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Distribution of Ixodid Ticks on cattle in Great Bahr El Ghazal Region, South Sudan

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Abstract:*A cross sectional survey was conducted during June to November, 2015 in localities of Northern and Western Bahr El Ghazal and Warrap States, South Sudan to investigate the distribution and population dynamics of ixodid ticks infesting indigenous zebu (Nilotic) cattle kept under traditional management system. A total of 7088 ticks were collected from 600 heads of cattle of three age groups; < 1 year, 1-3 years and > 3 years. The result revealed that the mature ticks represented 83.9% and immature tick stages 16.1%. Eight tick species belonged to three genera of the family Ixodidae, namely Amblyomma, Hyalomma and Rhipicephalus were identified. These included A. variegatum (58.4%), R. e. evertsi (13.9%), R. decoloratus (13.5%), Hyalomma rufipes (5.1%), R. annulatus (4.8%), H. truncatum (3.4%), R. sanguineus group (0.6%) and R. praetextus (0.3%). The mean ticks load was 17.8, 6.2 and 5.7% in Northern Bahr El Ghazal, Western Bahr El Ghazal and Warrap States, respectively. The study concluded that three tick genera and eight species were prevalent in Great Bahr El Ghazal Region.*

Keywords: Ixodid ticks, Distribution, Great Bahr El Ghazal Region, South Sudan.

Introduction

Ticks and tick-borne diseases seriously limit livestock production in most of African countries (Norval *et al*., 1992). Ticks constitute the most important livestock pest in Africa and they are found in the entire 30 million square kilometers of the Africa continent (Punyua, 1992). Losses due to tick-borne diseases are incurred by mortality, abortion, reduction in milk yield and weight losses, reduce productive life and cost of treatment (Gamal and El Hussein, 2003). Most of the important species of the African ticks are found in the Sudan and South Sudan (Hoogstraal, 1956). These include the genera *Argas*, *Ornithodoros*, *Amblyomma*, *Rhipicephalus*, *Haemaphysalis*, *Hyalomma*, *Ixodes* and *Margaropus*. Hoogstraal (1956) identified 46 species and subspecies from nine genera of ticks that infest both domestic and wildlife in South Sudan. Julla (1994) identified 13 species and subspecies form five genera infesting livestock in South Sudan, namely*: Amblyomma lepidum, A. variegatum, Rhipicephalus anuulatus, R. decoloratus, Haemophysalis leachi leachi, H. Rufipes, H. truncatum, R. appendiculatus, R. e. evertsi, R. pravus, R. sanguineus* group and *R. pretextatus*. Korok (2005) found that *A. lepidum* represented 56.6% of the tick population in Jonglei State. Marcellino *et al*. (2011a) reported *R. appendiculatus* and *A. variegatum* represented 57.7% of the tick population in Central Equatoria State, South Sudan. Nyoap *et al*. (2015) stated that *A. variegatum* represented 62% of the tick population in Jonglei State; however, they did not report *R. appendiculatus*. Host density, susceptibility, vegetation type, host grazing behavior and nutritional status of the animal are important factors in the regulation of tick distribution (Tatchell and Easton, 1986; Latif, 1984).

The aim of this study is to investigate the distribution and population dynamics of ixodid ticks on indigenous zebu (Nilotic) cattle kept under traditional management system in Great Bahr El Ghazal, South Sudan.

Materials and Methods

Study area

South Sudan consists of ten states and three Great Regions (Bahr El Ghazal, Upper Nile and Equatoria). The principal types of livestock found in these states are cattle, sheep and goats. Great Bahr El Ghazal Region is located in west and north part of South Sudan. It is consisting of four states; Lakes (8°-5°N, 31°-28°E), Warrap (9°-6°N, 29°-27°E), Western Bahr El Ghazal (10°-6°N, 28°-24°E) and Northern Bahr El Ghazal States (9°-6°N, 27°-26°E). Twelve localities of three states in Great Bahr El Ghazal were selected for conducting this study (Fig. 1).

Ticks collection and identification

In a cross-sectional survey conducted during June to November 2015, total of 7088 ticks were randomly sampled from all the predilection sites of cattle (head, under tail, back, perineum region and ventral parts) from 600 heads of indigenous zebu (Nilotic) cattle, which are kept under traditional management system. Fifty heads of three age groups of animals (< 1 year, 1-3 years and > 3 years) in each of the twelve localities of the study area were sampled. A pair of blunt metal forceps was used for collection of ticks without damaging their mouth parts. All visible attached adults, nymphs and larvae from each site were collected in separate tube containing 70% ethanol. Appropriate labels

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were fixed on the tick tubes indicating the number, sex and age of animal, location, and date of collection. Ticks were identified under a dissecting microscope, counted and recorded by species and their developmental stages. Identification was done according to the keys of Hoogstraal (1956) and Walker *et al*. (2003).

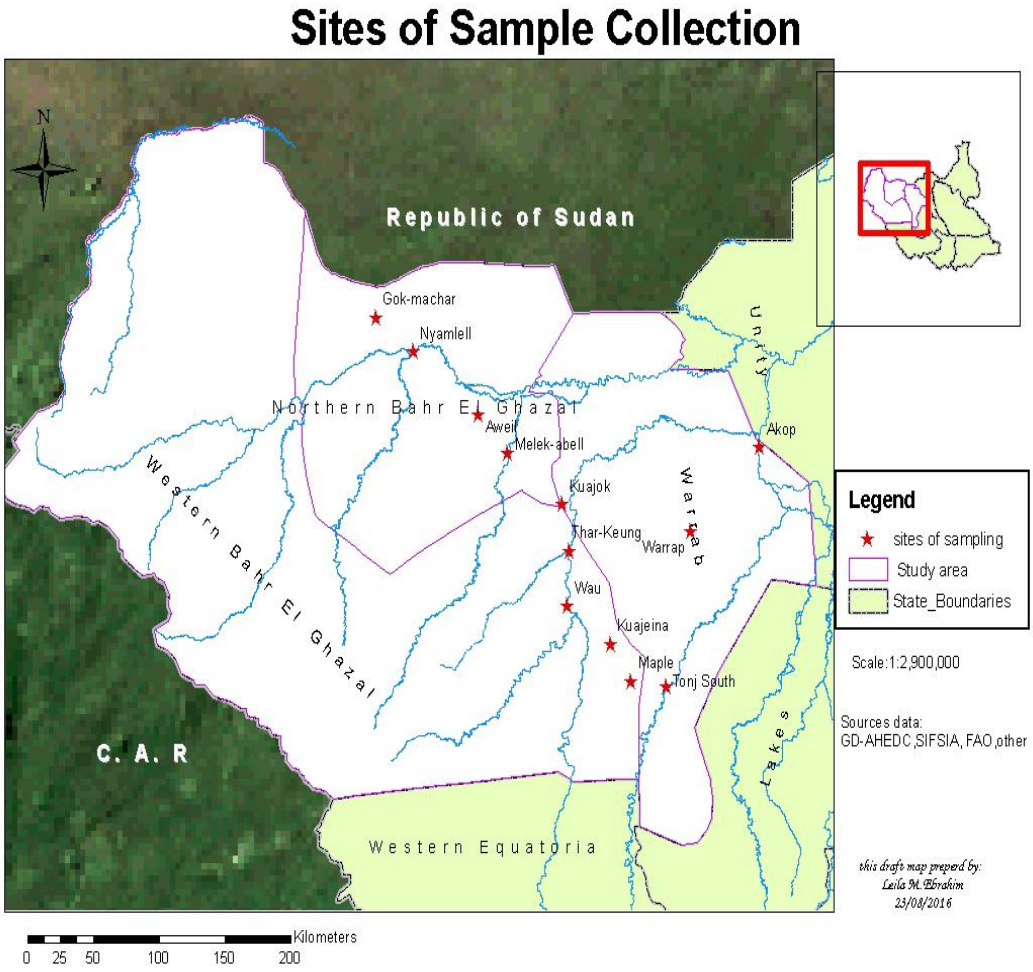

Figure 1: Map of South Sudan and Great Bahr El. Ghazal, showing the locations of samples collection (indicated with red star).

Statistical analysis

The collected ticks were subjected to appropriate general liner model (GLM) procedure of statistical analysis using SAS package. The SAS was used to perform analysis of variance (ANOVA) and mean separations were performed using Ryan-Einto-Welsch multiple range test (REGWQ) according to Day and Quinn (1989). Correlation analysis was carried out to relate the means of the total body collections with predilection sites, localities, age's group and animal sex.

Results

Cattle were found to be infested with three tick genera of ixodidae; namely *Amblyomma*, *Hyalomma* and *Rhipicephalus*. The most abundant tick species reported included *Amblyomma variegatum* 3477(58.4%) which was recorded in all sampled localities of Bahr El Ghazal States, *Rhipicephalus e. evertsi* 827 (13.9%), *Hyalomma rufipes* 801(13.5%), *R. decoloratus* 301(5.1%), *R. annulatus* 287(4.8%), *H. truncatum* 201(3.4%), *R. sanguineus* group 37(0.6%) and *R. praetextus* 19(0.3%). Out of 7088 total ticks collected, 5950 (83.9%) were mature ticks and 1138 (16.1%) were immature ticks. The highest mean of adult ticks (22.38±1.26) was recorded in Nyamlell (Northern Bahr El Ghazal State) and the lowest mean (2.41±0.41) was recorded in Kuajiena (Western Bahr El Ghazal State), while for immature ticks the highest and lowest means recorded were (7.42±1.37) and (0.10±0.07) in Aweil and Warrap, respectively (Table 1). The means of adult and immature stages of the identified tick species in different localities of the study area were shown in Table (1). The highest tick loads were recorded in Northern Bahr El

Ghazal State (17.8) followed by Western Bahr El Ghazal State (6.2) and Warrap State (5.7) (Table (2). The mean tick's infestation on cattle according to age group and sex of the animals, sex of the ticks and predilection sites for encountered tick's species in the study area were shown in Table (3).

Table 1: Means (±SE) of ticks collected from cattle in Great Bahr El Ghazal, South Sudan during June to November, 2015.

State	Localities	No. of Animal	*A. variegatum*	*H. rufipes*	*H. truncatum*	*R. annulatus*	*R. decoloratus*	*R. evertsi*	Total Adult	Total Immature
Northern Bahr El Ghazal	Nyamlell	50	16.16±0.91a	1.32±0.31b	0.24±0.10bc	1.96±0.34a	2.70±0.51ab	0.00±0d	22.38±1.26a	5.14±0.91b
	Gok-machar	50	15.42±1.15a	2.28±0.48a	0.82±0.27ab	0.38±0.16bc	0.80±0.32cd	0.02±0.02d	19.72±1.58a	1.08±0.40cde
	Aweil	50	9.32±0.72b	1.30±0.39b	0.88±0.22a	0.98±0.26b	3.22±0.63a	0.06±0.06d	15.76±1.31b	7.42±1.37a
	Malek-alell	50	9.22±0.75b	0.08±0.06c	0.02±0.02c	0.62±0.16bc	2.36±0.49abc	0.80±0.18bcd	13.10±1.03b	3.10±0.71bcd
Warrap	Kuajok	50	4.04±0.82cd	0.00±0c	0.00±0c	0.48±0.22bc	1.98±0.48abcd	1.14±0.22bcd	7.64±1.03c	1.42±0.42cde
	Warrap	50	1.84±0.37de	0.10±0.05c	0.02±0.02c	0.22±0.11bc	0.34±0.14d	0.48±0.14cd	3.00±0.51d	0.10±0.07e
	Akop	50	3.84±0.50cd	0.24±0.11c	0.08±0.05c	0.06±0.03bc	0.42±0.16d	0.86±.23bcd	5.50±0.63cd	0.28±0.10e
	Tonj	50	1.08±0.36e	0.00±0c	0.14±0.07c	0.22±0.11bc	0.80±0.30cd	4.28±0.67a	6.52±0.91cd	0.62±0.23de
Western Bahr El Ghazal	Kuajiena	50	0.84±0.24e	0.02±0.02c	0.22±0.09bc	0.00±0c	0.70±0.28d	0.68±0.18bcd	2.46±0.41d	0.34±0.11e
	Mapel	50	1.02±0.20e	0.04±0.03c	0.22±0.09bc	0.14±0.06c	0.52±0.19d	1.90±0.30b	3.84±0.49cd	0.40±0.10e
	Thar-kueng	50	1.60±0.33de	0.08±0.04c	0.20±0.13bc	0.02±0.02c	0.72±0.26d	1.72±0.26bc	4.36±0.56cd	1.2±0.624cde
	Wau	50	5.22±0.74c	0.56±0.17bc	1.18±0.31a	0.66±0.23bc	1.48±0.33bcd	4.58±0.66a	13.68±1.29b	3.66±0.67bc

Mean (±SE) followed by the same letter in each column for each parameter is not significant difference at 5% level according to REGWQ range test. ●SE = Standard error ● NO = Numbers.

Table 2: Tick loads at selected localities in Bahr El. Ghazal States, South Sudan during June to November, 2015

State	Locality	No. of Animals	No. of Ticks	Ticks Load
Northern Bahr El Ghazal	Nyamlell	50	1120	22.4
	Gok-machar	50	992	19.8
	Aweil	50	792	15.8
	Malek-alell	50	655	13.1
	Total	**200**	**3559**	**17.8**
Warrap	Kuajok	50	383	7.7
	Warrap	50	152	3.0
	Akop	50	275	5.5
	Tonj	50	341	6.8
	Total	**200**	**1151**	**5.7**
Western Bahr El Ghazal	Kuajiena	50	135	2.7
	Maple	50	197	3.9
	Thar-kueng	50	219	4.4
	Wau	50	689	13.9
	Total	**200**	**1240**	**6.2**
Grand Total		**600**	**5950**	**9.9**

Table 3: Means (±SE) of ticks collected from different ages, predilection sites, and sex infesting cattle in Great Bahr El Ghazal, South Sudan during June to November 2015.

Parameter	No. of Animal	*A. variegatum*	*H. rufipes*	*H. truncatum*	*R. annulatus*	*R. decoloratus*	*R. evertsi*	Total Adult	Total Immature
Animal Age									
< 1 year	92	3.56±0.62c	0.15±0.08b	0.19±0.12a	0.33±0.16a	0.86±0.29b	0.48±0.14c	5.57±0.84b	1.51±0.48b
1-3 year	213	6.82±0.54a	0.40±0.09ab	0.28±0.06a	0.54±0.10a	1.68±0.20a	1.15±0.16b	10.88±0.70a	2.87±0.39a
>3 year	295	5.76±0.38b	0.69±0.12a	0.42±0.07a	0.48±0.07a	1.24±0.15ab	1.82±0.18a	10.40±0.53a	1.66±0.23b
Predilection Site									
Back	600	0.04±0.02b	0.00±0b	0.00±0b	0.01±0.01c	0.02±0.01b	0.00±0b	0.06±0.02 d	0.01±0.01b
Head	600	0.06±0.03b	0.00±0b	0.00±0b	0.21±0.03a	0.98±0.0.10a	0.01±0.01b	1.26±0.012c	1.55±0.18a
Perineum	600	2.83±0.17a	0.06±0.01b	0.22±0.03a	0.13±0.03b	0.13±0.03b	0.05±0.03b	3.42±0.19a	0.24±0.04b
Tail	600	0.12±0.02b	0.43±0.06a	0.07±0.02b	0.08±0.02bc	0.06±0.02b	1.30±0.11a	2.05±0.15b	0.08±0.01b
Ventral	600	2.75±0.17a	0.02±0.01b	0.07±0.01b	0.06±0.01bc	0.15±0.03b	0.02±0.01b	3.04±0.18a	0.18±0.03b
Animal Sex									
Males	210	6.34±0.53a	0.40±0.09a	0.25±0.05a	0.58±0.12a	1.10±0.20a	1.10±0.16b	10.11±0.68a	2.66±0.41a
Females	390	5.51±0.34b	0.55±0.09a	0.38±0.06a	0.42±0.05a	1.29±0.14a	1.53±0.15a	9.68±0.48a	1.75±0.21b

Mean (±SE) followed by the same letter in each column for each parameter is not significant difference at 5% level according to REGWQ range test. ●SE = Standard error ● NO = Numbers.

Discussion

This study was initiated to determine the level of tick infestation, genus and species involved, predilection sites and to assess the tick burden between, sex groups and among age groups of cattle in Great Bahr El Ghazal Region. Investigations directed toward determining the magnitude of infestation and the species of tick involved may play a magnificent role in designing strategic control of ticks and tick-borne diseases. Moreover, a species level identification will assist the diagnosis of different tick-borne diseases and their respective control programmes.

A. variegatum was the most abundant of all tick species comprising 58.4% of the collected ticks in the study areas. This finding confirms the results of previous workers who reported that *A. variegatum* is the most common and widely distributed cattle tick in South Sudan (Hoogstraal 1956; Salih *et al*., 2008; Marcellino *et al*., 2011b; Nyoap *et al*., 2015). The highest mean of *A. variegatum* was found in perineum region. It has a great economic importance, and may cause damage of udder and hide due to its long mouth parts. It is an efficient vector of *Ehrlichia ruminatum* (*Cowderia*) (Solomon *et al*., 2001). Mohammed *et al*.(2019) detected *T. parva* DNA in *A. variegatum* in this study area which may indicate the role of this tick species in transmission of East Coast Fever among cattle. Besides disease transmission, the tropical bont tick can cause significant blood loss in its hosts (Ndumu *et al*., 1999).

There are 30 *Hyalomma* species known to exist worldwide and serve as vectors of diseases, transmitting a great variety of parasitic, bacterial, and viral pathogens to both humans and animals (Horak *et al*., 2002). Among these only two species, *H. rufipes* and *H. truncatum*, were identified in this study. This is in favour with Hoogstraal (1956); Julla (1994); Salih *et al*. (2008) who reported these species in Equatoria region of South Sudan.

The presence of *R. decoloratus* and *R. annulatus* in almost all areas of South Sudan is similar to previous findings of Julla (1994); Salih *et al*. (2008) and Nyoap *et al*. (2015). This may result in endemicity of diseases transmitted by these ticks (De Vos *et al*., 2004). Male ticks constituted the majority of all species with the exception of *R. annulatus* and *R. decoloratus* which males are difficult to find on hosts (Tatchell and Easton, 1986).

R. *e. evertsi* is a known vector of *Anaplasma marginale*, *Babesia bigemina*, *B. caballi*, and *Theileria equi*, and can cause paralysis in sheep, lambs, and calves from components of its saliva. *R. e. evertsi* has highest mean in age group

above three years. This finding is in agreement with the fact that the big size and long movement of older cattle forcing them to be exposed to lot of ticks.

R. appendiculatus (Brown ear tick) which acts as a vector for *Theileria parva* and *T. taurotragi* (Norval and Horak, 2004) was not found in this study. This finding disagreed with that reported by Hoogstraal (1956) who collected *R. appendiculatus* from this province (El Ghali and Hassan, 2012). The absence of *R. appendiculatus* during these months of study may be due to the changes in seasonal activity of this tick species. These results were in line with observations of cattle keepers as they say that the brown tick of ear become higher in dry season.

R. sanguineus group is the tick of dogs but was collected in few numbers together with *R. praetextatus*. This finding is in agreement with Walker *et al*. (2003) who stated that *R. praetextatus* occurs in savanna region and has never been encounter in very large numbers. According to predilection sites, the lowest amount of ticks was found on the back. This could be due to directions of surface to the sun light and exposure to birds that feed on them. Nymph and larvae were collected during the period of study, with prevalence of 16.1%. This low prevalence may be due to management systems of cattle by cattle keepers as separation of calves during the grazing, sleeping places and handing of calves for younger's youth to remove the ticks by the hand.

Presence or absence of any tick species could be due to the difference in the agro-climatic conditions of the study areas. Ticks are faced within their habitats with a variety of environmental factors such as temperature, relative humidity and rain (Pegram *et al.,* 1981). Due to economic and veterinary importance of ticks, their control and the transmission of tick-borne diseases remain a challenge for the cattle industry in tropical and subtropical areas of the world (Lodos *et al*., 2000). The presence of *Amblyomma variegatum* in relatively high abundance is an interesting finding. Remain to be confirmed if *Amblyomma variegatum* play an important role in transmissions of *T. parva* parasites.

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