Proceedings of the First International Conference of the Egyptian British Biological Society (EBB Soc)
Egyptian Journal of Natural History, 2001, Vol. 3, pp. 62- 80 © Printed in Egypt. Modern Press

Insect Diversity in Zaranik Protectorate, Northern Sinai, Egypt

Aly El-Moursy[1], Magdi El-Hawagry[1*], Mahmoud Abdeldayem[1] & Hassan Fadl[2]

1. Entomology Department, Faculty of Science, Cairo University, Giza
2. Entomology Department, Faculty of Science, Ain Shams University, Cairo

ABSTRACT

Patterns of species diversity and community organization in insect fauna were studied in 4 sites in Zaranik Protectorate, northern Sinai, Egypt. Local communities of insects included 187 species and subspecies belonging to 49 families and representing 15 orders; 25 of these species were very rare and seem to be threatened. Five of the collected species were recorded for the first time from Egypt. The insect diversity and abundance showed differences among different sites. Faunal similarity and diversity measures and species composition suggest the division of the insect fauna of Zaranik Protectorate into 2 main communities; one occurring at the area surrounding the rest building, 10 km away from the sea shore and the other community at the sea shore including some nearby small islands. The present study may constitute a basis for any attempt to include insects in any conservation assessment.

KEYWORDS: insects, diversity, conservation, Zaranik, Sinai, Egypt

INTRODUCTION

Insects constitute 85% of the world's animal diversity (Groombridge 1992) and deserve increased attention in regions of the world, such as wetlands, where species-rich habitats are under threat. Conservation methods often prioritize areas based on the diversity patterns (species richness) of birds and mammals. Although these charismatic organisms are conspicuous to the public, they represent a very small percentage of the world's species. Inventories that do not include insect diversity overlook most organisms, do not guarantee preservation of the greatest diversity and ignore the major contributors to essential ecosystem processes (Wilson 1987; Fisher 1997).

* Address for correspondence

Conservation efforts in Zaranik Protectorate, northern Sinai, Egypt, are directed mainly at preserving birds, with some recent attention being given to other taxa including insects. The insect fauna of Zaranik Protectorate have never been studied before. All previous work has dealt either with the entire insect fauna or particular insect groups in the general areas of Egypt, Sinai or northern Sinai, without specific mention of Zaranik and its immediate vicinity. However, various species have been recorded at nearby locations (Arish, Mazar, Lanafet El-Rissan, and El-Moweilla) in scattered works on the insect fauna of Egypt in general or Sinai in particular, e.g.: Hart (1891), Kneucker (1903, 1922), Peyerimhoff (1907), Pic (1913, 1929), Bodenheimer (1932), Schatzmayr (1936), Efflatoun (1930, 1934, 1937, 1945), Priesner (1953), Alfieri (1920, 1976) and Zalat (1995)

The present study deals with the insect community in Zaranik Protectorate. It is a compendium of current biogeographic information on all of the known insect species of the Protectorate, demonstrating its biodiversity. The provided list of species may alert researchers to do further work aimed at conserving the Zaranik Protectorate communities.

We hope to present in this study some information on the insect fauna of Zaranik Protectorate that will be considered in any conservation assessment in the future.

MATERIALS AND METHODS

Study area: Zaranik Protectorate is regarded as one of the most internationally important wetlands for migratory waterbirds; notably herons, egrets, ducks, waders, gulls and terns. These birds pass through the Zaranik area each autumn, mostly originating from a wide area of eastern Europe and western Asia. Zaranik Protectorate is situated in the North of Sinai Peninsula (fig. 1) at the eastern end of Lake Bardawil, 35 km West of Arish. The protectorate is approximately 22 km long and 17 km wide, with a surface area of approximately 230 km^2.

The mean daily temperature usually ranges between 13°C in winter (December-February) and 25°C in summer (June-August). The daily fluctuation in temperature is approximately 10°C. Rapid increases in temperature are known to occur during the "Khamasin" sandstorms in spring. The whole northern Sinai, including Zaranik Protectorate, is an arid desert where the rainfall is relatively scarce, with an annual average of 100 mm at Arish and only 80 mm at Telul.

During the course of the present study five entomological expeditions to Zaranik Protectorate were carried out between (August and November 2000), each lasting for four days. Four sites were chosen and surveyed for studying the patterns of insect diversity and abundance (fig.1). These sites are: **Site I:** (Lat. 31° 04'34" – 50, Long. 33° 27' 57" – 59"): The area at the rest building and visitor centre and their surroundings. This site is characterized by 3 different habitats: 1- Sand dunes with variable plantations like *Artemisia monosperma* Delile, *Retama reatam* (Forssk), *Panicum turgidum* Forssk, *Nitraria retusa* (Forssk), *Stipagrostis scoparia* (Trin. *et* Rupr.) and small trees of cultivated apple, fig, citrus, pomegranate, and watermelon; 2- Moorland with saline soil and dense cover of *Zygophyllum album* L.; 3- Salt marshes with low dry vegetation of *Z. album*. **Site II**: (Lat. 31° 08' 03" – 09", Long. 33° 28' 07" – 18"): Including settlements of fishermen and adjacent localities to the north. It comprises 2 different habitats: 1- Salt marshes with high population of *Z. album*.; 2- Sandy shore of Zaranik lagoon mainly with scattered patches of *Z. album*. **Site III:** (Lat. 31° 06' 51" – 07' 05", Long. 33° 24' 33" – 26' 21"): Includes all areas of Khwyinat and Flossyiat, involving 2 habitats: 1- Sand dunes, which cover most of the area, mainly with a plant cover of *A. monosperma*, *R. reatam*, *P. turgidum*, *N. retusa* and *S. scoparia*. 2-Moorland with saline soil and *Z. album*. **Site IV:** (Lat. 31° 08' 25" – 09' 03", Long. 33° 27' 15" – 28' 39"): Represented by the sandy bar at the North of the Protectorate, separating the Protectorate from the Mediterranean Sea and characterised with a few scattered patches of *Z. album.* In addition, site IV includes all islands in the lagoon, which are mainly mixed habitat of moorland and salty marshes. The most common plants on these islands are *Z. album*, *Halocnemum strobilaceum* (Pallas), and *Salicornia europaea*

The four sites are separated from one another by distances ranging from 3 km to 10 km (see map in fig. 1) and are apparently isolated. Site I is the largest an open area, while others are confined by sea and lagoons. At each site we selected four standard plots (quadrats) each measuring 25 x25 m, chosen with the intent of sampling different habitats.

Sampling methods: Insect material from various habitats within the sites was collected by different sampling methods in order to reduce systematic errors and to speed and simplify the sampling process. The methods included pitfall traps, sticky traps, yellow pan traps, sweeping, and hand collecting.

At each quadrat, 15 pitfall traps were installed in an 3 x 5 grid at approximately 5-m intervals, together with 5 yellow pan traps and 10 sticky traps. All were left in place for 48 hours during each visit. For three periods of 15 minutes (in the morning, around midday and in the afternoon), as many insects as possible were collected with an insect net at each quadrate. This process was completed twice during each visit. The collected insects were killed using ethyl acetate, pinned and identified with taxonomic keys and by comparison with the material preserved in the main Egyptian insect collections. The number of species at each site was determined as a measure of species richness. The Shannon-Wiener diversity index value was calculated using the formula $H` = -(pi (ln pi))$ where pi = proportion of the i^{th} species in the site. The similarities between the different insect communities at different sites were also calculated using the Sorenses Index of similarity (I_s) = 2J/A+B where J = common species present in both samples, A and B = species present in samples A and B, respectively.

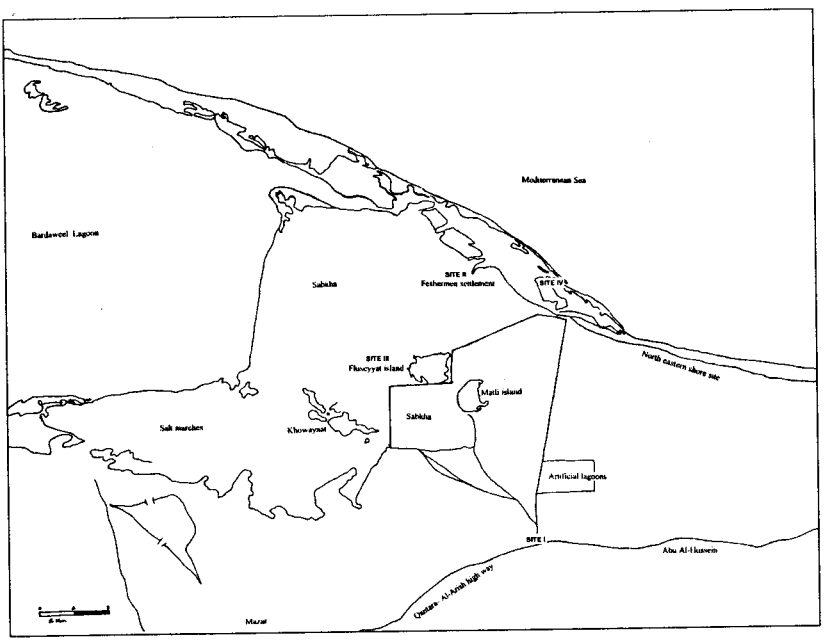

Fig 1: Map of Zaranik Protectorate

RESULTS

A total number of 187 insect species and subspecies (some identified only to the genus or family level) belonging to 49 families and representing 15 orders are known to occur in Zaranik Protectorate (table 1).

Table 1: Checklist of insect species and subspecies collected from 4 different sites in Zaranik Protectorate, and the species diversity indices (H') in each site (* = new record to the Egyptian fauna).

Taxon	Site I	Site II	Site III	Site IV
BLATTARIA				
Blattidae				
Blattella arundinicola Werner	6	0	0	0
Heterogamodes cerverae Bolivar	30	2	0	0
Periplaneta americana (L.)	3	1	0	0
Periplaneta tartara Saussure	1	0	0	0
COLEOPTERA				
Anobiidae				
Lasioderma sp.	1	0	0	0
Stegobium panicum (L.)	15	6	2	0
Xyletinus bucephalus bucephalus Illiger	2	0	1	0
Anthicidae				
Anthicus floralis (L.)	1	0	0	0
Anthicus sp1	7	6	1	3
Anthicus sp2	6	4	0	5
Anthicus sp3	2	1	1	1
Anthicus sp4	3	4	0	4
Carabidae				
Cicindela aulica Dejean	0	1	0	0
Cicindela litorea Forskal	22	27	14	23
Megacephala euphratica Lat.	1	0	1	0
Paussus thomsoni Reiche	2	0	0	0
Pogonus gilvipes Dejean	2	3	0	0
Scarites guineensis Dejean	10	3	2	2

Syrdenus grayi Wollaston	7	0	0	21
Tachys scutellaris aegyptiacus Schatzmayr & Koch	12	0	0	0
Thermophilum sexmaculatum pharaonum (Bedel)	10	1	2	0
Trichis maculatus Klug	2	0	0	0
Cerambycidae				
Phytoecia sp.*	1	0	0	0
Prionus aegyptiacus Pic	20	1	0	0
Cleridae				
Necrobia rufipes (Degeer)	2	2	0	0
Coccinellidae				
Coccinella undecimpunctata	0	0	0	15
Dermestidae				
Attagenus sp.	0	0	5	0
Dermestes maculatus Degeer	0	7	0	0
Dytiscidae				
Eretes sticticus L.	1	1	0	0
Elateridae				
Isidus letourneuxi Pic	1	0	0	0
Histeridae				
Saprinus sp1	2	0	0	0
Saprinus sp2	3	1	0	1
Hydrophilidae				
Sternolophus solieri Lapouge	1	0	0	0
Lathrididae				
Melanophthalma distinguenda Comolli	2	1	0	0
Nitidulidae				
Nitidula ciliata Erichson	4	0	2	0
Nitidula sp1	5	0	0	0
Nitidula sp2	1	0	0	0

Phalacridae				
Olibrus corticalis Panzer	1	0	0	0
Ptinidae				
Ptinus soubironi Pic	23	0	1	1
Scarabaeidae				
Aphodius dorsalis Klug	3	1	0	1
Aphodius hydrochoerus (Fabricius)	1	0	0	0
Aphodius lucidus Klug	11	2	2	1
Aphodius pallescens Walker	16	7	4	0
Aphodius sp.	1	0	0	0
Onthophagus melanocephalus Klug	4	0	0	0
Oryctes nasicornis (L.)	3	0	0	1
Phyllognathus excavatus Forster	35	6	3	0
Rhyssemus coluber Klug	1	0	0	0
Scarabaeus cristatus Fabricius	6	2	1	0
Trox squalidus (Olivier)	1	0	0	0
Staphylinidae				
Bledius capra capra Fauvel	10	0	0	16
Philonthus sp.	1	0	0	0
Tenebrionidae				
Alphitobius diaperinus Panzer	0	0	8	0
Blaps polychresta Forskal	11	2	0	0
Cataphronetis apicilaevis Marseul	1	0	0	0
Clitobius oblongiuscalus lineicollis Fairmaire	1	0	0	0
Clitobius ovatus Erichson	0	0	0	3
Mesostena sp.	6	1	2	1
Oterophloeus alreatus peyerimhoffi Koch	5	0	7	0
Phaleria prolixa aegyptiaca Seidlitz	17	3	21	1
Pimelia angulata sinaitica Schatzmayr & Koch	15	3	1	0
Pimelia barthelemyi Solier	9	0	16	0
Prionotheca coronata Olivier	0	0	20	0

Scaurus aegyptiacus Solier	29	0	19	0
Scleron sp.	1	0	0	0
Tentyrina orbiculata Fabricius	5	0	0	0
Zophosis plana plana Fabricius	2	0	0	0
Throscidae				
Throscus sp.	9	2	2	1
DERMAPTERA				
Labiduridae				
Labidura confusa Capra	3	9	13	0
DIPTERA				
Asilidae				
Apoclea femoralis Wiedemann	9	0	0	0
Nemochtherus clypeatus Becker	18	2	0	0
Neolophonotus molitor Wiedemann	7	0	0	0
Promachus griseiventris Becker	11	0	0	0
Bombyliidae				
Exhyalanthrax sp.	0	0	0	2
Petrorossia sp.	2	0	1	1
Spogostylum candidum (Sack)	1	0	0	2
Chironomidae				
Cricotopus mediterraneus	16	33	6	3
Culicidae				
Culex pusillus (Macquart)	12	14	2	0
Ephydridae				
Actoecetor margaritatus Wiedemann	25	0	0	0
G1 sp.	0	20	13	25
G2 sp.	0	18	4	25
Notiphila setigera Bick.	0	4	1	27
Muscidae				
Musca albina Wiedemann	1	0	0	0
Musca domestica L.	30	22	24	18
Musca sp.	1	0	0	0

Otitidae				
Physiphora alcae (Preyssler)	8	0	0	0
Physiphora smaragdina Loew	6	1	0	0
Sarcophagidae				
Wohlfahrtia villeneuvi Sal.	0	0	0	5
Stratiomyidae				
Nemotelus albifascies Bick	0	1	0	0
Syrphidae				
Syrphus corollae Fabricius	3	0	0	0
Tabanidae				
Ochropus agrestis Wiedemann	6	0	0	0
Tabanus albifacies Loew	1	0	0	0
Tachinidae				
Actia crassicornis (Meigen)	1	0	0	0
*Eurithia castellana (*Strobl)	3	0	1	0
Exorista larvarum (L.)	5	0	1	0
Nemorilla floralis (Fallen)	2	0	0	0
Siphona efflatouni Mesnil	1	0	0	0
Therevidae				
Hoplosathe frauenfeldi (Loew)	0	0	0	2
Neotherevella citrina (Becker)	0	0	0	3
EMBIOPTERA				
Oligotomidae				
Oligotoma sp.	1	0	0	0
HETEROPTERA				
Cydnidae				
Geotomus intrusus Wagner	2	0	1	0
Macroscytus brunneus (Fieber)	4	0	0	0
Lygaeidae				
Geocoris henoni Puton	2	0	1	0
Lamprodema maurum Fabricius	1	0	0	0
Nysius cymoides (Spinola)	2	0	1	0

Pachybrachius annulipes (Bar.)	0	0	1	2
Miridae				
Campylomma sp.	1	0	0	0
Lygus apicalis Fieber	2	0	1	0
Tuponia lethierryi Reuter	1	0	0	0
Tuponia sp.	1	0	0	0
Pentatomidae				
Acrosternum heegeri (Fieber)	6	0	3	0
Acrosternum millieri (Mulsant & Rey)	1	0	0	0
Choarntha ornatula (H-Sch.)	12	2	1	0
Mecidea lindbergi Wagner	1	0	0	1
Liorhyssus hyalinus Fabricius	2	1	0	0
HYMENOPTERA				
Evaniidae				
Evania dimidiata	1	0	0	0
Formicidae				
Camponotus maculatus	2	0	5	0
Camponotus oasium Forel	72	0	60	0
Cardiocondyla sp1	6	0	0	0
Cardiocondyla sp2	8	0	0	0
Cataglyphis diehli (Forel)*	0	0	16	0
Cataglyphis lividus (Andre)	26	1	40	0
Cataglyphis niger (Andre)	0	0	11	0
Crematogaster aegyptiacus Mayr	0	0	53	0
Messor aegyptiacus Emery	5	0	0	0
Messor ebininus Santschi	1	0	0	0
Monomorium carbonarium (Smith)*	9	0	0	0
Monomorium niloticum Emery	7	0	0	0
Pheidole katonae Forel*	77	0	0	0
Pheidole sp.	5	0	0	0

Mutillidae				
G1 sp.	0	0	3	0
G2 sp.	0	0	3	0
LEPIDOPTERA				
Arctiidae				
Utetheisa pulchella L.	3	1	0	0
Noctuidae				
Agrotis herzogi Rebel	1	0	0	0
*Agrotis ipselon (*Hufnagel)	1	0	0	0
Autographa gamma L.	1	0	0	0
Earias insulana (Boisduval)	1	0	0	0
Grammodes boisdeffrei Oberthur	2	0	0	0
Helicoverpa armigera Hubner	2	0	0	0
Leucanitis kabyfaria	1	0	0	0
Mythemna loryei Duponchel	2	0	0	0
Noctua floralis H.	3	1	0	0
Noctua pronuba L.	1	0	0	0
Ophiusa tirhaca Cramer	1	0	0	0
Spodoptera exigua (Hubner)	2	1	0	0
Spodoptera littoralis Boisduval	1	0	0	0
Pyralidae				
Anerastia nitidicostella Ragonot	3	1	0	0
Nephoterix cleopatrella Ragonot	1	0	0	0
Nomophila noctuella D. & Sch.	3	0	0	0
Syria pilosella Zeller	1	0	0	0
Sphingidae				
Agrius convolvuli L.	1	0	0	0
Macroglossum stelltarum L.	2	0	0	0
Tineidae				
Trichophaga abruptella	1	0	0	0
Trichophaga tapetzella L.	1	0	0	0
MANTODEA				

Mantidae				
Blepharobsis mendica (F.)	3	0	2	0
Emeles aegyptiaca Werner	3	1	0	0
Iris orlatoria (L.)	1	0	0	0
Reivetina fasciata (Thunberg)	1	0	0	0
NEUROPTERA				
Chrysopidae				
Chrysoperla carnea carnea (Stephens)	4	1	0	0
Myrmelionidae				
Creoleon antennatus (Navas)	3	0	1	0
Cueta lineosa (Rambur)	5	2	0	0
Gepus curvatus Navas	3	0	0	0
Gepus invisus Navas	4	0	1	0
Myrmecaelurus laetus (Klug)	2	0	0	0
Neoclisis lineata Navas	7	1	0	0
Neurleon lugubris	4	0	0	0
Phanoclisi longicollis	3	0	0	0
Pseudoformicales nobilis Navas	3	0	0	0
ODONATA				
Aeschnidae				
Anax parthenope (Selys)	1	3	0	5
Coenagriidae				
Ischnura senegalensis (R.)	5	14	2	14
Libellulidae				
Crocothemis erythraea Brulle	2	22	13	19
ORTHOPTERA				
Acrididae				
Hyalorhipis rhamses Saussure	1	0	0	0
Leptopternis gracilis Ev.	1	0	0	0
Platypterna gracilis Krauss	1	0	0	0
Tryxalis nasuta (L.)	1	0	0	0

Gryllidae				
Gryllodes sigillatus (Walker)	1	0	0	0
Gryllomorpha rufescens Uvarov	13	0	3	0
Gryllopsis mareoticus (Warner)	1	0	0	0
Gryllus bimaculatus Degeer	3	1	0	0
Modicogryllus algericus (Saussure)	2	0	0	0
Modicogryllus palmetorum (Krauss)	2	0	1	0
Stenonemobius gracilis (Jakovlev)	1	0	0	0
Pyrgomorphidae				
Pyrogomorpha sp.	2	1	0	0
SIPHONAPTERA				
Pulicidae				
Pulex sp.	1	0	0	0
STREPSIPTERA				
Mengenillidae*				
Mengenilla sp.*	1	0	0	0
THYSANURA				
G1 sp.	2	0	0	0
G2 sp.	4	0	0	0
G3 sp.	5	0	0	0
Number of species (Richness)	167	54	56	34
Number of individuals (Abundance)	977	280	427	255
Shannon index of diversity (H`)	4.292	3.19	3.216	3.029

34% of the known faunal richness is accounted for by order Coleoptera (63 species), Diptera or flies comprise (16%), Lepidoptera (12%), Hymenoptera (9%), Heteroptera (8%), Orthoptera, (6%) and Neuroptera (5%). The other insect orders made up 9.6% of all recorded species. Within the 187 recorded species, 25 species (13%) were very common, whereas 55 species (29%) very rare, represented by only one individual. Likewise, 74 species (40%) were moderately common, and 33 species (18%) were rare, represented by not more than 3 individuals.

The richness of different sites was compared with the total number of species sampled (Table 1) and it was found that 167 species were confined to site I, constituting 89% of the total species; while 54, 56 and 34 species were confined to sites II, III and IV respectively. General diversity as measured by H` was relatively high in site I, while in the other three sites it was moderate. The relationship between plant diversity (richness) and insect diversity (richness) showed a significant correlation ($r = 0.97$, $p < 0.05$). To compare the insect biodiversity of the four different sites with something more ecologically meaningful than species richness, we compared the composition of the four sites. Results demonstrating that sites varied in their species composition (fig. 2). The figure summarizes variation in species composition in two ways: firstly, by the number of species shared between different pairs of sites and secondly, by the number of species unique to each site. Moreover, each pair of sites was compared using similarity values (Sorenses Index) as displayed in table 2, which shows that the highest values of similarity were among sites II, III and IV. In addition, sites I & II showed a high value of similarity, while the lowest similarity values were among sites I, III and IV.

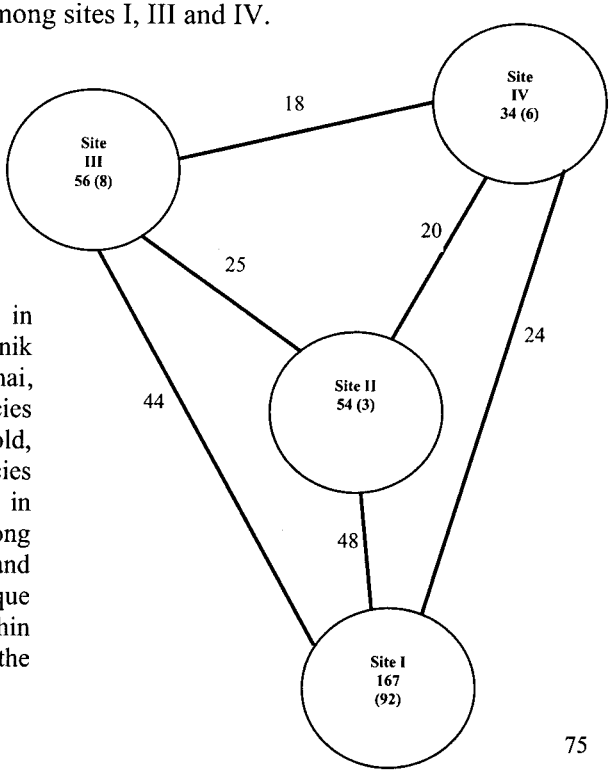

Fig. 2: Insect species in different sites in Zaranik Protectorate, North Sinai, Egypt. The number of species in each site in given in bold, the number of species occurring in common in different sites is given along the lines joining the sites, and the number of species unique to each site is given within parentheses within the circles.

Table 2: Sorenses Index (I_s) of similarity between the different sites in Zaranik Protectorate, Northern Sinai, Egypt.

	Site I	Site II	Site III
Site I	----		
Site II	0.434	----	
Site III	0.395	0.454	----
Site IV	0.239	0.454	0.4

DISCUSSION

The numbers of individuals found per species suggests a pattern reported since the days of the early naturalists; that is, some species are found in great numbers and others are rare (Resh *et al.*, 1975). In the present study, it was found that some species were collected regularly, while others were rare within one site or even within the whole Protectorate. These findings are consistent with many other community studies, which show that a small number of species dominates the community, whilst the majority of species are relatively rare (El-Moursy *et al.* 1999). Site I had more insect species and individuals than were found collectively at other sites. These differences could be the result of habitat and microhabitat differences among the sites. It is concluded that site I harbours a mixed habitat, which may explain the higher total number of species captured at this site.

Insect diversity (richness) was found to show a positive linear correlation with plant diversity (richness). Davidson (1977) found that the species diversity of consumers should depend to some degree upon the diversity, as well as the productivity, of resources. Krichner (1977) concluded that although plant species diversity was significantly correlated with arthropod diversity, unknown treatment effects had the greatest influence on arthropod diversity. The differences in diversity and abundance could also be the result of the distances between the sites, because distance could affect the ability of species to disperse between sites (Fisher, 1996). The distance between site I and any other site (>10 km) was

longer than the distance between any other two sites. Moreover, there are potential barriers (artificial lagoons) separating site I from the other three sites.

There is also little doubt that abiotic conditions (relative humidity, soil moisture, temperature, etc.) may affect insect distribution within the Protectorate. Fisher (1997) concluded that if the diversity of traditionally inventoried taxa (i.e., birds, plants) were to correlate strongly with insect diversity, then it would be valid to assume that birds and plants provide an "umbrella" to protect other taxa. In the present study this conclusion is valid only for plants and not for the visitor birds. A great number of water birds were found to visit sites near the sea shore (sites II, III& IV) in Autumn, but non of these birds were found to visit site I. We assume that these birds do not provide an "umbrella" to protect any insects within the protectorate as plants do, because of the fact that these birds are not resident there. Many of these birds however, seem to feed on different insect species, which may contribute to the low abundance and diversity of insects at sites II, III & IV.

Faunal similarity and diversity measures (Tables 1 & 2) and species composition (Fig. 2) suggest the division of the insect fauna of Zaranik Protectorate into two main communities: one occurring in site I (10 km before sea shore) and the other in sites at the shore, especially sites III & IV, while site II seems to be transitional between the two communities. This suggestion is deduced from the fact that similarity was low between site I and sites III & IV, and high between sites III & IV; while similarities between site II and all other sites were relatively high.

Comparison of the species list (Table 1) with other previous studies shows that many species can be characterized as threatened. Consequently, insects should not be excluded from any conservation assessment in Zaranik Protectorate. Fisher (1997) and Moore (1991) concluded that managing and monitoring a specific area for the protection of a single higher taxon such as birds, may only preserve those conditions needed for that taxon, but that taxa with high species diversity such as insects, on the other hand, may show significant decreases in richness. Consequently, prioritization of protected areas such as Zaranik Protectorate based on preserving representative species of birds or mammals may not equally protect taxa with higher levels of diversity such as insects.

In summary, we recommend and support the managing of a conservation assessment including not only higher taxa such as birds but

also taxa with high diversity such as insects. The present investigation may provide a basis for including insects in any future conservation assessment.

Acknowledgement: Many workers have contributed to this study. We particularly thank Mr. Saad El-Dien Osman, the manager of Zaranik Protectorate, and his assistants for their help in facilitating our tasks. Also we thank curators of the various collections, who kindly allowed us to examine specimens under their care. Special thanks to Mr. Abdel-Fatah Mabrouk, Entomology Department, Faculty of Science, Cairo University, for his help in identifying specimens of Lepidoptera. Also we would like to express our gratefulness to Mr. Moustafa Rizk Sharaf, Entomology Department, Faculty of Science, Ain Shams University, for identifying ant specimens.

REFERENCES

Alfieri A (1920) Contributions à la faune entomologique du Nord-Est du Sinai. *Bulletin de la Société Entomologique d' Egypte* 6: 40-55.

Alfieri A (1976) The Coleoptera of Egypt (Monograph). *Mémoires de la Societé Entomologique d' Egypte* 5: 1-14 + 1-362.

Bodenheimer FS (1932) Some remarks on the Orthoptera of the Sinai-Peninsula. *Bulletin de la Société Royale Entomologique d'Egypte* 16: 24-32.

Davidson DW (1977) Foraging ecology and community organization in desert seed-eating ants. *Ecology* 58: 711-724.

Efflatoun HS (1930) A monograph of the Egyptian Diptera, part 3, Family Tabanidae. *Mémoires de la Societé Entomologique d' Egypte* 4: 1-114.

Efflatoun HS (1934) A monograph of the Egyptian Diptera, Family Asilidae. *Mémoires de la Societé Entomologique d' Egypte* 4: 1-198.

Efflatoun HS (1937) À monograph of the Egyptian Diptera, Family Asilidae, Section II. *Mémoires de la Societé Entomologique d' Egypte* 4: 199-433.

Efflatoun HS (1945) A monograph of the Egyptian Diptera, part 4, Family Bombylidae, section (1). *Bulletin de la Societé Fouad 1er Entomologie* 29: 1-483.

El-Moursy AA, GILBERT F, ZALAT S & EL-HAWAGRY MS (1999) Foraging behaviour of anthracine flies (Diptera: Bombyliidae) in Southern Sinai, Egypt. *Egyptian Journal of Biology* 1: 87-95.

Fisher BL (1996) Ant diversity patterns in the reserve Integrale d'Andringitra, Madagascar. Pages 93-108 *in* S. M. Goodman (eds). Fieldiana New Series Number 85.

Fisher BL (1997) Concordance of Diversity Patterns in Eastern Madagascar: a preliminary analysis. website (unpublished).

Groombridge B (1992) Global biodiversity: Studies of the Earth's living resources. World Conservation Monitoring Center. Chapmaan and Hall, London

Hart HC (1891) Some account of the Fauna and Flora of Sinai, Petra, Wady Arabah. *London* 175-185.

Kneucker A (1903) Zoologische Ausbeute einer botanischen Studienreise durch die Sinai-Halbinsel im März und April 1902. *Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien* 53: 575-587.

Kneucker A (1922) Zoologische Ergebnisse zweier in den Jahren 1902 und 1904 durch die Sinaihalbinsel unternommener botanischer Studienreisen. *Entomologische Blätter* 18(1):20-28.

Krauss HA (1909) Dermaptera und Orthoptera aus Aegypten, der Halbinsel Sinai, Palestina und Syriea. *Verh. Natwiss. Verein Karlsruhe* 21: 23-43.

Krichner TB (1977) The effects of resources enrichment on the diversity of plants and arthropods in shore grass prairies. *Ecology* 58: 1334-1344.

Moore NW (1991) Observe extinction or Conserve diversity. Pages 1-8 *in* NM Collin & JA Thomas (eds). The conservation of insects and their habitats. Academic Press, London, UK.

Peyerimhoff P (1907) Liste des Coléoptères du Sinai. *L'Abeille* 31:1-48.

Pic M (1913) Coléoptères d'Egypte et du Sinai. *Bulletin de la Société Entomologique d'Egypte* 3: 11-13.

Pic M (1929) Coléoptères d'Egypte et Sinai. *Bulletin de la Société Royale Entomologique d'Egypte* 13: 108-110.

Resj VH, Haag KH & Neff SE (1975) Community structure and diversity of caddisfly adults from the Salt River, Kentucky. *Environmental Entomology* 4(2): 241-253.

Schatzmayr A (1936) Risultati scientifici della spedizione entomologica di S.A.S. il Principe Alessandro della Torre e Tasso in Egitto e nella penisola del Sinai. XII. Catalogo ragionato dei Carabidi finora noti d'Egitto e del Sinai. *Pubblicazioni del Museo entomologico Pietro Rossi, Duino* 14 (1): 114pp.

Wilson EO (1987) The little things that run the world (the importance and conservation of invertebrates). *Conservation biology* 1: 344-346.

Zalat SM (1991) The Sinai desert training center, Insecta. Reports 3, Foreign relations coordination unit, Supreme Council of Universities, Egypt.

الملخص العربي

التنوع الحشري فى محمية الزرانيق بسيناء الشمالية بمصر

علي علي المرسى ، مجدي الحواجرى ، محمود صالح و حسن حمدنا الله فضل

١- قسم علم الحشرات – كلية العلوم – جامعة القاهرة – الجيزة
٢- قسم علم الحشرات – كلية العلوم – جامعة عين شمس – القاهرة

فـــي هذا البحث درست نماذج من التنوع الحشري وتركيب الفونة الحشرية فـــي أربعة مواقع بمحمية الزرانيق بسيناء الشمالية بمصر ولقد احتوت هذه المواقـــع علي ١٨٧ نوعا ونويعا حشريا تابعة لتسع وأربعين فصيلة وتمثل ١٥ رتبة من الرتب الحشرية ومن بين هذه الأنواع وجد أن ٢٥ نوعا منها كانـــت نـــادرة جدا ويحتمل أن تكون مهددة بالانقراض كما سجلت ٥ أنواع جديدة تضاف إلى الفونة الحشرية بمصر .

ولقـــد أظهر التنوع والوفرة الحشرية اختلافات بين المواقع كما أوضحت معايـــير التشـــابه والتـــنوع والتركيب النوعي أن ا لفونة الحشرية بمحمية الزرانـــيق تنقسم إلى قسمين رئيسيين القسم الأول يقع في منطقة الاستراحة بمســـافة عشرة كيلومترات بعيدا عن شاطيء البحر والقسم الثاني يقع علي شاطيء البحر نفسه وبعض الجزر القريبة.

الدراســـة الحالـــية قـــد تعتبر أساسا لادراج الأنواع الحشرية في أي برامج لحماية الأنواع المهددة بالانقراض.