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Arthropod Borne Diseases at Toshka, Upper Egypt

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Abstract: The Egyptian Government plan to move in 25 years from an inhabited area of 6-25% of the total Nile land area to a larger one to compensate the huge increase of Egyptian populations. The decision was recently made to begin a development project at Toshka, on the western bank of the River Nile, Upper Egypt. Toshka depression is more or less close to Wadi Halfa of Sudan. Therefore, it was necessary to develop of Toshka on the west bank of the River Nile. Consequently, two specialized teams, one is national and the other is from WHO, were interested to study the health risk impact of the project on the vector-borne diseases and pests and to plan recommendations for prevention and feasible control of these diseases. The present study was initiated during spring of 2007 & 2008, as spot light survey, on wild rodents and the arthropods having medical and/or veterinary importance. Whilst *Psammomyes obesus* Cretzchmar, 1828 was the only recognized rodent, the following arthropods were identified: the scorpion, *Buthus quinquestriatus* Hante en E., the insects, *Cephus tabidus* (F.), *Ischnura senegalensis* (Rambur, 1842), *Mantis religiosa* Linnaeus, 1758 and *Tabanus taeniola* Palisot de Beauvois, *Culicoides riethi* Kieffer, *Anopheles sergenti* Theobald and *Phlebotomus papatasii* (Scopoli). The medical, veterinary and agriculture importance of each species have been discussed and feasible control measures were suggested.

Key words: Health risk · Vector-borne zoonotic diseases · Rodents

INTRODUCTION

No doubt, arthropods are the most successful creature of all the animal kingdom. They are found in every type of habitats and in all regions of the world. They feed on a wide variety of plant or animal materials and have been known as the major causes of diseases transmission for many centuries [1].

Generally speaking, in any new reclaimed areas survey for the arthropod-borne diseases to man, animals and plants is a must. The outcome results pave the way for understanding the diseases that could be introduced by the humans themselves or from the neighboring countries [2]. One must keep in mind that Egypt lies at the cross road of many countries and susceptible to sudden arthropod-borne epidemics [3].

In Sub-Saharan Africa mainly Sudan which borders Toshka, many arthropod-borne diseases were reported. These are Anthrax, Dengue fever, Loiasis (*Loa loa*), Malignant malaria (*P. falciparum*), Onchocerciasis (*Onchocerca volvulus* and *O. gibsoni*) and Plague (last outbreak in 1979). Menegon *et al*. [4] reported drug-resistance malignant malaria in Sudan. *Anopheles sergentii* was detected in southern Nile Valley very near to Sudan [5].

Epidemic and endemic relapsing fever, Spotted fever (*Rickettsia conorii*), Epidemic typhus fever (*R. typhi*) African Trypanosomiasis, (*Trypanosoma b. gambiense* and possibly *T. b. rhodesience*) and Yellow fever were also common. This is apart from others diseases introduced to Egypt from Sudan as Blue tongue of horses and Rift Valley fever [6, 7].

This work aimed at identification of the arthropods and wild rodents in the vicinity of Toshka and to discuss their risk impact factors on man, domestic and farm animals and cultivated plants.

MATERIALS AND METHODS

Five field trips of one week each were carried out over the spring seasons of 2007 & 2008. At that time the environmental conditions favored the life activities of the arthropods. Also, the conditions favored the field team avoiding the very hot burning summer and the very cold winter.

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Fig. 1: A map showing Toshka Project

Safely Capture of Scorpion: Scorpions were captured by placing a quart-sized glass jar over the scorpion and sliding a sheet of heavy construction paper under the jar opening, thus trapping the scorpion. With the sheet of paper securely over the mouth of the jar, invert the jar opening and the scorpion will fall to the bottom of the jar. Screw a secure lid over the mouth of the jar. Scorpions can also be picked up safely with the forceps which were 10 to 12 inches in length or with other long mechanical devices made for picking up small objects and placed in a glass jar secured with a screw-type lid [8].

The normal hand swapping traps were used at the daytime to collect *Ischnura senegalensis, Cephus tabidus, Mantis religiosa* and *Tabanus taeniola* [9]. All of them are daily active insects particularly around desert plants and camels.

Both *Culicoides* species and *Phlebotomus* species are known to night active blood sucking flies.

So, the biting midges of the genus *Culicoides* were collected by a locally designed wooden box light traps [10].

The traps were distributed just before sunset till sunrise. Captured insects were collected by a labeled plastic aspirator.

Also, the sand-flies of the genus *Phlebotomus* were collected by the sticky traps and/or CDC light traps. Both traps were distributed new rodents' borrows, just before sunset and collected on sun rise next morning [11].

The Fat Sand Rat or Al-Jarada, *Psammomyes obesus* (Cretzschmar, 1828) was collected by the digging trapping technique around the characteristic tunnels' opening. It lives in groups inside the deep desert tunnels [12]. *P. obesus* feed on the root of the desert plant, *Chenopodium* and thus any bait was not valuable to attract its attention. The collected rodents were put separately in cloth bags to protect the collectors from any of their ecto-parasites as ticks, mites, fleas or sandflies.

RESULTS

The Bio-safety measures were sharply taken into consideration and samples were immediately transported to the temporary field laboratory. The standard international keys were adopted to verify the preliminary identifications of the present authors.

Three *Buthus quinquestriatus* are collected. They are characterized by elongated body divided into sac-like cephalothorax and segmented abdomen of two parts with the last segment modified into a pyriform telson ending into hooked stinger.

One black *Cephus tabidus* and two of *Ischnura senegalensis* were found. *I. senegalensis* was found in slow-stagnant or leisurely flowing water.

Mantises have two grasping, spiked forelegs (raptorial legs) in which prey items are caught and held securely. The prothorax segment is commonly elongated and flexibly articulated, allowing for greater range of

Table 1: Average No. of Arthropods collected from five field-trips of three nights each over two spring seasons

Arthropod	Number collected	Percent
Buthus quinquestriatus	3	7.5
Ceph*us tabidus*	1	2.5
Ischnura senegalensis	2	75.0
Mantis religiosa	3	7.5
Tabanus taeniola	4	10.0
Culicoides riethi,	5	12.5
Anopheles sergernti	10	25.0
Phlebotomus papatasii	12	30.0
Total	40	100

movement of the front limbs, while the remainder of the body is more or less immobile. The articulation of the head is also remarkably flexible, permitting nearly 300 degrees of movement in some species, allowing for a great range of vision (their compound eyes have a large binocular field of vision) without having to move the remainder of the body. As their hunting relies heavily on vision, they are primarily diurnal, but many species will fly at night.

Four *Tabanus taeniola* are found which rarely investigate traps that presumably mimic hosts. Five *Culicoides riethi* are collected, only females feed on worm-blooded vertebrates. This habit makes them pests of man and livestock.

Ten *Anopheles sergenti* are found which the potential malaria vector not only in Egypt but also in many of the Eastern Mediterranean Countries. *Phlebotomus papatasii* the vector of zoonotic cutaneous leishmaniasis in the old world were found in close contact with *Psammomys* burrows.

Three female *Psammomys obesus* were trapped. One showed a skin lesion caused by *Leishmania major* as indicated by smear examination and inoculation into clean laboratory breed hamster.

DISCUSSION

Buthus quinquestriatus; scorpions (Order: Scorpionida) are approximately 19 species in this genus. They are easily distinguished by their crablike appearance, with a pair of pincers, four pairs of legs and a long, segmented tail ending with an enlarged segment bearing a stinger.

Although they have two eyes in the middle of the head and usually form additional two to five eyes along the margin on each side, they do not see well and thus depend on touch. When running, they hold their pincers outstretched and the posterior end of the abdomen is usually curved upward. Scorpions that hide under stones and other objects during the day tend to carry their stinger to one side, whereas burrowing scorpions hold their stinger up over their backs [13].

Fatani *et al*. [14], reported that scorpion was a real problem and compared between the protective effects of Saudi and Egyptian anti-venoms.

The scorpion venomous species cause severe systemic reactions, lymphadenitis, twitching, muscle spasm and convulsions. Besides, the patients may die of respiratory paralysis with pulmonary edema within 2 to 3 hours after being sting [15].

The lipid composition of the haemolymph and hepatopancreas of *B. quinquestriatus* is the high density lipoproteins (HDL). The major content of HDL is the phospholipids. The predominating fatty acids in the haemolymph are oleic, palmitic and linoleic acids. The triglycerides and cholesterol amounts in hepatopancreas are 0.3 and 0.003 g/g tissue, respectively.

Using thin-layer chromatography, spots with mobility corresponding to cholesterol esters, triglycerides, free fatty acids, partial glycerides and phospholipids were observed in the lipid extract of the hepatopancreas [16]. The major fatty acids in the hepatopancreas were oleic, linoleic and Palmitic acids [17]. Farghly and Ali [18] and [19] stated that the scorpion as a real environmental health problem in Upper Egypt mainly among the pre-school and school aged children. Engelmann and Hallof [20] considered the scorpions as one of the medical occupational problem in Egypt's early times.

Wheat stem sawflies (Hymenoptera: Cephidae) are important pests of wheat and other grain crops in the northern hemisphere [21]. The family consists of approximately 100 species in 11–15 genera and includes species whose larvae feed in the stems or twigs of grasses, berry canes, shrubs and trees [22-24]. In addition to *C. cinctus, C. pygmaeus* and *T. tabidus* mentioned above, several other species are key pests of cereal crops in Europe, North Africa and Asia. In Israel, sawfly larvae were reported in wild oat (Avena sp.), though it is unclear whether either or both *C. pygmaeus* or *T. tabidus* was found in this host [25].

Streams and Coles [26], reported that during the period from 1935-38, *Collyria calcitrator* (Gravenhorst), a parasite of the European wheat stem sawfly, *Cephus pygmaeus* (Hymenoptera: Cephidae) was released in Eastern United States by the USDA but not recovered until 1957, when adults of *Collyria calcitrator* were collected near Moorestown [New Jersey] and the southeastern Pennsylvania [27]. In 1962-63, the survey on

wheat fields in the Northeastern States showed that *C. calcitrator* was distributed throughout the range of *Cephus pygmaeus* and parasitized a high percentage of the larvae of this species but apparently did not attack the closely related black grain stem sawfly, *Cephus tabidus* (F.) recorded in Europe [13].

In Canada, as well sawfly caused great economic loss in the wheat [14]. About 5% of *C. pygmaeus* and 18% of *C. tabidus* were parasitized by *Pediobius nigritarsis* (Thomson). Multiple parasitisms of *C. pygmaeus* larvae by *Collyria calcitrator* and *P. nigritarsis* were observed. *P. nigritarsis* might be superior and supersede *C. calcitrator* when both attack the same host [31]. Although, *Cephus pygmaeus* has declined as a pest since *Collyria calcitrator* was introduced, yet this declined was coincidental, since *Cephus tabidus* has also decreased in importance [32].

Ischnura senegalensis (Zygoptera: Odonata; Coenagrio-nidae) are variously known as Common Blue-tail, Marsh Blue-tail, African Blue-tail, Ubiquitous Blue-tail, Senegal Golden damsel fly [33]. It is a widespread native fly from Africa, through the Middle East, throughout southern and eastern Asia [34]. Although it was believed that at least 52 species are expected to occur in Egypt, the dragonfly fauna found in Egypt in 1990 appears to be extremely poor in most parts of the country [29]. This can probably be mainly attributed to the fact that virtually all waters are severely influenced by man: regulation of water level, pollution, mechanical disturbance etc. Most 'green' parts of Egypt are composed of irrigated fields and polluted irrigation canals. Species found in the fields and along irrigation canals are (in order of decreasing abundance): Orthetrum trinacria, Ischnura senegalensis, Trithemis annulata and Orthetrum sabina. The few small lakes are generally inhabited by the same (few) dragonfly species. Most of the species found in these areas are abundant (in order of decreasing abundance): Ischnura senegalensis, Brachythemis leucosticta, Crocothemis erythraea, Orthetrum trinacria, Trithemis annulata and Orthetrum sabina.

Yamawaki and Toh [35], reported that *Mantis religiosa*, referred to as the European *Mantis* outside of Europe and known simply as the Praying *Mantis* in Europe and elsewhere, is one of the most well known and widespread species of the Order, Mantodea. Originating in the southern Europe, the European *Mantis* was introduced to North America in 1899 on a shipment of nursery plants. Now they are found all over the north-eastern United States and Canada to the Pacific Northwest.

The praying mantids were thought to be so strictly predacious that, historically, carnivorousness has been used as defining characteristics of the taxon Mantodea and no data exist on other ingestive behaviors [36].

Koehler and Predel [37] mentioned that the European *Mantis* is usually 5-7.5 cm (2-3 inches) in length and has shades of bright green to tan. It can be distinguished easily by a black-ringed spot beneath the fore coxae. It is one of several different insects for which a name used within Europe to refer to only a single insect species (in this case, praying mantis) became adopted throughout the globe to refer to the larger group of insects to which that one species belongs (e.g., compare "hornet" to European hornet, or "wasp" to Common wasp).

The *Tabanus taeniola* (Family: Tabanidae) or the horseflies have been previously recorded and a total of 21 species and subspecies of the genus *Tabanus* were identified in Egypt by [38].

In Aswan district, both *Tabanus taeniolaa* and *Haematopota minuscula* were trapped on camels and equines at daytime during summer of 2000 [39].

In general, tabanids species are the mechanical transmittors of *Bacillus anthracis* and *Francisella tularenis*. The latter bacterium which causes tularemia exists in a natural cycle involving the rabbits, mice, squirrels, beavers and other animals (also dogs, cats, sheep may be infected) as well as the birds [40]. Besides, *Trypanosoma theileri* of cattle is cyclically transmitted by species of *Tabanus* [41].

Besides, *Tabanus* larvae are carnivorous and produce edema of the human feet. The adult tabanids have very painful and severe irritating bites to man and animals while taking its blood meal [42].

*Culicoides rieth*i (Family: Ceratopogonidae) has been previously reported in Egypt [43]. At least ten species of the genus *Culicoides* were reported and that *C. schultzei* (Enderlein) was the most common and predominant species [44].

In general, *Culicoides* species are vectors of the non-periodic filarial worms, *Dipetalonema perstans* and *Mansonella ozzardi*, other species are vectors of viral diseases, as blue tongue of sheep and horse sickness [45]. On the other hand, they have a very painful and irritating bite causing allergic dermatitis due to the hypersensitivity associated with the increase of the histamine in the host blood particularly in summer [46] and man [47].

Mellor *et al*. [48] reported that the bluetongue virus existed all worldwide in a broadband covering much of the Americas, Africa, southern Asia, northern Australia, Europe and Mediterranean basin. They attributed the

dramatic change in BT epidemiology due recent extensions in the distribution of its major vector, *C. imicola*, to the involvement of novel *Culicoides* vector(s) and to the ongoing climate change on the world.

As to *Anopheles sergenti* [5] reported it as a new record of the malaria vector in the southern Nile Valley. This species was reported in El Fayoum Governorate which was categorized as a high risk area for malignant malaria during the last two decades with a unique biotic presence of [49, 50]. El-Bahnasawy *et al*. [51] evaluated the clinical and parasitic status of malaria as a cause of fever among patients admitted to the Military fever hospitals. Thirty six patients were included twenty already diagnosed as malarial patients, who were recruited from Peace Keeping Mission Forces in Africa., Menegon *et al*. [52] reported that malignant malaria was common in Sudan with antimalaria drug resistance mainly in *P. faciparum*.

Phlebotomus papatasii (Family: Psychodidae) was previously reported in Egypt [53]. The Illustrated keys for the identification of the nine Egyptian species of *Phlebotomus* were given [54].

The sandflies of the genus *Phlebotomus* are considered as the primary vectors of visceral and cutaneous leishmaniasis, including *P. sergenti*, *P. orientalis*, *P. alexandri* and *P. bergeroti* [55] *P. papatasi* is the proved vector of papataci fever and ZCL in the Eastern Mediterranean Countries [56] and *P. langeroni* Nitzulescu is infantile visceral leishmaniasis proven vector in Egypt [57].

Endemic foci of *Leishmania major* were reported in Sinai [58-61]. The zoonotic *Leishmania major* with three Zymodemes was identified from man, rodents and sand-flies on different occasions [53-54, 62-66]. The identified Egyptian ZCL was the Zymodeme London 1, Zymodeme London 2 and Zymodeme London 70. However, the Zymodeme London 1 and 2 were typed from man and rodents, while the Zymodeme London 70 was typed from man and sand-flies. On the other hand, scattered cases of infantile visceral leishmaniasis were reported from five Egyptian Governorates [68-71].

The sand-rat, *Psammomys obesus* (Cretzchmar, 1828) has been previously reported in Egypt [67]. There are three sub-species; which are *Psammomys o. terraesanctae, P. o. nicoli* and *P. o. obesus***.** This Fat Sand Rat or Jarada is very common in Algeria, Arabia, Egypt, Israel, Libya, Morocco, the Sudan and Tunisia [72].

In Egypt, they are common in Northern and southern parts of Sinai Peninsula, northern part of Eastern Desert and northeastern and north-western parts of Nile Delta. Morsy *et al*. [12] gave a key and distribution map of rodents in Sinai.

In conclusion, no doubt, the establishment of the new reclaimed areas of Egypt such as Toshka is a great project of long life value to the human welfare. This pilot study showed the presence of some arthropods that have medical, veterinary and/or agriculture importance. This fact must be considered by the Egyptian Health and economic authorities. In general, the new intruders to the new reclaimed areas or newly established areas are hosts that add in the prevalence and dissemination of zoonotic diseases.

RECOMMENDATION

No doubt, the epidemics and the epizootic of risky diseases emerged in new reclaimed areas, when man comes in close contact with wild reservoir animals and the ecto- and endo-parasites.

The Toshka Project authorities decided not to apply any chemical insecticides by any means. Feasible control of these vectors and pests should be forwarded biological and or natural control measures. Besides, the periodical surveys would identify other vectors and pests.

On the other hand, studying the vector ecology, seasonal activity and variations, hibernation, behavior periodicity, population ecology, is a must to pave the way for safe biocontrol measures.

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