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SEASONAL ABUNDANCE OF *ORNITHODOROS (O.) SAVIGNYI* AND PREVALENCE OF INFECTION WITH *BORRELIA* SPIROCHETES IN EGYPT

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Abstract

The seasonal dynamics of *Ornithodoros (O.) savignyi* and infection with *Borrelia sp.* in the tick, domestic animals and man were investigated in the village of Dahshore, Giza governorate from August 1996 through July 1997. The tick population densities of adults and immatures were high during the period from June to October with maximum levels in August and September respectively. Adults predominated (58.6% - 80.0%) in October to May with the highest abundance in January while immatures prevailed (51.3% - 65.8%) during the rest of the year reaching a peak in September. Of 1202 tick examined, the spirochetes were detected in 427 (35.5%). The annual infection rate in adults and immatures varied from 34.4% - 36.9% with no significant difference among larvae, nymphs, males and females. Of 1396 sera from man and 553 sera from host animals tested, 309 (22.1%) and 157 (28.4%), respectively, were reactive for antibody to *Borrelia sp.* antigen with the highest infection rate in camel (47.8%), followed by sheep (23.8%), goat (18.0%) and cow (16.0%), then the least in buffalo (10.9%). Changes in prevalence of *Borrelia* infection in the tick population correlated positively with changes in antibody prevalence in man and camel and with changes in the tick population density. The four events were lowest in winter and early spring and increased afterward to reach maxima during summer or the early fall (July – September).

Introduction

The sand tampan *Ornithodoros (O.) savignyi* (Audouim) occurs in arid biotopes of northern and southern Africa, and from Arabia to India and Sri-Lanka (Hoogstraal, 1956). This species has not been incriminated as a vector of microorganisms that cause disease in human beings or animals (Hoogstraal, 1985). However, African swine fever virus has been successfully transmitted by this species in the laboratory (Mellor and Wilkinson, 1985). The distribution of *O. savignyi* in Africa suggests that this species could be a natural field vector of African swine fever. Also, *O. savignyi* transmitted *Anaplasma marginale* to splenectomized calves (Raja *et al.*, 1986). It is well known that domestic animals, including camels, goats, and sheep, may suffer or die from loss of blood when parasitized by numerous sand tampans. People attacked by this species may suffer from severe irritation (Hoogstraal, 1985). The immature and adult *O. savignyi* were susceptible to experimental infections by *Borrelia crocidurae* and transstadial transfer of *B. crocidurae* was also evident (Gaber *et al.*, 1984). The same authors suggested that the ability of the infected tick to transmit the spirochaete while feeding on uninfected hamsters proved the capacity of the tick to serve as vector of this agent. Hoogstraal (1985) reported that *O. savignyi* had never been found to be naturally infected with *Borrelia* in any part of the world. However, natural infection of *O. savignyi* with *Borrelia sp.* was recorded for the first time Southeast of Egypt in Halayeb region during 1996 by Shanbaky and Helmy (in preparation). The isolated *Borrelia* showed specificity for *O. savignyi* and could be transovarially transmitted from one generation to the next.

In the present study, natural borrelial infecton of *O. savignyi* is recorded in another locality of Egypt, namely Dahshore village in Giza governorate. The seasonal abundance of *O. savingyi* and prevalence of borrelial infection of the tick, domestic animals and humans are investigated.

Materials And Methods

The argasid tick, *Ornithodoros (O.) savignyi* Audouin was collected once a month (August 1996 through July, 1997) from sand under trees where camels, horses, cattle, other animals and humans rest in the desert of Dahshore, Giza governorate. The sand (within 1 m^2/tree) under ten trees, 200-400 m. distant from each other were examined for ticks, each month using a small-mesh metal sieves. The collected ticks were sorted to the developmental stage and sex and the number of each was recorded. Climatic data (mean minimum and mean maximum monthly temperatures and mean monthly relative humidity) were obtained from the Imbaba weather station near the study locality.

The monthly collected ticks of each life stage were examined for

The percentages of the different life-stages of the tick and that of *Borrelia* infected ticks and blood samples in each monthly collection were determined. Data were analyzed with the chi-square test. The correlation between the rate of infection in the tick, camel and man, and the number of the collected ticks was examined with Pearson's correlation coefficient. Data analysis were carried out with the aid of Statistical Package for Social Science (SPSS), version 8.0 for Windows.

Results And Discussion

Table (1): Mean minimum and maximum monthly temperatures and relative humidity near Dahshore, Giza governorate (August 1996 – July 1997)

Month	Mean Temperature (°C) Minimum	Maximum	Mean Relative Humidity (%)
August 1996	21.3	36.0	69.2
September	19.2	34.0	69.0
October	17.7	32.5	65.0
November	12.9	27.9	69.5
December	8.5	22.5	71.4
January 1997	6.5	21.3	65.7
February	8.0	21.9	66.9
March	9.8	23.5	62.0
April	13.5	28.9	54.5
May	16.7	32.0	55.0
June	19.9	35.9	57.5
July	21.0	34.7	66.0

During the period of study (August 1996 – July 1997), the mean maximum and minimum temperature were lowest in December – March and highest in June – September. The mean RH was highest in November – December and lowest in April – June (Table 1).

Table (2): Prevalence of adults and immatures of the sa nd tampans, *O. savignyi* in Dahshore village, Giza governorate during one year (August 1996 – July 1997)

Month	Total Tick No.	Tick Collected					
		Adults			Immatures		
		%	M %	F %	%	Nymphs %	Larvae %
August'96	228	48.7	14.9	33.8	51.3	31.1	20.1
Sept.	298	34.2	15.8	18.5	65.8	36.6	29.2
Oct.	140	72.1	50.0	22.1	27.9	13.6	14.3
Nov.	30	66.7	46.7	20.0	33.3	33.3	0.0
Dec.	23	60.9	39.1	21.7	39.1	26.1	13.0
Jan. '97	15	80.0	40.0	40.0	20.0	20.0	0.0
Feb.	14	71.4	28.6	42.9	28.6	21.4	7.1
March	25	52.0	20.0	32.0	48.0	28.0	2.0
April	37	70.3	21.6	48.6	29.7	27.0	2.7
May	82	58.5	36.6	21.9	41.5	17.1	24.4
June	110	47.3	36.4	10.9	52.7	20.9	31.8
July	200	45.0	25.0	20.0	55.0	15.0	40.0
Total	1202	49.8	26.4	23.5	50.2	25.3	24.9

During the period of study a total of 1202 *O. savignyi* was collected from Dahshore, Giza governorate (Table 2). Tick population densities of adults and immatures were the lowest in winter and early spring (December – March) increasing gradually in late spring and summer reaching maxima in August and September, respectively to decrease afterward in the late fall (November). Adults constituted 49.8% (26.4% M and 23.5% F) while immature represented 50.2% (25.3% N and 24.9% L) of the total collected ticks. The percentages of adults were lowest ($P < 0.05$) (34.2% to 48.7%) during summer and early fall (June to September), increased ($P < 0.05$) (58.5% to 80.0%) during late fall, winter and spring (October to May) except in March (52.0%) with the highest abundance ($P < 0.001$) in January (80.0%). Males predominated the female during late spring, most of summer, late fall and early winter (May to December except in August and September). However, the female predominated ($P < 0.05$) during late winter and most of spring (February to April). In contrast to adults, immatures prevailed ($P < 0.05$) during summer and early fall (June – September) with the highest abundance ($P < 0.01$) in September (65.8%) and receded the rest of the year. The nymphs predominated the larvae throughout the period of study except in May to July. The obtained results suggested a correlation between changes in adult and immature *O. savignyi* populations densities and the seasonal climatic changes. These changes might affect the reproductive and developmental cycle. At a relatively low temperature, the *O. savignyi* adult pre-oviposition, oviposition, and postoviposition periods are prolonged (Cunliffe, 1922). In nature this retardation might have resulted in a greater adult abundance similar to that observed in the population of *O. savignyi* in Dahshore during late fall, winter and spring (October to May) than during warmer summer and early fall period (June to September) where immatures prevailed. Generally, the biological activities of *O. savignyi* (Cunliffe, 1922) and other closely related species *O. erraticus*, increase at temperatures in the range of those of summer and early fall in Giza, Egypt and decrease at temperature in the range of those in the governorate during winter (Elshora,1987; Khalil *et al.*, 1986). Seasonal changes in the population of *O. savignyi* and populations of its different life stages are similar to those of *O. erraticus*, in Giza governorate (Imbaba village)(Khalil *et al.*,1984)and to other closely related species of soft ticks studied in Egypt (Guirgis, 1971).

In *O. savignyi*, the earlier emergence of males (chiefly from the 4th and 5th nymphal instars) than of females (from the 5th to 7th nymphal instars) (Hefnawy *et al.*, 1979) is probably the cause for the significant predomination of males over females during late spring, most of the summer, late fall and early winter (May to December). Also, the great number of nymphal instars (1-7) of *O. savignyi* is probably the cause for the significant predomination of nymphs over larvae during the period of study except in May to July where the higher temperature shortens the oviposition, postoviposition and molting periods. However, other climatic and environmental factors including photoperiod and availability of other hosts, may have prominent effects on the tick activity and population (Balashov, 1972).

monthly collected sample, as well as to the success in nature of this symbiotic spirochete of the tick (Hoogstraal, 1979). The chief factor is the transovarial transmission of the agent from the parent female to the F_1 generation. In the present study, the relatively high rate of infection in the unfed collected larvae (larvae of *O. savignyi* do not feed) suggested the occurrence of transovarial transmission in this tick species. Another factor is the transstadial transmission from stage to stage, from larvae to nymphs and from nymphs to adults. Both transovarial and transstadial transmissions of *Borrelia* have been reported in naturally infected adults and nymphs of *O. savignyi* reared in laboratory (Shanbaky and Helmy, in preparation). Furthermore, Gaber *et al.*, 1984 found that adults and immatures of *O. savignyi* were susceptible to experimental infection by *B. crocidurae* and an evident transstadial transfer of the spirochetes was observed.

Table (4): Prevalence of *Borrelia sp.* infection in blood samples from man and animals in Dahshore, Giza governorate (August 1996 – July 1997)

Month	Blood samples examined and percent infection (No. infected /No. examined)											
	Man		Camels		Goats		Sheep		Buffalo		Cow	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Aug. 1996	150	58.0	26	80.8	0	0.0	10	20.0	21	28.6	5	40.0
Sept.	130	22.3	23	47.8	3	33.3	19	31.6	3	33.3	1	0.0
Oct.	120	30.0	18	66.7	10	10.0	-	-	2	0.0	5	20.0
Nov.	160	3.8	10	50.0	-	-	3	33.3	14	0.0	6	0.0
Dec.	140	4.3	22	31.8	9	22.2	10	10.0	7	0.0	13	0.0
Jan. 1997	153	0.0	14	21.4	7	0.0	-	-	16	0.0	1	0.0
Feb.	100	0.0	11	9.1	5	0.0	-	-	20	10.0	2	0.0
March	115	15.7	20	30.0	9	22.2	3	0.0	10	10.0	-	-
April	90	24.4	8	37.5	1	0.0	24	0.0	5	0.0	8	37.5
May	129	41.9	25	40.0	2	50.0	18	16.7	7	0.0	5	20.0
June	52	42.3	15	60.0	15	26.7	11	63.6	11	9.1	4	25.0
July	57	50.9	9	88.8	-	-	24	37.5	3	66.7	-	-
Total	1396	22.1	201	47.8	61	18.0	122	23.8	119	10.9	50	16.0

Blood samples from man and animals (camel, goat, sheep, buffalo and cow) in the studied locality were examined for *Borrelia sp.* during the period of study (August 1996 – July 1997). *Borrelia* positive samples represented 22.1% of the examined blood samples (No. 1396) (Table 4) collected from 6-13 years old boys and girls in Dahshore, Giza governorate. The infection rate in the blood samples of man was relatively high ($P < 0.05$) during late spring and summer (May – August) reaching a maximum ($P < 0.001$) in August (58.0%) and decreased ($P < 0.05$) in September (22.3%) and October (30.0%) reaching a minimum in January and February (0.0%). Of the blood samples collected from animals; camel showed the highest infection rate (47.8%)($P < 0.001$), followed by sheep (23.8%), goat (18.0%), cow (16.0%) and buffalo (10.9%). However, there was no significant difference ($P > 0.05$) between the infection rates in sheep, goat, cow and buffalo except that between sheep and buffalo ($P < 0.05$). The infection rates in the blood samples of all animals were relatively low ($P < 0.05$) during winter and early spring (December – March). Generally, the infection rates were the highest ($P < 0.05$) recorded during late spring and summer (May – August) (Table 4) and decreased to lower level ($P < 0.05$) in the fall. Serological results from blood samples of man and animals showed that the infection rates of *Borrelia sp.* were relatively low during winter and early spring. However, the infection rates gradually increased in spring to reach the highest levels at the end of spring and in summer (May – August). During the period of study, a significant ($P < 0.0001 – 0.05$) positive correlation was observed between changes in the infection rate in the tick and those in each of man ($r = 0.66$) and camel ($r = 0.76$) and changes in the tick population density ($r = 0.97$). The four events increased in late spring and summer and decreased afterwards to reach their lowest levels in winter and early spring (Fig. 1).

It is concluded that *Borrelia sp.* infected *O. savignyi* in Dahshore area, Giza governorate may represent a potential source of borreliosis in animals and man shading or reclining on sandy ground under the infested trees. Humans exposed to bites of the sand tampans in the studied locality had complains about suffering illness and symptoms most probably similar to those of the relapsing fever. However, no attempt for a medical diagnosis of the disease was performed on those persons. It is possible that borreliosis in man is underestimated due to misdiagnosis or a failure of detection of the low *Borrelia* densities in patients blood. The present data are useful in evaluating the size of borrelial diseases (including relapsing fever and Lyme disease) in Egypt and understanding the role of some common animals

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