Some observations on ticks (Acari: Ixodidae) infesting sheep in River Nile Province of Northern Sudan

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ABSTRACT

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Five species of ixodid ticks were found in a cross-sectional survey in which 200 sheep were examined for ticks in River Nile Province, Sudan. *Hyalomma anatolicum anatolicum* was the predominant species (73.6 %), whereas ticks belonging to the *Rhipicephalus sanguineus* group (14.7 %), *Rhipicephalus evertsi evertsi* (9.1 %), *Rhipicephalus simus* (2 %) and *Hyalomma dromedarii* (0.5 %) were also found. The mean tick load was 11.2 per animal. In a subsequent longitudinal survey ticks were collected on a monthly basis from eight sentinel sheep that were introduced into the area. It was found that *H. a. anatolicum* almost disappeared during the hot period between April and August, whereas it's highest numbers were present in winter between November and February. It is concluded that there is only one generation of *H. a. anatolicum* per year, which may explain the year-round appearance of clinical cases of malignant ovine theileriosis indicating endemic instability of this disease in River Nile Province.

Keywords: Northern Sudan, sheep, survey, ticks

INTRODUCTION

River Nile Province in northern Sudan covers an area of about 124 000 km^2. The province has borders with Egypt to the north, the Red Sea and Kassala Provinces to the east, Khartoum Province to the south and the Northern Province to the west. The numbers of animals in River Nile Province are modest compared to other regions of the country. Sheep and goats constitute the majority of the animal wealth with an estimated 953 000 and 1 149 000 head, respectively (Anon. 2002). They are usually raised as small mixed flocks along the Nile River and the banks of the seasonal Atbara River.

River Nile Province is part of the so-called disease-free zone of northern Sudan, where major contagious diseases such as peste des petits ruminants, sheep pox, and foot-and-mouth disease are rare. The area is used for fattening sheep and as a quarantine of animals for export before they are shipped to neighbouring countries. However, clinical cases of malignant ovine theileriosis are reported throughout the year in this area, but are most prevalent during the hot and dry season between March and May (El Ghali & El Hussein 1995). Very little work has been carried out on the ticks infesting small ruminants in the Sudan (Osman 1997). We therefore conducted the present study to shed some light on the tick fauna in this part of the country.

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MATERIALS AND METHODS

Study area

River Nile Province lies within the tropical zone and occupies both desert and semi-desert areas. The most important climatic feature of the Province is the occurrence of a long dry season extending for approximately eight months from November to June, while the rainy season is restricted to the months of July to October with rainfall occurring mostly in August. The average annual rainfall ranges between zero in the northern part of the province, to around 100 mm in the southern part. The hot season extends from March to October with May and June usually being the hottest months when daily maximum temperatures can be well above 40 °C. The cold dry season extends from November to February, January being the coldest month.

The vegetation of the state is poor and sparse. In the desert zones, it is virtually absent except along the banks of the Nile River and water courses where ephemeral herbs and grasses occur after the occasional rainfall. In the basins and along the Nile banks *Acacia* spp. are found. In the southern part the vegetation is typical of a semi-desert region, and is dominated by *Acacia toritilis*. Other trees are *Acacia seyal*, *Balanites aegyptica* and *Ziziphus spinachristi*. Ground shrubs include *Calotropis procera, Caparis decidua, Lyptadenia pyrotechnica* and *Cassia* spp. The dominant grasses are *Aristida mutabilis* and *Cympopogon nervatus* (Anderson 1948, Harrison & Jackson 1958).

Cross-sectional survey

Whole body tick collections were made from 200 randomly selected sheep in 15 different localities in the southern part of River Nile Province. The ticks were preserved in 70 % ethanol and identified according to the keys provided by Hoogstraal (1956).

Longitudinal survey

Eight indigenous sheep between 6–12 months old were obtained from a local market and subsequently introduced into El Akad village, located at the east bank of the Nile River near Atbara. The animals were monitored as sentinel animals to study the dynamics of the local tick population. The sheep were kept as one flock under traditional husbandry adjacent to village herds of cattle and flocks of sheep and goats. During daytime they were allowed to mix with village animals while grazing on residual agricultural crops grown along the banks of the Nile River. Additional feed was provided to the animals upon return to their sheds at sunset.

The sheep were completely deticked at monthly intervals for 18 months between October 1996 and March 1998. The ticks were preserved in 70 % ethanol, labelled and identified as above.

RESULTS

Cross-sectional survey

An average of 11.2 ticks per animal were collected from the 200 sheep. The majority of the ticks (1 506) were adults and 723 were nymphs; only four larvae were collected (Table 1).

The range and mean tick load per animal of *H. a. anatolicum* was found to be significantly higher ($P < 0.001$) than that of all other tick species together. Males usually outnumbered females except for *R. simus* (eight males and 11 females). *Hyalomma a. anatolicum* was found on 59.5 % of the animals examined, whereas *R. sanguineus* group, *R. e. evertsi* and *R. simus* were found on 24 %, 31.5 % and 15.5 % of the animals, respectively. *Hyalomma dromedarii* was found on only two animals (1 %) (Table 1).

Longitudinal survey

Only *H. a. anatolicum* and *R. sanguineus* group ticks were found on sentinel sheep at El Akad village. *Hyalomma a. anatolicum* was the predominant species, comprising 92 % of the total number of ticks collected, while *R. sanguineus* group ticks represented only 8 %. Only one female of *R. e. evertsi* was collected. With the exception of one *Rhipicephalus* spp. nymph, all immature ticks collected (1 963 nymphs and 1 673 larvae) were *Hyalomma* ticks.

The seasonal activity of *H. a. anatolicum* ticks is shown in Table 2 and Fig. 1. Adults of *H. a. anatolicum* were found to be active throughout the year, but they were most prevalent during the period September to March (late rainy season to early summer). Peak infestations occurred during November and a second peak occurred in March. A drastic decrease in tick numbers was observed from May to August (mid-summer to early rainy season). The mean *H. a. anatolicum* tick load was relatively high (11.6) during winter (November to February) decreasing to 10.6 during summer (March-June) with a further decrease to 7.3 during the rainy season (July to October). A significant difference ($P < 0.05$) in mean tick load was found only between winter and the rainy season.

TABLE 1 Prevalence of different tick species infesting sheep in River Nile Province. Figures in parenthesis represent numbers of animals infested

Tick species	No. of adults collected	Male/female	Percentage of total tick burden	Average no. of tick/animal	
				Range	Mean ± SE
H. a. anatolicum	1 108 (119)	766/342	73.57	1–60	9.31 ± 0.97
R. sanguineus group	222 (48)	170/52	14.74	1–22	4.63 ± 0.70
R. evertsi evertsi	137 (63)	97/40	9.10	1–5	2.17 ± 0.19
R. simus	31 (17)	8/11	2.06	1–5	1.82 ± 0.30
H. dromedarii	8 (2)	5/3	0.53	1–7	4.00 ± 3.00

TABLE 2 Monthly variations of *H. a. anatolicum* found on sheep at El-Akad area

Month	Adults		Immatures (larvae and nymphae)	
	Total	Mean	Total	Mean
Oct. 1996	31	3.9	58	7.3
Nov.	43	5.4	572	71.5
Dec.	97	12.1	28	3.5
Jan.	91	11.4	16	2
Feb.	10	1.3	181	22.6
Mar.	107	13.4	4	0.5
Apr.	55	6.9	0	0
May	1	0.1	0	0
June	11	1.4	0	0
July	14	1.8	0	0
Aug.	7	0.9	0	0
Sep.	91	11.4	331	41.3
Oct.	121	15.1	570	71.3
Nov.	163	20.4	368	46
Dec.	125	15.6	135	16.9
Jan.	113	14.1	766	95.4
Feb.	100	12.5	189	23.6
Mar. 1998	251	31.4	112	14
Total	1 431	9.9	3 330	23.1

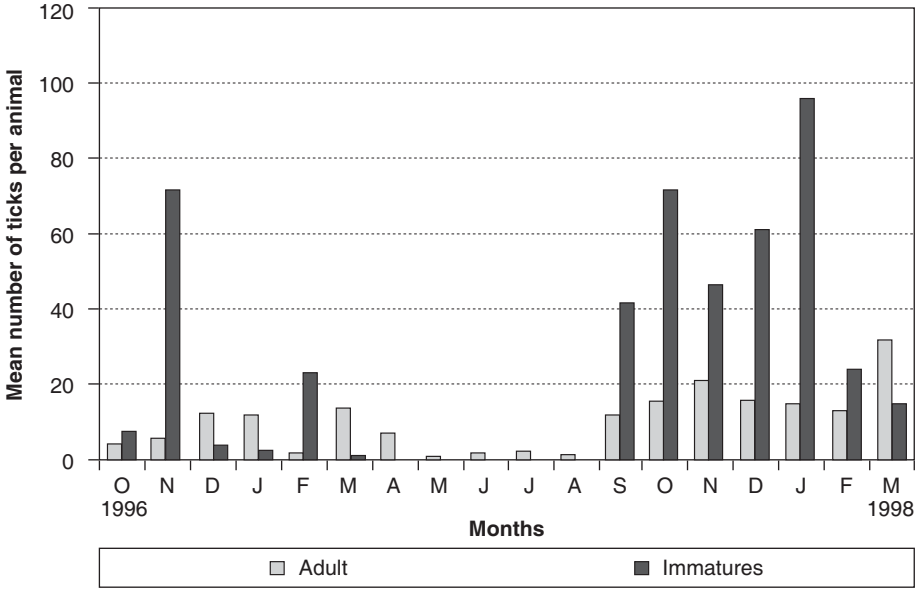

FIG. 1 The monthly activity of adults and immature stages of *Hyalomma a. anatolicum* on sheep in El-Akad area

The immature stages of *Hyalomma* spp. (presumably *H. a. anatolicum*) showed a pronounced activity during the same period as adult *H. a. anatolicum* (September to March), but they completely disappeared from the animals between April and August (Fig. 1). In general, males of *H. a. anatolicum* outnumbered female ticks throughout the study period (Table 1).

The mean number of *H. a. anatolicum* ticks per animal decreased during months when the maximum temperature exceeded 40 °C and also in months when the minimum temperature was below 15 °C (Table 2, Fig. 1).

DISCUSSION

Thirty-five species of ticks are known to infest sheep and goats in the Sudan (Osman 1997). During the present investigation, five species of ticks were found to infest sheep in River Nile Province, Northern Sudan. These were (in order of abundance), *H. a. anatolicum, R. sanguineus* group, *R. e. evertsi, R. simus* and *H. dromedarii.* These species were previously reported on sheep from northern Sudan (Hoogstraal 1956) and from Khartoum Province in central Sudan (Jongejan, Zivkovic, Pegram, Tatchell, Fison, Latif & Paine 1987).

In general, the mean number of ticks per sheep (11.2) was comparable to those reported by Jongejan *et al.* (1987) (11.5) and Karrar, Kaiser & Hoogstraal (1963) (13.0), and higher than the 6.7 reported by Mohamed (1999). Jongejan *et al.* (1987) indicated that the mean tick load varied between 4.2 in Khartoum Province and 15.9 in Blue Nile Province, where more favourable conditions for survival and reproduction of ticks exist. It is clear that the ecological conditions of River Nile province do not allow for survival and reproduction of several other species that do infest sheep e.g. *Amblyomma lepidum, Amblyomma variegatum, Hyalomma* spp. and *Boophilus* spp. present in other regions of the country (Karrar *et al*. 1963; Osman, El Hussein, Ahmed & Abdulla 1982).

Male ticks represented the majority for all species collected except for *R. simus*. This confirms the results of Jongejan *et al*. (1987) who reported that male ticks usually outnumbered females of all species infesting cattle except for *Boophilus* spp. in central and southern Sudan.

Hyalomma a. anatolicum has been described by many workers as a tick adapted to harsh environments (Hoogstraal 1956; Jongejan *et al*. 1987). This xerophilic species is the most abundant tick in Khartoum Province (desert scrub zone in central Sudan) (Jongejan *et al*. 1987; Mohamed 1999). Further south, its distribution was limited to north of latitude 14 °. *Hyalomma impeltatum*, on the other hand, is the most common tick of sheep in the arid zone of Kordofan (western Sudan) (Osman *et al*. 1982). In the present study, *H. a. anatolicum* appeared to be the most successful tick on sheep in this arid zone. This may be explained by the fact that it can easily adapt to man-made microenvironments, which are to be found in the agricultural areas along the Nile River banks. This may also explain recent reports of this species in areas further south in Blue and White Nile Provinces where intensive farming using indigenous and crossbred animals is now practiced (Jongejan *et al.* 1987; El Imam 2003).

Jongejan *et al.* (1987) indicated that different species of the *R. sanguineus* group may inhabit different ecological zones in the Sudan. Thus, whereas *Rhipicephalus camicasi* was restricted to northern Sudan, *Rhipicephalus turanicus* and *Rhipicephalus guilhoni* occurred in southern Sudan, and *Rhipicephalus bergeoni* occurred only in eastern Sudan adjacent to the sub-highland ecological zone of Ethiopia (Jongejan *et al*. 1987). *Rhipicephalus sanguineus* group was found primarily on sheep in eastern Sudan (Karrar *et al*. 1963) and in the semiarid and savannah zones in Kordofan in western Sudan (Osman *et al*. 1982). *Rhipicephalus sanguineus* group ticks collected in River Nile province may represent different species (most probably *R. camicasi*) with different ecological and biological properties.

Rhipicephalus simus (or more correctly, the *R. simus* group [Horak & Walker 2003]) only occasionally infests sheep in Sudan (Karrar *et al.* 1963; Osman *et al*. 1982) whereas *R. e. evertsi* is more common on this host (Karrar *et al.* 1963). Both species were found on sheep in the present study area but in low numbers.

Hyalomma dromedarii was collected only on two animals in the present investigation. Since camels are rare in agricultural areas along the Nile River in this province this may contribute to the rarity of this species on sheep. However, similar findings were reported by Karrar *et al.* (1963) in eastern Sudan, where camels are abundant indicating that sheep are not a preferred host for this species.

In this study, the adults of *H. a. anatolicum* were active throughout the year. However, the results indicate that there are some critical months during which development ceased or was very low. The adults were abundant on sheep during the period

between September and March (late rainy season to winter) when the average monthly temperature ranged between 21 °C and 36 °C. On the other hand, the number of adults ticks was very low during the hot months (April to August) when the maximum temperature exceeded 40 °C and the average monthly temperature ranged between 31.5 °C and 36.5 °C. This high temperature in combination with low relative humidity generally below 50 % may cause mortality or suppress tick activity. This is especially true for the immature ticks that completely disappeared during the same period, put resumed activity when temperatures decreased (September to March).

Similar results were reported by Mohamed (1999) in Khartoum Province in the semi-arid zone. *Hyalomma a. anatolicum* adults and immatures were collected on sheep throughout the year except during December and January (winter) when adult ticks disappeared, and during January when no immatures were found (Mohamed 1999).

It appears from the present study that there are two peaks of tick activity, one in January and one in March. However, during the second peak that occurred in March no immatures were found as a result of the high environmental temperature during this time of the year.

El Ghali & El Hussein (1995) reported the year-round occurrence of clinical cases of malignant ovine theileriosis with outbreaks occurring annually (Ahmed, El Hussein, El Ghali & Salih 2003), indicating endemic instability of the disease in River Nile Province. The generally low adult *H. a. anatolicum* burden and the great fluctuation in their numbers reported here, in addition to their low infection rate (6.2 %) with the parasite *Theileria lestoquardi* (Ahmed *et al.* 2003) and the relative inefficiency of immature stages (nymphs) in transmitting the infection (Hooshmand-Rad & Hawa 1973) may not ensure continuous and high transmission rates that are required to create endemic stability in this area. Hence, susceptible populations of sheep are always available for the disease to appear.

Discussion on the seasonal dynamics of *R. sanguineus* group is impossible because the numbers encountered during the present study were too low. However, in this study, few specimens or none were reported during most of the year except for the marked increase during March (1997). Osman 1978, Osman *et al*. (1982), Jongejan *et al*. (1987) and Mohamed (1999) reported a marked increase in the population of this tick during and after the rainy season (June to October) in Darfur, Kordofan, Blue and White Nile, and Khartoum states in the Sudan.

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