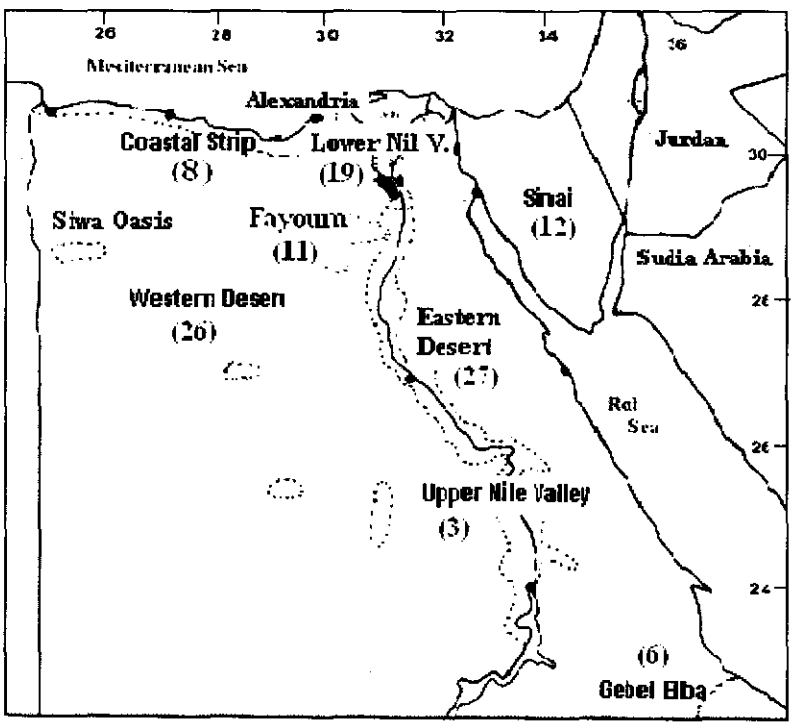

Fig.1: Map of Egypt showing the ecological zones, with the number of shore-fly species (between parentheses) recorded from each zone.

I. The water surface:

Genus *Ephydra* *

II. The open soil: (A) Sand ground:

Genus *Scatella* *

Genus *Hecamede* *

(B) Mud ground:

Genus *Paracoenia* *

Genus *Discocerina*

Genus *Napaea*

Genus *Ilythea*

Genus *Pelina*

(C) Wrack:

Genus *Dichaeta*

III. Vegetation: (A) Reed:

Genus *Notiphila*

(B) Grass:

Genus *Hydrellia*

(C) Meadow:

Genus *Hyadina*

Genus *Hydrina*

Genus *Psilopa*

Genus *Scatophila* *

Genus *Limnellia*

According to Deonier (1979), the following habitats can be recognized: (1) floating vegetation, (2) floating algal mat, (3) salt pool, (4) mud shores, (5) sand shore, (6) grass shore, (7) limnic wrack, (8) marsh reeds, (9) wet meadow and (10) hot springs. He also stated that: larvae of Ephydrini are associated with floating or submerged filamentous algae. Larvae associated with salt pools are known in some *Glenanthe*, *Haloscatella* and *Scatella*. Mud shores contain abundant microflora, especially diatoms and organic detritus. Sandy shores are preferred by *Scatella* and *Scatophila*. Limnic wrack is selected by *Scatella*. Preferences for marsh reeds were observed in *Philotelma*. Hot springs on Iceland are one of the most unusual habitats occupied by ephydrid larvae. The larvae of *Scatella tenuicosta* Collin, a species widely distributed in the western palearctic, is also adopted to survive in hot water and represents the last group.

In the present study *Scatella tenuicosta* Collin was collected from Dakhla (Western Desert) and Safaga (Eastern Desert) near springs of warm water.

The results of the present study mostly coincide with the above facts which may interpret the abundant presence of *Ephydra* spp. in Delta & Lower Nile Valley, Eastern Desert, Fayoum, and Western Desert; *Scatella* spp. & *Hecamede* spp. in Coastal Strip, Delta and Lower Nile Valley, Eastern Desert and Western Desert; *Scatophila* spp. in Fayoum and Western Desert; and *Paracoenia* (=*Coenia*) in Delta & Lower Nile Valley and Coastal Strip.

Activity periods:

Periods of activity (imago-times) of the 47 studied species (table 1 & fig. 2) extend mostly along two seasons (6 months) or more in all zones (excluding Upper Nile Valley) with a peak in April, May and January. Activity in Upper Nile Valley, on the other hand, was mostly in January; whereas in Gebel Elba, the activity exceeded in December and January. A more surveyable picture of the activity period of each species separately is given in table 1. Every capture of a species is noted by a slanting line, precisely to the day, not only to the month or to the week.

The activity periods (imago-times) of the studied shore fly species showed a considerable variation. These results coincide with the facts noted by many authors that species living in moist biotopes have a longer imago-time than those bound to dry biotopes. Thus the species appearing just for one or two months have a xerophilous tendency, while the species appearing during a longer part of the year have a hygrophilous tendency.

According to their Activity periods, Dahl (1959) placed shore fly species in 5 phenological groups as follows:

1- Species that may be collected throughout the whole year.

2- Species that may be observed during the entire vegetation-period. These species certainly appear in more than one generation but the generation limits have not proved distinctly in many of the species. Species appearing in one month and disappearing in the next month.

3-Species appearing and disappearing in one month.

4-Species that may be characterized as "high-summer species" Species of the last 3 groups appear in only one generation a year.

Fig. 2: Activity periods of ephydrid fly species of subfamilies Ephydrinae and Gymnomyzinae in different ecological zones of Egypt

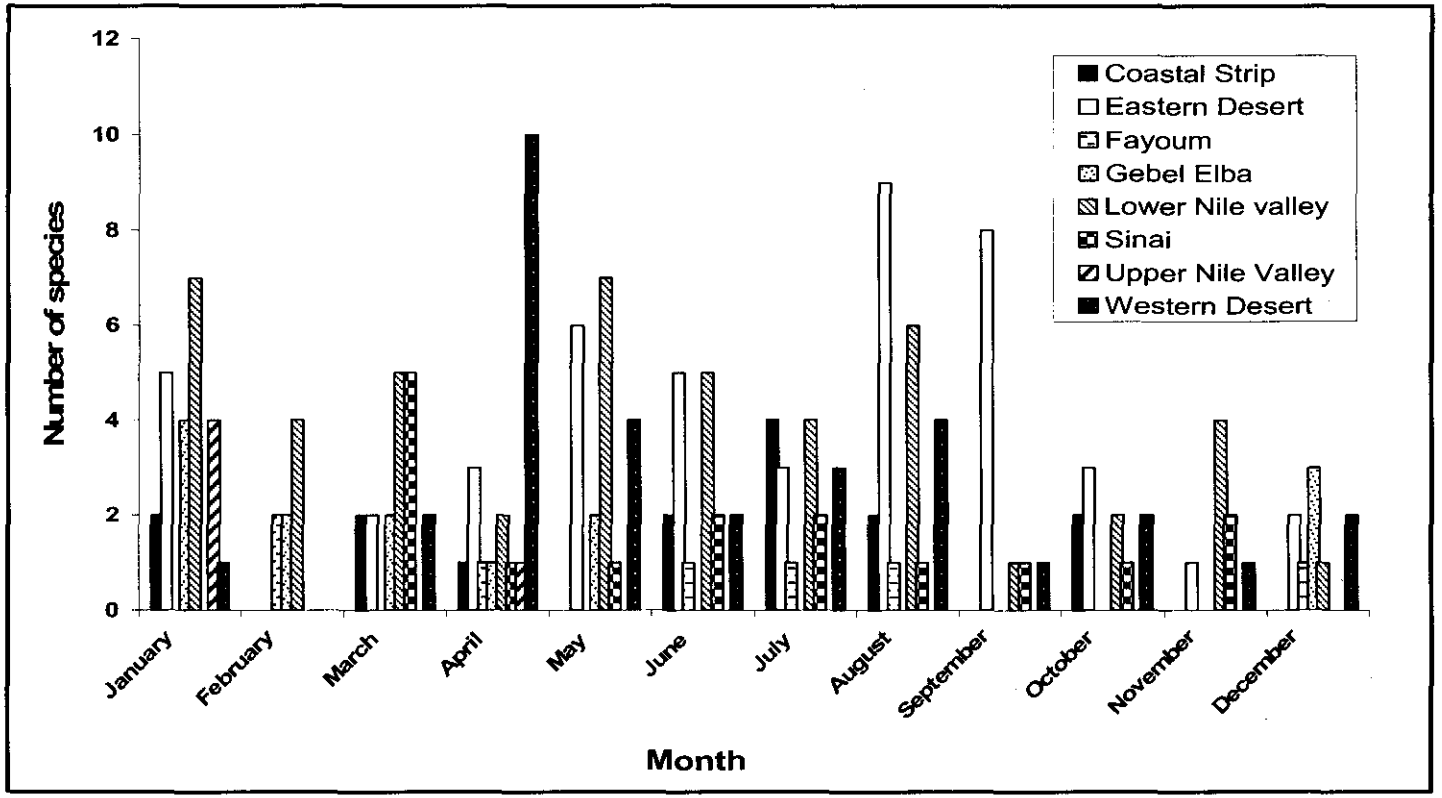

TABLE (I)

Distribution and activity periods (Imago-time) of each species of subfamilies Ephydrinae and Gymnomyzinae in Egypt

Subfamily	Species	Distribution								Activity periods*											
		Coastal Strip	Western Desert	Eastern Desert	Lower Nile Valley	Upper Nile valley	Sinai	Fayoum	Gebel Elba	Jan.	Feb.	Mar.	Apr.	May.	Jun.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Ephydrinae	*Brachydeutera ibari*		+	+	+			+		/		/	/	///	/	//	/	/			/
	Ephydra attica		+	+	+					/		/	/	//	///	/					
	E. bivittata		+										/								
	E. flavipes		+		+							/	//	//	//	/	/				
	E. macellaria	+	+	+	+			+		///////	//	/////	/	////	////	///	//	/	//	///////	////
	E. sp1.								+	/											
	Halmopota kozlovi		+									/									
	Paracoenia fumosa		+									/						/	/		
	Setacera breviventris		+	+												/		/			
	Haloscatella dichaeta			+				+					/	/							
	Scatell maculosa		+									/									
	Scatella subguttata		+	+	+					/		//	/					/			
	S. Ciliata		+							/		/	/								

Table 1 continued

Subfamily	Species	Distribution								Activity periods*											
		Coastal Strip	**Western Desert**	**Eastern Desert**	**Lower Nile Valley**	**Upper Nile valley**	**Sinai**	**Fayoum**	**Gebel Elba**	Jan.	Feb.	Mar.	Apr.	May.	Jun.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Ephydrinae	*S. favillacea*		+							/	/		/								
	S. indistincta		+	+	+							/	///			/		/			
	S. lutosa		+	+	+									/	///	/					
	S. paludum	+	+	+	+	+		+		////	//	/	/	/	/	//					
	S. rufipes		+	+	+			+				//	/	/				/			
	S. stagnalis	+	+	+	+	+		+		//////	/		///	//////	//					/	/
	S. tenuicosta			+			+									/	/				
	Scatella variofemorata		+		+								/	/							
	Scatophila farinae		+					+							/	/					
Gymnomyzinae	*Diclasiopa galactoptera*		+											/							
	Hecamedoides costatus			+						/							//				/
	Polytrichophora sp2.				+							/									
	Athyroglossa argyrata						+										/				

Table I continued

Subfamily	Species	Distribution								Activity periods*											
		Coastal Strip	Western Desert	Eastern Desert	Lower Nile Valley	Upper Nile valley	Sinai	Fayoum	Gebel Elba	Jan.	Feb.	Mar.	Apr.	May.	Jun.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Gymnomyzinae	*A. vorticis*						+												/	/	
	A. africana						+	+		/			/	/							/
	Chlorichaeta albipennis	+		+	+		+	+	+	//	//		//	//	///	////	//			//	
	C. tuberculosa			+			+		+				/	/	//		/		/	/	
	Mosillus subsultans			+	+		+			/				/	/	/	////		/		
	Allortichoma augierasi			+						/											/
	A. biroi			+													/				
	A. laterale			+			+		+	/				/	/				/	/	
	A. quadripectinatum			+	+		+	+		/			//	/	/		/	/	/	/	/
	Elephantinosoma chnumi		+	+	+					/	/	/	///	/	//						
	Ermotrichoma agens			+				+		/	/					/	//			/	
	E. kugleri			+			+		+	/		/					//				/
	E. perspiciendum			+	+	+	+			//		/		/			/	/	/		
	E. simplicior		+										/			/	/				

Table I continued

Subfamily	Species	Distribution								Activity periods*											
		Coastal Strip	**Western Desert**	**Eastern Desert**	**Lower Nile Valley**	**Upper Nile valley**	**Sinai**	**Fayoum**	**Gebel Elba**	Jan.	Feb.	Mar.	Apr.	May.	Jun.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Gymnomyzinae	*Hecamede albicans*	+		+			+		+	/		/		///	///	////		/	/		
	H maritima	+		+								/			/	//	/		/		
	Glenanth ripicola		+										/								
	Glenanth fasciventris		+										/								
	Homalometopus albiditinctus		+										/				/				
	Ochthera pilimana	+	+		+					/							//				
	Ochthera schembrii	+		+	+					//	/				/		/	/			

Zatwarnicki (1997) noted that: to the first group belong *Scatella stagnalis* (Fallen) and the majority of species belong to the second and third sections. Typical representatives of the second group are various species of genus *Scatella*. The same author also stated that a minority of species is multivoltine, passing through several generations each year, and the flight period of the majority of species is limited to the warm season.

The above facts obviously interpret the significantly varying activity periods of studied species within the different zones and in different months as shown in Fig (2) and Table (1).

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SUMMARY

A total of 47 shore fly species belonging to 21 genera of the subfamilies Gymnomyzinae and Ephydrinae were studied. The diversity of species within the eight Egyptian ecological zones was in the following descending order: Eastern Desert (27 species), Western Desert (26 species), Delta and Lower Nile Valley (19 species), Sinai (12 species), Fayoum (11 species), Coastal Strip (8 species), Gebel Elba (6 species), and Upper Nile Valley (3 species). Within the 47 studied species only 5 were found to be very common and highly abundant while 21 species were very rare and represented only by very few individuals. The rest of species (21 species) were represented by moderate numbers and moderately distributed in the ecological zones. Periods of activity (imago-times) for all species were studied and showed that species living in moist biotopes have a longer imago-time than those bound to dry biotopes. Thus the species appearing just for one or two months have a xerophilous tendency, while the species appearing during a longer part of the year have a hygrophilous tendency.

Keywords: Ephydridae, Gymnomyzinae, Ephydrinae, Distribution, Diversity, Activity periods.

REFERENCES

ARDO, P. (1957): Studies on the marine shore dune ecosystem with special reference to the dipterous Fauna. *(Opusc. Ent., Suppl. XIV. Lund.).*

BRAUNS, A. (1939): Zur Biologie der Meeresstrandfliege *Scatella subguttata* Meigen (Familie Ephydridae; Diptera). *(Zool. Anz. 126: 273-285).*

BUSACCA, J.D., and FOOT, B.A. (1978): Biology and immature stages of two species of *Notiphila*, with notes on other shore flies occurring in Cattail Marshes (Diptera: Ephydridae). *(Annals of the Entomological Society of America, 71(3): 457-466).*

COQUILLETT, D.W. (1899): Description of a new *Psilopa*. *(The Canadian Entomologist, 31(1): 8).*

DAHL, R.G. (1959): Studies on Scandinavian Ephydridae (Diptera Brachycera). *(Opuscula Entomologica, Supplementum 15: 1-224).*

DEONIER, D.L. (1972): Observations on mating, oviposition, and food habits of certain shore flies (Diptera: Ephydridae). *(Ohio Journal of Science, 72(1): 22-29).*

DEONIER, D.L. (1979): Introduction-A prospectus on research in Ephydridae. *(In: D.L. Deonier, editor, First Symposium on the Systematics and Ecology of Ephydridae (Diptera). 147+iii pages. North American Benthological Society, Oxford, Ohio, 1-19).*

DEONIER, D.L., and REGENSBURG, J.T. (1978): Biology and immature stages of *Parydra quadrituberculata* (Diptera: Ephydridae). *(Annals of the Entomological Society of America, 71(3): 341-353).*

EASTIN, W.C., and FOOT, B.A. (1971): Biology and immature stages of *Dichaeta caudata* (Diptera: Ephydridae). *(Annals of the Entomological Society of America, 64(1): 271-279).*

LARSEN, T.B. (1990): The Butterflies of Egypt*: (Apollo Books, Svendborg, Denmark, 8-17.).*

LATREILLE, P.A. (1804): Tableu methodique des Insectes. *(In: Tableaux methodiques d'histoire naturelle. Deterville, Paris, 129-200).*

LINDROTH, C. H. (1931): Die Insektenfauna Islands und ihre Probleme. *(Zool. Bidr. 13. Upsala).*

SCHINER, I.R. (1863): Die Fliegen (Diptera): *(In: Fauna Austriaca, 2(9-10): 81-288. Carl Gerold's Sohn, Wien).*

STEYSKAL, G.C., and S. EL-BIALY (1967): A List of Egyptian Diptera with a bibliography and key to families. *(Technical Bulletin of the Ministry of Agriculture, UAR, 3: 1-87).*

STRICKLAND, E.H. (1953): The ptilinal armature of flies (Diptera: Schizophora). *(Canadian Journal of Zoology, 31: 263-299).*

TUXEN, S.L. (1936): Die Arten der Gattung *Scatella* (Ephydridae) in heissen Quellen. *(Opuscula Entomologica, 1(4): 105-111).*

ZATWARNICKI, T. (1997): Diptera Ephydridae, Shore Flies. *(In: Anders N. Nilsson (ed): Aquatic Insects of North Europe. A Taxonomic Handbook. 2: 383-399. Apollo Books, Denmark).*